SECTION 20 05 48 – vibration isolation

1. GENERAL
	* + 1. RELATED DOCUMENTS
				1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
				2. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.
			2. SUMMARY
				1. Perform all Work required to provide and install inertia bases and vibration isolation indicated by the Contract Documents with supplementary items necessary for their proper installation.
			3. REFERENCE STANDARDS
				1. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
				2. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
				3. All materials, installation and Workmanship shall comply with the applicable requirements and standards addressed within the following references:

ASHRAE ‑ Guide to Average Noise Criteria Curves.

* + - 1. QUALITY ASSURANCE
				1. Provide for vibration isolation supports for all equipment, piping and ductwork indicated herein. The transmission of perceptible vibration, structural borne noise or objectionable air borne noise to occupied areas by equipment installed under this Contract will not be permitted. Install vibration isolators as specified herein or shown on the Drawings or otherwise required to prevent the transmission of vibration which would create objectionable noise levels in occupied areas.
				2. The vibration isolation supplier must be a firm capable of dealing effectively with vibration and noise characteristics effects and criteria; and one that can provide facilities and capabilities for measuring and evaluating the aforementioned disturbances.
				3. Maintain ASHRAE criteria for average noise criteria curves for all equipment at full load condition.
				4. Provide vibration isolation devices, from a single manufacturer or supplier who will be responsible for complete coordination of all phases of this Work.
			2. SUBMITTALS
				1. Product Data:

Submit Shop Drawings, installation instructions, and product data.

Indicate vibration isolator locations, with static and dynamic load on each, on Shop Drawings and described on product data.

Contractor shall furnish complete submittal data, including Shop Drawings, which shall indicate the size, type and deflection of each isolator; and the supported weight, disturbing frequency and efficiency of each isolator proposed; and any calculations and other information as may be required for the Architect/Engineer to check the isolator selection for compliance with the specification.

* + - * 1. Record Documents:

Indicate inertia bases on Shop Drawings, including dimensions.

All steel bases and concrete inertia bases shall be completely detailed, and shall show completely any reinforcing steel that may be required to provide a rigid base for the isolated equipment. Further, the submittal data shall clearly indicate outlined procedures for installing and adjusting the isolators and bases mentioned above.

Submittals on riser isolation system shall show initial and final loads on the structure at each support point, initial and final deflection of each isolator, amount and direction of each deflection change, total expansion and contraction of each riser and operating temperature of 180 degrees F in the riser.

Riser diagrams shall be prepared by the vibration isolation manufacturer and submitted for approval. These diagrams shall show initial and final spring deflections, amount and direction of deflection changes, overall expansion and contraction of the riser, and operating temperature of the medium.

Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist in the design proposed when installed in accordance with submittal and these Specifications.

* + - * 1. Operation and Maintenance Data:

Provide manufacturer’s recommended maintenance procedures.

1. PRODUCTS
	* + 1. GENERAL
				1. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
				2. All vibration isolators and bases shall be designed for and treated for resistance to corrosion.
				3. Steel components shall be PVC coated or phosphated and painted with industrial grade enamel. All nuts, bolts and washers shall be zinc‑electroplated or cadmium plated.
				4. All isolators exposed to the weather shall have steel parts hot‑dip galvanized or zinc‑electroplated plus coating of Neoprene or Bitumastic paint. Aluminum components for outdoor installation shall be etched and painted with industrial grade enamel.
				5. Required spring deflections for isolators supporting various items of equipment are shown on the Drawings or tabulated elsewhere in these Specifications, but in no case shall be less than one inch. Springs shall be capable of 30 percent over‑travel before becoming solid.
				6. Where height‑saving brackets for side mounting of isolators are required, the height‑saving brackets shall be designed to provide for an operating clearance of 2 inches under the isolated structure and designed so that the isolators can be installed and removed when the operating clearance is 2 inches or less. When used with spring isolators having a deflection of 2-1/2 inches or more, the height‑saving brackets shall be of the pre‑compression type to limit exposed bolt length between the top of the isolator and the underneath side of the bracket.
				7. All isolators supporting a given piece of equipment shall limit the length of the exposed adjustment bolt between the top and base to a maximum range of 1 inch to 2 inches.
				8. All isolators supporting a given piece of equipment shall be selected for approximately equal spring deflection.
				9. Isolators for equipment installed outdoors shall be designed to provide adequate restraint due to normal wind conditions and to withstand wind load of 55 pounds per square foot applied to any exposed surface of the equipment without failure.
			2. manufacturers
				1. Amber Booth.
				2. Korfund Dynamics.
				3. Consolidated Kinetics.
				4. Mason Industries.
			3. Isolation bases
				1. Type SFB: A structural steel fan and motor base with NEMA standard motor side rails and holes drilled to receive the fan and motor. The steel members shall be adequately sized to prevent distortion and misalignment of the drive.
				2. Type CPF: Concrete inertia base, consisting of full depth perimeter steel pouring form, 3000 psi concrete reinforcing bars welded in place, bolting templates with anchor bolts and height‑saving brackets for side mounting of the isolators. The base shall be sized with a minimum overlap of 4 inches around the base of the equipment. Fan bases are to be supplied with NEMA standard motor slide rails.
				3. The bases for pumps shall be sized to support the suction elbow of end suction pumps and both the suction and discharge elbows of horizontal split-case pumps. The bases shall be T-shaped where necessary to conserve space.
				4. Structural bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer. A finish coat of industrial grade enamel shall be applied over the primer.
			4. Isolator types
				1. Isolator types and required deflections are specified under "Application." Isolator type designations are Amber Booth designators. The isolators shall comply with the following descriptions for each type required on the Project:

Type XL: Aluminum‑housed, adjustable, spring mounting having telescoping top and bottom sections separated by resilient inserts of Neoprene or other suitable material to limit horizontal motion. The inserts shall be permanently lubricated to minimize vertical friction. Steel or cast iron housings may be used if they are hot‑dip galvanized after fabrication. A Neoprene pad having a minimum thickness of ¼ inch shall be bonded to the baseplate.

Type SW: Adjustable, freestanding, open-spring mounting with combination leveling bolt and equipment fastening bolt. The spring mounting to baseplate and compression plate must be rigid. The neoprene pad with a minimum thickness of ¼ inch is bonded to the baseplate. A minimum horizontal-to-vertical spring rate of 1.0 is required.

Type BS: Spring hanger consisting of a rectangular steel box, coil spring, spring retainers, neoprene-impregnated fabric washer and steel washer.

Type BSA: Spring hanger consisting of a rectangular steel box capable of 200 percent minimum overload without visible deformation, coil spring, spring retainers, neoprene impregnated fabric washer and steel washer. Incorporate a 30 degree angularity feature that will permit up to a 15 degree misalignment of the hanger rod from the vertical without shorting out to the hanger box.

Type BSR: Combination spring and rubber hanger consisting of a rectangular steel box, coil spring, spring retainers and elastomeric mounting designed for ½ inch deflection.

Type BSRA: Combination spring and elastomeric hanger consisting of a rectangular steel box capable of 200 percent minimum overload without visible deformation, coil spring, spring retainers and elastomeric element. Incorporate a 30 degree angularity feature that will permit up to a 15 degree misalignment of the hanger rod from the vertical without shorting out to the hanger box.

Type RSW: Adjustable spring isolator as describe for Type SW with the addition of a fabricated steel housing suitable for recessing into a concrete inertia block. The housing has a side access.

Type PBS: Spring hanger as described for Type BS with the addition of a load transfer plate to hold the equipment or piping at a fixed elevation during installation and to permit transferring the load to the spring after installation.

Type PBSA: Spring hanger consisting of a rectangular steel box capable of 200 percent minimum overload without visible deformation, with the addition of a load transfer plate to hold the equipment or piping at a fixed elevation during installation, and to permit transferring the load to the spring after installation, a coil spring, spring retainers, neoprene impregnated fabric washer and steel washer. Incorporate a 30 degree angularity feature that will permit up to a 15 degree misalignment of the hanger rod from the vertical without shorting out to the hanger box.

PBSR: Combination spring and elastomeric hanger as described for Type BSR with the addition of a load transfer plate to hold the equipment or piping at a fixed elevation during installation and to permit transferring the load to the spring after installation.

Type PBSRA: Combination spring and elastomeric hanger consisting of a rectangular steel box capable of 200 percent minimum overload without visible deformation, with the addition of a load transfer plate to hold the equipment or piping at a fixed elevation during installation, a coil spring, spring retainers and elastomeric element. Incorporate a 30 degree angularity feature that will permit up to a 15 degree misalignment of the hanger rod from the vertical without shorting out to the hanger box.

Type CT: Adjustable, open-spring isolator having one or more coil springs attached to a top compression plate and a base plate. A neoprene pad with a minimum thickness of ¼ inch is bonded to the base plate. The spring assembly must fit within a welded steel enclosure consisting of a top plate and rigid lower housing, which serves as a blocking device during installation. The isolator includes restraining bolts for connecting the top plate and lower housing to prevent the isolated equipment from rising when drained of water.

Type SP-NRE: Pad-type mounting consisting of two layers of 3/8 inch thick ribbed or waffled neoprene pads bonded to a 16 gauge galvanized steel separator plate. Size pads for approximately 20 to 40 psi load and a deflection of 0.12 to 0.16 inch.

Type BRD: Elastomeric hanger consisting of a rectangular steel box and an elastomeric isolation element of neoprene. A high-quality synthetic rubber may be used if it contains antiozone and antioxidant additives. The elements are designed for approximately ½ inch deflection and loaded so that the deflection does not exceed 15 percent of the free height of the element.

Type TRK: For static pressure of 3 inch water or greater, provide a set of spring-loaded thrust resistors (two or more) installed across the flexible duct connection on the fan discharge, designed to limit the movement of the fan. Coil spring static deflection capabilities of thrust resistors shall equal those of the isolators supporting the equipment up to a maximum of 2 inches.

Type RVD: An elastomeric mounting having a steel baseplate with mounting holes and a threaded insert at top of the mounting for attaching equipment. All metal parts shall be completely embedded in the elastomeric material. Mountings shall be designed for approximately ½ inch deflection.

1. EXECUTION
	* + 1. INSTALLATION
				1. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
				2. All installation shall be in accordance with manufacturer’s published recommendations.
				3. Install motor driven equipment with vibration isolators.
				4. Set steel bases for one-inch clearance between housekeeping pad and base. Set concrete inertia bases for 2 inch clearance. Adjust equipment level.
				5. Isolate pumped water-piping systems with spring-type vibration isolators to produce a floating mechanical system. Provide spring isolators on piping connected to isolated equipment as follows: Static deflection for the two supports closest to equipment on each pipe connected to the equipment shall be equal to the deflection of isolated equipment. All other supports for horizontal piping shall have a minimum operating deflection of ¾ inch with a capability of an additional 50 percent travel to solid.
				6. All open-type spring isolators shall be restrained as recommended by the manufacturer.
				7. Pumps:

 Each centrifugal pump and its driving motor shall be mounted on a common inertia base and the base, in turn, shall be mounted on the scheduled vibration isolator type to prevent transmission of vibration and noise to the building structure.

In general, all inertia bases shall be formed and poured in place onto a hard, flat surface from which the base can be separated when cured. The base shall be shimmed, using flat material, to the intended final height prior to equipment mounting and piping connection.

After piping connections are made and the system filled with water and ready to put into service, the isolator adjustment bolts shall be extended until the shim blocks can be removed. Isolators may then be backed down slightly to restore the intended height. The locknuts should then be tightened on the isolators. Jack bolts shall be trimmed to a length that will allow no more than 1 inch of additional height adjustment. After final adjustment, the inertia base shall not support any piping load. All springs supporting piping that is connected to a piece of isolated equipment shall be sized for static deflection equal to that of the isolated equipment.

* + - * 1. Piping (Including Generator Piping):

Floor mounted supports shall have the same type of isolator or media as is used for the nearest isolated equipment connected to the piping.

The pipe hanger system shall have provisions for all piping to be shimmed or blocked in place until all connections are made and the system filled with water; then, the isolators adjusted to support the weights and the shim blocks removed.

The first three support points from a piece of isolated equipment shall be of the positioning type and provide not less than the static deflection of the equipment isolators.

All springs supporting piping shall be capable of an additional ½ inch deflection prior to complete compression and springs supporting vertical risers shall have provisions for limit stops.

Support risers up through 16 inches at every third floor, and risers 18 inches and over at every second floor. All supports for risers must have a deflection capability at least four times the anticipated expansion and contraction. Install temporary anchors as required to permit preadjustment of springs in the risers. Furnish permanent limit stops to prevent excessive vertical motion of risers in the event risers are drained. Wall sleeves for takeoffs from risers shall be sized for insulation outside diameter plus two times the calculated thermal movement to prevent binding.

System operating temperatures (degrees F) are as follows:

|  |  |  |
| --- | --- | --- |
| Service | Supply | Return |
| Chilled Water | 42-45 | 56-59 |
| Heating Water | 180 | 160 |
| 25-pound Steam and Condensate | 318 | 318 |
| 70-pound Steam and Condensate | 318 | 318 |

* + - * 1. Resilient Sleeves: Resilient sleeves shall be provided at all points where equipment room walls, floors or ceilings are penetrated by ducts, piping or refrigerant line, etc.
				2. Fans and Air Handling Units: Such units shall have electrical flexible connections not less than 36 inches long and the flexible duct connections with a free length of not less than 8 inches.
				3. Ductwork: Isolate all high pressure ductwork within each equipment room and to a minimum of 50 feet from fan with Type BS hangers or Type SW floor supports, sized for ¾ inch deflection.
				4. To prevent excessive transfer of piping load from floor to floor, all water riser support springs shall have a deflection capability of four times the expansion or contraction to be accommodated by the support with the additional runout capability to absorb the movement. Isolators supporting steam and diesel engine exhaust risers shall be selected for deflections equal to two times the anticipated thermal movement at the support point. Riser isolation system shall be designed such that it supports the riser in tension, eliminating the need for guides; requires no anchors; and has a zero movement point at or near the center to divide thermal movement approximately in half, thus reducing vertical movement of horizontal pipe takeoffs.
			1. APPLICATION
				1. The following is a schedule of equipment on a typical project that requires vibration isolation and base isolators of the types specified. Refer to Drawings for equipment scheduled for the Project. Any equipment, system or condition that may be altered, added, or changed; or that is not specifically described in the Contract Documents shall be isolated in a manner specified for similar equipment, system or condition in order to comply with these Specifications.

| Equipment Type | Isolator Type/Minimum Deflection (Inches) | Base Type |
| --- | --- | --- |
|  |  |  |
| Air Handling Units Floor Mounted – Up to 15 HP | SW 2” | N/A |
|  Floor Mounted – 15 HP and Over | SW2.4” | N/A |
|  Suspended – Up to 15 HP | PBSRA 2” | SFB |
|  Suspended – 15 HP and Over | PBSRA 3.5” | SFB |
|  High pressure Fan Sections | SW 2” with TRK 3.5 | CPF |
| Fan Coil Units – Suspended | PBSRA 1” | N/A |
| Fan Powered Terminal Units Not Internally Isolated | PBSRA 1” | N/A |
| Centrifugal FansClass I and II – Up to 54-¼ inch Diameter Up to 15 HP | SW 2” | SFB (If required) |
| Class I and II – 60-inch Diameter and Over, 15 HP and Over | SW 4.5” | SFB (If required) |
|  Class III – All sizes | SW 3.5” with TRK 2” | CPF |
|  Arrangement # 3 Fans | SW 4.5” | SFB |
| Vane Axial Fans | SW 4.5” with TRK 2” | SFB |
| Vent Sets: |  |  |
|  Floor Mounted – Up to 15 HP | SW 1.5” | SFB (If required) |
|  Suspended – Up to 15 HP | PBSRA 1.5” | SFB (If required) |
| Unit Substations | RVD 0.5” | N/A |
| Compressors | CT 1.5” | N/A |
| Engine Driven Generators: Skid Mounted | CT 3” | N/A |
|  Exhaust Pipe | PBSRA 3” | N/A |
| Pumps: Up to 5 HP | RSW 0.5” | CPF |
|  5 HP to 10 HP | RSW 1” | CPF |
|  10 HP and Over | RSW 2” | CPF |
|  Vacuum Pumps | RSW 1” | CPF |

* + - * 1. Piping Application:

Type PBSRA for hangers in all horizontal piping at equipment; except at connections to risers use BS.

Type SW for all floor supports of floor supported piping at equipment or stanchion.

END OF SECTION 20 05 48