

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Vibration isolation for piping, ductwork and equipment.
- B. Flexible hangers.

1.2 REFERENCES

- A. ASHRAE - Guide to Average Noise Criteria Curves.
- B. International Building Code 2003.
- C. NFPA 5000 - The Building Construction and Safety Code.
- D. NFPA 13 and 14 for Fire Protection Systems.
- E. Mason Industries Seismic Restraint Guidelines, Latest Edition.

1.3 QUALITY ASSURANCE

- A. Maintain ASHRAE criteria for average noise criteria curves for all equipment at full load condition.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 013300.
- B. Indicate vibration isolator locations, with static and dynamic load on each, on shop drawings and described on product data.
- C. Submit manufacturer's installation instructions under provisions of Section 013300.
- D. Where walls, floors, slabs or supplementary steel work are used for seismic, restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers submittals must include spacing, static levels, and seismic loads at all attachment and support points.
- E. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.

1.5 CERTIFICATES

- A. Submit manufacturer's certificate under provisions of Section 013300 that isolators are properly installed and properly adjusted to meet or exceed specified requirements.

1.6 CODE AND STANDARD REQUIREMENTS - INTENT

- A. Provide seismic restraints to keep all mechanical building systems and components in place during a seismic event. All such systems must be installed in strict accordance with seismic codes, component manufacturer's, and building construction standards.
- B. Seismic restraints shall be designed in accordance with seismic force levels equal to or exceeding the requirements of IBC 2003 USE Group III, category C.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Mason.
- B. Vibration Mountings and Controls.
- C. Peabody.
- D. Vibration Eliminator.
- E. Vibro-Acoustics.
- F. Substitutions: Approved equal under provisions of Section 01600.

2.2 MOUNTINGS

- A. Type A: Bridge-bearing neoprene mountings shall have a minimum static deflection of 0.2" (5mm) and all directional seismic capability. The mount shall consist of a ductile iron casting containing two separated and opposing molded neoprene elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock absorbing neoprene materials shall be compounded to bridge-bearing specifications. Mountings shall have an Anchorage Preapproval "OPA" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Mountings shall be type BR as manufactured by Mason Industries, Inc.
- B. Type B: Spring type isolation shall be free standing and laterally stable without any housing and complete with 1/4" neoprene acoustical friction pads between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minim additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflections, compressed spring height and solid spring height. Mountings shall be type SLF as manufactured by Mason Industries, Inc.
- C. Type C: Restrained spring mountings shall have an SLF mounting as described in Type B, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed. The housing shall serve as blocking during erection. Installed and operating heights are equal. A minimum clearance of 1/2" (12mm) shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Restraining Bolts shall have a neoprene bushing between the bolt and the housing. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position there must be an internal isolation pad. Housing shall be designed to resist all seismic forces. Mountings shall be type SLR or SLRS as manufactured by Mason Industries, Inc..

- D. Type P: Neoprene cross ribbed or waffle pattern, 5/16 inches thick. Provide 1/4 inch hot dipped galvanized steel bearing plates. Permanently identify durometer. Mason Industries, Inc. Type W.
- E. Type Q: Neoprene mountings shall have a minimum static deflection of 0.35". All metal surfaces shall be neoprene covered to prevent corrosion and have friction pads, both top and bottom. Bolt holes shall be provided on the bottom and a tapped hole with cap screw and washer on top. Mountings shall be type ND as manufactured by Mason Industries, Inc.

2.3 HANGERS

- A. Type D: Hangers shall consist of rigid steel frames containing minimum 1-1/4" (32mm) thick neoprene elements at the top and a steel spring with general characteristics as in Type B seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30E arc from side to side before contacting the rod bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30E capability. Hangers shall be type 30N as manufactured by Mason Industries, Inc.
- B. Type E: Hangers shall be as described in Type D, but they shall be precompressed and locked at the rated deflection by means of a resilient seismic upstop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30E capability. Hangers shall be type PC30N as manufactured by Mason Industries, Inc.
- C. Type F: Vibration hanger shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing thru a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have minimum additional travel to solid equal to 50% of the rated deflection. Hangers shall be provided to attach the housing to the flat iron duct straps. Submittals shall include a scale drawing of the hanger showing the 30 degree capability. Hangers shall be type W30 as manufactured by Mason Industries, Inc.

2.4 BASES

- A. Type G: Provide integral structural steel bases. Bases shall be rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases which may be 'T' or 'L' shaped. Pump bases for split case pumps shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the base. Beam depth need not exceed 14" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of one inch. Bases shall be type WFSL as manufactured by Mason Industries, Inc.
- B. Type H: Provide steel members welded to height saving brackets to cradle machines having legs or bases that do not require a complete supplementary base. Members shall be sufficiently rigid to prevent strains in the equipment. Inverted saddles shall be type ICS as manufactured by Mason Industries, Inc.

- C. Type J: Provide rectangular structural beam or channel concrete pouring forms for floating and inertia foundations. Bases for split case pumps shall be large enough to provide support for suction and discharge base ells. In general, bases shall be a minimum of 1/12th of the longest dimension of the base, but not less than 6". The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcement consisting of half-inch bars welded in place on 6" centers running both ways in a layer 1-1/2" above the bottom, or additional steel as is required by the structural conditions. Forms shall be furnished with steel templates to hold the anchor-bolt sleeves and anchors while concrete is being poured. Height saving brackets shall be employed in all mounting locations to maintain a 1" clearance below the base. Base shall be Type BMK or K as manufactured by Mason Industries, Inc.

2.5 PIPE CONNECTORS

- A. Type K: Flexible spherical expansion joints shall employ peroxide cured EPDM in the covers, liners and Kevlar® tire cord frictioning. Any substitutions must have equal or superior physical and chemical characteristics. Solid steel rings shall be used within the raised face rubber flanged ends to prevent pullout. Flexible cable bead wire is not acceptable. Sizes 2" and larger shall have two spheres reinforced with a ductile iron external ring between spheres. Flanges shall be split ductile iron or steel with hooked or similar interlocks. Sizes 16" to 24" may be single sphere. Sizes 3/4" to 1-1/2" may have threaded two piece bolted flange assemblies, one sphere and cable retention. Connectors shall be rated at 250 psi up to 170EF with a uniform drop in allowable pressure to 215 psi at 250EF in sizes through 14". All expansion joints must be factory tested to 150% of rated pressure for 12 minutes before shipment. Safety factors to burst and flange pullout shall be a minimum of 3/1. Concentric reducers to the above ratings may be substituted for equal ended expansion joints. All expansion joints shall be installed on the equipment side of the shut off valves. Expansion joints shall be type SAFEFLEX SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR as manufactured by Mason Industries, Inc.
- B. Type L-1: Flexible bellows type bronze hose with bronze braid, sweat connections. Length: 8 times diameter, 10" minimum. Suitable for freon refrigerant service. Compressor discharge servicing working pressure 200 psi at 100 degrees F. Mason Industries, Inc. Type BBF.
- C. Type L-2: Flexible stainless steel type hose with 304 stainless steel braided hose, flanged, sweat or grooved connections. Provide hoses with a safety factor of 4, with one fixed and one floating raised face carbon steel plate flange. Sizes 2-1/2" and smaller may have threaded nipples. Copper sweat ends, 4" and smaller may have SS (gas service) or Bronze (water service) bodies. Grooved ends may be used in sizes 2" through 12" where grooved piping is allowed elsewhere in the specification. Welding is not acceptable. Minimum lengths, minimum live lengths, and minimum number of convolutions per foot to assure flexibility are as tabulated. Shorter lengths are not acceptable. Hoses shall be installed on the equipment side of the shut off valves horizontal and parallel to the equipment shafts wherever possible. Submittals shall include test data showing force/displacement, fittings, material, live lengths, number of corrugations per foot, and safety factor at pressure ratings. Hoses shall be Mason Industries, Inc. Type BSS or CPSB. Hoses suitable for refrigerant service, and compressor discharge service shall have a working pressure 200 psi at 100 degrees F.

Pipe or Tubing Size (in)	FLANGED		THREADED		GROOVED		COPPER SWEAT BRONZE		Min. Convol-uti ons per (foot)
	Face to Face (in)	Live Length (in)	End to End (in)	Live Length (in)	End to End (in)	Live Length (in)	End to End (in)	Live Length (in)	
1/2	-	-	24	19-3/4	-	-	18	14-1/4	92
3/4	-	-	24	19-3/4	-	-	18	13-3/4	80
1	-	-	24	19-3/4	-	-	18	13-3/8	72
1-1/4	-	-	24	18-3/4	-	-	18	13-1/4	67
1-1/2	24	21-7/8	24	18-3/4	-	-	18	13	63
2	24	21-1/8	24	18	24	18	18	12-1/2	58
2-1/2	24	21-1/8	24	17	24	18	18	10-3/4	48
3	36	33-1/8	36	29	36	30	18	10-1/2	46
4	36	33-1/8	36	29	36	28	24	15-1/2	32
5	36	32-7/8	-	-	36	28	-	-	29
6	36	32-7/8	-	-	36	28	-	-	25
8	36	32-5/8	-	-	36	28	-	-	23
10	36	32-5/8	-	-	36	26	-	-	21
12	36	32-5/8	-	-	36	26	-	-	20
14	36	32-5/8	-	-	-	-	-	-	18
16	36	32-5/8	-	-	-	-	-	-	16

2.6 ACOUSTICAL SEALS

- A. Type M: Split Wall Seals consist of two bolted pipe halves with minimum 3/4" (19mm) thick neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1" past either face of the wall. Where temperatures exceed 240EF, 10# density fiberglass may be used in lieu of the sponge. Seals shall be type SWS as manufactured by Mason Industries, Inc. .

2.7 PIPE ANCHORS

- A. Type N: All-directional acoustical pipe anchor, consisting of two sizes of steel tubing separated by a minimum 1/2" thick 60 durometer neoprene. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material should not exceed 500 psi and the design shall be balanced for equal resistance in any direction. All-directional anchors shall be type ADA as manufactured by Mason Industries, Inc.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Unless otherwise noted on the equipment schedule, all mechanical equipment shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonable uniform deflection. Deflections shall be as noted in the schedule.
- B. The first four pipe hangers in the main lines near isolated mechanical equipment shall be supported with hangers as described in the Type E. Horizontal runs in all other locations in mechanical rooms and equipment rooms shall be isolated by hangers as described in Type D. Floor supported piping shall rest on isolators as described in Type C. Heat exchangers shall be considered part of the piping run. All Type E hangers or the first three Type C mounts as noted above, will have the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceiling under occupied spaces, the first three hangers shall have 0.75" deflection for pipe sizes up to and including 3", 1.5" deflection for pipe sizes up to and including 6", and 2.5" deflection thereafter. All other hangers and mounts will have a minimum steel spring deflection of 0.75". Hangers shall be located as close to the overhead supports as practical.
- C. All piping passing through boiler or equipment room walls, floors, or ceilings, shall be protected against sound leakage by means of an acoustical wall seal as described in Type M.
- D. Piping risers shall be suspended from or supported by Type E hangers or Type C mountings and the piping anchored or guided with Type N anchors. Steel spring deflections shall be minimum of 0.75" except in those expansion locations where additional deflection is required to limit deflection or load changes to plus or minus 25% of the initial stress.
- E. All duct discharge runs for a distance of 50' from the connected equipment shall be isolated from the building structure by means of Type D hangers or Type B floor supports. Spring deflections shall be a minimum of 0.75".

3.2 SCHEDULE

<u>ISOLATION EQUIPMENT</u>	<u>LOCATION</u>	<u>TYPE</u>	<u>DEFL.(IN)</u>
Ceiling Mounted FCU	All	D	0.75"

END OF SECTION 230548