

SECTION 15070
VIBRATION CONTROL AND SEISMIC RESTRAINTS

PART 1- GENERAL

1.01 PROVISIONS INCLUDED

- A. The general provisions of the Contract, including General and Supplementary Conditions, and Division 1 General Requirements, apply to work specified in this Section.
- B. Requirements of Section 15050, "Basic Mechanical Materials and Methods" apply to work specified in this Section.

1.02 SUMMARY

- A. Work Included: Furnish and install vibration control isolators, and seismic restraints and snubbers.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of vibration control product. Submit schedule showing size, type, deflection, and location for each product furnished.
- B. Shop Drawings: Show designs and calculations, certified by a professional engineer, for the following:
 - 1. Design Calculations: Calculations for selection of vibration isolators, design of vibration isolation bases, and selection of seismic restraints.
 - 2. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to the structure and to the supported equipment. Include auxiliary motor slides and rails, and base weights.
 - 3. Seismic Restraint Details: Detail fabrication and attachment of restraints and snubbers.
- C. Compile and submit as specified in 01770, The manuals shall include a table of contents, specifications, drawings, and description of equipment; installation instructions; operating instructions; Maintenance instructions; parts lists; and test data.
 - 1. Include a list of recommended spare parts and a schedule of required lubricants, as recommended by the Manufacturer.
 - 2. Include nameplate information and shop order numbers for each item of equipment and component part thereof.

1.04 QUALITY ASSURANCE

- A. Comply with USM IDAT requirements.
- B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control products, of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.
 - 1. Except as otherwise indicated, obtain vibration control products from a single manufacturer.
 - 2. Engage manufacturer to provide technical supervision of installation of vibration control products.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Maine and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of vibration isolation bases and seismic restraints that are similar to those indicated for this Project in material, design, and extent.

1.05 COORDINATION

- A. Coordinate the size, location, and special requirements of vibration isolation equipment and systems with other trades. Coordinate plan dimensions with size of housekeeping pads.
- B. Coordinate layout and installation of vibration isolation and seismic -restraint devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- C. Supply and install incidental materials such as mounting brackets, attachments and other accessories as may be needed to meet the requirements stated herein, even if not expressly specified or shown on the drawings.
- D. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Manufacturer: Subject to compliance with specifications, furnish vibration isolation mounts and seismic restraints from one of the following manufacturers:
 - 1. Amber/Booth Co., Houston, TX [A.B.]
 - 2. Mason Industries Inc., Hauppauge, NY [M.I.]
 - 3. Vibration Mountings & Controls Inc., Butler, NJ [V.M.&C.]

4. Kinetics Noise Control [KNC]

2.02 VIBRATION ISOLATOR TYPES

A. General:

1. Springs installed out-of-doors shall be cadmium-plated, zinc electroplated or powder-coated after fabrication. Hardware and other metal parts shall be cadmium-plated or galvanized. Galvanizing shall meet ASTM Salt Spray Test Standards and Federal Test Standard No. 14.
2. Isolators installed out-of-doors shall have base plates with bolt holes for fastening the isolators to the support members.
3. Isolator types are scheduled to establish minimum standards. At the Contractor's option, laborsaving accessories can be an integral part of isolators supplied to provide initial lift of equipment to operating height, hold piping at fixed elevations during installation and initial system filling operations, and similar installation advantages. Accessories and seismic restraint features must not degrade the isolation performance of the isolators.
4. Provide static deflection of isolators shall be as indicated. All static deflections stated are the minimum acceptable deflection for the mounts under actual load. Isolators selected solely on the basis of rated deflections are not acceptable and will be disapproved.

B. Type FSN (Floor Spring and Neoprene):

1. Spring isolators shall be freestanding and laterally stable without any housing. Spring diameter shall be not less than 0.8 of the compressed height of the spring at the rated load. Springs shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately one. All mounts shall have leveling bolts.
2. The spring element in the isolator shall be set in a neoprene cup and have a steel washer or a flat surface in contact with the neoprene to distribute the load evenly over the bearing surface of the neoprene. Alternatively, each isolator shall be mounted on a Type NP isolator. If the NP isolator is used, a rectangular bearing plate of appropriate size shall be provided to load the pad uniformly within the manufacturer's recommended range. If the isolator is to be fastened to the building and the NP isolator is used, neoprene grommets shall be provided for each bolt hole in the base plate.
3. If the basic spring isolator has a neoprene friction pad on its base and an NP isolator is to be added to the base, a galvanized steel, stainless steel or aluminum plate shall be used between the friction pad and the NP isolator. If the isolator is outdoors, the plate shall not be made of galvanized steel. The NP isolator, separator plate and friction pad shall be permanently adhered to one another and to the bottom of the bearing plate.

4. Type FSN isolators shall be one of the following products with the appropriate neoprene pad (if used) selected from Type NP:
 - a. A.BType SW
 - b. M.I.....Type SLF
 - c. K.N.C..... Type FDS
 - d. V. M & C.....Series A

C. Type HN (Hanger Neoprene)

1. Vibration isolation hangers shall consist of a neoprene-in-shear element contained within a steel housing. A neoprene neck bushing shall be provided where the hanger rod passes through the hanger housing to prevent the rod from contacting the hanger housing. The diameter of the hole in the housing shall be sufficient to permit the hanger rod to swing through a 30-degree arc before contacting the hanger housing.
2. Type HN isolators shall be one of the following products:
 - a. A.B. Type BRD-A
 - b. M.I.....Type HD
 - c. K.N.C..... Type RH or FH
 - d. V. M & C.....Type RHD or RFD

D. Type NP (Neoprene Pad)

1. Neoprene pad isolators shall be one layer of 1/4" to 3/8" thick ribbed or waffled neoprene. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.
2. Type NP isolators shall be one of the following products:
 - a. A.B. Typr NR
 - b. M.I.....Type W
 - c. K.N.C..... Type NPS
 - d. V. M & C.....Series Shear Flex

E. Type FSNTL (Floor Spring and Neoprene Travel Limited):

1. Spring isolators shall be free-standing and laterally stable without any housing. Spring diameter shall be not less than 0.8 of the compressed height of the spring at the rated load. Spring shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. Springs shall be so designed that the ratio of horizontal stiffness is approximately 1 (one). All mounts shall have leveling bolts. All mounts shall have vertical travel limit stops to control extension when weights is removed. The travel limit stops shall be capable of serving as blocking during erection of the equipment. a minimum clearance of 1/4" shall be maintained around restraining bolts and between the limit stops and the spring to avoid interference with the spring action.
2. The spring element in the isolator shall be set in a neoprene cup and have a steel washer or a flat surface in contact with the neoprene to distribute the load evenly over the bearing surface of the neoprene. Alternatively, each isolator shall be mounted on a Type NP isolator. If the NP isolator is used, a rectangular bearing plate of appropriate

size shall be provided to load the pad uniformly within the manufacturer's recommended range. If the isolator is to be fastened to the building and the NP isolator is used, neoprene grommets shall be provided for each bolt hole in the base plate.

3. If the basic spring isolator has a neoprene friction pad on its base and an NP isolator is to be added to the base, galvanized steel, stainless steel or aluminum plate shall be used between the friction pad and the NP isolator. If the isolator is outdoors, the plate shall not be made of galvanized steel. The NP isolator separator plate and friction pad shall be permanently adhered to one another and to the bottom of the bearing plate.
4. Type FSNTL isolators shall be one of the following products, with the appropriate neoprene pad (if used) selected from Type NP or approved equal:
 - a. A.B. Typr CT
 - b. M.I. Type SLR
 - c. K.N.C. Type FLS
 - d. V. M & C. Series AWR

2.03 FLEXIBLE PIPE CONNECTIONS

- A. Flexible pipe connections shall be fabricated of multiple plies of nylon cord, fabric, and neoprene; and shall be vulcanized so as to become inseparable and homogeneous. Flexible connections shall be formed in a double sphere shape, and shall be able to accept compressive, elongating, transverse, and angular movements.
- B. The flexible connections shall be selected and specially fitted, if necessary, to suit the system temperature, pressure, and fluid type. In addition, suitable flexible connections should be selected which do not require rods or cables to control extension of the connector.
- C. Connectors for pipe sizes 2-inch or smaller shall have threaded female union couplings on each end. Larger sizes shall be fitted with metallic flange couplings.
- D. Flexible pipe connections shall be one of the following:
 1. A.B. Type 2600 or 2655
 2. M.I. Type MFTNC or MFTFU
 3. Metraflex. Type Twin Sphere

2.04 GROMMETS

- A. Grommets shall either be custom made by combining a neoprene washer and sleeve, be Isogrommets as manufactured by MBIS, Inc. (Bedford Heights, OH), or be Series W by Barry Controls (Watertown, MA). Grommets shall be sized so that they will be loaded within the manufacturer's recommended load range. Grommets shall be specially formed to prevent bolts from directly contacting the isolator base plate.

2.05 ACOUSTICAL SEALANT

- A. Sealants for acoustical purposes as described in this specification shall be silicone or one of the nonsetting sealants indicated below:
 - 1. D.A.P. Acoustical sealant
 - 2. Pecora..... BR-96
 - 3. Tremco..... Acoustical sealant
 - 4. U.S.G. Acoustical sealant

2.06 SEISMIC CONTROLS

- A. General:
 - 1. Seismic equipment shall be designed to safely accept, distribute, and transfer external seismic forces in any direction, without failure or permanent displacement. The seismic force (Fp) shall be calculated using the equations and coefficients established for Seismic Hazard Exposure Group III; and shall maintain the equipment in a captive position, and not short circuit isolation during normal operating conditions. Isolators shall have provisions for bolting and welding to the structure.
 - 2. Attachment plates to be cast into housekeeping pads, concrete inserts, beam clamps, etc., that may be required for seismic compliance, shall be provided by this section.
- B. Seismic Restraints - Type I:
 - 1. Type I restraint shall comply with general characteristics of Type FSN spring isolators with the following additional features: Incorporate snubbing restraint in all directions, and capable of supporting equipment at fixed elevations during installation. Cast or aluminum housings, except ductile iron, are not acceptable.
 - 2. M.I..... Type SSLFH
- C. Seismic Restraints - Type II:
 - 1. A seismic restraint having a minimum of 5/8-inch thick all directional resilient pad limit stop. Restraints shall be fabricated of plate, structural members or square metal tubing. Angle bumpers are not acceptable.
 - 2. M.I..... Type Z-1011 or Z-1225
- D. Seismic Restraints - Type III:
 - 1. Multiple metal cable type with approved fastening devices to equipment and structure. System to be field bolted to deck or overhead structural members using two sided beam clamps or appropriately designed inserts for concrete. All parts of the system including cables (excluding fasteners) are to be of single supplier to assure seismic compliance.
 - 2. M.I..... Type SCB Seismic restraining system
- E. Seismic Restraints - Type IV:

1. Double deflection neoprene isolator (min. 0.3") encased in ductile iron or steel casing.
2. M.I..... Type BR or RBA

PART 3. - EXECUTION

3.01 GENERAL

- A. Install isolation and seismic restraint system in strict accordance with the manufacturer's written instructions. Vibration isolators shall not cause any change of position of equipment resulting in stress on equipment connections.
- B. Anchor interior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural floors as required by authorities having jurisdiction.
- C. Anchor exterior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural supports as required by authorities having jurisdiction.

3.02 VIBRATION ISOLATION EQUIPMENT INSTALLATION

- A. Isolate equipment in accordance with the Vibration Isolation Schedule at the end of this Section.
- B. Flexible pipe connections shall be installed at all pipe connections to vibration-isolated equipment, including chillers, pumps and where shown on the contract drawings.
- C. Electrical connections to vibration-isolated equipment shall be flexible, as called for in the electrical portion of the specification.
- D. Thrust restraints shall be installed on floor-mounted fans developing 4-inches or more of static pressure, unless the horizontal component of the thrust force can be demonstrated to be less than 10% of the equipment weight. Thrust restraints shall be attached on each side of the fan at the vertical centerline of thrust. The two rods of the thrust restraint shall be parallel to the thrust force. Thrust restraints shall be adjusted to constrain equipment movement to the specified limit.
- E. Additional requirements:
 1. The minimum operating clearance under inertia bases shall be two inches.
 2. The minimum operating clearance under other bases shall be one inch.
 3. All bases shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the machine, isolators and restraints.
 4. The isolators shall be installed without raising the equipment.
 5. After the entire installation is complete, and under full operational load, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. When the isolators are properly adjusted, the blocks shall be barely free and shall be removed.

Remove all debris from beneath the equipment and verify that there are no short circuits of the isolation. The equipment shall be free in all directions.

6. Install equipment with flexibility in wiring.

F. Isolators:

1. Align vibration isolators squarely above or below mounting points of the supported equipment.
2. Locate isolators for equipment with bases on the sides of the bases which are parallel to the equipment shaft unless this is not possible because of physical constraints.
3. Locate isolators to provide stable support for equipment, without excess rocking. Consideration shall be given to the location of the center of gravity of the system and the location and spacing of the isolators. If necessary, a base with suitable footprint shall be provided to maintain stability of supported equipment, whether or not such a base is specifically called for herein.
4. Where a housekeeping pad is provided, the isolators shall bear on the housekeeping pad and the isolator base plates shall rest entirely on the pad.
5. Hanger rods for vibration-isolated support shall be connected to structural beams or joists, not the floor slab between beams and joists. Provide suitable intermediate support members as necessary.
6. Vibration isolation hanger elements shall be positioned as high as possible in the hanger rod assembly, but not in contact with the building structure, and so that the hanger housing may rotate a full 360° about the rod axis without contacting any object.
7. Parallel running pipes may be hung together on a trapeze that is isolated from the building. Isolator deflections must be the greatest required by the provisions for pipe isolation for any single pipe on the trapeze. Do not mix isolated and unisolated pipes on the same trapeze.
8. Pipes, ducts and equipment shall not be supported from other pipes, ducts and equipment.
9. Resiliently isolated pipes, ducts and equipment shall not come in rigid contact with the building construction or rigidly supported equipment.
10. Adjust all leveling bolts and hanger rod bolts so that the isolated equipment is level and in proper alignment with connecting ducts or pipes.

3.03 PIPING AND DUCTWORK ISOLATION

- A. Isolate piping from the building structure by means of vibration isolators, resilient lateral supports, and resilient penetration sleeve/seals, in accordance with this paragraph:
 1. Isolate the following piping and ductwork:

- a. Piping within mechanical rooms;
 - b. Piping within 50 feet total pipe length of connected vibration-isolated equipment (pumps, air handling units, etc.);
 - c. HVAC piping that is 6 inches or larger.
- B. Isolators for the first three support points adjacent to connected equipment shall achieve one half the specified static deflection of the isolators supporting the connected equipment. When the required static deflection of these isolators is greater than 1/2-inch, Type FSN or HSN isolators shall be used. When the required static deflection is less than or equal to 1/2-inch, Type FN or HN isolators shall be used. All other pipe support isolators within the specified limits shall be either Type FN or HN achieving at least 1/4-inch static deflection.
- C. Where lateral support of pipes is required, this shall be accomplished by use of resilient lateral supports.
- D. The isolators shall be installed with the hanger box attached to, or hung as closely as possible to, the structure. Hanger rods shall not short circuit the hanger box.
- E. The isolators shall be suspended from substantial structural member sized for 0.08 inch deflection at center of span, not from slab diaphragm, unless specifically permitted.
- F. All piping in the Custom Mechanical Rooftop Unit and Custom Rooftop air handling units will be isolated.

3.04 SEISMIC RESTRAINTS

- A. Installation:
- 1. Floor mounted equipment whether isolated or not shall be bolted or welded to the structure to allow for required acceleration. Bolt points, diameter of inserts, imbedment depth and weld length as shown on the approved submittal drawings shall be followed in all respects.
 - 2. Suspended equipment shall be four point independently braced with Type III restraints, installed taut for non-isolated equipment, piping, or ductwork, and slack with 1/2-inch cable deflection for isolated equipment.
 - a. Piping, Schedule 10, 20, 40 or 80, welded or Victaulic, shall be braced at a maximum of 40 foot intervals and at turns of more than 4 feet. Provide lateral bracing at 80 foot intervals.
 - b. Ductwork shall be braced a maximum of every 30 feet and at every turn and run end. Provide lateral bracing every 60 feet.
 - 3. Each corner or side of equipment base shall incorporate Type II restraints.
 - 4. Seismic restraints are not required on the following:
 - a. Piping in mechanical equipment room less than 1-1/4-inch ID.
 - b. Piping in other areas less than 2-1/2-inch ID.
 - c. Ducts less than 6 sq. ft. in cross sectional area.

- d. Piping suspended by individual hangers 12-inches or less in length from the top of the pipe support to the supporting structure.
 - e. Ducts suspended by individual hangers 12-inches or less in length from the top of the duct to the supporting structure.
- 5. Where base anchoring of equipment is insufficient to resist seismic forces, restraints such as Type III shall be located above the unit's center of gravity to suitably resist "G" forces.
 - 6. For overhead support equipment, overstress of the building structure must not occur. Bracing may occur from flanges and structural beams.
 - 7. Pipe risers through cored shafts require no additional seismic bracing. (Core diameters to be a maximum of 2-inches larger than pipe OD.)
- B. Non-isolated Equipment Installation:
- 1. Restraint Type III or IV.
 - a. Suspended pipe and duct not excluded by diameter or distance from structure allowances. Where VAV boxes are rigidly attached to duct (no flex) they shall be considered ductwork.
 - b. Suspended equipment, including, but not limited to, fans, VAV boxes and unit heaters.
 - c. Floor mounted equipment.
 - 2. Restraint Type III: Diffusers in acoustical tile ceilings to be four point independently cable braced.

3.05 FIELD QUALITY CONTROL

- A. Should any rotating equipment cause excessive noise or vibration when properly installed on the specified isolators, rebalance, realign, or perform other remedial work required to reduce noise and vibration levels. "Excessive" is defined as exceeding the manufacturer's specifications for the unit in question.
- B. When installation of vibration isolation and seismic restraint devices has been completed, the manufacturer's representative shall inspect the completed project and certify in writing to the Contractor that all systems are installed properly, or require correction. Submit a report to the Architect, including the representative's report. Certify correctness of the installation or detail corrective work to be done.
- C. Make adjustments as directed by the Architect at the time of inspection prior to Substantial Completion.

3.06

VIBRATION ISOLATION SCHEDULE

Unit	Isolator	Min Static	Base	Remarks
Energy recovery Exhaust Fans -- Centrifugal	FSN	1.5	BSF	
Suspended Fans & Fan Coil Units	HN	1.5		
AHU Internal Fans	FSNTL	2.5		Provided by AHU manufacturer

END OF SECTION 15070