SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:
   1. Pipe Hangers and Supports for Plumbing Piping and Equipment
   2. Wall and Floor Sleeves
   3. Building Attachments
   4. Flashing
   5. Miscellaneous Metal and Materials

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Pipe Hangers and Supports for Plumbing Piping and Equipment:
   1. Pipe Hangers/Supports:
      a. B-Line Systems, Inc.
      b. Anvil International
      c. HOLDRITE
      d. Erico Co., Inc.
      e. Snappitz Thermal Pipe Shield Manufacturing
      f. Rilco Manufacturing Co. Inc.
      g. Nelson-Olson Inc.
      h. Or approved equivalent.
   2. Channel Support Systems:
      a. B-Line Systems, Inc.
      b. Anvil International, Anvit-Strut
      c. Erico Hanger Co., Inc.; O-Strut Div.
      d. Unistrut Corp.
      e. HOLDRITE EZ-Strut Systems
      f. Or approved equivalent.
   3. Thermal-Hanger Shield Inserts:
      a. Erico Hanger Co., Inc.
      b. Pipe Shields, Inc.
      c. Rilco Manufacturing Co., Inc.
      d. HOLDRITE Insulation Couplings
      e. Or approved equivalent.
   4. Freestanding Roof Supports:
      a. Erico Hanger Co., Inc.
      b. Nelson-Olson Inc.
      c. B-Line
      d. M. Fab
      e. Or approved equivalent.
   5. Pipe Alignment and Secondary Supports:
a. HOLDRITE
b. Starquick
c. Or approved equivalent.

B. Wall and Floor Sleeves:
1. Below Grade and High Water Table Areas:
   a. Modular Link Sealing System at Pipe Sleeves:
      1) Thunderline Corporation
      2) Or approved equivalent.
   b. Pre-Engineered Firestop Pipe Penetration Systems:
      a. HOLDRITE HydroFlame
      b. Proset
      c. Or approved equivalent.

C. Building Attachments:
   1. Anchor-It
   2. Gunnebo Fastening Corp.
   3. ITW Ramset/Red Head
   5. Or approved equivalent.

D. Flashing:
   1. Fastenal
   2. Or approved equivalent.

E. Miscellaneous Metal and Materials:
   1. See Miscellaneous Metal and Materials article below.
   2. Powder-Actuated Fastener Systems:
      a. Gunnebo Fastening Corp.
      b. Hilti, Inc.
      c. ITW Ramset/Red Head.
      d. Masterset Fastening Systems, Inc.
      e. Or approved equivalent.

2.2 PIPE HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

A. Horizontal Piping Hangers and Supports - Horizontal and Vertical Piping, and Hanger Rod Attachments:
   1. Factory fabricated horizontal piping hangers and supports to suit piping systems in accordance manufacturer's published product information.
   2. Use only one type by one manufacturer for each piping service.
   3. Select size of hangers and supports to exactly fit pipe size for bare piping and to exactly fit around piping insulation with saddle or shield for insulated piping.
   4. Provide copper-plated hangers and supports for uninsulated copper piping systems.
   5. Provide padded pipe hangers, clamps and supports for thermoplastic piping system.
   6. Install no hub cast iron pipe and fittings per CISPI 301-09 Installation Procedures for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain Waste and Vent Piping Applications. Brace hubless cast iron pipe and fittings 5-inch and larger with HOLDRITE No Hub Pipe Restraints or approved equivalent.

B. Pipe Hangers, Guides and Channel Systems:
   1. Hanger Rods: Hanger rods continuously threaded or threaded ends only in concealed spaces and threaded ends only in exposed spaces; finish electro-galvanized or cadmium-plated in concealed spaces and prime painted in exposed spaces; sizes per MSS.
2. Hanger Rod Couplings: Malleable iron rod coupling with elongated center sight gap for visual inspection; to have same finish as hanger rods.

3. Pipe Rings for Hanger Rods: Pipe sizes 2-inch and smaller, MSS SP Type 6 or Type 10, or approved equivalent. Pipe sizes 2-1/2-inches and larger, clevis type hangers with adjustable nuts on rod. MSS SP Type 1. Pipe rings to have same finish as hanger rods.

4. Pipe Slides: Type 35 reinforced Teflon slide material (3/32-inch minimum thickness) bonded to steel; highly finished steel or stainless steel contact surfaces to resists corrosion; 60-80 PSI maximum active contact surface loading; steel parts 3/16-inch minimum thickness; attachment to pipe and framing by welding.

5. Pipe Guides:
   a. Furnish and install pipe guides on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides securely to pipe and structure. Any contact with chilled water pipe is not to permit heat to be transferred in sufficient quantity to cause condensation on any surface.
   b. Furnish and install guides approximately 4 pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Guides are not to be used as supports and are in addition to other pipe hangers and supports.

6. Channel Type Pipe Hanging System: Framing members No. 12 gauge formed steel channels, 1-5/8-inch square, conforming to ASTM A570 GR33; one side of channel to have a continuous slot with in-turned lips; framing nut with grooves and spring 1/2-inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A307; fittings conforming to ASTM A575; parts enamel painted or electro-galvanized.

C. Pipe Saddles and Shields:
   1. Factory fabricated saddles or shields under piping hangers and supports for insulated piping.
   2. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12-inches in length (4-inch pipe and larger to be three times longer than pipe diameter).

D. Thermal-Hanger Shield Inserts: 100-PSI (690-kPa) minimum compressive strength insulation, encased in sheet metal shield.
   1. Material for Cold Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with vapor barrier.
   2. Material for Hot Piping: Water-repellent-treated ASTM C533, Type 1 calcium silicate.
   3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
   4. For Clevis or Band Hanger: Insert and shield to cover lower 180 degrees of pipe.
   5. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.
   6. Thermal Hanger Shield Inserts should be provided at the hanger points and guide locations on pipes requiring insulation. The Inserts should consist of Polyisocyanurate (urethane or phenolic insulation) encircling the entire circumference of the pipe with a 360 degree PVC (1.524 mm thick) with a living hinge and J lock and installed during the installation of the piping system.

E. Roller Hangers:
   1. Adjustable roller hanger. Black steel yoke, cast iron roller. MSS Type 41.

F. Concrete Inserts:
   1. Malleable iron body, hot dipped galvanized finish. Lateral adjustment. MSS Type 18.

G. Continuous Concrete Insert:
H. Beam Clamps:
   1. MSS Type 19 and 23, wide throat, with retaining clip.
   2. Universal Side Beam Clamp: MSS Type 20.

I. Below Ground:
   1. Pipe Hangers: Adjustable Clevis type, Federal Specification WW-H-171 (Type 1), UL listed, stainless steel Type 316. MSS Type 1. If PVC piping to be used, provide Type 1 hanger, coated for PVC piping.
   2. Rod: 5/8-inch stainless steel Type 316.
   3. Eyebolt: Stainless steel Type 316.
   4. Nuts and Washers: Stainless steel Type 316.

J. Hangers for Pipe Size 2-inches and Smaller:
   1. Adjustable swivel ring hanger, UL listed, Type 6 or Type 10.

K. Hangers for Pipe Size 2-1/2-inches and Larger:
   1. Adjustable clevis type, UL listed, Type 1.

L. Riser Clamps:
   1. Steel, UL listed. MSS Type 8.

M. Plumbers Tape:
   1. Not permitted as pipe hangers or pipe straps.

N. Pipe Alignment and Secondary Support Systems:
   1. Secondary Pipe supports for general applications (Non-Acoustical).
      a. Supports will be manufactured in compliance with IAPMO Product Standard PS 42-96. All products provided will be listed by IAPMO for secondary pipe support.
      b. Supports may be used when sound and/or vibration transfer is not a concern.
   2. Secondary pipe supports for sound and vibration attenuation (Acoustical).
      a. Supports will be manufactured in compliance with IAPMO Product Standard PS 42-96. All products provided will be listed by IAPMO for secondary pipe support.
      b. Acoustical pipe supports will be manufactured and installed in compliance with International Organization for Standardization (ISO) 3822-1 with current amendments.
      c. Supports will be used when sound and/or vibration transfer is a concern. Locations where acoustical supports will be provided and include but are not limited to partition walls between living units, tenant spaces, retail units, mechanical rooms and lobbies.
      d. Support Products:
         1) Support to Wall Brace and Wall Stud Penetrations: HOLDRITE #261, #262, #263, and #264, or approved equivalent.
         2) Pipe Wrap for Pipe Clamps and Channel-Mounted Pipe Clamps: HOLDRITE #270, or approved equivalent.
         3) Pipe Wrap for Pipe Hangers: HOLDRITE #271, #272-2, and #272-4, or approved equivalent.
         4) Drop-Ear Fitting Support: HOLDRITE #265, or approved equivalent.
         5) Floor Riser Isolation Pads: HOLDRITE #275-T, or approved equivalent.
         6) Floor Isolation Pads (General Applications): HOLDRITE #274, #275, #276, and #278, or approved equivalent.

O. Freestanding Roof Pipe Supports:
   1. Polyethylene high-density U.V. resistant quick "pipe" block with foam pad.
   2. Recommended installation is for pipe blocks to be freestanding.
   3. Piping 3-inches and larger mounted on block type supports.
2.3 WALL AND FLOOR SLEEVES

A. Below Grade and High Water Table Areas:
   1. Modular Link Sealing System at Pipe Sleeves: Neoprene gasket links bolted together around an interior sleeve forming a watertight seal. Use a modular link sealing system at sleeves to continuously fill the annular space between the pipe and the wall opening. Provide Link-seal Type C unless otherwise noted. OS with S-316 stainless construction for continuous water/tank walls.
   2. Sleeves through concrete foundation walls and floors. Ductile iron pipe. Class 50 or 51 pipe conforming to ANSI/AWWA C151/A21.51, cement lined. Pipe sleeve will extend a minimum of 6-inches beyond outside perimeter of foundation. Final placement of sleeve will be confirmed with project's structural engineer. In areas with a high water table, provide AWWA C900, Class 235 plastic pipe in lieu of ductile iron pipe.

B. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814.

C. Insulating Caulking: Eagle or Pitcher Super 66 high temperature cement.

D. Fabricated Accessories:
   1. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.
   2. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide following minimum gauges for sizes indicated:
      a. Sleeve Size 4-inches in Diameter and Smaller: 18 gauge.
      b. Sleeve Sizes 5-inches to 6-inches: 16 gauge.
      c. Sleeve Sizes 7-inches and Larger: 14 gauge.
   3. Fire-Rated Safing Material:
      1) Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 lbs./cu.ft. density with melting point of 1985 degrees F and K value of 0.24 at 75 degrees F.
      2) Calcium Silicate Insulation: Noncombustible, complying with FS-HH-I-523, Type II, suitable for 100 degrees F to 1200 degrees F service with K value of 0.40 at 150 degrees F.

2.4 BUILDING ATTACHMENTS

A. General: Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project Structural Engineer. Provide anchor bolts suitable for cracked concrete.

B. Anchor Bolts:
   1. Anchor Bolts (Cast-In-Place): Steel bolts, ASTM A307. Nuts to conform to ASTM A194. Design values for shear and tension not more than 80 percent of the allowable listed loads.
   2. Anchor (Expansion) Bolts: Carbon steel to ASTM A307; nut to conform to ASTM A194; drilled-in type. Design values for shear and tension not more than 80 percent of the allowable listed loads.

C. Beam Clamps:
   1. MSS Type 19 and 23, wide throat, with retaining clip.
   2. Universal Side Beam Clamp: MSS Type 20.
D. Powder-Actuated Drive Pin Fasteners:
   1. Powder-Actuated Drive-Pin Fasteners: Powder actuated type, drive pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

E. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

F. Grout: ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
   1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
   3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

2.5 FLASHING

A. Steel Flashing: 26 gauge galvanized steel.

B. Safes: 8 mil thick neoprene.

C. Caps: Steel, 22 gauge minimum, 16 gauge at fire-resistant structures.

D. Provide hot dipped galvanized components for items exposed to weather.

2.6 MISCELLANEOUS METAL AND MATERIALS

A. Miscellaneous Metal: Provide miscellaneous metal items specified hereunder, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on Drawings or otherwise not shown on drawings, that are necessary for completion of the project. The Contractor is responsible for their design.
   1. Fabricate miscellaneous units to size, shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.

B. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.

C. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.

D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.

E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.

F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods and equipment required for fabrication.

G. Provide hot dipped galvanized components for items exposed to weather.
H. Use straps, threshold rods and wire with sizes required by SMACNA to support piping.

I. Grout: ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
   1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
   2. Properties: Nonstaining, noncorrosive, and non gaseous.
   3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Examination:
   1. Verify building materials to have hangers and attachments affixed in accordance with hangers to be used. Provide supporting calculations.

B. Preparation:
   1. Examine Drawings and coordinate for verification of exact locations of fire and smoke rated walls, partitions, floors and other assemblies. Indicate, by shading and labeling on Record Drawings such locations and label as "1-Hour Wall," "2-Hour Fire/Smoke Barrier," and the like. Determine proper locations for piping penetrations. Set sleeves in place in new floors, walls or roofs prior to concrete pour or grouting.

C. Install hangers, supports, anchors and sleeves after required building structural work has been completed in areas where the work is to be installed. Coordinate with project structural engineer proper placement of inserts, anchors and other building structural attachments.

3.2 PIPE HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

A. Hangers and Supports:
   1. Comply with MSS SP-58. Pipe Hanger and Support Installation: Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. For horizontally hung grooved-end piping, provide a minimum of 2 hangers per pipe section.
   2. Pipe Ring Diameters:
      a. Uninsulated and Insulated Pipe, except where oversized pipe rings are specified: Ring inner diameter to suit pipe outer diameter.
      b. Insulated Piping Where Oversized Pipe Rings are Specified and Vibration Isolating Sleeves: Ring inner diameter to suit outer diameter of insulation or sleeve.
   3. Oversize Pipe Rings: Provide oversize pipe rings of 2-inch and larger size.
   5. Steel Backing in Walls: Provide steel backing in walls to support fixtures and piping hung from steel stud walls.
   6. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
      a. Field assemble and install according to manufacturer's written instructions.
   7. Pipe Guides:
      a. Install on continuous runs where pipe alignment must be maintained. Provide a minimum of two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides to pipe structure. Any contact with chilled water pipe should not permit heat to be transferred in sufficient quantity to cause condensation on any surface.
b. Install approximately 4 pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Do not use as supports. Provide in addition to other required pipe hangers and supports.

8. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
   a. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
   b. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1

9. Group parallel runs of horizontal piping to be supported together on trapeze-type hangers.

10. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe.

11. Do not support piping from other piping.

12. Fire protection piping will be supported independently of other piping.

13. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated.

14. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.

15. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchor, and to facilitate the action of expansion joints, expansion loops, expansion bends and similar units.

16. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

17. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping" is not exceeded.

18. Insulated Piping: (comply with the following)
   a. Attach clamps and spacers to piping.
      1) Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      2) Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      3) Do not exceed pipe stress limits according to ASME B31.9.
   b. Install MSS SP-58, Type 39 protection saddles, if insulation without a vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
   c. Install MSS SP-58, Type 40 protective shields on cold piping having a vapor barrier. Shields to span arc of 180 degrees.
      1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
   d. Shield Dimensions for Pipe, not less than the following:
      1) NPS 1/4 to NPS 3-1/2 (DN8 to DN 90): 12-inches long and 0.048-inch thick.
      2) NPS 4 (DN100): 12-inches long and 0.06-inch thick.
      3) NPS 5 and NPS 6 (DN125 and DN150): 18-inches long and 0.06-inch thick.
      4) NPS 8 to NPS 14 (DN200 to DN350): 24-inches long and 0.075-inch thick.
      5) NPS 16 to NPS 24 (DN400 to DN600): 24-inches long and 0.105-inch thick.
   e. Pipes NPS 8 (DN200) and Larger: Include wood inserts.
   f. Insert Material: Length at least as long as protective shield.
   g. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
19. Equipment Clearances: Do not route equipment or piping through electrical rooms, transformer vaults, elevator equipment rooms, IT rooms, MPOE rooms, or other electrical or electronic equipment spaces and enclosures and the like. Within equipment rooms, provide minimum 3-feet lateral clearance from all sides of electric switchgear panels. Do not route piping or equipment above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with Electrical and coordinate exact equipment or pipe routing to provide proper clearance with such items.

20. Pipe supports and hanger spacing (pipe supported from structure or floor-supported) to meet the requirements of References and Standards Article in Part 1 above.

B. Pipe Curb Assemblies:
1. Provide for piping and electrical conduit which penetrates the structural roof deck to service equipment above the roof level (i.e., piping, electrical power and control wiring). Meet requirements of roof warranty.
2. Provide prefabricated units for roof membrane and insulation penetrations related to equipment. Coordinate with roofing system. Set supports on the structural deck. Do not set supports on insulation or roofing. Provide level supports by prefabricated pitch built into the curb.
3. Piping above roof to be supported with freestanding roof pipe supports unless detailed otherwise. At roofing applications, the adhesion mastic is to be specifically submitted to and approved by the roofing system manufacturer/installer to maintain the integrity of all warranties.
4. At concrete floors, install a polyurethane mastic to the support block and adhere in place.

C. Vertical Piping:
1. Support with U-clamps fastened to wall to hold piping away from wall unless otherwise approved.
2. Riser clamps to be directly under fitting or welded to pipe. Provide neoprene pads for all systems except natural gas.
3. Riser to be supported at each floor penetration.
4. Provide structural steel supports at the base of pipe risers. Size supports to carry forces exerted by piping system when in operation.

D. Adjusting and Painting:
1. Adjust hangers so as to distribute loads equally on attachments. Provide grout under supports to bring piping and equipment to proper level and elevations.
2. Prime paint ferrous nongalvanized hangers, accessories, and supplementary steel which are not factory painted.

3.3 WALL AND FLOOR SLEEVES
A. "Link-Seal" Pipe Sleeves: Install at slab on grade floor/below grade piping penetrations. Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations (except for DWV piping at slab on grade). Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations.

B. Fabricated Pipe Sleeves:
1. Provide either steel or sheet metal pipe sleeves accurately centered around pipe routes. Size such that piping and insulation, if any, will have free movement within the sleeve, including allowance for thermal expansion. Sleeve diameter to be determined by local seismic clearance requirement, and by waterproofing requirements.
2. Length: Equal to thickness of construction penetrated, except extend floor sleeves 1-inch above floor finish.
3. Provide temporary support of sleeves during placement in concrete and other work around sleeves. Provide temporary end closures to prevent concrete and other materials from entering pipe sleeves.

4. Seal each end airtight with a resilient nonhardening sealer, UL listed and fire rated per ASTM 814.

### 3.4 BUILDING ATTACHMENTS

A. Install within concrete slabs or attach to structural steel or wood. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints and at changes in direction of piping.

B. Attachment to Wood Structure: Provide MSS Type 34 for attachment to wooden beam or approved attachment for a wood structure.

C. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer’s written instructions.

D. Install concrete inserts before concrete is placed; fasten insert secure to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top in inserts.

E. Install powder-actuated drive pin fasteners 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. Test powder-actuated insert attachments with a minimum load of 100 pounds.

F. Bolting: Provide bored, drilled or reamed holes for bolting to miscellaneous structural metals, frames or for mounts or supports. Flame cut, punched or hand sawn holes will not be accepted.

G. Anchor Bolts:
   1. Install anchor bolts for mechanical equipment and piping as required. Tightly fit and clamp base-supported equipment anchor bolts at equipment support points. Provide locknuts where equipment and piping are hung.
   2. Anchor Bolts (Cast-In-Place): Embed anchor bolts in new cast-in-place concrete to anchor equipment. Install a pipe sleeve around the anchor bolt for adjustment of the top 1/3 of the bolt embedment; sizes and patterns to suit the installation conditions of the equipment to be anchored.

H. Pipe Anchors: Provide anchors to fasten piping which is subject to expansion and contraction, and adjacent to equipment to prevent loading high forces onto the equipment.

I. Escutcheon Plates: Install around horizontal and vertical piping at visible penetrations through walls, partitions, floors, or ceilings, including penetrations through closets, through below ceiling corridor wall, and through equipment room walls and floors.

J. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:
   1. Install fabricated pipe sleeve.
   2. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification with specified material.
   3. Seal each end airtight with a resilient nonhardening UL listed fire resistant ASTM 814 sealant.

K. Piping Penetrations Through Fire-rated (1 to 3 hour) Assemblies:
1. Select and install pre-engineered pipe penetration system in accordance with the UL listing and manufacturer's recommendation.

2. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814. Use HOldRITE HydroFlame or approved equivalent.

L. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.

3.5 FLASHING

A. Flash and counterflash where piping passes through weather or waterproofed walls, floors and roofs.

B. Flash vent soil pipes with flashings per Division 01, General Requirements.

C. Flash floor drains over finished areas and roof drains, 10-inches clear on sides, minimum 36-inches x 36-inches sheet size. See Division 01, General Requirements. Fasten flashing to drain with clamping device.

D. Install built up fixtures (mop sinks, shower stalls, shower floors) with water sealing systems/membranes to meet Code and as prescribed by Division 01, General Requirements and Section 22 00 00, Plumbing Basic Requirements. Meet all Code testing requirements. Provide drainage devices with appropriate flanges, clamps, etc. to meet these installation requirements and ensure a water-tight installation.

3.6 MISCELLANEOUS METAL AND MATERIALS

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required. Avoid cutting concrete reinforcing when drilling for inserts. Reference structural drawings and reinforcing shop drawings and determine locations of stirrups prior to drilling into concrete.

C. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete masonry or similar construction.

D. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.


1. Set loose leveling and bearing plates on wedges or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not
exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.

2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

F. Fabrication:
1. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on Drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates and similar devices. Hot dip galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.

2. Finishes:
   a. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with 1 coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas with primer of same material before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.
   b. Metal in contact with Concrete, Masonry and Other Dissimilar Materials:
      1) Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
   c. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

G. Metal Fabrication:
1. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
2. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
3. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of weld and methods used in correcting welding work, and with the following:
   a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   b. Obtain fusion without undercut or overlap.
   c. Remove welding flux immediately.
   d. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
4. Provide hot dipped galvanized components for items exposed to weather.

END OF SECTION