

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Vibration-isolated equipment support bases.
- C. Vibration isolators.

1.02 COORDINATION

- A. Contractor's Responsibility:
 - 1. Verify the completeness of the isolation installation and the overall suitability of the equipment to meet the intent of this specification. Any additional equipment needed to meet the intent of this specification, even if not specifically mentioned herein or in the Contract Documents, shall be supplied by the Contractor without claim for additional payment.
 - 2. Performance or waiving of inspection, testing or surveillance for any portion of the Work shall not relieve the Contractor of the responsibility to conform strictly with the Contract Documents. The Contractor shall not construe performance or waiving of inspection, testing or surveillance by the Owner or Architects to relieve the Contractor from total responsibility to perform in strict accordance with the Contract Documents.
 - 3. Coordinate selection and arrangement of vibration isolation components with the actual equipment to be installed.
 - 4. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 5. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 6. Sequencing:
 - a) Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.
- B. Manufacturer's Responsibility:
 - 1. Determine vibration isolation types for all equipment and systems in accordance with the local governing code.

2. Calculate the static deflection requirements for all equipment and systems to provide uniform deflection based on distributed operating weight of actual installed equipment.
3. Select the vibration isolation systems to provide static deflection indicated on the Vibration Isolation Schedule and as specified below. Determine the mounting sizes and layout.
4. Guarantee specified isolation system deflection.
5. Select and size vibration isolators to not exceed the recommended loading of the isolators.
6. Provide installation instructions, drawings and field supervision to ensure proper installation and performance.
7. Verify that all equipment to be isolated has sufficient support structure to distribute equipment loads onto isolators.

1.03 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification method for spring element load capacities. Include clearly outlined procedures for installing and adjusting the isolators.
- B. Shop Drawings:
 1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators on each piece of isolated equipment. Indicate equipment weights and static deflections.
 2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable. Indicate equipment mounting provisions.
 3. Piping isolators shown and identified on piping layout drawings.
 4. Concrete foundations, supports, and required reinforcing and forms. These appurtenances shall be provided by another trade. This trade shall furnish the shop drawings, including the following:
 - a) Concrete reinforcing steel details and templates for all foundations and supports.
 - b) Required hanger bolts.
 - c) All other appurtenances necessary for proper installation of equipment.
- C. Vibration Isolation System Schedule: Include the following for each isolation element:

1. Manufacturer, isolator type, model number, size.
2. Height when uncompressed and static deflection.
3. Spring constant.
4. Spring outside diameter, free operating, and solid heights.
5. Design of supplementary bases.
6. Details of attachment to load-bearing structure or supplementary framing.

D. Post-Installation Inspection Report:

1. Vibration isolation vendor notice of inspection of all vibration isolators.
2. Vibration isolation vendor notice of approval that all vibration isolators have been properly installed and conform to the specification.
3. Itemized list of deficiencies.
4. Vibration Isolation System Schedule.
5. For each isolator containing steel springs, record the following:
 - a. Size.
 - b. Uncompressed height.
 - c. Design static deflection.
 - d. Measured static deflection.

1.04 QUALITY ASSURANCE

- A. All vibration isolation equipment shall be furnished by one manufacturer unless specifically approved otherwise in writing by the Engineer.
- B. All vibration isolation equipment and materials shall be new and manufactured specifically for the purpose intended.
- C. Maintain at the project site a copy of each reference document that prescribes execution requirements.
- D. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

- A. Caldyn, California Dynamics Corp.
- B. Kinetics Noise Control.
- C. Mason Industries, Inc.
- D. Vibration Eliminator Co., Inc.
- E. Vibration Mounting and Controls.
- F. Vibro-Acoustics.

2.02 VIBRATION ISOLATION REQUIREMENTS

- A. Construct vibration isolators out of resilient materials resistant to oil, ozone, and oxidant.
- B. Select vibration isolators to provide the static deflection as specified in Part 2 “Products” unless otherwise specified for the application listed in Part 3 “Execution.”
- C. Where a pipe run connects multiple equipment, select the pipe isolators for the entire run to suit the connected equipment of greatest static deflection.
- D. Vibration isolators shall have either known undeflected heights or calibration markings so that the amount of deflection can be verified after adjustment to determine that the load is within the proper range of the device and that the correct degree of vibration isolation is provided according to the design.
- E. Vibration isolators, base frames, and inertia bases shall provide uniform deflection and stability under all operating loads.
- F. Isolators for fans shall be sized so that thrust restraints (which would act against turning moment caused by static pressure) are not required.
- G. Lateral restraining isolators shall have the same static deflection as the vertical isolators for the equipment being isolated.

- H. The theoretical vertical natural frequency for each support point based upon load per isolator and isolator stiffness shall not differ from the design objectives for the equipment as a whole by more than plus/minus 10 percent.
- I. All elastomeric mountings shall have a Shore hardness of 30 to 60 plus/minus 5 after minimum aging of 20 days or corresponding over-aging, or as specified herein.
- J. Elastomeric isolators that will be exposed to temperatures below 32 degrees F shall be fabricated of natural rubber instead of neoprene.
- K. Equipment mounted on vibration isolated bases shall have minimum operating clearance of 1 inch between the base and floor or support beneath unless noted otherwise.
- L. Vibration Isolator Assemblies with Steel Springs:
 - 1. Housed or caged spring isolators are not acceptable.
 - 2. Assemblies shall use bare springs, color coded or otherwise identify springs to indicate load capacity.
 - 3. Spring diameter shall not be less than 0.8 of the loaded operating height of the spring.
 - 4. The ratio of the horizontal to vertical spring constant shall be between 1 and 2.
 - 5. Springs shall be sized to be non-resonant with equipment forcing frequencies or support structure natural frequencies.
 - 6. Assembly shall be designed and installed so that the ends of the spring remain parallel during and after the spring installation.
 - 7. Springs shall operate in the linear portion of their load versus deflection curve over a deflection range of not less than 50 percent above the design deflection.
- M. Vibration isolators exposed to weather and other corrosive environments shall be protected with factory corrosion resistance.
 - 1. Exterior applications:
 - a) Springs: Cadmium-plated and neoprene coated.
 - b) Nuts and bolts: Cadmium plated.
 - c) Other metal mounting parts: Hot-dip galvanized.
 - 2. Interior applications: Painted.

2.03 VIBRATION ISOLATED EQUIPMENT SUPPORT BASES

- A. Pre-Engineered Roof Equipment Support (Type RES):
 - 1. Reference Section “Hangers and Supports for HVAC Piping and Equipment” for specification of non-vibration isolated, pre-engineered roof equipment supports.

- B. Concrete Inertia Base (Type CIB):
 - 1. Description: Engineered steel forms into which concrete is poured, with integrated motor slide base, isolator brackets and anchor bolts, welded or tied reinforcing bars running both ways in a single layer. Where anchor bolt locations fall in concrete, reinforcing steel forms shall include drilled members with sleeves welded below the steel to accept bolts. Height saving steel brackets shall be used in all mounting locations.
 - 2. Size: Beam depth equal to 10 percent of the longest span of the base, 6 inches minimum but not more than 12 inches. Size to accommodate incoming pipe suction diffuser or elbow supports.
 - 3. Mass: Minimum of 1.5 times weight of isolated equipment.
 - 4. When the concrete base is "T" shaped, isolators shall be located under the projections as well as under the main body in order to prevent cantilever distortion.
 - 5. The structural perimeter frame, mounting templates, height saving brackets, and spring system shall be provided as an assembly by the vibration control vendor.
 - 6. Type CIB: Mason Industries Type KSL or approved equal.

2.04 VIBRATION ISOLATORS

- A. Ribbed Neoprene “Waffle” Pads (Type WP):
 - 1. Assembly: Single ribbed or crossed double ribbed elastomer in-shear pads, in one or more layers separated and bonded to a minimum 1/4 inch thick galvanized steel shim plate as required to provide selected deflection.
 - 2. Thickness: Each layer 5/16 inch thick.
 - 3. Selection: Maximum durometer of 50 and designed for 15 percent strain, static deflection of 0.05 inches.
 - 4. Type WP: Mason Industries Type W, Type WSW, or approved equal.

- B. Neoprene and Cotton Duck Pads (Type DP):
 - 1. Assembly: Neoprene and cotton duck construction, 12 Plys per 1/2 inch thickness.

2. Selection: Thickness or multiple pads in series as required to limit maximum loading to 500 psi and static deflection of 0.1 inches.
3. Type DP: Mason Industries Type HL, or approved equal.

C. Steel Spring Neoprene Mounts (Type SPNM):

1. Assembly: Single or multiple free-standing and laterally stable steel springs without a housing.
 - a) Light capacity base: Molded elastomeric neoprene load plate.
 - b) Heavy capacity base: Springs welded to the load plate assembly furnished with integral elastomeric pad.
 - c) Leveling Device: Rigidly connected to equipment or frame.
2. Selection:
 - a) Minimum static deflection for equipment mounted on grade slabs shall be 1 inch unless specified otherwise.
 - b) Minimum static deflection for equipment mounted above grade (suspended) slabs shall be 2 inches unless specified otherwise.
3. Type SPNM: Mason Industries Type SLFH or approved equal.

D. Neoprene Bushing (Type NR):

1. Assembly: Neoprene restraint, rubber-in-shear bushings for lightweight, suspended equipment supported from structure with all-thread rod and angle iron or Unistrut.
2. Selection: Maximum durometer of 50 and designed for 15 percent strain, static deflection of 0.15 inches.
3. Type NR: Mason Industries Type HMIB or approved equal.

E. Double Deflection Neoprene Hangers ((Type DDNH)

1. Assembly: Steel hanger box containing a laterally stable, double deflecting, neoprene isolator . Neoprene isolator shall prevent contact between the lower hanger rod and hanger box and short-circuiting the isolating function.
 - a) Housing: Bottom opening sized to allow hanger rod to swing through a 30 degree arc.
2. Selection: Maximum durometer of 50 and designed for 15 percent strain, static deflection of 0.4 inches.
3. Type DDNH: Mason Industries Type HD or approved equal.

F. Spring and Neoprene Hanger (Type SPNH)

1. Assembly: Steel hanger box containing a laterally stable, double deflecting, neoprene isolator in series with a steel spring.
 - a) Housing: Include a neoprene bushing to prevent contact between the lower hanger rod and hanger box and short-circuiting the isolating function. Bottom opening sized to allow hanger rod to swing through a 30 degree arc.
 2. Selection:
 - a) Neoprene isolator: Maximum durometer of 50 and designed for 15 percent strain, static deflection of 0.4 inches unless specified otherwise.
 - b) Spring isolator: Minimum static deflection of 2 inches unless specified otherwise.
 3. Type SPNH: Mason Industries Type 30N or approved equal.
- G. Neoprene Mounting Sleeves, Grommets, and Bushings: Designed to prevent steel-to-steel contact within vibration isolators.
- H. Flexible Connectors:
1. Pipe: Refer to Section “Hydronic Piping Specialties.”
 2. Duct: Refer to Section “Air Duct Accessories.”
- I. Pipe Riser Anchor (Type PRA)
1. Assembly: Telescoping arrangement of two sizes of steel tubing separated by minimum 1/2 inch thick, 60 durometer neoprene. Anchor shall include tapped hole on the top plate for bolt attachment to riser clamp. Anchor shall allow for all-directional movement.
 2. Selection: Static deflection of 0.1 inches, maximum allowable load on the isolation material shall not exceed 500 psi.
 3. Type PRA: Mason Industries Type ADAH or approved equal.
- J. Pipe Riser Guide (Type PRG):
1. Assembly: Telescoping arrangement of two sizes of steel tubing separated by minimum 1/2 inch thick, 60 durometer neoprene with set screw to prevent lateral movement. Guide shall include tapped hole on the top plate for bolt attachment to riser clamp.
 2. Type PRG: Mason Industries Type VSGH or approved equal.
- K. Riser Suspension Anchor (Type PRSA):

1. Assembly: Steel hanger box containing laterally stable steel spring with integral deflection scale, adjustment plate, and nut. Housing shall include tapped hole at the top for hanger rod attachment.
2. Selection: Minimum static deflection of 4 inches.
3. Type PRSA: Mason Industries Type HES or approved equal.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that mounting surfaces are ready to receive vibration isolation and associated attachments.

3.02 INSTALLATION - GENERAL

- A. Install in accordance with manufacturer's instructions.
- B. External spring isolators are not required if unit is provided with internal spring isolation. If external spring isolators are provided, internal spring isolation shall not be approved.
- C. Mount or suspend all equipment, piping, ductwork, etc. from approved foundations and supports as specified herein or as shown on the drawings.
- D. Secure fasteners according to manufacturer's recommended torque settings.
- E. Support piping, ductwork, conduit, and mechanical equipment from the building structure. Do not support from other equipment, piping, or ductwork.
- F. Install isolators to prevent short-circuiting of the isolation.
- G. All wiring connections to mechanical equipment on isolators shall have a minimum 18 inch long flexible conduit in a "U" shaped loop. Coordinate with Division 26.
- H. Flexible Connectors: Install flexible connectors sized to match equipment connections and to provide sufficient slack for vibration isolation as required.
- I. Equipment connected to water or other fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping. Block-up equipment with temporary shims to final operating height. When the

system is assembled full load is applied, adjust the isolators shall be adjusted to allow shim removal.

- J. Refer to Division 23 Section “Common Work Results for HVAC” for noise critical spaces.

3.03 INSTALLATION OF VIBRATION ISOLATED EQUIPMENT SUPPORT BASES

- A. All floor-mounted equipment shall be erected on housekeeping pads. Refer to Section “Common Work Results for HVAC” for concrete housekeeping pad requirements.
- B. Maintain minimum 4 inches clearance between isolated equipment and the walls, ceiling, floors, columns, and any other equipment not installed on vibration isolators.
- C. Set steel bases for one inch clearance between housekeeping pad and base.
- D. Set concrete inertia bases for 2 inches clearance between housekeeping pad and base.
- E. Adjust equipment to be level.
- F. Verify no material is left to short-circuit the isolator.

3.04 INSTALLATION OF VIBRATION ISOLATORS

- A. Neoprene Mounting Sleeves, Grommets, and Bushings: Install on vibration isolators to prevent any metal to metal contact.
- B. Spring Isolators:
 - 1. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
 - 2. Install springs so that the ends of springs remain parallel and all springs are installed with adjustment bolts.
 - 3. Locate isolation hangers at the top of hanger rods.
 - 4. Type SPNM: Unless otherwise specified, isolators need not be bolted to the floor for indoor installations.
 - 5. Type SPNH and DDNH: Install the hanger box to allow it to rotate a full 360 degrees without encountering any obstruction.

C. Isolating Pipe Anchors:

1. Weld anchor base to support steel or bolt base plate to structure. Weld or bolt pipe clamp or bracket to anchor.

3.05 EQUIPMENT ISOLATION

A. Air Handling Units:

1. Units that are furnished with internal structural frames and external lugs (both of suitable strength and rigidity), or without any severe overhangs, do not require an additional structural frame installed beneath the unit.
2. Support condensate drain pipes from the isolated air handling unit frame.
3. Slab-on-Grade: Housekeeping pad base, Type SPNM isolation with 1 inch static deflection.
4. Suspended Slab: Housekeeping pad base, Type SPNM isolation with 2 inch static deflection.

B. Water Source Heat Pumps, Fan Coil Units, and Computer Room Units:

1. Floor-mounted (Concealed): Housekeeping pad base, Type SPNM isolation with 0.75 inch static deflection.
2. Floor-mounted (Exposed): Type WP isolation continuous along support.
3. Suspended: Flexible duct connectors with Type SPNH with 1 inch static deflection.

C. VAV Terminal Units:

1. All other Types: Flexible duct connectors.

D. Centrifugal or Scroll Chillers:

1. Slab-on-Grade: Housekeeping pad base, Type WP isolation continuous along support.

E. Screw Chillers:

1. Slab-on-Grade: Housekeeping pad base, Type WP isolation continuous along support.

F. Boilers:

1. All Applications: Housekeeping pad base, Type WP isolation continuous along support.

- G. Inline Pumps:
 - 1. Pump supported independent of piping:
 - a) Provide flexible connectors on each side of pump. The vertical load shall be carried by the supports, not by the flexible couplings.
 - b) Suspended: Type SPNH isolation with 2 inch static deflection.
- H. Base-mounted Pumps:
 - 1. Slab-on-Grade:
 - a) Less than 50 hp: Housekeeping pad.
- I. Fans
 - 1. Suspended:
 - a) Fans 1 hp and less: Type NR isolation with 0.15 inch static deflection.
 - b) Fans greater than 1 hp: Type SPNH isolation with 2 inch static deflection.
 - 2. Roof-mounted:
 - a) Curb mounting: Type RES curb base, with closed cell sponge gasket for sealing, continuous along support sealed to curb top rail.
- J. Pneumatic Air Compressors and Vacuum Pumps
 - 1. Slab-on-Grade up to 10 hp: Housekeeping pad, Type SPNM isolation with static deflection of 0.75 inches.
 - 2. Slab-on-Grade 10 hp and greater: Housekeeping pad under Type CIB base, Type SPNM isolation with 1 inch static deflection.
 - 3. Suspended Slab: Housekeeping pad under Type CIB base, Type SPNM isolation with 2 inch static deflection.
- K. Unit Heaters: Type SPNH isolation with 2 inch static deflection.
- L. All other equipment not specifically identified in this specification that contains rotating or vibrating elements and any associated electrical apparatus installed by this division that contains transformers or inductors shall be installed on Type DDNM or RNM neoprene isolators as appropriate.

3.06 PIPING ISOLATION

- A. Provide isolation supports on the following HVAC pipe:
1. Piping within 50 feet of the following connected rotating equipment. Provide Type SPNH or SPNM isolators. The first three isolators both upstream and downstream of equipment shall have a static deflection equal to that of the equipment isolators, up to a maximum of 2 inches. The static deflection of the remaining pipe isolators shall be 0.75 inch.
 - a) Chillers.
 - b) Pumps with motors greater than 5 hp.
 - c) Base mounted air handling units with fan motors greater than 5 hp and no internal isolation.
 2. Piping within 20 feet of the following suspended equipment: Provide Type SPNH isolators. The first isolator both upstream and downstream of equipment on springs shall have a static deflection equal to that of the equipment isolators, up to a maximum of 2 inches. The static deflection of the remaining pipe isolators shall be 0.75 inch.
 - a) Pipes connected without flexible connectors to suspended equipment that is installed with spring vibration isolators.
 - b) Pipes connected without flexible connectors to suspended in-line pumps.
 3. Steam Pipe Connected to PRV Stations
 4. Piping installed below or adjacent to noise sensitive areas:
 - a) Refer to Section "Common Work Results for HVAC" for definition of noise sensitive areas.
 - b) Isolate all piping larger than 2 inch from the structure with spring and rubber type SPNH or SPNM isolators with 0.75 inch deflection.
 - c) Isolate all 2 inch and smaller HVAC piping from the structure with sponge neoprene, felt, or glass/mineral fiber sleeves between the pipe and pipe clamp or with Type WP pads between the clamp and the structure. The sleeve shall be not less than 1/8-inch in thickness when compressed.
- B. Provide flexible connectors for piping system connections on equipment side of shutoff valves for all pumps, mechanical equipment supported or suspended by spring isolators, and where indicated on Drawings.
- C. Provide resilient diagonal mountings or other approved devices as required to limit piping motion due to equipment startup or shut down to a maximum of 1/8 inch.

- D. Where supplementary steel is required to support pipes, size the supplementary steel so that maximum deflection between supports does not exceed 0.08 inches. Isolate the supplementary steel from building structure using the same isolator required for the pipe. Rigidly suspend or support the pipe from the supplementary steel.
- E. Provide pre-compressed hanger rod isolators for all pipes greater than 12 inch diameter and all supplementary steel supports used for the large pipe. Factory set the pre-compression at 75 percent of rated deflection.
- F. Where isolated pipe 8 inch and larger is supported from exposed steel beams, use welded channel beam attachments located directly under the web of the beam. For piping 6 inch and smaller, beam clamps may be used in lieu of welding, subject to approval of beam clamp selection.
- G. Vertical Piping Riser Supports:
 - 1. Do not exceed pipe stresses allowed by ASME B31.9.
 - 2. Provide multiple supports along riser so that each isolator support is loaded for 50 psi maximum. Provide tapped hole in top of support for rigid attachment of pipe riser clamp to support.
 - 3. Riser Supports: Pipe clamp on top of Type DP or Type WP.
 - 4. Risers Subject to Thermal Expansion:
 - a) Support vertical pipe risers subjected to thermal expansion and/or contraction with spring isolators, anchors, and guides designed to ensure loading within design limits at support points. Perform design calculations for sizing the riser supports incorporating the initial load, initial deflection, change in deflection, final load and change in load at support locations. Design calculations must include anchor loads when installed, cold filled and at operating temperature and pipe stress at end connections and branch locations. Design system for an initial spring deflection of at least 4 times the thermal movement. Design must be stamped and signed by a licensed professional engineer.
 - b) Spring Isolators: Type SPNH, DDNH, or PRSA.
 - c) Anchors: Type PRA.
 - d) Guides: Type PRG.
 - e) Reference Section "Expansion Fittings and Loops for HVAC Piping" for expansion joints.

3.07 DUCT ISOLATION

- A. Connect ducts to equipment, fans, fan casings, and fan plenums with flexible connectors.

- B. Support grease exhaust ducts with Type SPNH and/or SPNM isolators as appropriate. Install neoprene riser guides if lateral restraint is required in shafts.

3.08 FIELD QUALITY CONTROL

- A. Arrange for inspection of all isolation and noise control equipment by the vibration isolation vendor and submit post-installation inspection report.
- B. The installation of all vibration isolation systems shall be under the supervision of the manufacturer's representative.
- C. Guarantee: If, in the actual installation, any equipment fails to meet the vibration control requirements specified herein, that equipment shall be corrected or replaced without claim for additional payment, inclusive of all labor and material costs. Such corrective measures shall be done within a time schedule specified by the Owner.

END OF SECTION

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