

SECTION 230529 – HANGERS AND SUPPORTS FOR HVAC SYSTEMS

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(Engineer shall edit specifications and blue text in header to meet project requirements. This includes but is not limited to updating Equipment and/or Material Model Numbers indicated in the specifications and adding any additional specifications that may be required by the project. Also turn off all “Underlines”.)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 23.

1.2 SUMMARY

- A. This section includes the requirements for hangers and supports for HVAC piping and equipment as follows:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Thermal hanger shield inserts.
 - 4. Fastener systems.
 - 5. Pipe stands.
 - 6. Pipe positioning system.
 - 7. Pipe supports and curbs – roof level.
 - 8. Miscellaneous materials.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.
 - 4. Support for all conditions of operation, including variations in installed and operating weight of equipment, piping and ductwork, to prevent excess stress and allow for proper expansion and contraction.

- C. Support materials shall be steel or stainless steel unless specifically indicated.
- D. Support devices shall be factory fabricated by manufacturers and have published load ratings.
- E. Unless otherwise indicated, design structural support members and support devices, including couplings, rods, trapeze supports and strut systems, with safety factor in accordance with AISC Manual of Steel Construction, but not less than 2.0.
- F. Unless otherwise indicated, hangers, support devices and hardware shall be steel and shall have factory standard black, primed, galvanized or electroplated finish for indoor application, and hot-dipped galvanized finish for outdoor application and corrosive atmospheres. Coat cut edges, welds or any damaged finish with galvanized paint.
- G. Material in contact with pipe shall be compatible with piping material so that neither shall have deteriorating action on the other. If materials such as copper, stainless steel or other materials are not compatible, provide nonmetallic separation between uninsulated piping and metal supports. Plastic coated steel supports are acceptable.
- H. Unless otherwise indicated, steel support devices exposed to ventilation air stream shall be stainless steel or steel with either galvanized finish or paint finish.
- I. Fiberglass piping system supports shall meet the more stringent of (a) the requirements of these specifications and (b) the piping manufacturer's recommendations.
- J. Contractor is responsible for proper placement and sizing of supporting devices to accommodate insulation thickness and pitching of pipe. Coordinate with Contractor performing work specified in Section "Insulation for HVAC Pipe and Duct Systems".
- K. Refer to Section "Vibration and Seismic Controls for HVAC" for piping to be provided with vibration isolation hangers or supports.
- L. Where piping can be conveniently grouped to allow trapeze type supports, supporting steel shall be by means of standard structural shapes.
- M. Hangers and rods shall be plumb when pipelines are at their normal operating temperatures.
- N. Unless otherwise indicated, continuous insert channels are not allowed.
- O. Punching, drilling, or welding of building structural steel is not allowed unless approved by Structural Engineer.

- P. Application of concrete inserts and concrete anchors shall be reviewed and approved by Structural Engineer prior to installation.
- Q. Lateral bracing for piping and equipment shall be reviewed and approved by Structural Engineer prior to installation. Lateral braces shall be designed and detailed to apply loads as directly as possible to structural floor slabs, roof decks, or other building lateral elements. Braces shall not be applied to bottom flanges of steel beams or bottom chords of steel joists.
- R. Any proposed weld attachments to building structure shall be reviewed by Structural Engineer prior to execution of work. This review may result in use of other welding codes or standards, which may apply to "structural work". Execution of this work may be assigned to General Trades responsible for building structural steel. Cost for this work, however, will remain the responsibility of this Contractor.
- S. Fasteners including concrete anchors for seismic application shall have ICC Evaluation Service Report (ESR) and meet requirements of local authorities.

1.4 ACTION SUBMITTALS

- A. Product Data: For each specified product, include manufacturers cut sheets, dimensional data, performance data, installation instructions, wirings diagrams, power requirements, specified options, and warranty information.
- B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. < Delete paragraph 'B' if not required>
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Include a copy of each approved submittal along with any applicable maintenance data in the project operation and maintenance manual.

1.7 QUALITY ASSURANCE

- A. Materials and application of pipe hangers and supports shall conform to latest requirements of ANSI/ASME B31 Code for Pressure Piping and MSS Standard Practice SP-58 (Materials, design and Manufacture), SP-69 (Selection and Application), and SP-89 (Fabrication and Installation Practices), except as supplemented or modified herein.
- B. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.8 WARRANTY/GUARANTEE

- A. See Division 23 Specification Section "Basic Mechanical Requirements – HVAC" for warranty and guarantee requirements.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- A. Design and Selection: Hangers and supports shall be designed and selected, for the intended use, in accordance with the requirements of this specification.
- B. Acceptable Manufacturers: Subject to compliance with requirements, provide comparable product by one (1) of the following:
 - 1. Metal Pipe Hangers and Supports:
 - a. B-Line.
 - b. Fee and Mason.
 - c. Anvil.
 - d. Michigan Hanger.
 - 2. Thermal-Hanger Shield Inserts (Pre-Insulated Pipe Supports):
 - a. Pipe Shields, Inc. (Piping technology & Products, Inc.)
 - b. Bergen Pre-Insulated Pipe Supports
 - c. Rilco.
 - 3. Thermal-Hanger Shield Inserts:
 - a. Pipe Shields, Inc. (Piping technology & Products, Inc.)
 - b. Bergen Pre-Insulated Pipe Supports
 - c. Rilco.
 - 4. Fastener Systems (Concrete Anchors):
 - a. Hilti,

- b. Powers Fasteners or
- c. Red Head

- 5. Metal Framing Support System:
 - a. Unistrut,
 - b. B-Line Strut Systems
 - c. Anvil-Strut
 - d. Kindorf
 - e. Hilti

- 6. Pipe Guides and Anchors:
 - a. Shaw Pipe Shields
 - b. Bergen Pre-Insulated Pipe Supports
 - c. Rilco

- 7. Pipe and Equipment Supports - Roof Level:
 - a. Pate Company.
 - b. Roof Products and Systems (RPS).
 - c. Tybar Corporation.

2.2 METAL PIPE HANGERS AND SUPPORTS <Coordinate hangers and support systems with structural engineer.>

A. Non - Insulated Horizontal Piping Hangers: Condenser Water:

- 1. Two (2) inch and smaller: Figure No. B3108 with metal shield, Figure No. B3151.
- 2. Two and one-half (2-1/2) inch and larger: Figure No. B3108 with metal shield, Figure No. B3151

B. Non-Insulated Horizontal Copper Piping Hangers: Condenser Water:

- 1. Two (2) inch and smaller: Figure NO. B3104 CT.
- 2. Two and one-half inch (2-1/2) inch and larger: Figure No. B3104 CT.

C. Insulated Horizontal Piping Hangers: Chilled Water, Reheat Water, Glycol Solution, Heating Hot Water (fluid temperature at or below 100 °F):

- 1. Two (2) inch and smaller: Figure No. B3108 with metal shield, Figure No. B3151.
- 2. Two and one-half (2-1/2) inch and larger: Figure No. B3108 with metal shield, Figure No. B3151.

D. Insulated Horizontal Piping Hangers: Steam and Condensate Return, Reheat Water, Glycol Solution, Heating Hot Water, Perimeter Heating Water (fluid temperature above 100 °F):

1. Two (2) inch and smaller: Clevis hanger, B-Line Figure No. B3108.
2. Two and one-half (2-1/2) inch and larger: Roller hanger, B-Line Figure No. B3110.

E. Insulated and non-insulated vertical piping hangers:

1. Figure No B3373

F. Insulated and non-insulated vertical piping hangers:

1. Hangers Copper: B3373F.

2.3 TRAPEZE PIPE AND EQUIPMENT HANGERS

A. Description: Direct mounting hangers:

1. Anvil Figure No. 46.
2. Piping: Use straps, slides or rollers as specified below for Flat Surface (Trapeze, Rack Type) support system.
3. Suspended Equipment: Contractor shall support suspended equipment with any combination of trapeze supports, or miscellaneous steel angles or channels properly sized for the weight and hung from the structure with spring isolation hangers.

2.4 FLAT SURFACES (TRAPEZE, RACK TYPE)

A. Description: Use structural steel members such as struts, angles, channels and beams to support pipes as required. Select members properly for pipe support types and loading conditions. Submit support details with type of members selected and load calculations. Provide straps, clamps, rollers or slides indicated below at each support point.

B. Non - Insulated Horizontal Piping:

1. Six (6) inch and smaller (steel): Vibra-Clamp, B-Line, Figure No. BVT.
2. Eight (8) inch and larger (steel): U-Bolt, B-Line, Figure No. B3188.
3. All sizes (copper): Vibra-Clamp, B-Line, Figure No. BVT.

C. Insulated Horizontal Piping: Chilled Water, Chilled Beam Cooling Water, Process Cooling Water, Condenser Water (fluid temperature at or below 100 °F):

1. Eight (8) inch and smaller: U-Bolt, B-Line, Figure No. B3188.
2. Ten (10) inch and larger: Roller, B-Line Figure No. B3120, B3122, B3122A, B3117SL.

D. Insulated Horizontal Piping: Steam and Condensate Return, Reheat Water, Glycol Solution, Heating Hot Water, Perimeter Heating Water (fluid temperature above 100 °F):

1. Two (2) inch and smaller: Roller, B-Line Figure No. B218, Strap, B-Line Figure No. B2417.
2. Two and one-half (2-1/2) inch and larger: Roller, B-Line Figure No. B3120, B3122, B3122A, B3117SL, B3118SL.

2.5 INSULATION PROTECTION SHIELDS

- A. B-Line Figure No. 3151 constructed of galvanized carbon steel. Per the latest edition of Standard MSS SP-58, select shield to accommodate outer diameter of insulation. Shield length and gauge for insulation compression strength not less than 15 psi.
- B. Minimum 18 gauge thick and 12" long for piping up to 4", 16 gauge thick and 18" long for piping 5" through 6", 14 gauge thick and 24" long for piping 8" through 14" and 12 gauge thick and 24" long for piping 16" and larger.
- C. Shields and saddles for fiberglass piping shall be provided as recommended by the piping system manufacturer.

2.6 INSULATION PROTECTION SADDLES

- A. B-Line Figure No. 3160 through 3165 constructed of carbon steel or alloy steel plate. Select saddles to accommodate insulation thickness specified.

2.7 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend two (2) inches beyond sheet metal shield for piping operating below ambient air temperature.

2.8 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.9 PIPE STANDS

- A. For support of pipe where axial movement is encountered: Figure No. B33117Sl where no vertical adjustments is required; and Figure B3118SL where vertical adjustments is required.
- B. Compact Pipe Stand: One (1) piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One (1) piece [plastic] [stainless-steel] base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: [Plastic] [Stainless steel].
 - 3. Vertical Members: Two (2) or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
 - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 2. Bases: One or more; plastic.
 - 3. Vertical Members: Two (2) or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.10 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.11 FABRICATED EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.
- B. Delegated Design: Calculate requirements for support of equipment weight and restraint of both lateral and vertical dynamic forces at 150% of operating conditions.
- C. Details: Detail fabrication of each support assembly. Show dimensions and methods of assembly and attachment to building structure.

2.12 PIPE SEALS, SUPPORTS AND CURBS - ROOF LEVEL

- A. General: Where piping systems and conduits for power and controls serve HVAC equipment located above the roof level where indicated on the drawings and as specified.
- B. Pipe Seal Assembly: Model PPS, for a single pipe application, shall be a one piece spun aluminum base with full five (5) inch sloped roof surface flange, graduated step PVC boot and adjustable stainless steel clamp.
- C. Pipe Supports: Pipe supports shall be one (1) of the following:
 - 1. Equipment Support Without Pipe Rollers: Pate Style ES equipment supports constructed of 18 gauge galvanized steel, unitized construction with integral base, continuous welded corner seams, pressure treated two (2) x four (4) wood nailer and counterflashing with galvanized screws. The overall height for each support shall be eighteen (18) inches from the finished roof to the top of the counterflashing plus the height of the pipe supports and the pipe. Contractor shall provide galvanized Unistrut type channel tracts, with galvanized washers, nuts, bolts, and pipe clamps to secure the pipe to the tract and the track to the equipment support.
 - 2. Equipment Support With Pipe Rollers: Pate Style PRS or MPRS equipment supports constructed of heavy gage galvanized steel, unitized construction with integral base, continuous welded corner seams, pressure treated (2) x four (4) wood nailer and counterflashing with galvanized screws. Roller assembly shall include galvanized steel channel tracks, galvanized steel fittings, washers, nuts, bolts, and painted cast iron rollers. The overall height for each support shall be eighteen (18) inches from the finished roof to the top of the counterflashing plus the height of the pipe rack. Contractor shall provide galvanized insulation shields to protect the pipe insulation at each support point.
- D. Pipe Curbs: Pipe curbs for pipes up to six (6) inches with or without insulation shall be as follows:

1. Pipe Curb Assembly: Pate Style PCC series pipe curb assembly constructed of heavy gauge galvanized steel, unitized construction with integral base plate, one and one half (1-1/2) inch insulation, pressure treated two (2) inch x two (2) inch wood nailer. The overall height for each curb shall be eighteen (18) inches from the finished roof level to the top of the pipe cover. Assembly shall be furnished with an acrylic clad thermoplastic cover, galvanized fastening screws and graduated step boots with stainless steel clamps fit around the pipe risers passing through the curb assembly and cover. Mechanical contractor shall coordinate with Pate to provide the appropriate cap and boot package for the installed pipe with pipe insulation in the submittal package.

2.13 DUCT SUPPORTS – ROOF LEVEL

- A. General: Where duct systems and conduits for power and controls serve HVAC equipment located above the roof level provide equipment supports as manufactured by The Pate Company or an approved equal.
- B. Duct Supports:
 1. Duct Supports: Pate Style ES equipment supports constructed of 18 gauge galvanized steel, unitized construction with integral base, continuous welded corner seams, pressure treated two (2) x four (4) wood nailer and counterflashing with galvanized screws. The overall height for each support shall be eighteen (18) inches from the finished roof to the top of the counterflashing plus the height of the pipe supports and the pipe. Contractor shall provide galvanized Unistrut type channel tracts, with galvanized washers, nuts, bolts, and pipe clamps to secure the pipe to the tract and the track to the equipment support.
- C. Roof Curbs: Curbs for ductwork penetrating the roof deck shall be as follows:
 1. Pate Style PC series curb assembly constructed of heavy gauge galvanized steel, unitized construction with integral base plate, one and one half (1-1/2) inch insulation, pressure treated two (2) inch x two (2) inch wood nailer. The overall height for each curb shall be eighteen (18) inches from the finished roof level to the top of the curb.

2.14 EQUIPMENT SUPPORTS – ROOF LEVEL

- A. General: Where HVAC equipment such as exhaust fan assemblies, condensing units, dry coolers are located above the roof level provide equipment supports as manufactured by The Pate Company or approved equal.
- B. Equipment Supports: Pate Style ES equipment supports constructed of 18 gauge galvanized steel, unitized construction with integral base, continuous welded corner seams, pressure treated two (2) x four (4) wood nailer and counterflashing with galvanized screws. The overall height for each support shall be eighteen (18) inches

from the finished roof to the top of the counterflashing plus the height of the pipe supports and the pipe. Contractor shall provide galvanized Unistrut type channel tracts, with galvanized washers, nuts, bolts, and pipe clamps to secure the ductwork to the tract and the track to the equipment support.

2.15 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5,000-psi, (34.5-MPa)(34.5-MPa)(34.5- MPa), twenty eight (28) day compressive strength.
 - 3. Water: Potable
 - 4. Packaging: Premixed and factory-packaged.
- C. Washers: ASTM F 844, steel, plain, flat washers.
- D. Vertical Piping Riser Clamps:
 - 1. Copper Pipe: Figure No. B3373CT.
 - 2. Steel Pipe: Figure No. B3136 and B3137.
- E. Beam Clamps and Attachments:
 - 1. For bolt-on locations to structure, Figure Nos. B3291, B3036, B3050.
 - 2. Welded beam attachments, Figure No. B3083.
- F. Concrete Inserts:
 - 1. For concrete spot inserts at single locations for casting into structure, Figure No. B3014 for pre- determined rod size and Figure No. B2500 for universal use.
 - 2. For continuous slot concrete insert at multi-locations for casting into structure, Figure No. B2505.
- G. Brackets:
 - 1. For equipment and piping adjacent to walls or steel columns, Figure Nos. B3066, B3063 and B3067 depending on weight to be supported.
- H. Pipe Rests:

1. For pipes close to floor where no expansion provision is required, Figure No. B3088T base stand with B3093 adjustable pipe saddles support.
- I. Hanger Rods:
1. Hanger rod, Figure No. B3205.
 2. Continuous threaded rod, Figure No. ATR.
 3. Eye rods, Figure No. B3210 or B3211, depending on load supported.
- J. Spring Hangers:
1. Light loads, movement less than one and one quarter (1-1/4) inches, Figure No. B3262 or B3264.
- K. Protection Saddles:
1. Cast iron pipe, insulated, Figure No. B3108 with metal shield, Figure No. B3151.
 2. For high temperature steel pipe, insulated, No. B3160, B3161, B3162, B3163, B3164, or B3165.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install supports to allow for free expansion of piping. Support piping from building structural members using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. At no time shall hangers and supports overload building structural members. Fasten ceiling plates and wall brackets securely to structure and test to demonstrate adequacy of fastening.
- B. Select and size building attachments properly in accordance with MSS Standards and manufacturer's published load rating information.
- C. Coordinate hanger and support installation to properly group piping of all trades.
- D. Suspend hangers by means of hanger rods. Perforated band iron and flat wire (strap iron) are not allowed.
- E. Piping and ductwork shall be supported independently from other piping or ductwork.
- F. Pipe hangers and supports shall not penetrate vapor barrier of pipe insulation.
- G. Do not support equipment, piping or ductwork from metal roof decking or ceiling grid.
- H. Install adequate supports so as not to over stress either piping or equipment to which piping is connected.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly supported piping from the building structure.
1. Horizontal Piping: Support horizontal piping within twelve (12) inches of each fitting and coupling.
 2. Base of Vertical Piping: Provide MSS Type 52, spring hangers.
 3. Vertical Pipe Supports: Install supports for vertical steel pipe and copper tubing at each floor level and at the roof level.
 4. Individual, Straight, Horizontal Piping Runs:
 - a. One hundred (100) Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
 - b. Longer than One Hundred (100) Feet: MSS Type 43, adjustable, roller hangers.
 - c. Longer than One hundred (100) Feet if Indicated: MSS Type 49, spring cushion rolls.
 - d. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - e. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - f. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
 3. Multiple, Straight, Horizontal Piping Runs One hundred (100) Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than four (4) inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Architectural Specification Section "Roof Accessories" for curbs.
- G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. Upper attachments to structures shall have an allowable load not exceeding one quarter (1/4) of the failure (proof test) load but are not limited to the specific methods indicated.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

P. Insulated Piping:

1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: Twelve (12) inches long and 0.048 inch thick.
 - b. NPS 4: Twelve (12) inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: Eighteen (18) inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: Twenty four (24) inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: Twenty four (24) inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

Q. Conform to the table below for maximum spacing of supports and rod sizes:

1. Steel and Copper Pipe:

	Steel Pipe	Copper Tube	
Nom. Pipe	Max. Span -	Max. Span -	Min. Rod
Size - In.	Ft. (In.)	Ft. (In.)	Dia. - In.

Up to 3/4	7 (84)	5 (60)	3/8
1	7 (84)	6 (72)	3/8
1-1/4	7 (84)	7 (84)	3/8
1-1/2	9 (108)	8 (96)	3/8
2	10 (120)	8 (96)	3/8
2-1/2	11 (132)	9 (108)	1/2
3	12 (144)	10 (120)	1/2
3-1/2	13 (156)	11 (132)	1/2
4	14 (168)	12 (144)	5/8 (1/2 for copper)
5	16 (192)	13 (156)	5/8 (1/2 for copper)
6	17 (204)	14 (168)	3/4 (5/8 for copper)
8	19 (228)	16 (192)	7/8 (3/4 for copper)
10	22 (264)	18 (216)	7/8 (3/4 for copper)
12	23 (276)	19 (228)	7/8 (3/4 for copper)

- a. Support vertical steel pipe and copper tube at each floor level.
- b. Rod diameter may be reduced one (1) size for double-rod hangers, with three eights (3/8) inch minimum rods.

3.3 PIPE SUPPORTS - ROOF LEVEL

- A. Install pipe supports at the roof level where indicated on the drawings, and/or details according to the manufacturers recommendations.
- B. Contractor shall provide galvanized insulation shields to protect the pipe insulation at each support point.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to one and one half (1-1/2) inches.

3.6 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Architectural Specification Sections "Exterior Painting" and/or Section "Interior Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529