

Part 1 - GENERAL

1.01 Scope

A. Intent

1. All mechanical equipment, piping and ductwork as noted on the equipment schedule or in the specification shall be mounted on or suspended from vibration isolators to reduce 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 reasonably uniform deflections.
2. All isolation materials shall be supplied by the same manufacturer.
3. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.

B. The work in this section includes, but is not limited to the following:

1. Vibration isolation for piping, ductwork and equipment.
2. Equipment isolation bases.
3. Flexible piping connections.
4. Resilient Pipe Anchors and Guides

1.02 Submittal Data Requirements

A. The manufacturer of vibration isolation shall provide submittals for products as follows:

1. Descriptive Data:
 - a. Schedules of flexibly mounted equipment, referencing drawings by number.
 - b. Catalog cuts or data sheets on vibration isolators.
2. Drawings:
 - a. Submit details of equipment bases including dimensions, structural member sizes and support point locations.
 - b. Submit details of isolation hangers for ceiling hung equipment, piping and ductwork.
 - c. Submit details of mountings for floor supported equipment, piping and ductwork.
 - d. All hanger, mounting or pad drawings shall indicate deflections and model numbers as well as any other requirements in the specifications.
 - e. Spring diameters, rated loads and deflections, heights at rated load and closed height shall be provided for all springs shown in the submittals in tabular form.
 - f. Complete flexible connector details.

Part 2 - PRODUCTS

2.01 Intent

- A. All vibration isolators described in this section shall be the product of a single manufacturer. Mason Industry's products are the basis of these specifications; products of other manufacturers will be considered provided samples strictly comply with the specification and have the approval of the specifying engineer. Submittals and certification sheets shall be in accordance with section 1.02.

2.02 Product Description

SPECIFICATION:

- A. Neoprene mountings shall have a minimum static deflection of 0.35"(9mm). All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes shall be provided on the bottom and a tapped hole and cap screw on top. Steel rails shall be used above the mountings under equipment such as small vent sets to compensate for the overhang. Mountings shall be type **ND** or rails type **RND** as manufactured by Mason Industries, Inc.
- B. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or 1/4"(6mm) neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height. Mountings shall be type **SLF**, as manufactured by Mason Industries, Inc.
- C. Multiple bellow air springs shall be manufactured with powder coated upper and lower steel sections connected by a replaceable, flexible Nylon reinforced Neoprene element to achieve a maximum natural frequency of 3 Hz. (We have found 3 Hz adequate when using air springs. Should the specifying engineer require a lower frequency, change the 3 Hz to the lower number). Burst pressure must be a minimum of 3 times the published maximum operating pressure. All air spring systems shall be equipped with 3 leveling valves connected to the building control air or a supplementary air supply to maintain elevation plus or minus 1/8"(3mm). An air filter and water separator shall be installed before the air distribution system to the leveling valves.

Submittals shall include natural frequency, as well as load and damping tests, all as performed by an independent lab or acoustician. Air springs shall be type **MT** and leveling valves type **LV** as manufactured by Mason Industries, Inc.

- D.** Equipment with large variations in the operating and installed weight, such as chillers, boilers, etc., and equipment exposed to the wind such as cooling towers, roof mounted fans and roof mounted air handling equipment shall be mounted on spring mountings, as described in Engineering Specification B, including the neoprene acoustical pad within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed and temporary steel spacers between the upper and lower housings. Housings shall serve as blocking during erection. When the equipment is at full operating weight, the springs shall be adjusted to assume the weight and the spacers removed, without changing the installed and operating heights. All restraining bolts shall have large rubber grommets to provide cushioning in the vertical as well as horizontal modes. The hole through the bushing shall be a minimum of 0.75"(19mm) larger in diameter than the restraining bolt. Horizontal clearance on the sides between the spring assembly and the housing shall be a minimum of 0.5"(13mm) to avoid bumping and interfering with the spring action. Vertical limit stops shall be out of contact during normal operation. Cooling tower mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting. Housings and springs shall be powder coated and hardware electro-galvanized. Mountings shall be **SLR** or **SLRSO** as manufactured by Mason Industries, Inc.
- E.** Equipment with large variations in the operating and installed weight, such as chillers, boilers, etc., and equipment exposed to the wind such as cooling towers, roof mounted fans and roof mounted air handling equipment shall be mounted on air springs, as described in Engineering Specification C, but within a rigid housing that includes vertical limit stops to prevent spring extension when weight is removed and temporary steel spacers between the upper and lower housings. Housings shall serve as blocking during erection. When the equipment is at full operating weight, the air springs shall be pressurized to take the weight so the spacers can be removed without changing the installed and operating heights. All restraining bolts shall have large rubber grommets to provide cushioning in the vertical as well as the horizontal modes. The hole through the bushing shall be a minimum of 0.75"(19mm) larger in diameter than the restraining bolt. Horizontal clearance between the air spring assembly and the housing shall be a minimum of 0.5"(13mm) to avoid bumping and interference with the air spring action. Vertical limit stops shall be out of contact during normal operation. Mountings and air spring parts shall be powder coated. Hardware electro-galvanized. Air spring systems shall be connected to the building control air or a supplementary air supply and equipped with three leveling valves to maintain level within plus or minus 0.125"(3mm). Cooling tower mounts are to be located between the supporting steel and the roof or the grillage and dunnage as shown on the drawings when there is no provision for direct mounting.

Mountings shall be **SLR-MT** and leveling valves type **LV** as manufactured by Mason Industries, Inc.

- F.** Hangers shall consist of rigid steel frames containing minimum 1 1/4"(32mm) thick LDS Rubber elements at the top and a steel spring with general characteristics as in specification B seated in a steel washer reinforced LDS Rubber cup on the bottom. The LDS Rubber element and the cup shall have LDS Rubber bushings projecting through the steel box. In order to maintain stability the boxes shall not be articulated as clevis hangers nor the LDS Rubber 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 30° arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30° capability. Hangers shall be type **30N** as manufactured by Mason Industries, Inc.
- G.** Hangers shall be as described in F, but they shall be precompressed and locked at the rated deflection by means of a steel precompression washer 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 30° capability. Hangers shall be type **PC30N** as manufactured by Mason Industries, Inc.
- H.** Hangers shall be manufactured with minimum characteristics as in Specification B, but without the LDS Rubber element. Springs are seated in a steel washer reinforced LDS Rubber cup that has a LDS Rubber bushing projecting through the bottom hole to prevent rod to hanger contact. Spring diameters and the lower hole sizes, shall be large enough to allow the hanger rod to swing through a 30° arc from side to side before contacting the cup bushing.

If ducts are suspended by flat strap iron, the hanger assembly shall be modified by the manufacturer with an eye on top of the box and on the bottom of the spring hanger rod to allow for bolting to the hanger straps. Submittals on either of the above hangers shall include a scale drawing of the hanger showing the 30° capability. Hangers for rods shall be Type **30** or for straps **W30** as manufactured by Mason Industries, Inc.

- I.** When total air thrust exceeds 10% of the isolated weight, floor mounted or suspended air handling equipment shall be protected against excessive displacement by the use of horizontal thrust restraints. The restraint shall consist of a modified Specification B spring mounting. Restraint springs shall have the same deflection as the isolator springs. The assembly shall be preset at the factory and fine tuned in the field to allow for a maximum of 1/4"(6mm) movement from stop to maximum thrust. The assemblies shall be furnished with rod and angle brackets for attachment to both the equipment and duct work or the equipment and the structure. Restraints shall be attached at the center line of thrust and

symmetrically on both sides of the unit. Horizontal thrust restraints shall be **WB** as manufactured by Mason Industries, Inc.

- J.** Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped. Pump bases for split case pumps shall be large enough to support suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14"(356mm) 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 1"(25mm). Bases shall be type **WF** as manufactured by Mason Industries, Inc.
- K.** Vibration isolation manufacturer shall provide steel members welded to height saving brackets to cradle equipment having legs or bases that do not require a complete supplementary base. Members shall have sufficient rigidity to prevent distortion of equipment. Inverted saddles shall be type **ICS**, as manufactured by Mason Industries, Inc.
- L.** Vibration isolation manufacturer shall furnish rectangular steel concrete pouring forms for floating concrete bases. Bases for split case pumps shall be large enough to provide support for suction and discharge elbows. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6"(152mm). The base depth need not exceed 12"(305mm) unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of 1/2"(13mm) bars welded in place on 6"(152mm) centers running both ways in a layer 1 1/2"(38mm) above the bottom. Forms shall be furnished with steel templates to hold the anchor bolt sleeves and anchor bolts while concrete is being poured. Height saving brackets shall be employed in all mounting locations to maintain a 1"(25mm) clearance below the base. Wooden formed bases leaving a concrete rather than a steel finish are not acceptable. Base shall be type **BMK** or **K** as manufactured by Mason Industries, Inc.
- M.** Curb mounted rooftop equipment shall be mounted on vibration isolation bases that fit over the roof curb and under the isolated equipment. The extruded aluminum top member shall overlap the bottom to provide water runoff independent of the seal. Aluminum members shall house electro-galvanized or powder coated springs selected for 0.75"(19mm) minimum deflection. Travel to solid shall be 1.5"(38mm) minimum. Spring diameters shall be no less than 0.8 of the spring height at rated load. Wind resistance shall be provided by means of resilient snubbers in the corners with a minimum clearance of 1/4"(6mm) so as not to interfere with the spring action except in high winds. Manufacturer's self adhering closed cell sponge gasketing must be used both above and below the base and a flexible EPDM duct like connection shall seal the outside perimeter. Foam or other sliding or shear seals are unacceptable in lieu of the

EPDM ductlike closure. Submittals shall include spring deflections, spring diameters, compressed spring height and solid spring height as well as seal and wind resistance details. Curb mounted bases shall be Type **CMAB** as manufactured by Mason Industries, Inc.

- N.** Curb mounted rooftop equipment shall be mounted on spring isolation curbs. The lower member shall consist of a sheet metal Z section containing adjustable and removable steel springs that support the upper floating section. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind forces. All directional neoprene snubber bushings shall be a minimum of 1/4"(6mm) thick. Steel springs shall be laterally stable and rest on 1/4"(6mm) thick neoprene acoustical pads. Hardware must be plated and the springs provided with a rust resistant finish. The curbs waterproofing shall consist of a continuous galvanized flexible counter flashing nailed over the lower curbs waterproofing and joined at the corners by EPDM bellows. All spring locations shall have access ports with removable waterproof covers. Lower curbs shall have provision for 2"(51mm) of insulation. Curb shall be type **RSC** as manufactured by Mason Industries, Inc.
- O.** Rubber expansion joints shall be peroxide cured EPDM throughout with Kevlar tire cord reinforcement. Substitutions must have certifiable equal or superior characteristics. The raised face rubber flanges must encase solid steel rings to prevent pull out. Flexible cable wire is not acceptable. Sizes 1 1/2" through 14"(40mm through 350mm) shall have a ductile iron external ring between the two spheres. Sizes 16" through 24" (400mm to 600mm) may be single sphere. Sizes 3/4" through 2"(19mm through 50mm) may have one sphere, bolted threaded flange assemblies and cable retention.

Minimum ratings through 14"(350mm) shall be 250psi at 170°F and 215psi at 250°F. (1.72MPa at 77°C and 1.48MPa at 121°C), 16"(400mm) through 24"(600mm) 180psi at 170°F and 150psi at 250°F. (1.24MPa at 77°C and 1.03 MPa at 121°C). Higher published rated connectors may be used where required.

Safety factors shall be a minimum of 3/1. All expansion joints must be factory tested to 150% of maximum pressure for 12 minutes before shipment.

The piping gap shall be equal to the length of the expansion joint under pressure. Control rods passing through 1/2"(13mm) thick Neoprene washer bushings large enough to take the thrust at 1000psi (0.7 kg/mm²) of surface area may be used on unanchored piping where the manufacturer determines the condition exceeds the expansion joint rating without them. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer. All expansion joints shall be installed on the equipment side of the

shut off valves. Expansion joints shall be **SAFEX SFDEJ**, **SFEJ**, **SFDCR** or **SFU** and Control Rods **CR** as manufactured by Mason Industries, Inc.

P. Flexible stainless steel hoses with a safety factor of 4 shall be manufactured using type 304 stainless steel braided hose with one fixed and one floating raised face carbon steel plate flange. Sizes 2 1/2" (65mm) and smaller may have threaded nipples. Copper sweat ends, 4" (100mm) and smaller, may have SS (gas service) or Bronze (water service) bodies. Grooved ends

Pipe or Tubing Size (in) (mm)	FLANGED		THREADED		GROOVED ENDS		COPPER SWEAT BRONZE		Minimum Convolutions per (100) (m)
	Face to Face (in) (mm)	Live Length (in) (mm)	End to End (in) (mm)	Live Length (in) (mm)	End to End (in) (mm)	Live Length (in) (mm)	End to End (in) (mm)	Live Length (in) (mm)	
1/2 15	—	—	24 600	193/4 501	—	—	18 457	141/4 362	92 302
3/4 20	—	—	24 600	193/4 501	—	—	18 457	133/4 349	80 262
1 25	—	—	24 600	193/4 501	—	—	18 457	133/8 340	72 236
1 1/4 30	—	—	24 600	183/4 469	—	—	18 457	131/4 337	67 220
1 1/2 40	24 600	217/8 469	24 600	183/4 469	—	—	18 457	13 330	63 207
2 50	24 600	211/8 450	24 600	18 450	24 600	18 450	18 457	121/2 318	58 190
2 1/2 65	24 600	211/8 450	24 600	17 425	24 600	18 450	18 457	103/4 273	48 157
3 75	36 900	331/8 841	36 900	29 737	36 900	30 750	18 457	101/2 267	46 151
4 100	36 900	331/8 841	36 900	29 737	36 900	28 700	18 457	151/2 394	32 105
5 125	36 900	327/8 822	—	—	36 900	28 700	—	—	29 95
6 150	36 900	327/8 822	—	—	36 900	28 700	—	—	25 82
8 200	36 900	325/8 816	—	—	36 900	28 700	—	—	23 75
10 250	36 900	325/8 816	—	—	36 900	26 650	—	—	21 69
12 300	36 900	325/8 816	—	—	36 900	26 650	—	—	20 66
14 350	36 900	325/8 816	—	—	—	—	—	—	18 59
16 400	36 900	325/8 816	—	—	—	—	—	—	16 52

may be used in sizes 2" (50mm) through 12" (300mm). 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 original test data showing force/displacement, fittings, material, live lengths, number of corrugations per foot and safety factor at pressure ratings. Hoses shall be type **BSS** or **CPSB** as manufactured by Mason Industries, Inc.

Q. Where pipes pass through structural openings, the space shall be sealed by a 2 piece clamp lined with 3/4"(19mm) thick Neoprene Sponge. Concrete or block shall be poured or built around the clamp or back packed with concrete. 10 Lb. density fibreglass with caulked ends will replace the sponge where temperatures exceed 225°F (107°C).

Seals shall be type **SWS** as manufactured by Mason Industries, Inc.

R. All-directional acoustical pipe anchors, consist of two sizes of steel tubing separated by a minimum 1/2"(13mm) thickness of 60 duro or softer LDS Rubber. Vertical restraint shall be provided by similar material arranged to prevent up or down vertical travel. Allowable loads on the isolation material shall not exceed 500 psi(3.45 N/mm²) 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.

- S.** Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum 1/2"(13mm) thickness of 60 durometer or softer neoprene. The height of the guides shall be preset with a set screw to allow vertical motion due to pipe expansion or contraction. Guides shall be capable of $\pm 15/8$ "(41mm) motion, or to meet location requirements. Pipe guides shall be type **VSG** as manufactured by Mason Industries, Inc.
- T.** The first four pipe hangers in the main lines near the mechanical equipment shall be as described in specification Type G. Hangers supporting piping 2"(50mm) and larger in all other locations throughout the building shall be isolated by hangers as described in specification F. Floor supported piping shall rest on isolators as described in specification D. Heat exchangers and expansion tanks are considered part of the piping run. The first four isolators from the isolated equipment shall 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 ceilings under occupied spaces the first four hangers shall have 0.75"(19mm) deflection for pipe sizes up to and including 3"(75mm), 1 1/2"(38mm) deflection for pipe sizes over 3"(75mm) and up to and including 6"(150mm), and 2 1/2" (64mm) deflection thereafter. Where piping connects to mechanical equipment install specification O expansion joints or specification P stainless hoses if O is not suitable for the service. All piping passing through the equipment walls, floors or ceilings shall be protected against sound leakage by means of an acoustical seal, as described in Specification Q.
- U.** All vertical risers shall be supported by spring isolators designed to support the riser filled with water, if it is a water line. Assigned loads must be within the building design limits at the support points. Neutral central resilient anchors close to the center of the run shall direct movement up and down. The anchors shall be capable of holding an upward force equal to the water weight when the system is drained. If one level cannot accommodate this force, anchors can be located on 2 or 3 adjacent floors. Resilient guides shall be spaced and sized properly depending on the pipe diameter. Submittals must include the initial load, initial deflection, change in deflection, final load and change in load at all spring and anchor support locations, as well as guide spacing. The initial spring deflection shall be a minimum of 0.75"(19mm) or four times the thermal movement at the isolator location, whichever is greater. Calculations shall include pipe stress at end conditions and branch off locations and the manufacturer must include installation instructions. Submittal must be stamped and signed by a licensed professional engineer in the employ of the vibration vendor for at least 5 years. Proper provision shall be made for seismic protection in seismic zones. The isolator manufacturer shall be the same firm supplying the mechanical contract. Support spring mountings shall be Specification B, anchors Specification R, telescoping guides Specification S.

OPTIONAL ADDITION TO SPECIFICATION

The isolation vendor shall design and provide all brackets or clamps at riser spring guide and anchor locations. The contractor must install and adjust all isolators under the supervision of the isolator vendor or his representative.

- V. All air ducts with a cross section of 2ft²(0.19m²) or larger shall be isolated from the building structure by specification H hangers or B floor supports with a minimum deflection of 0.75”(19mm). Isolators shall continue for 50’(15m) from the equipment. If air velocity exceeds 1000 fpm(5.3mps), hangers or supports shall continue for an additional 50’(15m) or as shown on the drawings.

Part 3 Execution

3.01 General

- A. All vibration isolators must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.
- B. Installation of vibration isolators must not cause any change of position of equipment, piping or duct work resulting in stresses or misalignment.
- C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.
- D. The contractor shall not install any equipment, piping, duct or conduit which makes rigid connections with the building unless isolation is not specified. “Building” includes, but is not limited to, slabs, beams, columns, studs and walls.
- E. Coordinate work with other trades to avoid rigid contact with the building.
- F. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/ engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractors expense.
- G. Bring to the architects/engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractors expense.
- H. Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractors expense.

- I. Hand built elastomeric expansion joints may be used when pipe sizes exceed 24”(600mm) or specified movements exceed 2.02–O capabilities.
- J. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide 2.02–Q seals.
- K. Locate isolation hangers as near to the overhead support structure as possible.
- L. Air handling equipment and centrifugal fans shall be protected against excessive displacement which results from high air thrust when thrust forces exceed 10% of the equipment weight. Horizontal thrust restraints shall be 2.02–I restraints.
- M. Rooftop equipment isolators must be bolted to the equipment and structure. Mountings must be designed to resist 100m/h(160 km/h) wind loads.

3.02 Vibration Isolation of Piping

- A. Horizontal pipe shall be installed in accordance with 2.02–T Horizontal Pipe Isolation.
- B. Risers shall be installed in accordance with 2.02–U Riser Isolation.

3.03 Vibration Isolation of Ductwork

- A. All duct runs shall be installed in accordance with 2.02–V Duct Isolation.

Part 4 SCHEDULES

4.01 Equipment Isolator Schedule

EQUIPMENT SCHEDULE	Vibration Isolation	
	Isolator, Base, Restraint, Flexible Connector Specification Letters	Minimum Static Deflection