

SECTION 15241 - VIBRATION CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Extent of vibration control work required by this section is indicated on drawings and schedules, and/or specified in other Division-15 sections.
- B. Types of vibration control products specified in this section include the following:
 - 1. Fiberglass Pads and Shapes.
 - 2. Neoprene Pads.
 - 3. Vibration Isolation Springs.
 - 4. All-Directional Anchors.
 - 5. Neoprene Mountings.
 - 6. Spring Isolators, Free-Standing.
 - 7. Spring Isolators, Vertically-Restrained.
 - 8. Seismic Snubbers.
 - 9. Thrust Restraints.
 - 10. Equipment Rails.
 - 11. Fabricated Equipment Bases.
 - 12. Inertia Base Frames.
 - 13. Roof-Curb Isolators.
 - 14. Isolation Hangers.
 - 15. Riser Isolators.
 - 16. Flexible Pipe Connectors.
- C. Vibration control products furnished as integral part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 15 sections.
- D. Refer to other Division 15 sections for equipment foundations; hangers; sealants; gaskets; requirements of electrical connections to equipment isolated on vibration control products; requirements of duct connections to air handling equipment isolated on vibration control products.

1.2 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control products, of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.
 - 1. Except as otherwise indicated, obtain vibration control products from single manufacturer.
 - 2. Engage manufacturer to provide technical supervision of installation of support isolation units produced, and of associated inertia bases (if any).

1.3 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of vibration control product. Submit schedule showing size, type, deflection, and location for each product furnished.

1. Include data for each type and size of unit, showing isolation efficiency, stiffness, natural frequency and transmissibility at lowest operating speed of equipment.
 2. For spring units, show wire size, spring diameter, free height, solid-compression height, operating height, fatigue characteristics, ratio of horizontal to vertical stiffness and bases of spring-rated selection for range of loading weights.
 3. Include performance certifications from manufacturers.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weights, required clearances, and method of assembly of components. Detail bases, and show location of equipment anchoring points, coordinated with equipment manufacturer's shop drawings.
1. Shop drawings showing structural design and details of inertia bases, steel beam bases and other custom-fabricated work not covered by manufacturer's submitted data.
 - a. Furnish templates, anchor bolts and sleeve for equipment bases, foundations and other support systems for coordination of vibration isolation units with other work.
 2. Submit shop drawings indicating scope of vibration isolation work and locations of units and flexible connections. Include support isolation points for piping and ductwork including risers, air housings and inertia bases.
 - a. Include schedule of units, showing size or manufacturer's part number, and weight supported and resulting deflection of each unit.
- C. Maintenance Data: Submit maintenance data for each type of vibration control product. Include this data, product data and shop drawings in maintenance manual; in accordance with requirements of Divisions 15.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
1. Vibration Control Products:
 - a. Mason Industries, Inc.
 - b. Peabody Noise Control, Inc.

2.2 VIBRATION CONTROL MATERIALS AND SUPPORT UNITS:

- A. Fiberglass Pads and Shapes: Glass fiber of not more than 0.18 mil diameter, produced by multiple-flame attenuation process, molded with manufacturer's standard fillers and binders through 10 compression cycles at 3 times rated load bearing capacity, to achieve natural frequency of not more than 12 Hertz, in thicknesses and shapes required for use in vibration isolation units.
- B. Neoprene Pads: Oil-resistant neoprene sheets of manufacturer's standard hardness and cross-ribbed or waffled pattern.

1. Mason Industries Type W.
- C. Vibration Isolation Springs: Wound-steel compression springs, of high-strength, heat-treated, spring alloy steel with outside diameter not less than 0.8 times operating height; with lateral stiffness not less than vertical stiffness and designed to reach solid height before exceeding rated fatigue point of steel.
1. Color coated springs for ease of identification.
 2. Spring shall have a minimum of 50 percent additional travel to solid.
- D. All-Directional Anchors: Provide all-directional acoustical pipe anchor consisting of telescopic arrangement of sizes of steel tubing separated by minimum ½ inch thickness of heavy-duty neoprene and duck, or neoprene isolation material. Provide vertical restraints by similar material arranged to prevent vertical travel in either direction. Design for maximum 500 psi load on isolation materials, and provide for equal resistance in any direction. Equip anchor with threaded hole on top and 2 holes in base plate for bolting down or provide welding provisions top and bottom, if indicated.
1. Mason Industries Type ADA.
- E. Neoprene Mountings: Provide neoprene mountings consisting of neoprene element bonded between 2 steel plates that are neoprene-covered to prevent corrosion. Provide minimum rated deflection of 0.35 inches. Provide threaded hole in upper plate and 2 holes in base plate for securing to equipment and to substrate.
1. Mason Industries Type ND.
- F. Spring Isolators, Free-Standing: Except as otherwise indicated, provide vibration isolation spring Type C between top and bottom loading plates, and with pad-type Type B isolator bonded to bottom of bottom loading plate. Include studs or cups to ensure centering of spring on plates. Include leveling bolt with lock nuts and washers, centered in top plate, arranged for leveling and anchoring supported equipment as indicated.
1. Include holes in bottom plate for bolting unit to substrate as indicated.
 2. Mason Industries Type SLFH.
- G. Spring Isolators, Vertically-Restrained: Provide spring isolators Type C in housing that includes vertical limit stops. Design housing to act as blocking during erection, and with installed height and operating height being equal. Maintain ½ inch minimum clearance around restraining bolts, and between housing and springs. Design so limit stops are out of contact during normal operation.
1. Mounting used out of doors shall be hot dipped galvanized, spring shall be cadmium plated.
 2. Mounting used out of doors shall have certified calculation by a registered professional engineer showing ability to withstand 109 MPH wind load in 3 principal axis.
 3. Mason Industries Type SLR.
- H. Thrust Restraints: Provide horizontal thrust restraints consisting of spring elements in series with neoprene pad. Select spring deflection same as for equipment loading. Design so thrust restraints can be pre-set and adjusted in field. Attach horizontal restraints at centerline of thrust and symmetrically on either side of unit.
1. Provide same deflection as isolated equipment.

2. Select load to provide $\frac{1}{4}$ inch maximum displacement under full system operating pressure.
 3. Mason Industries Type WBI.
- I. Equipment Rails: Where rails or beams are indicated for use with isolator units to support equipment, provide steel beams complying with ASTM A36, with minimum depth of 6 inches or $0.10 \times$ span of beam between isolators (whichever is greater). Provide welded bracket at each end of beams, and anchor each end to spring isolator unit. Provide bolt holes in beams matching anchor bolt holes in equipment. Provide beams of section modules indicated or, if not indicated, selected for normal-weight equipment loading to limit static load stress to 16,000 psi.
1. Beam depth need not exceed 14 inches provided that deflection and misalignment is kept within manufacturer's acceptable limits.
 2. Mason Industries Type ICS.
- J. Fabricated Equipment Bases: Where supplementary bases are indicated for use with isolator units to support equipment (base not integral with equipment), provide welded rectangular unit, fabricated of structural steel shapes, plates and bars complying with ASTM A36. Provide welded support brackets and anchor base to spring isolator units. Except as otherwise indicated arrange brackets to result in lowest possible mounting height for equipment, but provide minimum of 1 inch. Provide bolt holes in base matching anchor bolt holes in equipment.
1. Provide for auxiliary motor slide base under motor or motor slide rails for adjusting belt tension. Design primary base for bolting of rails or slide base in position.
 2. Where sizes of base framing members are not indicated, fabricate base with depth of structure not less than $0.10 \times$ longest span of base, rigidly braced to support equipment without deflections or distortions which would be detrimental to equipment or equipment performance.
 3. Beam depth need not exceed 14 inches provided that deflection and misalignment is kept within manufacturer's limits.
 4. Mason Industries Type WF.
- K. Inertia Base Frames: Where inertia bases are indicated for use with isolation units to support equipment, provide rectangular structural beam channel, or complete sheet metal box concrete forms for floating foundations, with materials complying with ASTM A36. Frame unit as shown or, if not shown, with minimum depth of $0.08 \times$ longest dimension of base, but not less than 6 inches deep. Size frame as shown or, if not shown, so that weight of frame plus concrete fill will be greater than operating weight of equipment supported. Provide steel reinforcing both ways with both ends of reinforcing butt-welded to base framing.
1. Provide welded support brackets and anchor base frame to spring isolator units.
 2. Provide anchor bolts, located as required for equipment anchorage and supported for casting of concrete. Locate bolts as indicated or, if not indicated, locate bolts so that operating weight of equipment will be centered both ways on inertia base.
 3. Provide adjustable bolts in pipe sleeves.
 4. Provide mounting bracket to provide 1 inch floor clearance.
 5. Provide sufficient mass to allow $\frac{1}{4}$ inch maximum displacement under starting and normal conditions.
 6. Mason Industries Type KSL.

- L. Roof-Curb Isolators: Fabricated frame units sized to match roof curbs, formed with isolation springs Type C between extruded aluminum upper and lower sections, which are shaped and positioned to prevent metal-to-metal contact. Provide continuous airtight and waterproof seal between upper and lower extrusions. Include provisions for anchorage of frame unit to roof curb, and for anchorage of equipment to unit.
1. Mason Industries Type CMAB.
- M. Isolation Hangers: Hanger units formed with brackets and including manufacturer's standard compression isolators of type indicated. Design brackets for 5 times rated loading of units. Fabricate units to accept misalignment of 15 degrees off center in any direction before contacting hanger box, and for use with either rod or strap type members, and including acoustical washers to prevent metal-to-metal contacts.
1. Provide vibration isolation spring Type C with cap in lower pad-type isolator rubber hanger element in bottom, securely retained in unit.
 2. Provide neoprene element, with minimum deflection of 0.35inch, securely retained in hanger box.
 3. Mason Industries Type 30N.
- N. Riser Isolators: Suspend risers from, or support risers by, spring hangers Type ND or spring isolators Type F. Wherever possible, anchor risers at central point with resilient anchors, Type D. Provide hanger or mounting deflection of 0.75 inches except in those expansion locations where additional deflection is required to limit deflection or load changes to +25 percent of initial deflection. Provide sliding guides held in position by resilient anchors, located between anchor points and end of piping, spaced as indicated.
- O. Flexible Pipe Connectors:
1. For non-ferrous piping, provide bronze hose covered with bronze wire braid with copper tube ends or bronze flanged ends, braze-welded to hose.
 2. Mason Industries Type BBF.
 - a. For ferrous piping, provide stainless steel hose covered with stainless steel wire braid with NPT steel nipples or 150 psi ANSI flanges, welded to hose.
 - 1) Mason Industries Type BSS.
- OR
- Flexible Pipe Connectors: Provide neoprene or EDPM construction consisting of multiple plies of nylon tire cord fabric and elastomer molded and cured in hydraulic rubber presses. Provide straight or elbow connector as indicated, rated at 125 psi at 220 degrees F (104 degrees C).
- 2) Mason Industries Type MFNC.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which vibration control units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Owner or his representative.

3.2 PERFORMANCE OF ISOLATORS:

- A. General: Comply with minimum static deflections recommended by ASHRAE, for selection and application of vibration isolation materials and units as indicated.
- B. Manufacturer's Recommendations: Except as otherwise indicated, comply with manufacturer's recommendations for selection and application of vibration isolation materials and units to achieve minimum static deflection and displacement requirements.

3.3 APPLICATIONS:

- A. General: Except as otherwise indicated, select vibration control products in accordance with ASHRAE Handbook, 1991 HVAC Applications Volume, Chapter 42 "Sound and Vibration Control", Table 34.
- B. Piping: For piping connected to equipment mounted on vibration control products, install isolation hangers Type N, as indicated, and for first 3 points of support for pipe sizes 4 inches and less, for first 4 points of support for pipe sizes 6 inches through 8 inches, and for first 6 points of support for pipe sizes 10 inches and over.
 - 1. Where applicable, apply restraint system in accordance with SMACNA GFSR 1982.
- C. Fan Sets: All fan sets should have thrust restraints when operating over 2 inches W.C. S.P. unless they are mounted on a concrete inertia base in which case the inertia base will not allow fan movement. The fan position at operating and stop positions should not move more than 1/4inch displacement at these two conditions.
- D. Earthquake Restraint: Where indicated, install Type H seismic snubber.

3.4 INSTALLATION:

- A. General: Except as otherwise indicated, comply with manufacturer's instructions for installation and load application to vibration isolation materials and units. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation.
- B. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces.
- C. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.
- D. Install inertia base frames on isolator units so that minimum of 1 inch clearance below base will result when frame is filled with concrete and supported equipment has been installed and loaded for operation.
- E. For air handling equipment, install thrust restraints as indicated, and also wherever thrust exceeds 10 percent of equipment weight.
- F. Locate isolation hangers as near overhead support structure as possible.

- G. Weld riser isolator units in place as required to prevent displacement from loading and operations.
- H. Flexible Pipe Connectors: Install on equipment side of shutoff valves, horizontally and parallel to equipment shafts wherever possible.

3.5 EXAMINATION OF RELATED WORK:

- A. Installer of vibration isolation work shall observe installation of other work related to vibration isolation work, including work connected to vibration isolation work; and, after completion of other related work (but before equipment startup), shall furnish written report to Engineer listing observed inadequacies for proper operation and performance of vibration isolation work. Report shall cover, but not necessarily be limited to the following:
 - 1. Equipment installations (performed as work of other sections) on vibration isolators.
 - 2. Piping connections including flexible connections.
 - 3. Ductwork connections including provisions for flexible connections.
 - 4. Passage of piping and ductwork which is to be isolated through walls and floors.
- B. Do not start-up equipment until inadequacies have been corrected in manner acceptable to vibration isolation installer.

3.6 ADJUSTING AND CLEANING:

- A. Clean each vibration control unit, and verify that each is working freely, and that there is no dirt or debris in immediate vicinity of unit that could possibly short-circuit unit isolation.

3.7 DEFLECTION MEASUREMENTS:

- A. Upon completion of vibration isolation work, prepare report showing measured equipment deflections theoretical floor deflection and isolation efficiency for each major item of equipment.

END OF SECTION 15241