This master should be used by designers working on Port of Portland construction projects and by designers working for PDX tenants (“Tenants”). Usage notes highlight a few specific editing choices, however the entire section should be evaluated and edited to fit specific project needs.

This section specifies supports and anchors for non-vibration isolated equipment, tanks, ductwork, and piping systems. If this section is used, always include Section 230545, Seismic Restraints for HVAC Piping and Equipment. If equipment requiring vibration isolation is specified, include Section 230548, Vibration and Seismic Controls for HVAC Piping and Equipment.

SECTION 230529 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

1. GENERAL
	* + 1. DESCRIPTION
				1. This section describes the following:

Hangers, supports, and anchors for equipment, tanks, ductwork, and piping systems.

Supplementary steel for support or attachment of tanks, equipments, ductwork, and piping to general construction elements of the project.

* + - 1. RELATED WORK SPECIFIED ELSEWHERE
				1. Section 230518, Expansion Compensation
				2. Section 230545, Seismic Restraints for HVAC Piping and Equipment
			2. REFERENCES
				1. ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers

ASHRAE Chapter 41: Absorption, Cooling, Heating, and Refrigeration Equipment

* + - * 1. ASTM: American Society for Testing and Materials

ASTM A36: Standard Specification for Carbon Structural Steel

* + - * 1. OSSC: Oregon Structural Specialty Code
				2. SMACNA: Sheet Metal and Air Conditioning Contractors’ National Association
			1. SUBMITTALS
				1. Product Data: For all products specified herein.
				2. Shop Drawings:

Submit shop drawings of Contractor-fabricated piping support structures, pipe racks, and anchors.

Suspended Piping and Ductwork: Indicate point loads and support locations, along with applicable details keyed to layouts.

Support Frames, Piping, Tank, and Equipment Supports, and Anchorage: Indicate point loads and support locations, along with engineers’ calculations and details keyed to the layouts pertaining to supports, support frames, and anchorages.

Supplementary Steel: Show details of fabrication and installation. Indicate materials, thicknesses, gauges, sizes, dimensions, methods of joining and fastening, welds, finishes, details of reinforcement and embedment, attachments, anchorages, miscellaneous metal items incidental to basic fabrication shown, provisions for work of other trades, and other pertinent information. Submit structural calculations for necessary supplementary steel for supports, anchors, and attachment of equipment, pipes, and ducts to general construction. Calculations shall be prepared and stamped by a registered professional structural engineer licensed in the state of Oregon.

As-Constructed Drawings and Data.

* + - 1. QUALITY ASSURANCE
				1. Supports and hangers for piping systems subject to expansion and contraction shall be chosen with careful consideration. The hanger support type selection depends on the directions in which the piping system will expand. See Section 230518.
1. PRODUCTS
	* + 1. SUPPORTS AND ANCHORAGE
				1. Provide pipe and equipment hangers and supports in accordance with the following:

When supports and anchorages for tanks, equipment, conduit, piping, and ductwork are not shown on the drawings, the Contractor shall be responsible for their design.

Supports and anchorages shall resist forces due to hydraulic testing and seismic forces as specified in the OSSC for the ground motion accelerations corresponding to the project location. Design exterior equipment, ducts, and piping to resist wind loads.

Supports and anchorages shall not introduce stresses in the piping caused by thermal expansion or contraction.

Connections to structural framing shall not introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.

* + - * 1. The following engineered support systems shall be designed, detailed, and bear the seal of a registered professional structural engineer licensed in the state of Oregon:

Supports, floor and roof-mounted tanks, and supports for suspended tanks and equipment.

Support frames, such as pipe racks or stanchions, for piping and equipment which provide support from below.

Tank, equipment, and piping support frame anchorage to supporting slab or structure.

* + - 1. SUPPORTS, GENERAL
				1. Acceptable Manufacturers: B-Line Systems, Anvil, Powerstrut and Kinline, Superstrut, Unistrut, or equal.
				2. Fabricate support members from welded standard structural shapes, pipe, and plate. Carry the necessary rollers, hangers, and accessories as required. Piping less than 4-inch pipe size may be supported from or by prefabricated roll-formed channels as specified in this section with necessary accessories to adequately support piping system.
				3. Supports and Accessories: Preformed roll-formed channels and accessories with matching compatible accessories as shown, as specified, and as required.
				4. Dissimilar Metal Protection: Cush-a-Strip, Hydra-Zorb cushions, or equal.
				5. Attachments to roof and floor decks to support dead loads are not allowed except as described in Part 3. Attachments to decks to support transient loads shall consider the effects of deck deflection.
				6. All exterior materials shall be hot-dip galvanized or stainless steel.
				7. Lateral Load Design Criteria:

Seismic:

SDS = 0.61.

IP = 1.0.

Wind:

20 mph basic wind speed (ultimate design).

Exposure C.

* + - 1. PIPE ATTACHMENTS
				1. Acceptable Manufacturers: B-Line Systems, Elcen, Anvil, Michigan Hanger, Superstrut, Telco, or equal.
				2. Clamps: Superstrut Series 700 through 702.
				3. Insulated Horizontal Steel Piping:

Chilled Water, 2 Inches and Under: Anvil 65 with Fig. 167 shield.

Chilled, Over 2 Inches: Anvil Fig. 260 with Fig. 167 shield.

Other, 2 Inches and Under: Anvil Fig. 65 with Fig. 167 shield.

Other, Over 2 Inches: Anvil Fig. 260 with Fig. 167 shield.

* + - * 1. Uninsulated Horizontal Steel Piping:

2 Inches and Under: Anvil Fig. 65.

Over 2 Inches: Anvil Fig. 260.

* + - * 1. Insulated Horizontal Copper Piping:

Chilled Water, 2 Inches and Under: Anvil Fig. 65 with Fig. 167 shield.

Chilled Water, Over 2 Inches: Anvil 260 with Fig. 167 shield.

* + - * 1. Uninsulated Horizontal Copper Piping:

2 Inches and Under: Anvil Fig. CT65, CT69.

Over 2 Inches: Anvil Fig. CT65.

* + - * 1. Riser Clamps, Steel and Cast Iron Pipe: 3/4-inch to 20-inch, Anvil Fig. 261.
				2. Riser Clamps, Copper Pipe: Anvil Fig. CT-121.
			1. PIPE ROLLERS
				1. Supported: Anvil Fig. 274, pipe roll chair, adjustable; or equivalent product by B‑Line Systems, Elcen, Superstrut, Telco, or equal.
				2. Supported: Superstrut C728H, pipe roller, aluminum wheels, steel brackets, or equivalent product by B-Line Systems, Elcen, Anvil, Telco, or equal.
				3. Suspended: Anvil Fig. 171 or Fig. 177 adjustable pipe roller; or equivalent product by B-Line Systems, Elcen, Superstrut, Telco, or equal.
			2. PIPE RACKS
				1. Acceptable Manufacturers: Kin-Line, Superstrut, Uni-Strut, or equal.
				2. Supports and Accessories: Preformed roll-formed channels and accessories with electrochromate or equal finish and matching compatible accessories as shown, as specified, and as required.
			3. PROTECTION SHIELDS
				1. Select protection shields based on actual outside diameter of pipe plus insulation. Use protection shields at hanger or roller assemblies on chilled or cold water piping, where hangers are installed around insulation, and on both sides of clamps or U-bolts where installed around insulation. Use Anvil Fig. 167, or equal.
			4. BUILDING ATTACHMENTS
				1. Acceptable Manufacturers: B-Line Systems, Elcen, Anvil, Superstrut, Telco, or equal.
				2. Beam Hangers – Beam Clamps: Anvil Fig. 218, adjustable malleable iron beam clamp, or Fig. 228, adjustable forged steel beam clamp.
				3. Beam Hangers – C-Type Clamps: Anvil Fig. 93. Sized for required rod to support load being carried.
				4. Beam Hangers – Welded: Anvil Fig. 66. Sized for required rod to support load being carried.
				5. Inserts:

Malleable iron or steel inserts, Superstrut M-732CB or S. Inserts sized for required rod to support load being carried.

Malleable iron or steel inserts, Grinnell, Fig. 152. Inserts sized for required rod to support load being carried.

* + - * 1. Expansion Plugs: Similar and equal to Phillips “red-head” self-drilling flush shell, selected for safety factor of 4.
			1. PIPE ANCHORS
				1. Fabricate from steel plate as detailed (steam, condensate, pumped condensate, and hot water).
				2. Insulated Pipe Anchors (Chilled Water):

Acceptable Manufacturers: Pipe Shields Inc., Rilco, or pre-bid approved equal.

Insulated pipe anchors shall maintain vapor barrier and a positive axial, lateral, and vertical stop.

Steel Inner Thrust Plates: Welded attachments, material shall be compatible with pipe, shipped loose.

Structural Inserts: High-density calcium silicate, compressive strength 600 psi minimum. Asbestos-free treated with water repellant.

Jackets: Galvanized steel.

Steel Straps Base and Outer Thrust Plates: Carbon steel.

Fasteners: Cadmium plated.

The anchor shall bear the piping system design load. Pipe Shields models C4000 through C4300.

* + - 1. ROOF-MOUNTED EQUIPMENT SUPPORT
				1. Acceptable Manufacturers: Greenheck – GES, or pre-bid approved equal.
				2. Welded aluminum or galvanized steel construction suitable for use on insulated (GESR) or non-insulated (GESS) flat roof decks, wood nailer, engineered to support gravity and seismic loads of supported equipment. Account for roof slope to provide level mounting surface for equipment.
1. EXECUTION
	* + 1. HANGERS AND SUPPORTS
				1. General:

Install all support systems as detailed and in accordance with manufacturer’s recommendations. Provide pipe racks, pipe stands, trapeze hangers, etc., as required and as detailed on the drawings.

Provide adjustable hangers complete with inserts, adjusters, bolts, nuts, swivels, all-thread rods, etc., for all pipes, except where specified otherwise.

Size hangers to clear insulation for piping services conveying liquids less than 70ºF.

Support fire protection piping independently of other piping.

Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods. Do not use tape for isolation.

Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. 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. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

Install piping systems in accordance with SMACNA standards.

* + - * 1. Vertical Piping:

Support with U-clamps fastened to wall to hold piping away from wall unless otherwise approved.

Riser clamps shall be directly under fitting or welded to pipe.

Risers shall be supported at each floor of penetration.

Provide structural steel supports at the base of pipe risers. Size supports to carry all forces exerted by piping system when systems are in operation.

* + - * 1. Horizontal Piping:

On all insulated piping, provide insulation protection shields at all roller locations.

Cold and Hot Piping Systems:

Install hangers outside of insulation.

On all piping, provide insulation protection shields at each hanger location.

* + - * 1. Trapeze Hangers: Multiple pipe runs where indicated shall be supported on channels with rust resistant finish. Provide all necessary supporting steel.

Channels: Unistrut with electro-chromate finish, or equal.

* + - * 1. Hanger Spacing: Provide hangers at minimum spacing in accordance with Chapter 41, ASHRAE Guide and as follows:

Steel Pipe, Copper Tubing: For straight runs of horizontal piping with no concentrated loads such as valves, flanges, expansion joints, or other components. Sections of piping with concentrated loads will have to be considered carefully and a determination made as to appropriate spacing and rod size for the given situation.

|  |  |  |  |
| --- | --- | --- | --- |
| Pipe Size | Max. SpanSteel | Max. SpanCopper | Rod Size |
| 1" and smaller | 7 feet | 5 feet | 3/8" |
| 1-1/4" to 2" | 8 feet | 8 feet | 3/8" |
| 2-1/2" to 3" | 11 feet | 9 feet | 1/2" |
| 4" to 5" | 14 feet | 10 feet | 1/2" |
| 6" | 17 feet | 12 feet | 5/8" |
| 8"  | 19 feet | 14 feet | 7/8" |
| 10" | 20 feet | N/A | 7/8" |
| 12" | 20 feet | N/A | 7/8" |
| 14" | 20 feet | N/A | 1" |
| 16" | 20 feet | N/A | 1" |
| 18" | 20 feet | N/A | 1 1/4" |
| 20" | 20 feet | N/A | 1 1/4" |
| 24" | 20 feet | N/A | 1 1/2" |

Maximum Rod Load: Below are maximum loads for hanger rods based on Chapter 41 of ASHRAE Guide and as follows for ASTM A36, with a safety factor of 5.

| Nominal Rod Diameter | Load |
| --- | --- |
| 3/8" | 610 pounds |
| 1/2" | 1,130 pounds |
| 5/8" | 1,810 pounds |
| 3/4" | 2,710 pounds |
| 7/8" | 3,770 pounds |
| 1" | 4,960 pounds |
| 1 1/4" | 8,000 pounds |
| 1 1/2" | 11,630 pounds |

* + - * 1. Insulation Protection:

Where piping is suspended from insulation, provide 16-gauge galvanized steel protection shields, 12 inches long.

Where pipe clamps are installed on insulated piping, provide 16-gauge galvanized steel protection shields, 12 inches long on both sides of insulated pipe.

Band shields firmly to insulation to prevent slippage.

* + - * 1. Building Attachments:

Where possible, support all piping and equipment from structural members, beams, and joists.

Provide structural steel angles, channels, or other members to support piping and equipment where structural members do not occur as required for proper support.

Arrange supports to prevent eccentric loading of joists and joist girders. Locate supports at joist panel points or provide web reinforcing as required.

Provide transverse and longitudinal bracing on piping at 75-foot intervals to provide a stabilized piping system. Bracing shall not introduce stresses in the piping system caused by thermal expansion or contraction.

Do not fasten or attach to unfilled steel roof deck structure.

Attach to concrete-filled steel floor deck structure for loads up to 400 pounds. Loads larger than 400 pounds shall be designed per code. Submit structural calculations stamped and signed by a structural engineer licensed in the State of Oregon showing that the concrete-filled floor deck has sufficient capacity to support the load at the points of anchorage.

* + - * 1. Pipe Racks:

General: Provide racks as shown with additional elements to adequately support piping.

Coordination: Where mechanical piping, tubing, etc., and electrical conduit, wiremold, wireways, etc., follow common routings, coordinate routing. Allow sufficient clearance to adequately operate, access, and maintain all devices without dismantling racks.

* + - * 1. General: Support all piping within 2 feet of change of direction on both sides of fitting.
				2. Insulated Pipe Anchors: Apply a wet coat of vapor barrier on all butt joints and seal the joints with a minimum of 3-inch-wide vapor barrier tape or band.
				3. Roof-Mounted Equipment Supports: Select appropriate model for insulated or uninsulated roof deck. Install in accordance with manufacturer’s instructions. Account for roof slope to provide level mounting service for equipment.

END OF SECTION 230529