

**PART 1 GENERAL****1.1 DESCRIPTION**

- A. The requirements of this section apply to the vibration isolation for mechanical equipment specified elsewhere.

**1.2 QUALITY ASSURANCE**

- A. Isolator Engineering: Selected and furnished by the equipment manufacturer. Select isolators for 98% efficiency unless indicated otherwise on the Drawings.
- B. Manufacturer: Provide field installed isolation required from a single manufacturer where possible.

**1.3 SUBMITTALS**

- A. Provide product data sheets on all vibration isolators and seismic restraints.
- B. Provide itemized list showing the items of equipment or piping to be isolated, isolator type and model number selected, isolator loading and deflection, and reference to specified drawings showing frame and construction.
- C. Provide manufacturer's drawings showing equipment frame construction for each item including dimensions, structural member sizes and support locations.

**PART 2 PRODUCTS****2.1 ACCEPTABLE MANUFACTURERS**

- A. Manufacturers: Amber/Booth, Mason Industries, Vibrex, Vibro-Acoustics.
- B. Manufacturer Model Numbers: Amber/Booth figure numbers are listed unless indicated otherwise.

**2.2 VIBRATION ISOLATORS**

- A. Types of Isolators:
  - 1. Open Spring: Series S.
  - 2. Housed Spring: Type CT.
  - 3. Hanger with Spring and Rubber Stop: Type BSR.
  - 4. Rubber-in-Shear: Types RV and RVD.
  - 5. Seismic Restraints: Mason Z-1011.

6. Hanger with Spring and Rubber Stop: Combination neoprene element and spring hangers – Hangers shall consist of a steel frame containing a neoprene isolation element at the top and a coil steel spring seated in a neoprene cup on the bottom. Both the element and the cup shall be molded with a neoprene bushing that passes through the steel frame. The neoprene element shall be capable of an average deflection of 0.35". The steel springs shall be capable of a minimum static deflection of 0.75" with a minimum additional travel to solid of 1/2". Spring diameters and hanger box lower hole size shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the box and short circuiting the spring. Hangers shall be factory precompressed 60% of the total deflection determined by the assigned load per hanger. Hangers shall be manufactured with provision for bolting or attaching to ceiling flat iron straps, rods or steel runners. Hangers shall be of a fail-safe design. Amber / Booth BSRA.
  7. Neoprene Pads: Neoprene pads shall be of waffle or ribbed design, 1/4" – 3/8" thick. They shall be installed as a single layer or in multiple layers with 16 gauge steel shims cemented between so that the combination of stiffness and total neoprene thickness achieves the static deflection listed in the vibration isolation schedule in conjunction with a distributed load area that will maintain 10-50 psi. If the equipment support location does not completely cover the pads or does not consist of flat steel footing, an additional full coverage, load distribution plate of minimum 3/8 steel shall be placed between the pad and attached to the equipment support. There shall be no rigid structure between top and bottom of mount. Amber / Booth Type NR Ampad.
- B. Spring Selection: Free standing, stable type with a one-to-one ratio on springs with deflections in excess of one inch. Provide with rails where indicated.
- C. Noise and Vibration Barrier Hanger: For ductwork and piping where indicated. Target Enterprises Inc. "ARH-1" or accepted substitute.
- D. Seismic and Start-Up Restraints: Select all isolators to withstand seismic loads equivalent two times the isolator load rating applied from any direction. Mason Industries type Z-1011 on all isolated equipment not utilizing isolators with integral restraints.
- E. Flexible Pipe Connectors - Type SS: All stainless steel hose and braid with carbon steel connections. Male thread ends on flexible connectors 2" and smaller, and flanged connections on 1-1/2" and larger connectors.
- F. Ductwork Flexible Connections:
1. Typical connections shall be made of 30 ounce woven glass fiber, coated with neoprene, sewn together at the edges and joints.
  2. The flexible connections shall be approximately 6" long and held in place with 1" wide bands of 12 gauge galvanized steel bolted to duct and to outlets and inlets of the units and fans with 1/8" stove bolts, 5" o.c.
  3. It is the intent that these flexible connections shall withstand the operating air pressure, shall not permit air leakage and shall not transmit vibration.
- G. Neoprene Mounts: Neoprene mounts shall be one piece, neoprene molded assemblies with a minimum loaded static deflection of 0.25". The mount shall incorporate both rubber-in-shear and compression load characteristics. All metal surfaces shall be neoprene covered. The mount shall have friction pads both top and bottom. Bolt holes shall also be provided for both surfaces. The top bolt hole shall be threaded. There shall be no rigid structure between top and bottom supports. Amber / Booth Type RV.

**PART 3 EXECUTION****3.1 INSTALLATION**

- A. General: Install vibration isolators and flexible connectors as specified herein, as shown on the Drawings and as recommended by manufacturer.
- B. Duct Flexible Connections: Install flexible duct connections on all externally spring isolated air handling units including roof mounted units down through roof curbs (and/or to unit side duct connections). Fan connections, both at inlet and discharge, shall be made with flexible materials so as to prevent the transfer of vibration from fans to ductwork connected thereto.
- C. Flexible Pipe Connections:
  - 1. Provide flexible connections on all piping to spring isolated equipment, where indicated on Drawings and for all coils mounted in spring isolated air handling units or plenums. Coils in rigid units and plenums do not require flexible connectors. Provide a flexible connection in both the supply and return connections to the coil as near the coil as possible.
  - 2. Install connectors in a straight line as recommended by the manufacturer without offsets or twists and support pipe without any load on flexible connectors. Minimum live length shall be as follows:

| <u>Pipe Size</u>  | <u>Minimum Live Length</u> |
|-------------------|----------------------------|
| 1" through 1-1/2" | 8"                         |
| 2" through 2-1/2" | 10"                        |
| 3" through 4"     | 12"                        |
| Over 4"           | 18"                        |

- D. Anchorage: Anchor all isolators to the floor, wall or ceiling structure and anchor points reinforced where necessary. Anchor bolts, cap screws, etc., shall not be continuous through the isolator such that vibrations are transmitted to the structure.
- E. Adjustment: Adjustable during and after installation, to ensure sufficient clearance between vibration isolation element and rigid restraining device. Do not install isolators until they have been loaded and adjusted to achieve the specified static deflection and clearances.
- F. Housekeeping Pads: Construct minimum 3" thick with chamfered edges using 3000 psi concrete. Provide #4 reinforcing bars 8" on center in each direction and within 4" of each edge, centered in pad thickness. Provide 1/2" dowel with 3" embedment into floor slab for each 2 square feet of pad area. Dowels and equipment anchor bolts shall be spaced a minimum of 6" from pad edges.

**3.2 EQUIPMENT RESTRAINTS**

- A. All equipment, duct and piping supports and restraints shall meet the requirements of the Washington Building Code based on the site specific Seismic Design Criteria listed on the Structural Code sheet and M6.01.
- B. All equipment shall be anchored to resist displacement including sliding, swinging, and overturning due to seismic forces. Friction due to equipment weight shall not be considered as anchorage.
- B. Contractor shall submit shop drawings showing seismic restraint design for all required equipment weighing 400 lbs. Design shall show analysis of supporting structure, anchorages, and restraints in accordance with the Washington Building Code.

**END OF SECTION**