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BuildingName
The Description of the Project
P00000000 0000

SPECIFICATION DIVISION 22

NUMBER SECTION DESCRIPTION

DIVISION 22 PLUMBING
SECTION 220548 - VIBRATION CONTROL

END OF CONTENTS TABLE

DIVISION 22 PLUMBING
SECTION 220548 - VIBRATION CONTROL

REVISIONS:

FEBRUARY 2017 REVISIONS/ SIGNIFICANT CHANGES.

APRIL 2018: REVISED TO LIST MFR.S FROM PML. R BENEDEK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

INCLUDE PARAGRAPH 1.1.A IN EVERY SPECIFICATION SECTION.

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 1 Specification Sections, and other applicable Specification Sections including the Related Sections listed below, apply to this Section.

1.2 SCOPE OF WORK:

SPEC EDITOR: THIS SECTION SHOULD BRIEFLY DESCRIBE ALL THE MECHANICAL WORK TO ENABLE POTENTIAL SUBCONTRACTORS TO DECIDE WHETHER OR NOT TO OBTAIN A FULL SET OF DOCUMENTS AND TO BID. PARTICULAR CARE SHOULD BE USED WHEN SELECTING VIBRATION ISOLATION TYPES FOR HIGHLY VIBRATION SENSITIVE BUILDINGS

A. Provide vibration control items for isolating vibration of mechanical equipment, piping and ductwork.

B. Provide all hangers, isolators, bases, pads, sleeves and other devices specified, required, or detailed for the project. Include all vibration isolation system elements as recommended by the equipment manufacturer's representative to make a complete, correct and safe installation. Supply and install all incidental materials needed.

1.3 QUALITY ASSURANCE

A. Work of this section shall be performed by skilled workers who are experienced in the necessary crafts to meet the requirements of this Section.

B. Provide field supervision and inspection to assure proper installation, adjustment and performance. Replace any isolators that are found to resonate with the supported equipment.

C. As a minimum provide vibration control per ASHRAE - 2015 - HVAC Applications, Chapter 48 - "Sound and Vibration Control".

D. Isolators shall be selected, installed and adjusted to prevent the transmission of objectionable vibration and noise to the building structure.

E. The size and number of mounts and hangers shall be chosen to meet these specifications, even if not specifically shown on the plans. Brackets, rails, bases, braces, etc., shall be provided as needed for a complete and correct installation.

1.4 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, manufacturers for products specified in this Section shall be one of the following:

1. Vibration Eliminator Co.
2. Mason Industries, Inc.
3. Kinetics Noise Control
4. Vibration Mounting and Controls (VMC)
5. Amber Both
6. Korfund
7. Vibration Isolation Co.

PART 2 - PRODUCTS

2.1 FLEXIBLE DUCT CONNECTIONS

A. Flexible sleeves for duct connections shall be fabricated from flexible, airtight, coated fabric. Each sleeve shall be installed with at least 3 inches slack across a clear metal to metal gap of at least 4 inches. That is, 7 inches of this fabric is required for each sleeve.

2.2 FLEXIBLE PIPE CONNECTORS

A. Flexible connectors for pipes shall be neoprene Mason Type MFNC, MFTNC or as approved.

2.3 FLEXIBLE METAL HOSE CONNECTORS:

USE THIS IN HOT WATER, STEAM, CONDENSATE AND REFRIGERATION SYSTEMS AS REQUIRED

A. Length and end fittings as shown in drawings, with an inner corrugated hose made of type 304, 321, or 316 stainless steel and outer braid made of 304 stainless steel. Manufacturers: Metraflex, Flexonics, Mason, Twin City Hose.

B. For copper piping systems, use copper construction braided hoses. Approved Manufacturers: Anaconda, Flexonics, Mason, Metraflex, Twin City Hose.

SPEC EDITOR: USE THE FOLLOWING ARTICLES FOR TUNNELS ONLY

2.4 FLEXIBLE METAL HOSE CONNECTORS FOR TUNNELS:

A. For steel piping systems, length and end fittings as shown in drawings, with an inner corrugated hose made of type 316 stainless steel and outer braid (double braided) made of 316 stainless steel. Dual floating flanges or one fixed and one floating flange may be used. Manufacturers: Metraflex, Flexonics, Mason.

B. For copper piping systems, (up to 2" in size) use copper construction braided hoses. Manufacturers: Anaconda, Flex Hose Co., Flexonics, Mason, Metraflex. For sizes 2½" above, all stainless steel with an inner corrugated hose made of type 316 stainless steel and outer braid made of 316 stainless steel, with stainless steel flanges. Dual floating flanges or one fixed and one floating flange may be used. All wetted parts shall be stainless steel. Approved Manufacturers: Metraflex, , Flexonics, Mason, Twin City Hose.

2.5 FLEXIBLE CONNECTORS (RUBBER):

SPEC EDITOR: USE THIS IN LARGE PUMP SYSTEMS

A. Flexible connectors with neoprene and nylon type elements, with carbon steel or ductile iron floating flanges. Rated for 150 psig working pressure at 200°F, with peroxide cured EPDM liner and cover, ultraviolet resistant, hand wrapped, non-molded, multiple arch body, with control rods or cables. Approved Manufacturers: Mason Industries, Inc. Type SFDEJ, Mercer Rubber Co., Metraflex Type DS, Twin City Hose.

2.6 INERTIA BASES

A. All mounts shall have leveling bolts rigidly secured to the equipment being isolated.

B. Provide vibration isolation bases as indicated in the table in section 3.2.

C. Base Type A

1. Floor mounted equipment that is mounted directly to the floor, no inertia base is required.

D. Base Type B

1. Inertia base Type B (Steel Inertia Base) shall be a structural steel base frame with clearance holes located to correspond to the mounting bolt holes of the equipment mounted on the base.
2. Bases shall have built-in motor slide rails and shall be reinforced as necessary to withstand belt pull without drive misalignment or base distortion. The bases shall be constructed with deep angle steel sections with a minimum vertical angle leg of 4 inches for motors of 7.5 hp or less, 5 inches for motors between 7.5 hp and 20 hp and 6 inches for motors over 20 hp.
3. Mason Industries Type WFSL with unhoused spring isolators SL, or approved equal.

E. Base Type C

1. Inertia base Type C (Concrete Inertia Base) shall have an integral rectangular structural steel form into which concrete is poured. Perimeter members shall be beams of depth equal to 10% of the longest span of the base, but not more than 12 inches nor less than 6 inches deep. Forms shall include motor slide base and all reinforcing steel. Where anchor bolt locations fall in concrete, the reinforcing steel shall include drilled members with sleeves welded below the steel to accept the anchor bolts. Height saving steel brackets shall be used in all mounting locations.
2. When the concrete base in "T" shaped, isolators shall be located under the projections as well as under the main body in order to prevent cantilever distortion.
3. Mason Industries Type BMK/KSL with unhoused spring isolators SL or approved equal.

2.7 VIBRATION ISOLATORS

A. The static deflection of isolators shall be as specified below and in ASHRAE - 2015 Chapter 48.

B. Vibration isolator sizes and layout shall be determined by the vibration isolator supplier.

C. Provide vibration isolator types as indicated in the table in section 3.2.

D. Isolator Mount Type 1

a. Type 1(Waffle Pads) shall be 3/8 inch thick neoprene pads ribbed or waffled on both sides. The pads shall be manufactured with quality neoprene and selected for a maximum durometer of 50 and designed for 15% strain. Where required, steel load-spreading plates shall be incorporated between the equipment and the neoprene pad.
b. If the isolator is bolted to the structure, a neoprene mounting sleeve shall be installed under the bolt head between the steel washer and the base plate.
c. Mason Industries Type Mini Super W or approved equal.

E. Isolator Mount Type 2

1. Type 2 (Double Deflection Neoprene Mounts) shall be laterally stable, double deflecting, molded neoprene isolators. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed and bolt holes shall be provided in the base. The mounts shall have a leveling bolts rigidly secured to the equipment.
2. The isolator shall be manufactured with bridge bearing quality neoprene and selected for a maximum durometer of 50 and designed for 15% strain. DDNM mounts shall be selected for a static deflection of 3/8 inch unless otherwise specified.
3. Mason Industries Type ND or approved equal.

F. Isolator Mount Type 3

1. Type 3 (Spring and Low Dynamic Stiffness Mounts) shall have a free-standing and laterally stable steel spring without any housing. Springs shall be designed so that the ratio of the horizontal to vertical spring constant is between one and two. The spring diameter shall be not less than 80% of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50% of the specified static deflection.
2. Unless otherwise specified, the minimum static deflection of Type 3 isolators for equipment mounted on grade slabs shall be 1 inch and for the minimum static deflection for equipment mounted above grade level shall be 2 inches.
3. Two Type 3 isolation pads sandwiching a 16 gauge stainless or galvanized steel separator plate shall be bounded to the isolator baseplate.
4. Unless otherwise specified, isolators need not be bolted to the floor for indoor installations. If the base plates are bolted to the structure, a neoprene mounting sleeve shall be installed under the bolt head between the steel washer and the base plate.
5. Mason Industries Type SLF or approved equal.

G. Isolator Mount Type 4

1. Laterally stable, restrained spring type with housings and heavy top plates for supporting the equipment and resisting seismic and wind loading. Spring isolators shall be comprised of two interfacing but independent elements; a coil spring element and a seismically rated housing. Housings and springs shall be powder coated and hardware galvanized. The spring coil element shall be comprised of one or more coil assemblies having all of the characteristics of freestanding coil spring isolators.
2. The seismically rated housing shall be sized to meet or exceed the force requirements applicable to the project and have the capability of accepting coils of various sizes, capacities, and deflections as required to meet the desired isolation criteria. All spring forces will be contained within the coil/housing assembly and under no seismic load condition shall the restraint anchoring hardware be exposed to spring generated forces. Top plate and restraining bolts shall be out of contact with the housing during normal operation.
3. The restraint element shall incorporate a steel housing with elastomeric elements at all dynamic contact points. The restraint will allow a maximum of 1/4 in. (25 mm) motion in any direction from the neutral position. All elastomeric elements shall be replaceable.
4. The leveling nut or screw shall be accessible for adjustment with the use of a pneumatic or electric impact wrench. The spring element shall be replaceable without having to lift or otherwise remove the supported equipment.

H. Isolator Hanger Type 2

1. Type 2 (Double Deflection Low Dynamic Stiffness Hangers) shall consist of a molded low dynamic stiffness (LDS) isolating element in a steel hanger box. A LDS sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod and permit the hanger rod to swing through a 30° arc. When installed, the hanger box shall be allowed to rotate through a full 360° without encountering any obstructions.
2. The isolator shall be manufactured with quality LDS and selected for a maximum durometer of 50 and designed for 15% strain. Unless otherwise specified, the static deflection of Type 2 hangers shall be minimum of 0.3 inches.
3. Mason Industries Type HD or approved equal.

I. Isolator Hanger Type 3

1. Type 3 (Spring and Low Dynamic Stiffness Hangers) shall consist of a steel spring in a series with a low dynamic stiffness (LDS) isolating element. The spring shall have a minimum additional travel to solid equal to 50% of the specified deflection. The neoprene element shall have a static deflection of not less than 0.3 inches with a strain not exceeding 15%.
2. Unless otherwise specified, the static deflection of SPH hangers shall be 2 inches.
3. Spring diameter and hanger box hole size shall be large enough to permit the hanger rod to swing through a 30° arc. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod. When installed the spring element shall not be cocked and the hanger box shall be allowed to rotate through a full 360° arc without encountering any obstructions.
4. Mason Industries Type 30N or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. All equipment mounted on vibration isolators shall have a minimum operating clearance of 1 inch between the bottom of the equipment or inertia base (and height saving bracket) and the concrete housekeeping pad (or bolt heads) beneath the equipment.

B. Check the clearance to ensure that no scraps have been left to short circuit the vibration isolators.

C. Provide a minimum of 4 inches between isolated equipment and the walls, ceiling, floors, columns and any other equipment not installed on vibration isolators.

D. Piping, ductwork, conduit or mechanical equipment shall not be hung from or supported on other equipment, pipes, or ductwork installed on vibration isolators.

E. 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. Equipment should be blocked-up with temporary shims to final operating height. When the system is assembled and fluid is added, the isolators shall be adjusted to allow removal of the shims.

F. All mechanical equipment not specifically identified in this specification that contains rotating or vibrating elements shall be installed on Mount Type 2 neoprene isolators as appropriate. Provide supporting steel structure between isolators and equipment if isolator does not readily connect to equipment.

G. All equipment and their respective isolators shall be directly mounted on primary steel. Units and isolators shall not be mounted on resiliently supported steel cabinets or plenum floors or other flexible construction.

H. Roof mounted fans or roof top units shall be installed on a curb mounted base.

I. All wiring connections to mechanical equipment on vibration isolators (either spring or neoprene type) shall be made with a minimum 36 inch long flexible conduit. Coordinate wiring connections with the Electrical Installer.

3.2 APPLICATION TABLES

A. **Floor Mounted Equipment**

Equipment Type	**Slab on Grade**		**Floor Span - Up to 30 Ft**		**Floor Span - 30 to 40 Ft**	
	Base Type	Isolator Type	Base Type	Isolator Type	Base Type	Isolator Type
Chillers:						
Water Cooled Reciprocating	A	Mount 1	A	Mount 1	A	Mount 1
Water Cooled Centrifugal	A	Mount 1	A	Mount 4	A	Mount 4
Absorption	A	Mount 1	A	Mount 1	A	Mount 1
Cooling Towers:						
All	A	Mount 1	A	Mount 4	A	Mount 4
Air Compressors:						
Tank Mounted - Horz < 20 HP	A	Mount 3	A	Mount 3	A	Mount 3
All Others	C	Mount 3	C	Mount 3	C	Mount 3
Pumps:						
Base mounted < 7.5 HP	A	NONE	C	Mount 3	C	Mount 3

Base Mounted All Others	A	NONE	C	Mount 3	C	Mount 3
Fans:						
< 22" dia	A	Mount 2	A	Mount 3	C	Mount 3
> 22" dia & < 2" SP	B	Mount 3	C	Mount 3	C	Mount 3
> 22" dia & > 2" SP	C	Mount 2	C	Mount 3	C	Mount 3
Roof Top Unit						
All	Curb	Mount 1	Curb	Mount 1	Curb	Mount 1
Computer Room Units:						
All	A	Mount 3	A	Mount 3	A	Mount 3
Generators:						
All	A	Mount 3	C	Mount 3	C	Mount 3

B. **Suspended Equipment**

Equipment Type	**Isolator Type**
Pumps:	
In Line Pumps < 5 HP	Hanger 3
Fans: (Including Fan Coil Unit and Heat Pumps)	
< 22" Dia	Hanger 2
> 22" Dia & < 2" SP	Hanger 3
> 22" Dia & > 2" SP	Hanger 3

"Floor Span": Defined as the distance between centers of floor joists

3.3 BASE MOUNTED PUMPS

A. Any rigid pipe elbows at the pump suction and discharge connections shall be supported from the inertia base. All pipe connections shall be with a flexible pipe connector.

3.4 FAN ISOLATION - GENERAL

A. All fan bases and isolators shall be sized so that thrust restraints (which would act against turning moment caused by static pressure) are not required.

3.5 PIPES WITH MULTIPLE CONNECTIONS

A. Where a pipe run connects multiple items of equipment in the Mechanical Room the pipe hanger isolators for the entire run shall be chosen to suit the connected equipment of greatest static deflection.

SPEC EDITOR NOTE: INCLUDE SUBSECTOIN 3.8 FOR VIBRATION SENSITIVE BUILDINGS.

3.6 INSPECTION

A. Isolator manufacturer service representative shall inspect and approve the installation of the vibration isolators and shall submit a report to the Owner which verifies that all of the isolation equipment has been properly installed and that the installation is in full conformance with the specification. The report shall record the vibration isolator identification and model or type.

B. For isolators containing steel springs the report shall also record the size and uncompressed height, design static deflection and measured static deflection of the isolators provided.

END OF SECTION 220548