

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment components.
- B. Horizontal-piping hangers and supports.
- C. Shields
- D. Vertical piping clamps
- E. Pre-engineered roof supports
- F. Anchors and fasteners.
- G. Miscellaneous materials.
- H. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "Plumbing Insulation", for high density insulation for protecting insulation vapor barrier and materials and methods for piping hanger installations.
 - 2. Division 22 "Water Distribution Piping and Specialties", for pipe hanger types and spacing for horizontal and vertical domestic water distribution and heat traced piping of sizes and materials indicated.
 - 3. Division 22 "Sanitary Drainage & Vent Piping and Specialties", for pipe hanger types and spacing for heat traced and cold sanitary piping of sizes and materials indicated.
 - 4. Division 22 "Storm Drainage & Piping and Specialties", for pipe hanger types and spacing for horizontal and vertical storm drainage piping of sizes and materials indicated.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.

5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.03 SUBMITTALS

- A. Product Data : Provide manufacturer's standard catalog pages and data sheets for each type of hanger and support. Include a hanger and support schedule showing manufacturer's figure number, size, location, and features for each hanger and support. Submit style and type to Structural Engineer for approval prior to installation.
- B. Product Certificates: Signed by the manufacturer of hangers and supports certifying the products meet the specified requirements.
- C. Welder Certificates: Signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.
- D. Maintenance Data: For inclusion in Operating and Maintenance manual specified in Division 01 and Division 22 Section "General Plumbing Requirements."
- E. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution. Include dimensions, weights, required clearances, and method of assembly.
1. Application of protective inserts, and shields at pipe hangers for each type of insulation and hanger.
- F. Installer's Qualifications: Include evidence of compliance with specified requirements.
- G. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.04 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Field-Welding:
1. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."

2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
 3. Qualify welding processes and welding operators in accordance with ASME BPVC Section IX, "Welding and Brazing Qualifications."
- D. Flame/Smoke Ratings: Provide hangers and supports with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E84 (NFPA 255) method.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

1.06 DEFINITIONS

- A. Terminology used in this Section is defined in MSS SP-90.

PART 2 - PRODUCTS AND MATERIALS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
1. Comply with MSS SP-58.
 2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of work.
 3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
 5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 6. Materials: Products and materials listed in this specification are based on indoor, dry locations. Use corrosion resistant materials suitable for the environment where installed.
 - a) Indoor Dry Locations: Painted carbon steel, galvanized steel or zinc-plated steel. Where supports will be field painted in exposed locations, provide carbon steel.

- b) Indoor Damp or Wet Locations: Galvanized steel or type 304 stainless steel.
- c) Natatorium or other treated pool environments: Type 316 stainless steel.
- d) Outdoor Locations: Galvanized steel or type 304 stainless steel.
- e) Dielectrics Barriers: Provide dielectric barriers between metallic supports and metallic piping and associated items of dissimilar type. Acceptable barriers include rubber, or copper-plated coatings where attachments are in direct contact with copper.
- f) Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
- g) Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- h) Stainless Steel: Type 304 or 316 in accordance with ASTM A240.

B. Metal Channel (Strut) Framing Systems:

1. Manufacturers:

- a. Cooper B-Line.
- b. Ferguson Enterprises/FNW.
- c. PHD Manufacturing.
- d. Thomas & Betts Corporation.
- e. Unistrut, a brand of Atkore International Inc.
- f. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

2. Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.

3. Comply with MSS SP-69, Type 59, MSS SP-89, and MFMA-4. Welds shall comply with AWS D1.1.

4. Channel Material:

- a. Indoor Dry Locations: Galvanized steel or zinc-plated steel.
- b. Indoor Damp or Wet Locations: Galvanized steel or type 304 stainless steel.
- c. Outdoor Locations: Galvanized steel or type 304 stainless steel.
- d. Natatorium or other treated pool environments: Type 316 stainless steel.
- e. All nuts, brackets, and clamps shall have the same finish as the channel.

5. Minimum Channel Thickness: Steel sheet, 14 gage, 0.0747 inch.

6. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height with factory-punched attachment holes.

7. Provide plastic galvanic isolators for connecting bare copper pipe for use with pre-engineered support strut system where indicated.

C. Hanger Rods:

1. Material:

- a. Indoor Dry Locations: Zinc-plated steel.

- b. Indoor Damp or Wet Locations or Outdoor Locations: Zinc-plated steel or type 304 stainless steel.
 - c. Natatorium or other treated pool environments: Type 316 stainless steel.
- 2. Threaded both ends or continuously threaded.
- 3. Minimum Size: Reference piping specification sections for rod thicknesses.
- 4. Threaded Rods: Threaded rods are not allowed for floor supports except when the maximum length of the rod is less than 12". Threaded rod sizes shall be the same size diameter as specified for pipe hanger rods based upon pipe size being supported. Refer to system piping specification sections for rod size requirements.

2.02 HORIZONTAL PIPING HANGERS AND SUPPORTS

A. MANUFACTURERS

- 1. ASC Engineered Solutions.
- 2. Cooper B-Line, Inc.
- 3. Elite Components
- 4. ERICO/Michigan Hanger Co./Caddy
- 5. Ferguson/FNW.
- 6. Halfen-DEHA.
- 7. Hilti.
- 8. National Pipe Hanger Corporation.
- 9. PHD Manufacturing.
- 10. Power-Strut.
- 11. Unistrut.

B. Single Hangers:

- 1. Split Ring: Carbon steel, adjustable swivel, split ring type.
- 2. Split Ring 2 inch and smaller: Copper alloy, split ring type.
- 3. Clevis Hanger: Carbon steel, adjustable, clevis type.
- 4. Roll Support Hanger: Adjustable steel yoke, cast iron roll.

C. Trapeze and Strut-mounted Supports:

- 1. Two-piece clamp: Designed for use with channel strut, held in place at channel shoulder when clamp attachment nut is tightened.
- 2. Roll Support: Adjustable cast iron roll attached to metal channel strut framing system with brackets and nuts.

D. Hangers and strut-mounted supports with pre-manufactured polymer inserts:

- 1. Manufacturers:
 - a) ASC Engineered Solutions.
 - b) Holdrite.
 - c) Klo-Shure.
- 2. Strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts designed to receive butted insulation internally. Inserts

shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation. Metal shields are not required with clevis hangers of this type.

E. Spring Hangers:

1. Reference Section “Vibration Isolation for Plumbing Piping and Equipment” for spring isolation hangers.

F. Wall Supports:

1. Two-hole strap, galvanized steel or copper to suit pipe material. Provide rigid insulation between strap and pipe to maintain continuous insulation and vapor barrier where required.
2. Welded steel bracket reinforced with angle or strut. Support pipe from bracket using horizontal pipe hanger or support appropriate for the pipe type.

G. Floor Supports:

1. Pipe Saddle: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
2. Roller Support: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

H. Pre-Insulated Supports:

1. Manufacturers:
 - a) Aeroflex USA, Inc.
 - b) Armacell.
 - c) Buckaroos, Inc.
 - d) Cooper B-Line, Inc.
 - e) Pipe Shields, Inc.
2. General Construction and Requirements:
 - a) Flexible elastomeric insulation with integral high-density pipe support insert shall conform to ASTM C534, Type I.
 - b) Surface Burning Characteristics: Assembly shall have a flame spread index/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c) Waterproof calcium silicate insulation shall conform to ASTM C795.
 - d) Rigid phenolic foam insulation shall conform to ASTM C1126, Type III.
 - e) Insulation inserts shall be surrounded by a 360 degree jacket or shield.
3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

2.03 SHIELDS

A. Insulation Protection Shield:

1. Sheet metal construction, meeting SP-58 Type 40, of 18 gauge for 5-1/2" inside dimension and smaller, 16 gauge for 6-1/2" to 10-3/4" inside dimension 14 gauge for 11-3/4" to 17" inside dimension, and 12 gauge for 18" to 28" inside dimension.
2. Shield shall cover half of the circumference of the pipe and shall be of length indicated by manufacturer for pipe size and thickness of insulation.
3. Lengths for pipes greater than 2 inches: Minimum 8 inch long section at each support. .
4. For pipes 2 inch and smaller using fiberglass or flexible elastomeric insulation without pre-insulated supports, provide insulation protection shields installed between hanger and pipe which meets the following minimum length requirements:

Pipe Size (NPS)	Insulation Thickness (inches)	Minimum Shield Length, (in)					
		Hanger Spacing, (ft)					
		5	6	7	8	9	10
≤ 1	0.5	5	6	8	-	-	-
	1	3	5	5	-	-	-
	1.5	3	5	5	-	-	-
	2	3	3	3	-	-	-
	3	3	3	3	-	-	-
≤ 2	0.5	8	8	11	11	12	14
	1	5	6	8	9	11	11
	1.5	5	6	8	8	9	9
	2	5	5	6	6	8	8
	3	5	5	6	6	6	8

- B. 360° Insulation Protection Shield: Shield shall cover all of the circumference of the pipe with two half circumference sections held together with bolts and nuts and shall be of length indicated by manufacturer for pipe size and thickness of insulation.

C. Plastic Shields:

1. Manufacturers:
 - a) Armacell.
 - b) Eaton.
 - c) Hydra-Zorb.
 - d) PHD Manufacturing.
 - e) Zsi Foster.
2. Polymer-based, snap-on or clip-on design, with non-adhesive surface and lip to allow lateral movement of piping without damaging insulation, field-paintable.

2.04 VERTICAL-PIPING SUPPORTS

- A. Manufacturers:
 - 1. ASC Engineered Solutions.
 - 2. Cooper B-Line, Inc.
 - 3. Halfen-DEHA.
 - 4. Hilti.
 - 5. ERICO/Michigan Hanger Co.
 - 6. National Pipe Hanger Corporation.
 - 7. PHD Manufacturing.
 - 8. Power-Strut.
 - 9. Unistrut.
- B. Components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.
 - 1. Components shall have galvanized coatings where installed for piping and equipment that will not have factory applied or field-applied finish.
 - 2. Pipe attachments shall be copper-plated or have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
 - 3. Components as listed below shall be made of 304 stainless steel where installed in corrosive environments and/or where indicated on the drawings.
- C. Riser Clamps with pre-manufactured polymer insert:
 - 1. Manufacturers:
 - a) Hydra-Zorb; Titan Riser Clamp.
 - b) National Pipe Hanger.
 - c) Pipe Hangers, Inc.
- D. Riser clamp with pre-manufactured polymer inserts designed to withstand vertical loading and receive butted insulation internally. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation.

2.05 PRE-ENGINEERED ROOF PIPE SUPPORTS

- A. Manufacturers:
 - 1. Airtec.
 - 2. ASC Engineered Solutions.
 - 3. Cooper B-Line, Inc.
 - 4. Elite Components.
 - 5. ERICO/Michigan Hanger Co./Caddy.
 - 6. Ferguson/FNW.
 - 7. Miro.

8. PHP Systems/Design.
 9. PHD Manufacturing.
 10. Roof Top Blox.
 11. Unistrut, a brand of Atkore International Inc.
 12. Zsi Foster.
- B. General: Pre-engineered devices with embedded pipe support fixtures as specified.
- C. Pedestals: Steel pedestals with thermoplastic or rubber base with the following dimensions:
1. Up to 12 inch strut length support: 18 inch x 18 inch.
 2. Up to 16 inch strut length support: 24 inch x 18 inch.
 3. Up to 24 inch strut length support: 30 inch x 18 inch.
 4. Thickness: Minimum 3/16 inch thick.
- D. Block Bases: Closed-cell polyethylene blocks with the following dimensions.
1. Length: Nominal 10 inch, 12 inch, 16 inch, or 24 inch
 2. Width: Nominal 4 inches.
- E. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
- F. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

2.06 ANCHORS AND FASTENERS

- A. Manufacturers:
1. Hilti, Inc.
 2. Illinois Tool Works, Inc.
 3. Phillips.
 4. Powers Fasteners, Inc.
 5. Rawl.
 6. Simpson Strong-Tie Company Inc.
- B. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
1. Concrete: Use preset concrete inserts or expansion anchors.
 2. Solid or Grout-Filled Masonry: Use expansion anchors.
 3. Hollow Masonry: Use toggle bolts.
 4. Hollow Stud Walls: Use toggle bolts.
 5. Steel: Use beam clamps.
 6. Sheet Metal: Use sheet metal screws.
 7. Wood: Use wood screws.
 8. Plastic and lead anchors are not permitted.
 9. Hammer-driven anchors and fasteners are permitted only as follows:

- a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction.
 - b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction.
- D. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - 1. Comply with MFMA-4.
 - 2. Channel Material: Use galvanized steel.
 - 3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
 - 4. Spot Inserts: Carbon steel with zinc plating or galvanized steel body and base plate, with protective sleeve for anchor rod insert, sized to accommodate anchor rod dimensions.
 - 5. Manufacturers:
 - a. Same as manufacturer of metal channel (strut) framing system.
 - b. DeWalt “Bang-It” concrete inserts.
- E. Post-Installed Concrete and Masonry Expansion Anchors:
 - 1. Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
 - 2. Self-drilling, drilled flush or shell type. Size inserts to suit threaded rods.
- F. Beam Clamps: MSS SP-58 C-Type or adjustable, Types 19 through 23, 25 or 27 through 30 based on required load.
 - 1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
 - 2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- G. Vibration Isolation Anchors: Reference Division 22 Section “Vibration Isolation for Plumbing Piping and Equipment” for vibration isolation anchors.

2.07 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Malleable Iron: ASTM A47
- H. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION, GENERAL

- A. Install hangers and supports in accordance with manufacturer's installation instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

3.03 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58 unless indicated otherwise.
- B. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
- C. Space attachments within maximum piping span length specified in Division 22 piping sections.
- D. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

- E. Install hangers, supports, clamps and attachments to support piping properly from building structure.
- F. Do not attach to ceilings, equipment, ductwork, conduit and other non-structural elements such as floor and roof decking.
- G. Hanger and clamps sizing:
 - 1. Cold Piping: Provide pipe hangers sized for the pipe outside diameter plus insulation thickness.
 - 2. Hot Piping: Provide pipe hangers sized for the pipe outside diameter.
 - 3. Vertical Piping: Provide clamps sized for the pipe outside diameter and extend clamp through insulation.
 - 4. Refer to Division 22 Section "Plumbing Insulation" for definition of hot and cold piping and required insulation thickness.
- H. Where several pipes can be installed in parallel and at the same elevation, Contractor has option to provide metal channel strut framing. Install supports with maximum spacing specified within Division 22 piping sections.
 - 1. Space strut framing at the required distance for the smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.
 - 2. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.
 - a) Uninsulated Copper Pipe: Install with plastic galvanic isolators
 - b) Insulated Tube or Pipe: Install with 360° insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 22 Section "Plumbing Insulation".
- I. Install building attachments within concrete or to structural steel.
 - 1. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping as specified in Division 22 piping sections.
 - 2. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.
- J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Provide two nuts on threaded supports to securely fasten the support.
- K. Install appropriate types of hangers and supports to allow controlled 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.

- L. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ASME B31.9 Building Services Piping Code is not exceeded.
- N. Insulated Piping: Comply with the following installation requirements.
 - 1. Riser Clamps: Attach riser clamps to piping with riser clamps projecting through insulation. Do not use riser clamps to support horizontal, insulated piping. Seal insulation for hot piping and protect vapor barrier for cold piping as specified in Division 22 Section "Plumbing Insulation".
 - a) Contractor's Option: Provide riser clamps with pre-manufactured polymer insert for cold piping 2-1/2 inches and larger.
 - 2. Insulation Protection Shield: Install insulation protection shield with high density insulation insert where vapor barrier is indicated, sized for the insulation thickness used as specified in Division 22 Section "Plumbing Insulation". Do not use polymer-based shields for hot piping.
 - a) Exception for horizontal cold-piping with fiberglass or flexible elastomeric insulation 2 inch and smaller: Rest fiberglass insulated pipe on hanger shield with length specified for pipe size and insulation thickness to prevent puncture or other damage.
 - 3. Contractor's Option: Provide pre-engineered thermal hanger inserts for piping insulated with flexible elastomeric insulation at pipe supports for piping 2-1/2 inches and larger.
 - 4. Contractor's Option: Provide strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts.
- O. Strut Framing Systems: Channel strut systems can be used at the Contractors option in lieu of individual hangers for horizontal pipes. Arrange for grouping of parallel runs of horizontal piping. Space channel strut systems at the required distance for the smallest pipe supported. Provide channel gauge and hanger rods per the manufacturer's recommendations for the piping supported. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.
 - 1. Uninsulated Copper Pipe: Install with plastic galvanic isolators
 - 2. Insulated Tube or Pipe: Install with 360 degree insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 22 Section "Plumbing Insulation".
- P. Vertical Piping Risers:
 - 1. Reference Section "Vibration Isolation for Plumbing Piping and Equipment" for piping riser supports.

- Q. Expansion Anchors: Use in existing concrete, masonry or in pre-cast concrete construction.
- R. Pre-Engineered Roof Pipe Supports: Set supports on an 18" X 18" x 3/16" thick roof walkway material compatible with the roof material.

3.04 EQUIPMENT SUPPORTS

- A. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
- B. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls.
- C. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
- D. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- E. Preset Concrete Inserts and Expansion Anchors: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
 - 1. Where concrete slabs form finished ceiling, locate anchors flush with slab surface.
- F. Secure fasteners according to manufacturer's recommended torque settings.
- G. Remove temporary supports.
- H. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
- I. Grouting: Place grout under supports for piping and equipment.

3.05 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.
- 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 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and 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 that no roughness shows after finishing, and so that contours welded surfaces to match adjacent contours.

3.06 FIELD QUALITY CONTROL

- A. Examine support and attachment components for damage and defects.
- B. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces. Comply with Division 09 Section "Painting."
 1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- E. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.
- F. Correct deficiencies and replace damaged or defective support and attachment components.

3.07 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Provide the following acceptable hangers and supports for each type of piping system. Hangers and supports may be single type or strut-mounted:
- C. Single Hangers:
 1. All pipe sizes 1-1/2 inch and less:
 - a. Band hanger.
 - b. Swivel split ring.
 - c. Clevis hanger.
 2. Cold and Hot pipe sizes 2 to 4 inches: Clevis hanger.
 3. Cold and Hot pipe sizes 6 inches and greater: Roll support hanger.
 4. All drainage pipe sizes: Clevis hanger.
- D. Trapezes and Strut-mounted Supports:

1. All pipe sizes less than 6 inches: Two-piece clamp.
 2. Pipe sizes 6 inches and greater: Roll support.
- E. Wall Supports:
1. Pipe sizes 3 inches and less:
 - a. Two-hole strap mounted to wall.
 - b. Welded steel bracket with reinforced angle or strut.
 2. Pipe sizes 4 inch and greater:
 - c. U-bolt
 - d. Welded steel bracket with reinforced angle or strut.
- F. Floor Supports:
1. Pipe sizes 4 inch and less: Pipe saddle.
 2. Pipe sizes 6 inch and greater: Roll support.

END OF SECTION