

SECTION 230529 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Inserts.
4. Flashing.
5. Equipment curbs.
6. Sleeves.
7. Mechanical sleeve seals.
8. Formed steel channel.
9. Firestopping relating to HVAC work.
10. Firestopping accessories.
11. Equipment bases and supports.

B. Related Sections:

1. Division 03 - Concrete Forming and Accessories: Execution requirements for placement of inserts and sleeves in concrete forms specified by this section.
2. Division 03 - Cast-In-Place Concrete: Execution requirements for placement of concrete housekeeping pads specified by this section.
3. Section 23 05 03 - Pipes and Tubes for HVAC Piping and Equipment: Execution requirements for placement of hangers and supports specified by this section.
4. Section 23 05 48 - Noise and Vibration Controls for HVAC Piping and Equipment: Product requirements for Noise and Vibration Isolation for placement by this section.
5. Section 23 21 16 - Hydronic Piping Specialties: Execution requirements for placement of hangers and supports specified by this section.
6. Section 23 22 13 - Steam and Condensate Heating Piping: Execution requirements for placement of hangers and supports specified by this section.

1.02 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.1 - Power Piping.
 - 2. ASME B31.5 - Refrigeration Piping.
 - 3. ASME B31.9 - Building Services Piping.
- B. ASTM International:
 - 1. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.
 - 4. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
 - 5. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
- C. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code - Steel.
- D. FM Global:
 - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 - 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
 - 4. MSS SP 77 - Guidelines for Supports – Contractual Relationship
 - 5. MSS SP-127 - Bracing for Piping Systems
- F. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
 5. UL - Fire Resistance Directory.
- G. Intertek Testing Services (Warnock Hersey Listed):
1. WH - Certification Listings.

1.03 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers. Include the following:
1. Manufacturer's technical literature showing hanger type (per MSS SP-69 Standard) material of construction, loading capacity and installation data.
 2. Hanger assembly details, including multiple supports and riser supports.
 3. Pipe attachment details for insulated lines including seismic restraints.
 4. Details of anchors, guides and restraints.
 5. Contractor shall submit pull-out strength for all inserts to the structural engineer for review.
- C. Product Data:
1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers. Submit calculations sealed by a registered Engineer.
- F. Manufacturer's Installation Instructions:
1. Hangers and Supports: Submit special procedures and assembly of components.
 2. Firestopping: Submit preparation and installation instructions.

- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- H. Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed Engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.
- I. Piping Layout Drawings:
 - 1. Provide piping layouts for all HVAC piping systems at same scale as ductwork shop drawings; where such piping is shown on the coordination drawings, separate piping shop drawings for the same area shall also be submitted. Piping shop drawings shall show all hangers and supports, fittings, valves, strainers and accessories. They shall show all sections necessary to establish pipe elevations, shall identify hanger types and loads, and show all tie-ins to structure.
- J. Sleeve Layout Drawings: Indicating sleeves in foundation walls, slabs and roofs, grade beams, footings, sound isolation partitions and ceilings.

1.04 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

- F. Perform Work in accordance with applicable authority for welding hanger and support attachments to building structure.
- G. Perform Work in accordance with IBC-NJ.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F (15 degrees C).
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.09 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for pipe hangers and supports.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

- A. Manufacturers: Subject to requirements of the specification, provide the following manufacturer's products by one of the following or approved equal:
 - 1. Carpenter & Paterson Inc.
 - 2. Anvil (formerly Grinnell).
 - 3. Witch.
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Pipe hangers and supports shall comply with the recommendation of Standards SP-58 and SP-69 of the Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, except where otherwise noted in the Specifications or on the Drawings.
 - 1. Hangers for copper piping shall be copper or copper clad to avoid contact between copper pipe and dis-similar (steel) metal pipe hangers.
- C. The Contractor shall comply with the contractual relationships recommended for the Pipe Hanger Engineer and the Mechanical Contractor, as stated in Standard MSS SP-77 unless otherwise noted in the Contract Documents.
- D. Pipe hangers shall be of the clevis, pipe-roll and pipe-clamp types.
 - 1. Piping subject to lateral or vertical movements shall be provided with supports of the spring hanger type. Refer to Section 230548 "NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT" for Spring Hanger Requirements. No exceptions to this will be granted.
- E. Pipe hangers shall be connected to the building structure as follows:
 - 1. All water piping 8 inches and over shall be supported directly from beams or by means of auxiliary steel furnished and installed by this Contractor attached to beams by means of isolation hangers.
 - 2. All other piping may be supported by inserts with sufficient holding capacity to support twice the calculated dead load. No expansion bolts shall be permitted without written permission from the Architect.
- F. Hangers supported from miscellaneous floor steel shall have approved I-beam clamps. I-beam clamps for hangers supporting piping two (2) inches and smaller shall be adjustable side beam clamp. Piping shall be 2-1/2 inches and larger. I-beam clamps shall be Universal forged steel beam clamps with nut right-hand thread.
- G. Water piping of 6 inches and over in banks shall be supported on trapeze hangers constructed of two (2) 4-inch channels with 1-inch threaded rods at each end. Top of each rod shall tie in auxiliary steel as specified hereinafter.

- H. Provide all auxiliary steel necessary to transmit loads for piping and equipment installed to building beams.
- I. Hydronic Piping:
1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.
 3. Hangers for Cold Pipe Sizes 2 inches (50 mm) and Larger: Carbon steel, adjustable, clevis. Provide cast iron roller for pipes with straight run large than 150 feet.
 4. Hangers for Hot Pipe Sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis cast iron roller.
 5. Hangers for Hot Pipe Sizes 6 inches (150 mm) and Larger: Adjustable steel yoke, cast iron roll, double hanger.
 6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches (150 mm) and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
 8. Wall Support for Cold Pipe Sizes 3 inches (76 mm) and Smaller: Cast iron hooks.
 9. Wall Support for Cold Pipe Sizes 4 inches (100 mm) and Larger: Welded steel bracket and wrought steel clamp.
 10. Wall Support for Hot Pipe, any size: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
 11. Vertical Support: Steel riser clamp.
 12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 13. Floor Support for Hot Pipe Sizes 2 inches (50 mm) and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 14. Floor Support for Hot Pipe Sizes 2-1/2 inches (75 mm) and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
 15. Copper Pipe Support: Copper-plated, carbon steel ring.
- J. Steam and Steam Condensate Piping:
1. Conform to ASME B31.1, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis cast iron roller.

4. Hangers for Pipe Sizes 6 inches (150 mm) and Larger: Adjustable steel yoke, cast iron roll, double hanger.
5. Multiple or Trapeze Hangers for Pipe Sizes 4 inches (100 mm) and Smaller: Steel channels with welded spacers, roller chairs and hanger rods.
6. Multiple or Trapeze Hangers for Pipe Sizes 6 inches (150 mm) and Larger: Steel channels with welded spacers and hanger rods; cast-iron roll and stand.
7. Wall Support for Pipe Sizes up to 5 inches (100 to 125 mm): Welded steel bracket and roller chair.
8. Wall Support for Pipe Sizes 6 inches (150 mm) and Larger: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll.
9. Vertical Support: Steel riser clamp.
10. Floor Support for Pipe Sizes 4 inches (100 mm) and Smaller: Roller chair and concrete pier or steel support.
11. Floor Support for Pipe Sizes 6 inches (150 mm) and Larger: Adjustable cast iron roll and stand steel screws, and concrete pier or steel support.
12. Copper Pipe Support: Copper-plated carbon-steel ring.

K. Refrigerant Piping:

1. Conform to ASME B31.5, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring with copper inserts to prevent steel hanger contact with copper piping or copper or copper clad hangers.
3. Hangers for Pipe Sizes 2 inches (50 mm) and Larger: Carbon steel, adjustable, clevis with copper inserts to prevent steel hanger contact with copper piping or copper or copper clad hangers.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes 3 inches (75 mm) and Smaller: Cast iron hook.
6. Wall Support for Pipe Sizes 4 inches (100 mm) and Larger: Welded steel bracket and wrought steel clamp.
7. Vertical Support: Steel riser clamp.
8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Copper-plated carbon-steel ring.

L. Trapeze and Clevis Hangers:

1. Where two or more lines run parallel and adjacent to each other, trapeze hangers may be used.

2. Secure pipes supported by trapeze hangers and not mounted on pipe rolls to trapeze with hold down pipe clamps or "J" bolts.
3. Support vertical piping passing through slabs with pipe clamps installed above slab, unless they are subject to expansion or contraction.
4. Provide copper inserts to prevent steel hanger contact with copper piping.

M. Roller Hangers:

1. Support hot lines (steam, hot water, steam condensate) 2 inches and larger on roller hangers. Support chilled water lines with straight runs (longer than 150 feet) on roller hangers.

N. Saddles and Shields:

1. Provide protective galvanized shield for supporting insulated lines 1-1/2 inches and smaller.
2. Provide galvanized saddles and roller hangers for supporting hot insulated lines 2 inches and larger and hard insulation for supporting cold insulated lines 2 inches and larger. Maintain vapor barrier for cold piping.
3. Insert insulation identical to pipe insulation in void between saddle and pipe.

2.02 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.03 INSERTS

- A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms for formed concrete. Provide steel metal deck ceiling bolts with threaded rod attachment for concrete with metal decking. Size inserts to suit threaded hanger rods. Inserts and loading shall be reviewed and approved by the Structural Engineer.
- B. Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 4 inches in diameter.
- C. In areas where the concrete slab is exposed, inserts shall be installed flush with slab surface.
- D. Where inserts are missed, drill through concrete slab and provide rod with recessed square steel plate and nut above slab. Under certain conditions, and only with written approval of the Architect, double expansion anchors meet Federal Specification FF-S-325C, as manufactured by HILTI or approved equal, having BS&A number, may be installed in existing slabs.

2.04 FLASHING

- A. Metal Flashing: 26 gage (0.5 mm) thick galvanized steel.
- B. Metal Counterflashing: 22 gage (0.8 mm) thick galvanized steel.
- C. Flashing:
 - 1. Waterproofing: 5 lb./sq. ft (24.5 kg/sq m) sheet.
 - 2. Soundproofing: 1 lb./sq. ft (5 kg/sq m) sheet.
- D. Flexible Flashing: 47 mil (1.2 mm) thick sheet butyl; compatible with roofing.
- E. Caps: Steel, 22 gage (0.8 mm) minimum; 16 gage (1.5 mm) at fire resistant elements.

2.05 EQUIPMENT CURBS

- A. Fabrication: Welded 18 gage (1.2 mm) galvanized steel or aluminum shell and base, mitered 3 inch (75 mm) cant, variable step to match roof insulation, 1-1/2 inch (38 mm) thick insulation, factory installed wood nailer. Connect curb to structural system to withstand 120 mph wind force.

2.06 ROOF-MOUNTED PIPING

- A. Support on minimum 1-1/2 inches x 1/1-2 inches x 1/2 inch painted galvanized angle iron framing with roof-mounted concrete anchor, appropriately flashed and counter flashed to roofing system. Horizontal support angle shall be a minimum of 18 inches above finished roof. Connect anchor to structural system to withstand 120 mph wind force.

2.07 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage (1.2 mm) thick galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Schedule 40 Steel pipe or 18 gage (1.2 mm) thick galvanized steel.
- C. Sleeves for below grade walls and foundation walls shall be mechanical sleeve, watertight.
- D. Sleeves for pipe through fire-rated construction shall be in accordance with UL 1479 and shall be fire-stopped.
- E. Sleeves for Round Ductwork: Galvanized steel.
- F. Sleeves for Rectangular Ductwork: Galvanized steel.
- G. Sealant: Acrylic; refer to Division 07.

2.08 MECHANICAL SLEEVE SEALS

- A. Manufacturers: Subject to requirements of the specification, provide the following manufacturer's products by one of the following or approved equal:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation.
 - 3. Substitutions: Division 01 - Product Requirements.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.09 FORMED STEEL CHANNEL

- A. Manufacturers: Subject to requirements of the specification, provide the following manufacturer's products by one of the following or approved equal:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems.
- B. Product Description: Galvanized 12 gage (2.8 mm) thick steel. With holes 1-1/2 inches (38 mm) on center.

2.10 FIRESTOPPING

- A. Definitions:
 - 1. Firestopping (Through-Penetration Protection System): Pipe sleeve, sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.
- B. System Description:
 - 1. Firestopping Materials: UL 1479 to achieve fire ratings as noted on Architectural Drawings for adjacent construction, but not less than 1 hour fire rating.
 - a. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.
 - 2. Surface Burning: ASTM E84 with maximum flame spread / smoke developed rating of 25/450.
 - 3. Firestop interruptions to fire rated assemblies, materials, and components.

- C. Performance Requirements:
1. Firestopping: Conform to applicable code for fire resistance ratings and surface burning characteristics.
 2. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.
- D. Manufacturers: Subject to requirements of the specification, provide the following manufacturer's products by one of the following or approved equal:
1. Dow Corning Corp.
 2. Fire Trak Corp.
 3. Hilti Corp.
 4. International Protective Coating Corp.
 5. 3M fire Protection Products
 6. Specified Technology, Inc.
- E. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 2. Foam Firestopping Compounds: Multiple component foam compound.
 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 4. Fiber Stuffing and Sealant Firestopping: Composite of ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 7. Firestop Pillows: Formed mineral fiber pillows.
- F. Color: Full range of colors shall be available to be selected by Architect.

2.11 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

- C. General:
 - 1. Furnish UL listed products or products tested by independent testing laboratory.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- D. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 - 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Division 01 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- D. Do not drill or cut structural members.

3.03 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches (100 mm) and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.04 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1, ASTM F708, MSS SP 58, MSS SP 69, MSS SP 89 and IBC-NJ.
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
- D. Place hangers within 12 inches (300 mm) of each horizontal elbow.
- E. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment.
- F. Support vertical piping at every floor.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat steel hangers and supports. Refer to Division 09. Underground hangers shall be painted with two (2) coats of black asphaltum.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.
- M. Provide all necessary hangers and supports of approved design to keep piping in proper alignment and prevent transmission of injurious thrusts and vibrations. In all cases where hangers, brackets, etc., are supported from concrete construction, care shall be taken not to weaken concrete or penetrate waterproofing. All hangers and supports shall be capable of screw adjustment after piping is erected with a locking nut provided to prevent loss of adjustment due to pipe vibration. Hangers supporting piping expansion loops, bends and offsets shall be secured to the building structure in such a manner that horizontal adjustment perpendicular to the run of piping supported may be made to accommodate displacement due to expansion. All such hangers shall be finally adjusted, both in the vertical and horizontal direction, when the supported piping is hot. All supports and components shall be rated for a minimum of two times the calculated dead load.

3.05 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 4 inches (87 mm) thick and extending 6 inches (150 mm) beyond supported equipment. Refer to Division 03.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of formed steel channel. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Section 21 05 48.

3.06 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.
- C. Provide curbs for roof installations 24 inches (600 mm) minimum high above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing to equipment and lap base flashing on roof curbs. Flatten and solder joints.
- D. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.07 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1 inch (25 mm) above finished floor level. Caulk sleeves.
- E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.08 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating to uniform density and texture.
- D. Place intumescent coating in sufficient coats to achieve rating required.
- E. Fire Rated Surface:
 - 1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
 - 2. Where conduit and wireway penetrate fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- F. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
 - 2. Install escutcheons floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
 - 4. Interior partitions: Seal all pipe penetrations. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.09 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements and Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.10 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.11 PROTECTION OF FINISHED WORK

- A. Division 01 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

3.12 SCHEDULES

- A. Copper and Steel Pipe Hanger Spacing:

PIPE SIZE Inches (mm)	COPPER TUBING MAXIMUM HANGER SPACING Feet (m)	STEEL PIPE MAXIMUM HANGER SPACING Feet (m)	COPPER TUBING HANGER ROD DIAMETER Inches (mm)	STEEL PIPE HANGER ROD DIAMETER Inches (mm)
Up to 1-1/2 (38)	6 (1.8)	6 (1.8)	1/2 (13)	3/8 (9)
2 (50)	8 (2.4)	8 (2.4)	1/2 (13)	1/2 (13)
2-1/2 (65)	10 (3)	10 (3)	5/8 (15)	5/8 (15)
3 (75)	10 (3)	10 (3)	5/8 (15)	5/8 (15)
4 (100)	-	10 (3)	-	3/4 (19)
5 (125)	-	10 (3)	-	3/4 (19)
6 (150)	-	10 (3)	-	3/4 (19)
8 (200)	-	10 (3)	-	7/8 (22)
10 (250)	-	10 (3)	-	1 (25)
12 (300)	-	10 (3)	-	1 (25)
14 (350) - 20 (500)	-	12 (3) -	-	1-1/4 (32)

- B. When several pipes rest on a common hanger, increase rod diameter accordingly, and spacing noted above must remain.

END OF SECTION