# GENERAL

## Coordinate requirements of this specification with all other specifications and trades. Requirements of this specification take precedence over other specification sections. For example, the requirements of this section with regard to pipe supports in mechanical rooms take precedence above the requirements of Section 23 05 29.

## This specification pertains to the furnishing and installation of vibration isolation devices for rotating or reciprocating mechanical equipment and piping and conduit systems attached thereto, and electrical transformers and attached switchgear and conduit systems.

## This work shall include all material and labor required for installation of the resilient mounting and suspension systems, adjusting each mounting system, and measurement of isolator system performance when so requested by the Architect. Specific mounting arrangements for each item of mechanical and electrical equipment shall be as described herein and as indicated by schedules and details on the drawings.

## All vibration isolation equipment except for resilient pipe connectors, including steel framing and reinforcing for concrete inertia bases and including steel rail bases, shall be furnished by Mason Industries or Kinetics Noise Control. A single manufacturer for all vibration isolation equipment in Sections 22 05 48, 23 05 48, and 26 05 48 will be required except as specifically approved in writing by the Architect or by his specific approval of shop drawings or as specified herein. For resilient pipe connectors refer to provisions of this specification that follow.

## SECTION INCLUDES

### Vibration isolation systems.

## REFERENCE SECTION 23 05 00 FOR THE FOLLOWING GUIDELINES

### References

### Submittals

### Delivery, storage and handling

## ADDITIONAL REQUIREMENTS

### The Contractor and the vibration isolation manufacturer or his regularly designated and factory authorized representative shall perform the following tasks in addition to the supply and installation of isolation equipment:

#### Obtain from the Architect the approved manufacturer's name, model number, and other necessary identifying data for each item of mechanical and electrical equipment to be resiliently mounted. Coordinate all resilient mounting systems with the exact equipment to be furnished in regard to physical size, isolator locations, weight, rotating speed, etc. Direct contact and cooperation between the vibration isolation device fabricator and the equipment manufacturer will be required.

#### Obtain all necessary data in regard to piping systems which are to be resiliency supported so that proper isolators can be selected. Select piping system isolators for proper coordination with the physical arrangement of pipe lines and with the physical characteristics of the building.

#### Submit shop drawings as required by other portions of this specification. These drawings shall include specification information as follows:

##### Manufacturer's model number for each isolator, the machine or pipeline to which it is to be applied, and the number of isolators to be furnished for each machine or pipeline.

##### For steel spring mounts or hangers - Free height, deflected height, solid height, isolator loading, and diameter of spring coil.

##### For elastomer or glass fiber isolators - Free height, deflected height, and isolator loading.

##### Dimensional and weight data for concrete inertia bases, steel and rail bases, and details of isolator attachment.

#### Provide on-the-job supervision as required during installation of resiliently mounted equipment and piping to assure that all vibration isolators are installed in strict accordance with normally accepted practices for critical environments.

#### Replace at no extra cost to the Owner any isolators which do not produce the required deflection, are improperly loaded above or below their correct operating height, or which in any way do not produce the required isolation.

#### Cooperate with all other Contractors engaged in this project so that the installation of vibration isolation devices will proceed in a manner that is in the best interests of the Owner.

#### Notify the Architect of any project conditions which affect vibration isolation system installation or performance and which are found to be different from conditions indicated by the drawings or described by the specifications. Should vibration isolation system installation proceed without such notifications any remedial work required to achieve proper isolator performance shall be accomplished by the Contractor at no additional cost to the Owner.

#### Be alert for possible "short-circuiting" of vibration isolation systems by piping supports, electrical connections, temperature control connections, drain lines, building construction, etc., and notify the involved contractor as to these problems or potential problems. Where such situations cannot be easily resolved, notify the Architect so that preventive or remedial action can take place on a timely basis. Any remedial measures required shall be undertaken by the contractor responsible at no additional cost to the Owner.

#### This specification does not include provisions for seismic restraints that might be required by isolations systems due to the geographic location of the project, building codes, or other considerations.

# PRODUCTS

## VIBRATION ISOLATION SYSTEMS:

#### General:

##### The vibration isolation systems described herein and identified by type letter designations shall be applied to specific classifications of mechanical and electrical equipment as indicated by Section C of this document.

##### The minimum static deflection of the isolators for each classification of mechanical or electrical equipment shall be as indicated by Section C of this document or as otherwise indicated herein.

#### Type A Isolation:

##### The equipment shall be rigidly mounted on a large reinforced concrete inertia base which has length and width dimensions approximately 20% greater than the supported equipment. The inertia base and equipment shall be supported by steel spring vibration isolators. Brackets for the spring isolators shall be located off the sides of the inertia base or integral with the perimeter of the inertia base with the tops of the springs near the vertical center of gravity of the equipment and inertia block; or if the center of gravity is higher than the top of the inertia base, the tops of the springs shall be at the top of the inertia base. The spring isolators shall rest on curbs or pedestals if necessary. There shall be a 2 inch minimum space between the bottom of the inertia base and the top of the housekeeping pad or floor slab when a housekeeping pad is not indicated to be employed.

##### Concrete inertia bases shall be formed by a welded steel channel frame which incorporates prelocated equipment anchor bolts, and reinforcing bars in each direction welded in place. Concrete shall be standard 150-160 Ib/cu.ft. structural concrete. The base thickness shall be determined by the weight requirements but it shall be a minimum of 8% of the longest span between isolators or 6 inches, whichever is greater. For centrifugal and axial fans and centrifugal pumps the inertia base shall have a minimum weight equal to that of the isolated equipment. For reciprocating equipment the inertia base shall have a minimum weight equal to twice the weight of the equipment.

##### Springs shall be of the free standing unhoused type. Horizontal spring stiffness shall not be less than 0.8 of vertical stiffness. Springs shall be selected for reasonably uniform deflection taking into consideration any difference in machine weight at each supporting point, but deflection of each spring shall not be less than that specified for each classification of mechanical equipment. The spring deflection from the point of rated deflection to the point at which the spring is solid shall not be less than 1/2 of the rated static deflection. The yield point of the steel used in the springs shall be sufficiently great so that the springs may be compressed to shorted turns without danger of spring failure. At least two layers of ribbed waffle pattern neoprene pads or equivalent glass fiber pads shall be installed under the base plate of each spring isolator. Springs shall have leveling bolts and proper means for bolting to the machines. To prevent corrosion, springs for outdoor installation shall be galvanized or otherwise coated as approved by the Architect.

#### Type B Isolation:

##### The equipment shall be rigidly mounted on wide flange or channel structural steel members which shall run perpendicular to any support channels or similar members which are an integral portion of the equipment, or which shall be fabricated to form a complete frame for machine mounting. Height saving spring mounting brackets shall be welded to the ends of the structural steel saddle members or to the sides of structural steel frames to attach free standing steel spring isolators. Unless otherwise approved, the depth of the structural steel saddle members or the perimeter members of mounting frames shall be at least one-tenth of the longest frame dimension.

##### Steel spring isolators shall be as specified for Type A isolation.

##### Minimum clearance between the steel base and the housekeeping pad or floor shall be 2 inches.

#### Type C Isolation:

##### The equipment shall be rigidly mounted in a steel frame which is sufficiently stiff so that it may be supported on resilient isolators without distortion of the frame or misalignment of the equipment. If the equipment has an integral frame which is suitably rigid, the resilient isolators may be secured directly to the integral equipment frame or base.

##### Isolators shall be selected on the basis of the required static deflection as scheduled or otherwise indicated, and as follows:

###### Required deflection 0.25 to 0.4 inches - double deflection neoprene-in-shear isolators.

###### Required deflection 0.5 inches and greater - steel spring isolators as specified for the Type A mounting.

##### Isolators shall be selected for reasonably uniform deflection taking into consideration any difference in machine weight at each supporting point, but deflection shall not be less than that specified for each classification of equipment.

##### Minimum clearance between the equipment base and the house keeping pad or floor shall be 2 inches.

#### Type D Isolation:

##### The equipment shall be mounted on resilient "pads". These pads shall be multiple layers of waffle or ribbed neoprene, neoprene and cork sandwich, or precompressed glass fiber with height and stiffness as required to provide the static deflection as scheduled or specified and as required to properly support the load.

##### Pads shall be loaded in accordance with the manufacturer's recommendations and sized to achieve this recommended loading. The equipment weight at each sup porting point shall be considered in selecting pad dimensions along with the recommended loading.

#### Type E Isolation:

##### The equipment shall be suspended with steel spring vibration isolators which are complete with neoprene-in-shear isolators for high frequency noise control. The neoprene-in-shear isolators shall provide static deflection of 0.20 inches minimum. In addition, elastomer washers shall be furnished as necessary to prevent metal-to-metal contact.

##### Hanger rod misalignment of up to 15 degrees relative to vertical shall not cause "short-circuiting" of the isolation components due to metal-to-metal contact.

##### Spring hangers shall utilize free standing springs which are unhoused except for the required partial and open housing assembly. Spring hangers shall be selected for reasonably uniform deflection taking into consideration any difference in machine weight at each supporting point, but deflection of each hanger shall not be less than that specified for each classification of mechanical equipment. The spring deflection from the point of rated deflection to the point at which the spring is solid shall not be less than one-half of the rated static deflection. The yield point of the steel used in the springs shall be sufficiently great so that the springs may be compressed to shorted turns without danger of spring failure.

##### Resilient hangers shall be installed as near as possible to the supporting overhead structure. The machine suspension points shall be in a rigid and heavy portion of the building structure. Suspension of machines from lightweight floor slabs shall be avoided, particularly at the center of structural spans.

##### Suspension rods shall be attached to rigid members of the machine structure. When such attachment points do not exist, a heavy steel framework shall be furnished to support the machine with suspension rods attached to this framework.

#### Type F Isolation:

##### The equipment shall be suspended with double deflection neoprene-in-shear hangers which are complete with elastomer washers as required to prevent metal-to-metal contact.

##### Hangers shall be installed as near as possible to the supporting overhead structure. Suspension points shall be on a rigid portion of both the overhead structure and equipment framework.

#### Type G Isolation:

##### This mounting shall be the same as the Type E mounting except that the suspended machine shall be supported by a concrete inertia base. Suspension rods shall be attached to the concrete base.

#### Type K Isolation (Curb Mounted Roof-top Air Conditioning Machines):

##### The roof-top air conditioning machine shall be mounted on a free standing steel spring isolated rectangular rail (curb) system. The isolation system shall be suitable for outdoor unprotected locations and it shall include a soft and flexible elastomer air and water seal which shall not short circuit the spring isolators. The isolation system shall not allow lateral movement greater than 5/8 inch for wind loads up to 100 miles per hour. Suitable systems of this type are Kinetics Noise Control Type ESR and Mason Industries Type RSC.

#### Type L Isolation (Water Chillers and Similar Equipment):

##### Same as Type C except that steel spring isolators shall employ vertical limit stops with provisions to prevent short circuiting of the limit stops when the springs are loaded normally.

# EXECUTION

## GENERAL

### Install in accordance with manufacturer's instructions.

## EXAMINATION

### Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

### Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

### Proceed with installation only after unsatisfactory conditions have been corrected.

## VIBRATION-CONTROL DEVICE INSTALLATION

### Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

### Equipment Restraints:

#### Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

### Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

### Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

### Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

### Drilled-in Anchors:

#### Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

#### Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

#### Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

#### Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

#### Set anchors to manufacturer's recommended torque, using a torque wrench.

#### Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

## ADJUSTING

### Adjust isolators after piping system is at operating weight.

### Adjust active height of spring isolators.

### Adjust restraints to permit free movement of equipment within normal mode of operation.

## RESILIENT MOUNTINGS FOR SPECIFIC CLASSIFICATIONS OF MECHANICAL EQUIPMENT:

## [Note to A/E: Fill in table with project specific requirements ]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **EQUIPMENT** | **LOCATION** | **ESTIMATED MINIMUM ROTATING SPEED (RPM)** | **ISOLATION TYPE** | **MINIMUM ACTUAL STATIC DEFLECTION (INCHES)** |
|  |  |  |  |  |
|  |  |  |  |  |
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## ISOLATION OF PIPING SYSTEMS:

### All piping and rigidly connected devices such as pressure reducing valves which connects to resiliently mounted equipment shall be suspended with resilient hangers or supported by floor mounted isolators for a distance of 100 pipe diameters from the connected machine or within the mechanical equipment room, whichever is the greater distance. The first three supports from the connected machine shall have the same static deflection as indicated for the machine; the next two supports shall have static deflection at least equal to one-half of the static deflection indicated for the machine mounting, and remaining pipe supports shall provide static deflection of 0.35 inches minimum. These remaining isolators may be elastomer.

### Steel spring hangers shall be as specified for Type E isolation except that a scale shall be attached to the hanger housing to indicate deflection. Elastomer hangers shall be as specified for Type F isolation. Floor mounts shall be free standing steel spring isolators as specified for Type A isolation where static deflection in excess of 0.35 inches is required. Floor mounts, where static deflection of 0.35 inches or less is required, shall be double deflection neoprene-in-shear as specified for Type C isolation.

### Vertical pipe risers shall be resiliently mounted, preferably with each riser anchored near the center of the run. The risers shall be supported at the anchor points with steel spring or double deflection neoprene-in-shear isolators which provide static deflection of at least 0.35 inches. Isolators for the remainder of each run shall be steel spring type specifically designed to control load shifting due to pipe expansion and contraction. At least 0.35 inches deflection shall be maintained under all conditions.

### Flexible synthetic rubber connectors shall be used to connect all piping to all isolated equipment. Flexible synthetic rubber connectors shall be fabricated using peroxide cured EPDM synthetic rubber and Kelvar tire cord reinforcement and shall be Mason Industries Safeflex of the most current design. Resilient connectors shall be selected for the pressure rating and temperature rating appropriate for the particular piping and pipe contents. Where synthetic EPDM flexible connectors are not permitted by code due to pipe contents and/or pressures provide swing pipe connectors changing direction a minimum of 3 times before joining isolated equipment. Swing connections should be made within approximately 6 feet of the isolated equipment.

### Drain connections from isolated equipment to floor drains shall be at least 1" free from drain or use rubber hose.

## ISOLATION OF AIR SUPPLY AND RETURN DUCTS

### Sheet metal air handling ducts shall be connected to air handlers with resilient connectors and such ducts shall be suspended with resilient hangers or supported by floor mounted isolators for a distance of 30 feet from the connected machine or within the mechanical equipment room whichever is the greater distance. The first three supports from the connected machine shall have the same static deflection as indicated for the machine; the next two supports shall have static deflection at least equal to one-half of the static deflection indicated for the machine mounting, and remaining pipe supports shall provide static deflection of 0.35 inches minimum. These remaining isolators may be elastomer.

### Steel spring hangers shall be as specified for Type E isolation. Elastomer hangers shall be as specified for Type F isolation. Floor mounts shall be free standing steel spring isolators as specified for Type A isolation where static deflection in excess of 0.35 inches is required. Floor mounts, where static deflection of 0.35 inches or less is required, shall be double deflection neoprene-in-shear as specified for Type C isolation.

## ISOLATION OF FRACTIONAL HORSEPOWER EQUIPMENT:

### All fractional horsepower fans, pumps, etc., which are mounted on or suspended from floors that are not on-grade shall be isolated with neoprene-in-shear isolators furnished by the vibration isolation supplier except where such isolators are furnished as an integral part of the machine.

END OF SECTION 23 05 48