

SECTION 23 05 48
VIBRATION ISOLATION AND SEISMIC CONTROL
FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American National Standards Institute (ANSI).
 2. ASTM International (ASTM):
 - a. A36/A36M, Specification for Carbon Structural Steel.
 - b. E488, Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
 3. American Welding Society (AWS): D1.1/D1.1M, Structural Welding Code—Steel.
 4. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): Seismic Restrain Manual: Guidelines for Mechanical Systems.
 5. Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).

1.02 DEFINITIONS

- A. AHJ: Authority Having Jurisdiction.
- B. EPDM: Ethylene-Propylene-Diene Monomer.
- C. Withstand: Unit will remain in place without separation of any parts from the device when subject to seismic forces specified and unit will be fully operational after the seismic event.

1.03 DESIGN REQUIREMENTS

- A. Seismic Control:
1. Provide seismic control as required to maintain integrity of mechanical piping, ductwork, and requirement installed in this project, so they will “withstand” seismic forces.
 2. Design shall comply with requirements of this specification, applicable codes, and requirements of Section 01 67 00, Product Requirements.
 3. Design, size, and install for piping and equipment throughout facility, whether shown or not.

4. Designed by a registered Professional Engineer in the state where the work is to be installed.
5. Design seismic conforming to requirements of SMACNA's Seismic Restraint Manual: Guidelines for Mechanical Systems.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings, Vibration Isolators:
 - a. Include, as a minimum, basic equipment layout, length, and width, installed operating weights of equipment to be isolated and distribution of weight at isolation points.
 - b. Product Data:
 - 1) Manufacturer's product data including details of materials, construction, dimensions of individual components, installation details, and finishes.
 - 2) Schedule of vibration isolator type with location and static and dynamic load on each.
 - 3) Vibration Isolation Base Details:
 - a) Detail fabrication, including anchorages and attachments to structure and to supported equipment.
 - b) Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
2. Shop Drawings, Seismic Control Components:
 - a. Include, as a minimum, basic equipment layout, length, and width, installed operating weights of equipment to be isolated and distribution of weight at isolation points.
 - b. Signed and sealed by a registered Professional Engineer registered in the state where the project is located.
 - c. Include, as a minimum, a tabulation of design data for each snubber, including specific anchorage details.
 - d. Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
 - e. Product Data:
 - 1) Manufacturer's product data including details of materials, construction, dimensions of individual components, installation details, and finishes.
 - 2) Schedule of seismic control component type with location and static and dynamic load on each.
 - 3) Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y, and z planes.
 - 4) Anchorage and bracing data sheets and drawings as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

1. Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.
2. Certifications:
 - a. Manufacturer's Certificate of Compliance, in accordance with Section 01 67 00, Product Requirements.
 - b. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.
 - c. Welding Certificates: Welding procedures and personnel.
3. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

1.05 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Isolation materials, flexible connectors, shall be same manufacturer. Select and certify using published or factory certified data.
- C. Vibration isolation and seismic restraint manufacturers Association (VISCMA).
- D. Seismic Control:
 1. Designer Qualifications:
 - a. Professional Engineer registered in state where Project resides.
 - b. Minimum of 5 year's work experience certifying seismic snubber and anchorage details.

1.06 EXTRA MATERIALS

- A. Furnish extra materials described below which match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Seismic Snubber Units: Furnish replacement polychloroprene inserts for snubbers.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULES

- A. Refer to Article Supplement for product type and capacities.

2.02 VIBRATION ISOLATION

- A. Manufacturers:

- 1. Mason Industries, Inc.
 - 2. Or equal.

- B. General:

- 1. Physical Characteristics: Provide for mechanical piping, ductwork, and equipment as identified by this Specification.
 - 2. Functional Characteristics:
 - a. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 30 percent and 60 percent of maximum deflection.
 - 3. Performance Characteristics: Select in accordance with equipment, pipe, or duct weight distribution to produce uniform deflections.

- C. Elastomeric Pad:

- 1. Physical Characteristics:
 - a. Oil-resistant and water-resistant elastomer or natural rubber waffle pads, arranged in single or multiple layers, molded with a nonslip pattern.
 - b. Waffle pads bonded each side of minimum 1/4-inch-thick galvanized steel separator plate.
 - c. Height of waffle ribs shall not exceed 0.7 times width.
 - d. Minimum Single Layer Thickness: 1/4 inch.
 - e. Factory cut to size that matches requirements of supported equipment.
 - f. Waffle Pad Material: Standard polychloroprene or natural rubber.
 - g. Number of Layers: As required to support equipment load; refer to manufacturer's data for load capacities.
 - 2. Functional Characteristics:
 - a. Maximum Loading: 60 psi.
 - b. Separator plate of sufficient stiffness for uniform loading over pad area.
 - 3. Performance Characteristics: None.

D. Elastomeric Mount:

1. Physical Characteristics:
 - a. Double-deflection type, with molded, oil-resistant rubber or polychloroprene isolator elements.
 - b. Factory-drilled, encapsulated top plate for bolting to equipment.
 - c. Baseplate for bolting to structure.
2. Functional Characteristics: None.
3. Performance Characteristics: None.

E. Open Spring Isolator:

1. Physical Characteristics:
 - a. Freestanding, laterally stable, open-spring isolators.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Baseplate:
 - 1) Factory drilled for bolting to structure and bonded to 1/4-inch-thick rubber isolator pad attached to baseplate underside.
 - 2) Limit floor load to 100 psig.
 - d. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
2. Functional Characteristics:
 - a. Minimum Additional Travel: 50 percent of required deflection at rated load.
 - b. Lateral Stiffness: 80 percent minimum of rated vertical stiffness.
 - c. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
3. Performance Characteristics: None.

F. Restrained Spring Isolator:

1. Physical Characteristics:
 - a. Freestanding, steel, open-spring isolators.
 - b. Housing: Steel with resilient vertical limit stops to prevent spring extension because of wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch-thick elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - c. Outside Spring Diameter: 80 percent minimum of compressed height of spring at rated load.
2. Functional Characteristics:
 - a. Minimum Additional Travel: 50 percent of required deflection at rated load.

- b. Lateral Stiffness: 80 percent minimum of rated vertical stiffness.
- c. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- 3. Performance Characteristics: None.

G. Elastomeric Hanger:

- 1. Physical Characteristics:
 - a. Double-deflection type.
 - b. Molded, oil-resistant rubber or polychloroprene isolator elements bonded to steel housing.
 - c. Threaded connections for hanger rods.
- 2. Functional Characteristics: None.
- 3. Performance Characteristics: None.

H. Spring Hanger:

- 1. Physical Characteristics:
 - a. Combination coil spring and elastomeric insert hanger with spring and insert in compression.
 - b. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
 - c. Outside Spring Diameter: 80 percent minimum of compressed height of spring at rated load.
 - d. Elastomeric Element:
 - 1) Molded, oil-resistant rubber or polychloroprene.
 - 2) Steel washer reinforced cup to support spring and bushing projecting through bottom of frame.
- 2. Functional Characteristics:
 - a. Minimum Additional Travel: 50 percent of required deflection at rated load.
 - b. Lateral Stiffness: 80 percent minimum of rated vertical stiffness.
 - c. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- 3. Performance Characteristics: None.

I. Thrust Limit:

- 1. Physical Characteristics:
 - a. Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop.
 - b. Rod and angle iron brackets for attaching to equipment.
 - c. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.

- d. Outside Spring Diameter: 80 percent minimum of compressed height of spring at rated load.
- e. Elastomeric Element: Molded, oil-resistant rubber or polychloroprene.
- 2. Functional Characteristics:
 - a. Minimum Additional Travel: 50 percent of required deflection at rated load.
 - b. Lateral Stiffness: 80 percent minimum of rated vertical stiffness.
 - c. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - d. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.
- 3. Performance Characteristics: None.

2.03 EQUIPMENT BASES

A. Structural Steel Base:

- 1. Physical Characteristics:
 - a. Factory-fabricated, welded, structural steel base and rail.
 - b. Design Requirements:
 - 1) Lowest possible mounting height with not less than 1-inch clearance above floor.
 - 2) Provide equipment anchor bolts and auxiliary motor slide bases or rails.
 - 3) Provide supports for suction and discharge elbows for pumps.
 - c. Structural Steel:
 - 1) Steel shapes, plates, and bars complying with ASTM A36/A36M.
 - 2) Bases shall have shape to accommodate supported equipment.
 - d. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- 2. Functional Characteristics: None.
- 3. Performance Characteristics: None.

2.04 FLEXIBLE CONNECTORS

A. Flexible Pipe Connectors:

- 1. Manufacturers:
 - a. Mason Industries, Inc.
 - b. Or equal.

2. Physical Characteristics:
 - a. Braided Nonferrous: For nonferrous piping systems, provide bronze hose covered with bronze wire braid with copper tube ends or bronze flanged ends, braze-welded to hose.
 - b. Braided Stainless Steel: For ferrous piping, provide stainless steel hose covered with Type 304 stainless steel wire braid with NPT steel nipples or 150 psi ANSI flanges, welded to hose.
 - c. Rubber:
 - 1) Polychloroprene or EDPM construction consisting of multiple piles of polyamide tire cord fabric and elastomer, molded and cured in hydraulic rubber presses.
 - 2) Straight or elbow connector as shown, rated at 125 psi at 220 degrees F.
3. Functional Characteristics: None.
4. Performance Characteristics: None.

B. Flexible Duct Connectors: Refer to Section 23 31 13, Metal Ducts and Accessories.

2.05 SEISMIC RESTRAINTS

A. Manufacturers:

1. California Dynamics Corp.
2. Or equal.

B. Physical Characteristics:

1. Resilient Isolation Washers and Bushings: One-piece, molded polychloroprene, having a durometer 50, plus or minus 5, with a flat washer face.
2. Seismic Snubbers: Factory fabricated using welded structural steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
3. Restraining Cables: Galvanizes steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.

C. Functional Characteristics: None.

D. Performance Characteristics: None.

E. Anchor Bolts: See Section 05 05 19, Post-Installed Anchors, or Section 05 00 00, Metal Fabrications.

2.06 SHOP/FACTORY FINISHING

- A. Manufacturer's standard paint applied to factory-assembled and factory-tested equipment, before shipping.
 - 1. Powder coating on springs and housings.
 - 2. Electro-galvanized hardware.
 - 3. Hot-dip galvanized metal components for exterior use.
 - 4. Baked enamel coat metal components for interior use.
- B. Color-code or otherwise mark vibration isolation devices to indicate capacity range.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unacceptable conditions have been corrected.

3.02 INSTALLATION

- A. General:
 - 1. Install products in accordance with manufacturers' written instructions.
 - 2. Connect wiring to isolated equipment with flexible hanging loop.
 - 3. Install roof curbs, equipment supports, and roof penetrations as specified in Section 07 70 01, Roof Specialties and Accessories.
 - 4. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.
 - 5. Locate isolation hangers as near overhead support structure as possible.
- B. Vibration Isolators:
 - 1. Install spring hangers without binding.
 - 2. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

C. Equipment Bases:

1. Adjust equipment level.
2. Bases with seismic snubbers shall have snubbers located close to isolators.
3. Structural Steel Bases: Set steel bases for 1-inch clearance between housekeeping pad and base.
4. Concrete Inertial Bases:
 - a. Set concrete inertia bases for 2-inch clearance between housekeeping pad and base.
 - b. Fill concrete inertia bases, after installing base frame, with concrete; trowel to a smooth finish.

D. Flexible Connectors:

1. Install at pumps, air handling units, equipment on or with vibration isolation.
2. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

E. Seismic Restraint Devices:

1. Notify local representative of seismic restrain materials manufacturer prior to installing seismic restraint devices.
2. No rigid connections between equipment and building structures shall be made which degrades seismic restraint system herein specified.
3. Electrical conduit to restrain equipment shall be looped to allow free motion of equipment without damage to electrical wiring.
4. Install seismic snubbers in isolated equipment.
5. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
6. Install restraining cables at each trapeze and individual pipe hanger. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
7. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers.
8. At trapeze anchor locations, shackle piping equipment to trapeze.
9. Install resilient bolt isolation washers on equipment anchor bolts.
10. Upon completion of seismic restraint material installation and before startup of restrained equipment, clean debris from beneath protected equipment, leaving equipment free to contact snubbers.

3.03 FIELD QUALITY CONTROL

A. Testing:

1. Conduct the following field quality control testing:
 - a. Isolator deflection.
 - b. Isolation seismic restraint clearance.
 - c. Snubber minimum clearances.

B. Seismic Control Component Inspection:

1. Conduct periodic inspections of materials installation with assistance of manufacturer's representative. Report in writing deviations from good installation practice.
2. Upon completion of seismic restraint devices installation, inspect completed system with assistance of manufacturer's representative. Report in writing installation errors, improperly selected snubber devices, or other fault in the system that could affect performance of the system.

3.04 MANUFACTURER'S SERVICES

A. Manufacturer's Representative:

1. Present at site or classroom designated by Contracting Officer, for minimum person-days listed below, travel time excluded:
 - a. 1 person-day installation assistance and inspection.
 - b. 1 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation, in accordance with Section 01 67 00, Product Requirements.

3.05 ADJUSTING

A. Vibration Isolation Devices:

1. Adjust isolators after piping systems have been filled and equipment is at operating weight.
2. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height.
3. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
4. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.
5. Adjust isolators to ensure units do not exceed rated operating deflections or bottom out under loading and are not short circuited by other contacts or bearing points.

6. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading uniformly.

B. Seismic Control Components:

1. Adjust snubbers according to manufacturer's written recommendations.
2. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.
3. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

3.06 CLEANING

- A. After completing equipment installation, inspect vibration isolation and seismic control devices. Remove paint splatters and other spots, dirt, and debris.

3.07 SUPPLEMENT

- A. The supplement listed below, following "End of Section," is a part of this specification:
1. Vibration Isolation Schedule for HVAC Piping and Equipment.

END OF SECTION