

SECTION 15070

VIBRATION & SEISMIC CONTROL FOR HVAC PIPING & EQUIPMENT

PART 1 –GENERAL

1.1 SUMMARY

- A. Section includes inertia bases, vibration isolation, duct silencers, cross-talk silencers, acoustic housings, ductwork lagging, and acoustical louvers.

1.2 PERFORMANCE REQUIREMENTS:

- A. Provide vibration isolation on motor driven equipment over 0.5 hp, plus connected piping and ductwork

- B. Provide minimum static deflection of isolators for equipment as indicated.

- 1. Basement, Under 20 hp
 - a. Under 400 rpm: 1 inch
 - b. 400 – 600 rpm: 1 inch
 - c. 600 – 800 rpm: 0.5 inch
 - d. 800 – 900 rpm: 0.2 inch
 - e. 1100 – 1500 rpm: 0.14 inch
 - f. Over 1500 rpm: 0.1 inch
- 2. Basement, Over 20 hp
 - a. Under 400 rpm: 2 inch
 - b. 400 – 600 rpm: 2 inch
 - c. 600 – 800 rpm: 1 inch
 - d. 800 – 900 rpm: 0.5 inch
 - e. 1100 – 1500 rpm: 0.2 inch
 - f. Over 1500 rpm: 0.15 inch
- 3. Upper Floors, Normal
 - a. Under 400 rpm: 3.5 inch
 - b. 400- 600 rpm: 3.5 inch
 - c. 600 – 800 rpm: 2 inch
 - d. 800 – 900 rpm: 1 inch
 - e. 1100 – 1500 rpm: 0.5 inch
 - f. Over 1500 rpm: 0.2 inch
- 4. Upper Floors, Critical
 - a. Under 400 rpm: 3.5 inch
 - b. 400 – 600 rpm: 3.5 inch
 - c. 600 – 800 rpm: 3.5 inch

STANFORD UNIVERSITY, SCHOOL OF MEDICINE

- d. 800 – 900 rpm: 2 inch
- e. 1100 – 1500 rpm 1 inch
- f. Over 1500 rpm: 0.5 inch

- C. Consider upper floor locations critical unless otherwise indicated.
- D. Use concrete inertia bases for fans having static pressure in excess of 3.5 inch or motors in excess of 40 hp, and on base mounted pumps over 10 hp.
- E. Maintain sound level of spaces at levels not to exceed those listed below by utilizing acoustical devices.
- F. Maintain rooms at following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE Handbook.

1. Offices		
a. Conference Rooms	25	30
b. Private	30	35
c. Open-plan areas	35	40
d. Computer/business machine areas	40	45
e. Public circulation	40	45
2. Hospitals and Clinics		
a. Private Rooms	25	30
b. Wards	30	35
c. Operating Rooms	25	30
d. Laboratories	30	35
e. Corridors	30	35
f. Public areas	35	40
3. Churches	25	30
4. Classrooms		
a. Lecture and classrooms	25	30
b. Open-plan classrooms	30	35
5. Libraries	30	35
6. Concert Halls and Legitimate Theaters		
a. Theater	20	25
b. Stage house	20	25
c. Trap room	20	25
d. Orchestra pit	20	25
e. Rehearsal room	20	25
f. Teaching Studios	25	30
g. Practice Rooms	25	30

h. Ensemble rooms	25	30
i. Shop	40	45
7. Recording Studios		
a. Recording Room	15	20
b. Sound Control Room	20	25
c. Other control Rooms	20	25

1.3 SUBMITTALS

- A. Section 01330 – Submittal procedures: Submittal procedures.
- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.
- C. Product Data: Submit schedule of vibration isolator type with location and load on each. Provide catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.
- D. Design Data: Provide engineering calculations maximum room sound levels are not exceeded.
- E. Test Reports: Indicate dynamic insertion loss and noise generation values of silencers, acoustic housings meet or exceed specified sound transmission loss values.
- F. Manufacturer’s Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements that maintain integrity of sound isolation.
- G. Manufacturer’s Certificate: Certify that isolators meet or exceed specified requirements.
- H. Manufacturer’s Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01770 – Execution Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of cross-talk silencers, acoustic housings and ductwork lagging. Record actual locations of hangers including attachment points.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with AMCA 300, ANSI S1.13, ARI 575, ASA 16, (ANSI S1.36) standards and recommendations of ASHRAE 68.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum 3 years documented experience.
- B. Design application of duct silencers, acoustic housings and seismic snubbers under direct supervision of a professional engineer experienced in design of this work and licensed at the place where the project is located.

Motor Size	Min Thickness (inches)
5 – 15	6
20 – 50	8
60 – 75	10
100 – 200	12

1.7 PRE-INSTALLATION MEETING

- A. Section 01330 – Administrative Requirements: pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.9 WARRANTY

- A. Section 01770 – Execution Requirements: Product warranties and product bonds.
- B. Provide five-year manufacturer warranty for bases.

PART 2 –PRODUCTS

2.1 INERTIA BASES

A. Structural Bases:

1. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.
2. Vibrex Type “RMSBI”: Shall be constructed of concrete cast into a fabricated inertia base frame, the steel members of which are designed and supplied by the isolator manufacturer. The concrete shall be poured into a welded structural steel frame, incorporating prelocated mounting templates, ½” diameter reinforcing bars on nominal 8” center each way, and external isolator mounting brackets to reduce the mounting height of the equipment. The inertia base must have a welded solid steel bottom plate. No formed or bolted light gauge steel bases will be allowed.
3. Minimum thickness of the inertia base shall be according to the following tabulation:
4. A minimum operating clearance of 2 inches shall exist between the inertia base and housekeeping pad.
5. Construction: Welded structural steel with gusset brackets, supporting equipment and motor with motor slide rails.

B. Concrete Inertia Bases:

1. Mass: Minimum of 1.5 times weight of isolated equipment.
2. Construction: Structured steel channel perimeter frame, with gusset brackets and anchor bolts, adequately reinforced, concrete filled.
3. Connecting Point: Reinforced to connect isolators and snubbers to base
4. Concrete: Reinforced 3,000psi concrete

2.2 VIBRATION ISOLATORS

A. Open Spring Isolators:

1. Spring Isolators:
 - a. For Exterior and Humid Areas: provide hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity
2. Vibration Isolator Types:
 - a. Spring isolators shall incorporate the following:
 - 1) Minimum diameter equal to the loaded operating height and horizontal spring stiffness 0.9 to 1.5 times rated vertical spring stiffness. Corrosion resistance where exposed to weather, hardware shall be cadmium plated.
 - 2) Reserved deflection (from loaded to solid height) (of 50 percent of rated deflection with leveling device.

- 3) Minimum ¼ inch thick neoprene acoustical base pad on underside, unless designated otherwise. Neoprene acoustical grommets at baseplate lag holes.
 - 4) Designed and installed so that ends of springs remain parallel.
 - 5) Spring Isolators to be Vibrex Type “RMS”.
3. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
 4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.

B. Restrained Spring Isolators:

1. Seismic Restraints: Shall be capable of safely accepting 0.7 g’ external forces without failure, or one “g” for life safety equipment. Shall maintain equipment in a captive position. Shall no short circuit vibration isolation systems or transmit objectionable vibration or noise. Shall be provided on all equipment s scheduled on drawings. Calculations by California Structural or Civil Engineer shall be submitted to verify snubber capacities.
 - a. Seismic Restraint, Type II: Each corner of side seismic restraint shall incorporate minimum 5/16 inch thick resilient pad limit stops. Restraints shall be made of plate, structural members, or steel pipes in a welded assembly incorporating resilient pads. Vibrex Type SR – “e500” O.S.H.P.D. pre-approved seismic restraint, R #0029.
2. Spring Isolators:
 - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
3. Springs: Minimum horizontal stiffness equal to 50 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
4. Spring Mounts: provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
5. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
6. Restraint: Provide heavy mounting frame and limit stops.

C. Closed Spring Isolators:

1. Spring Isolators:
 - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b. Code: color code springs for load carrying capacity.
2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
3. Springs: Minimum horizontal stiffness equal to 50 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
4. Housings: Incorporate neoprene isolation pad meeting requirements for

neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.

D. Restrained Closed Spring Isolators:

1. Spring Isolators:
 - a. For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.
 - b. Code: color code springs for load carrying capacity.
2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
3. Springs: minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 maximum deflection.
4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators and neoprene side stabilizers with minimum 0.25 inch clearance and limit stops.

E. Spring Hanger:

1. Spring Isolators
 - a. For Exterior and Humid Areas: provide hot dipped galvanized housings and neoprene coated springs.
 - b. Code: color code springs for load carrying capacity.
2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators or rubber hanger with threaded insert.
4. Misalignment: Capable of 20 degree hanger rod misalignment.

F. Neoprene Pad Isolators:

1. Rubber or neoprene-waffle pads
 - a. 30 durometer
 - b. Minimum ½ inch thick
 - c. Maximum loading 40 psi
 - d. Height of ribs shall not exceed 0.7 times width.
2. Configuration: ½ inch thick waffle pads bonded each side ¼ inch thick steel plate.

G. Rubber Mount or Hanger: Molded rubber designed for 0.5 inch deflection with threaded insert.

H. Glass Fiber pads: Neoprene jacketed pre-compressed molded glass fiber.

I. Seismic Snubbers:

1. Type: Non-Directional and double acting unit consisting of interlocking steel members restrained by neoprene elements.
2. Neoprene Elements: Replaceable, minimum of 0.75 inch thick

3. Capacity: 4 times load assigned to mount groupings at 0.4 inch deflection.
4. Attachment Points and Fasteners: Capable of withstanding 3 times rated load capacity of seismic snubber.

2.3 DUCT SILENCERS

- A. Manufacturers: Industrial Acoustics or equal
- B. Description: Duct section with sheet metal outer casing, sound absorbing fill material, and inner casing of perforated sheet metal; incorporating interior baffles of similar construction. Fabricate in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible.
- C. Configuration: Tubular with inner casing and liner, with absorptive aerodynamically shaped center body with nose cone and truncated tail cone diameter as indicated, length 4 times diameter.
- D. Configuration: Rectangular with lined splitters with radius nose and contoured tails, modular height, width and length per design.
- E. Materials:
 1. Outer Casings: Minimum 20 gage thick galvanized steel stiffened as required, with welded seams 2 inches long, 11 gage slip joints on both ends.
 2. Inner Casing and Splitters: Minimum 24 gage thick perforated galvanized steel.
 3. Fill: Glass fiber or mineral wool of minimum 4 lb/cu feet density.
 4. Fill Liner: Bonded glass fiber matting.
- F. Rating:
 1. Provide ASTM E477 Insertion Loss (dB) and Maximum Generated Noise (dB) at 1000 fpm Face Velocity and Octave Band Center Frequencies (Hz) of 63, 125, 250, 500, 1000, 2000, 4000.
 2. Air Tight Static pressure: 10 inches w.g.

2.4 CROSS-TALK SILENCERS

- A. Manufacturers: Industrial Acoustics or equal
- B. Description: Duct sections with sheet metal outer casing, sound absorbing fill material and inner casing of perforated sheet metal; incorporating interior baffles of similar construction. Fabricate in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible.
- C. Configuration: Rectangular, lined with inner casing with splitters with radius nosed and contoured tails, height, width and length per design.

D. Materials:

1. Outer Casing: Minimum 22 gage thick galvanized steel with welded seams, 3 inches long, 11 gage slip joint on both ends.
2. Inner Casing and Splitters: Minimum 24 gage thick perforated galvanized steel.
3. Fill: Glass fiber or mineral wool of minimum 4 lb/cu feet density.
4. Fill Liner; bonded glass fiber matting.

2.5 ACOUSTIC HOUSINGS

A. Description: Modular panels, including access doors and windows, nominal 4 inches thick, with filled outer and inner casing. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible.

B. Materials:

1. Outer Casing: Minimum 18 gage thick galvanized steel stiffened as required, with welded seams for overlapping lip joining.
2. Inner Casing and Splitters: Minimum 22 gage thick perforated galvanized steel.
3. Fill: Glass fiber or mineral wool of minimum 4-3/4 lb/cu feet density.
4. Fill Liner: Bonded glass fiber matting
5. Window: Size per design. Double glazed with 1/4 inch safety glass

C. Rating: Provide ASTM E90 sound transmission loss minimum at Octave Band Center Frequencies (Hz) of 63, 125, 250, 500, 1000, 2000, 4000.

2.6 DUCTWORK LAGGING

A. Acoustic Insulation: 2 inch thick, 3 to 5 lb/cu ft density glass fiber or mineral wool insulation.

B. Covering: Gypsum board with surface weight minimum 4 lb/sq ft.

C. Acoustic Louvers: As specified in Section 10210.

D. Configuration: louvers with blades on 45 degree slope; sound absorbing fill material and inner surface of perforated sheet metal, heavy channel frame, bird screen.

E. Materials:

1. Louvers: 16 gage galvanized steel or 12 gage extruded aluminum, welded assemble, with factory prime coat, baked enamel, or color anodized finish.
2. Inner Surface: Minimum 24 gage thick perforated galvanized steel.
3. Fill: Glass fiber or mineral wool of minimum 4 lb/cu feet density.
4. Fill Liner: Bonded glass fiber matting or 1 mil (0.0254 mm) Mylar film.
5. Bird Screen: 1/2 inch square wire mesh.

F. Rating:

1. Provide sound transmission loss minimum at Octave Band Center Frequencies (Hz) of 63, 125, 250, 500, 1000, 2000, 4000.

PART 3 –EXECUTION

3.1 EXAMINATION

- A. Section 01330 – Administrative Requirements: Coordination and Project Conditions
- B. Verify that all equipment, ductwork and piping that are installed before work in this section begins are as shown on the Contract drawings.

3.2 EXISTING WORK

- A. Ensure access to existing piping and ductwork and other installations which remain active and which require access. Modify installation or provide access panel as appropriate.
- B. Extend existing piping and ductwork installations using materials and methods compatible with existing electrical materials and methods, or as specified.

3.3 INSTALLATION

- A. Support duct silencers independent of ductwork with flexible duct connections, lagged with leaded vinyl sheet on inlet and outlet.
- B. Install cross-talk silencers in wall. Calk wall penetrations; refer to Section 07900.
- C. Lag ductwork, where indicated by wrapping with insulation and covering. Apply covering to be airtight. Do not attach covering rigidly to ductwork.
- D. Attach ductwork to acoustic louvers with flexible duct connections.
- E. Install isolation for motor driven equipment.
 1. Bases:
 - a. Set steel bases for 1-inch clearance between housekeeping pad and base.
 - b. Set concrete inertia bases for 2-inch clearance between housekeeping pad and base.
 - c. adjust equipment level.
- F. Install spring hangers without binding.
- G. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

- H. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- I. Provide pairs of horizontal limit springs on fans with more than 6.0 inch static pressure, and on hanger supported, horizontally mounted axial fans.
- J. Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Each inertia base shall have minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 0.05-inch maximum clearance. Other snubbers shall have clearance between 0.15 inch and 0.25 inch.
- K. Support piping connections to isolated equipment resiliently as follows:
 - 1. Up to 4 inch diameter: First three points of support
 - 2. 5 to 8 inch diameter: First four points of support
 - 3. 10 inch diameter and over: First six points of support
 - 4. Select 3 hangers closest to vibration source for minimum 1.0-inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or ½ static deflection of isolated equipment.
- L. Connect wiring to isolated equipment with flexible hanging loop.

3.4 FIELD QUALITY CONTROL

- A. Section 01450 – Quality Requirements: Testing and Inspection; Section 01770 – Quality Requirements: Testing, Adjusting, and Balancing.
- B. Inspect isolated equipment after installation and submit reports. Include static deflections.
- C. After start-up, final corrections and balancing of systems take octave band sound measurements over full audio frequency range in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and other critical locations, as directed. Provide one-third octave band measurements of artificial sound sources in areas indicated as having critical requirements. Submit complete report of test results including sound curves.

3.5 MANUFACTURER’S FIELD SERVICES

- A. Section 01450- Quality Requirements: Manufacturers’ field services

- B. Provide services of testing agency to take noise measurement. Use meters meeting requirements of ASA 47 (ANSI S1.4).

END OF SECTION