# SECTION 23 05 48

# VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

**BASED ON DFD MASTER SPECIFICATION DATED 11/09/2023**

This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.

# P A R T 1 - G E N E R A L

## SCOPE

This section includes specifications for vibration isolation material for equipment, piping systems, and duct systems. Included are the following topics:

PART 1 - GENERAL

Scope

Related Work

Reference

Quality Assurance

Design Criteria

Shop Drawings

PART 2 - PRODUCTS

Materials

Vibration Isolation Manufacturers

Type 1: Neoprene Pad

Type 2: Neoprene Pad

Type 3: Unhoused Spring with Neoprene

Type 4: Housed Spring with Neoprene

Type 5: Spring Hanger with Neoprene

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PART 3 - EXECUTION

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## RELATED WORK

Section 01 91 01 or 01 91 02 - Commissioning Process

Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

Section 23 12 13 - Facility Fuel-Oil PumpsSection 23 21 23 - Hydronic Pumps

Section 23 73 13 - Modular Indoor Central-Station Air-Handling Units

Section 23 73 23 - Factory Fabricated Custom Air Handling Units

Section 23 73 24 - Factory Fabricated Custom Laboratory Exhaust Energy Recovery Units

Section 23 34 00 - HVAC Fans

Section 23 33 00 - Air Duct Accessories

## REFERENCE

Applicable provisions of Division 1 govern work under this section.

## QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions.

## DESIGN CRITERIA

Isolate all motor driven mechanical equipment from the building structure and from the systems in which they serve to prevent equipment vibrations from being transmitted to the structure. Consider equipment weight distribution to provide uniform isolator deflections.

For equipment with variable speed capability, select vibration isolation devices based on the lowest speed.

The A/E will have to specify the lowest anticipated speed for the mechanical equipment, especially that connected to variable frequency drives.

Provide flexible piping connections for all piping to rotating or reciprocating equipment mounted on vibration isolators except do not use flexible piping connectors on any type of gas piping or with inline pumps. Piping connected to a coil which is in an assembly mounted on vibration isolators is to have flexible piping connections and piping vibration hangers as specified below. Piping connected to a coil which is in an assembly where the fan is separately isolated by means of vibration isolators and duct flexible connections does not require flexible piping connectors or piping vibration hangers.

Credit will be given for the inherent flexibility and vibration absorption characteristics of mechanical grooved pipe connections providing that supporting calculations are submitted for approval.

Coordinate the selection of devices with the isolator and equipment manufacturers.

## SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Include isolator type, materials of construction, isolator free and operating heights, and isolation efficiency based on the lowest operating speed of the equipment supported.

# P A R T 2 - P R O D U C T S

## MATERIALS

Use materials that will retain their isolation characteristics for the life of the equipment served. Use industrial grade neoprene for elastomeric materials.

Treat all isolators to resist corrosion. For isolation devices exposed to the weather or used in high humidity areas, hot dip galvanize steel parts, apply a neoprene coating on all steel parts, or use stainless steel parts; include limit stops to resist wind.

Provide pairs of neoprene side snubbers or restraining springs where side torque or thrust may develop.

Use isolators with a ratio of lateral to vertical stiffness not less than 1.0 or greater than 2.0.

## VIBRATION ISOLATOR MANUFACTURERS

Mason Industries, Amber/Booth Co., Vibration Mounting & Controls, Kinetics Noise Control, or approved equal.

## TYPE 1: NEOPRENE PAD

Neoprene waffle pad, 40 durometer with 16 gauge shims between layers.

This specification is equivalent to Mason type WMW.

## TYPE 2: NEOPRENE PAD

Double deflection neoprene mount having a minimum static deflection of 0.35 inches. Cover all metal surfaces with neoprene to resist corrosion. Include friction pads on both top and bottom surfaces so mounts need not be bolted to the floor but include bolt holes for those areas where bolting is required. For equipment such as small vent sets and close coupled pumps, include steel rails for use between the isolator and the equipment to accommodate equipment overhang.

This specification is equivalent to Mason type ND or type DNR (with rails).

## TYPE 3: UNHOUSED SPRING WITH NEOPRENE

Combination freestanding, unhoused spring and neoprene with rib molded antifriction base. Include leveling bolts for securing the equipment. Springs to be laterally stable under load and selected so they have an additional travel to solid equal to 50% of the rated deflection. Use height saving brackets when appropriate to the application.

This specification is equivalent to Mason type SLF.

## TYPE 4: RESTRAINED SPRING WITH NEOPRENE

Combination spring and neoprene with rib molded base similar to Type 3 mount above, but with a housing that includes vertical limit stops to prevent spring extension when weight is removed such that the installed and operating heights are the same. Maintain a minimum clearance of 1/2" around restraining bolts, and between the housing and the spring, so as not to interfere with the spring action. Design isolator so limit stops are out of contact during normal operation. Use height saving brackets when appropriate to the application.

This specification is equivalent to Mason type SLR.

## TYPE 5: SPRING HANGER WITH NEOPRENE

Vibration hanger with a steel spring and 0.3" deflection neoprene element in series. Use neoprene element molded with a rod isolation bushing that passes through the hanger box. Select spring diameters and size hanger box lower holes large enough to permit the hanger rod to swing through a 30-degree arc before contacting the hole and short circuiting the spring. Select springs so they have a minimum additional travel to solid equal to 50% of the rated deflection.

This specification is equivalent to Mason type 30N or W30.

## TYPE 6: PRECOMPRESSED SPRING HANGER WITH NEOPRENE

Vibration hanger similar to Type 5 but pre-compressed to the rated deflection to keep the piping or equipment at a fixed elevation during installation. Design hanger with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load.

This specification is equivalent to Mason type PC30N.

## TYPE 7: SPRING HANGER WITH NEOPRENE

Steel spring hanger located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. Neoprene cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Design spring diameter and size hanger box lower hole sufficiently large to permit the hanger rod to swing through a 30° arc before contacting the hole perimeter and short circuiting the spring. Select spring so it has a minimum additional travel to solid equal to 50% of the rated deflection. Provide hanger with an eye bolt on the spring end and provision to attach the housing to the flat iron duct straps.

This specification is equivalent to Mason type W30 or 30N.

## TYPE IB: INERTIA BASE

Rectangular structural beam or channel concrete form for floating foundation. Include support for suction and discharge base ells for split case pump bases. Use perimeter steel members with a minimum depth equal to 1/12 of the longest dimension of the base but not less than 6"; base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity. Include concrete reinforcements consisting of steel angles or 1/2" bars welded in place on 6" centers running in two layers perpendicular to each other and 1-1/2" above the bottom; provide additional steel if required by structural conditions. Furnish form with steel bolting templates and anchor bolt sleeves to receive equipment anchor bolts where anchor bolts fall in concrete locations. Use height saving brackets in all mounting locations to maintain a base clearance of at least 1" above the floor or housekeeping pad.

This specification is equivalent to Mason type KSL or BMK.

## TYPE S: STEEL BASE

Structural steel base, rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases which may be "T" or "L" shaped. Include support for suction and discharge base ells for split case pump bases. Use perimeter steel members with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Use height saving brackets in all mounting locations to provide a base clearance of at least one inch above the floor or housekeeping pad.

This specification is equivalent to Mason type WF. Mason type M bases are not acceptable as Mason indicates that they are "lightweight frames built to no specific criteria".

## TYPE T: HORIZONTAL THRUST RESTRAINT

Spring element in series with a neoprene pad as described for Type 3 mount with the same deflection as specified for the mounting or hanger. Design the assembly so the spring element is contained within a steel frame, so it can be preset for thrust at the factory and adjusted in the field for a maximum of 1/4" movement at start and stop. Include threaded rod and angle brackets for attachment to both equipment and ductwork or equipment and structure.

This specification is equivalent to Mason type WB.

## FLEXIBLE PIPING CONNECTIONS

Suitable for pressure, temperature, and fluid involved; minimum pressure rating for any system is 125 psig at the design temperature of the fluid. Use 12-inch minimum line length of flexible hose or length required to absorb 3/4" lateral movement, whichever is greater.

MANUFACTURERS:

Flexonics, Mason, Kinetics, Mercer Rubber, Metraflex, PROCO Products, Twin City Hose, or approved equal.

WATER AND/OR PUMPED CONDENSATE:

Multiple plies of nylon tire cord fabric reinforced with an EPDM cover and liner. Do not use steel wire or rings as pressure reinforcement. Use threaded or soldered connections for sizes 2" and smaller and floating steel or ductile iron flanges for sizes 2-1/2" and larger; design the steel flange end so the steel flange is recessed to lock a steel wire bead ring in the raised face of the EPDM flange. Construct straight-through connections with twin spheres. Use control rods when recommended by the manufacturer.

This specification is equivalent to Mason Super-Flex MF series. Verify that the EPDM liner is suitable for the working fluid if other than water. Above 12 inch, this product may be available only in single sphere, neoprene construction where the pressure/temperature ratings will need verification.

STEAM AND STEAM CONDENSATE:

Seamless corrugated bronze or type 321 stainless steel flexible hose with type 321 stainless steel braided cover for 2" and smaller. Use threaded, soldered, or flanged connections, as applicable to the piping system. For sizes 2-1/2" and larger, use seamless corrugated type 321 stainless steel flexible hose with type 321 stainless steed braided cover and flanged connections.

Note that this specification is valid only for low pressure (15 psig maximum) steam and steam condensate systems. Do not use on high pressure steam or associated steam condensate systems.

FUEL OIL:

Seamless corrugated stainless steel or phosphor bronze flexible hose with bronze braided cover and threaded carbon steel or brass end connections for use on pipe sizes 2" and smaller.

This specification is valid for working pressures to 150 psig at ambient temperatures.

REFRIGERANT:

Seamless bronze corrugated flexible hose with bronze wire braided cover and solder type copper tube ends with the entire assembly fabricated specifically for refrigerant duty.

## PERFORMANCE

Select vibration isolation devices as indicated below or to provide not less than 95% isolation efficiency, whichever is greater.

|  |  |
| --- | --- |
|  | **Floor Span or Column Spacing** |
|  | **On Grade** | **20 Feet** | **30 Feet** | **40 Feet** |
| **TYPE OF EQUIPMENT** | Iso. Type | Min. Static Defl. In. | Iso. Type | Min. Static Defl. In. | Iso. Type | Min. Static Defl. In. | Min. Static Defl. In. | Iso. Type |
| **Refrigeration Machines:**  |  |  |  |  |  |  |  |  |
| Absorption | 1 | 0.10 | 4 | 0.75 | 4 | 0.75 | 1.5 | 4 |
|  |  |  |  |  |  |  |  |  |
| Centrifugal Open | 1 | 0.10 | 4-S | 0.75 | 4-S | 1.50 | 4-S | 1.50 |
| Centrifugal Hermetic | 1 | 0.10 | 4 | 0.75 | 4 | 1.50 | 4 | 1.50 |
|  |  |  |  |  |  |  |  |  |
| Reciprocating To 750 rpm | 4 | 0.75 | 4 | 1.50 | 4-S | 1.50 | 4-S | 2.50 |
| 751 rpm and over | 4 | 0.75 | 4 | 0.75 | 4-S | 1.50 | 4-S | 2.50 |
|  |  |  |  |  |  |  |  |  |
| **Pumps:** |  |  |  |  |  |  |  |  |
| Base Mounted Close Coupled - Thru 5 hp | Bolt | to pad | 3-IB | 0.75 | 3-IB | 0.75 | 3-IB | 0.75 |
| 7-1/2 hp and over  | Bolt | to pad | 3-IB | 0.75 | 3-IB | 1.50 | 3-IB | 1.50 |
|  |  |  |  |  |  |  |  |  |
| Base Mounted Flexible Coupled - Thru 40 hp | Bolt | to pad | 3-IB | 0.75 | 3-IB | 1.50 | 3-IB | 1.50 |
| 50 hp and over | Bolt | to pad | 3-IB | 1.50 | 3-IB | 2.50 | 3-IB | 2.50 |
|  |  |  |  |  |  |  |  |  |
| **Air-Cooled Condenser:** | Bolt | to pad | 3 | 0.75 | 3 | 1.50 | 3 | 2.50 |
|  |  |  |  |  |  |  |  |  |
| **Air-Cooled Condensing Units:** | Bolt | to pad | 3 | 0.75 | 4 | 1.50 | 4 | 2.50 |
|  |  |  |  |  |  |  |  |  |
| **Packaged Air Handling Units:** |  |  |  |  |  |  |  |  |
| Suspended Thru 5 hp | --- | --- | 5 | 1.00 | 5 | 1.00 | 5 | 1.00 |
| 7-1/2 hp and overThru 400 rpm | --- | --- | 5 | 1.50 | 5 | 1.50 | 5 | 1.50 |
| 401 rpm and over  | --- | --- | 5 | 1.00 | 5 | 1.00 | 5 | 1.50 |
|  |  |  |  |  |  |  |  |  |
| Floor mounted Thru 5 hp | 3 | 0.35 | 3 | 0.75 | 3 | 0.75 | 3 | 0.75 |
| 7-1/2 hp and over Thru 400 rpm | 3 | 0.35 | 3-S | 1.50 | 3-S | 1.50 | 3-S | 1.50 |
| 7-1/2 hp thru 40 hp 401 rpm and over | 3 | 0.35 | 3 | 0.75 | 3 | 0.75 | 3-S | 1.50 |
| 50 hp and larger 401 rpm and over  | 3 | 0.35 | 3 | 0.75 | 3-S | 1.50 | 3-S | 2.50 |
|  |  |  |  |  |  |  |  |  |
| **Air Compressors:** |  |  |  |  |  |  |  |  |
| Thru 3 hp | 3 | 1.00 | 3-IB | 1.50 | 3-IB | 2.50 | 3-IB | 3.50 |
| 5 hp and over | 3-IB | 1.00 | 3-IB | 1.50 | 3-IB | 1.50 | 3-IB | 3.50 |
|  |  |  |  |  |  |  |  |  |
| **Utility Sets:** |  |  |  |  |  |  |  |  |
| Suspended | --- | --- | 5 | 0.75 | 5 | 1.50 | 5 | 2.00 |
| Floor mounted | 2 | 0.35 | 3 | 0.75 | 3-S | 1.50 | 3-S | 2.00 |
| Roof mounted | Use type 4 mount with deflection from blower minimum deflection guide up to 0.75" deflection.  Over 0.75" deflection, use type 4-S mount. |
|  |  |  |  |  |  |  |  |  |
| **Centrifugal Blowers:** |  |  |  |  |  |  |  |  |
| Suspended | Use type 5-T hangers with deflection from blower minimum deflection guide. Type T needed only when air thrust exceeds 10% of equipment weight. |
| Floor mounted | Use type 3-IB mount with deflection from blower minimum deflection guide. |
|  |  |  |  |  |  |  |  |  |
| **Tubular Centrifugal and Axial Fans:** |  |  |  |  |  |  |  |  |
| Suspended | Use type 5-T hangers with deflection from blower minimum deflection guide. Type T needed only when air thrust exceeds 10% of equipment weight. |
| Floor mounted with motor on/in fan casing | Use type 2 for 0.35" deflection, type 3 for 0.75" and type 3-S for over 0.75" with deflection from blower minimum deflection guide. Use type 3-S-T for deflection over 4". |
| Floor mounted | Use type 2 for 0.35" deflection, type 3 for 0.75" and type 3-S for over 0.75" with deflection from blower minimum deflection guide. Use type 3-S-T for deflection over 4". |
|  |  |  |  |  |  |  |  |  |
| **Cabinet Fans and fan sections of air handling units:**  |  |  |  |  |  |  |  |  |
| Suspended | Type 5-T supports with deflection from blower minimum deflection guide. Type T needed only when air thrust exceeds 10% of equipment weight. |
| Floor mounted | Type 2-T for 0.35" deflection, type 3-T for 0.75" deflections and type 3-S-T for deflections over 0.75" with deflection from blower minimum deflection guide. |
|  |  |  |  |  |  |  |  |  |
| **Cooling Tower:** | Type 4 mounts with deflection from blower minimum deflection guide. Determine the need for cooling tower vibration isolation on a case by case basis. |
|  |  |  |  |  |  |  |  |  |
| **Piping connected to rotating or reciprocating Equipment:** | Flexible piping connections, and type 5 or 6 hangers for a distance of 100 pipe diameters or a distance of three hangers away from the equipment, whichever is greater. Type 6 hangers shall be utilized for the first two upstream and downstream hangers. The Type 5 and/or type 6 hangers must have the same deflection as the hangers supporting the rotating or reciprocating equipment. Where piping is floor supported, the above requirement applies, but use type 3 mounts instead of type 5 or 6 hangers. |
|  |  |  |  |  |  |  |  |  |
| **Vertical Pipe Risers:** | DFD requires every vertical pipe riser be evaluated by the AE and proper isolation, expansion compensation and support be provided. List all information on the drawings and add all support and isolator information to the project specification.  |
|  |  |  |  |  |  |  |  |  |
| **Ductwork In Mechanical Equipment Rooms:** | Use type 7 hanger with .75" minimum deflection for all ducts with a cross sectional area greater than 2.0 square feet and, where either the air velocity is great than 3500 fpm or, the pressure class is 4" water column or higher. |
|  |  |  |  |  |  |  |  |  |

## BLOWER MINIMUM DEFLECTION GUIDE

|  |  |
| --- | --- |
|  | Required Deflection (Inches) |
| **Fan Speed (RPM)** | On Grade | 20' Floor Span | 30’ Floor Span | 40’ Floor Span |
| 175-224 | 0.35 | 3.50 | 4.50 | 4.50 |
| 225-299 | 0.35 | 3.50 | 3.50 | 3.50 |
| 300-374  | 0.35 | 2.50 | 2.50 | 3.50 |
| 375-499  | 0.35 | 1.50 | 2.50 | 3.50 |
| 500 and over | 0.35 | 0.75 | 1.50 | 2.50 |

# P A R T 3 - E X E C U T I O N

## INSTALLATION

Install vibration isolation devices for motor driven equipment in accordance with the manufacturer's installation instructions.

Set steel and inertia bases for one inch clearance between the concrete floor or housekeeping pad and the base.

Do not allow installation practices to short circuit any isolation device.

Install flexible piping connections on the equipment side of shut-off valves.

## PACKAGED AIR HANDLING UNITS, CUSTOM AIR HANDLING UNITS AND CENTRIFUGAL FANS

Attach horizontal thrust restraints at the centerline of thrust and symmetrically on either side of the unit. Thrust restraints are not required when the fan section in not isolated from the remainder of the air handling unit by means of duct flexible connections.

## COOLING TOWER SUPPORT

Provide common supporting rail above the vibration isolators for cooling towers.

## ISOLATION DEVICES OUTDOORS OR IN HIGH HUMIDITY AREAS

Use only hot dip galvanized, stainless steel, or neoprene coated steel parts.

END OF SECTION