



SECTION 22 05 48 - VIBRATION & SEISMIC CONTROLS FOR PLUMBING PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Inertia bases.
 - 2. Vibration isolators.
 - 3. Flexible Connectors.
 - 4. Seismic Restraint Devices.

1.2 REFERENCES

- A. Comply with appropriate standards.
 - 1. ANSI S1.8 - Reference Quantities for Acoustical Levels.
 - 2. ANSI S12.36 - Survey Methods for the Determination of Sound Power Levels of Noise Sources.
 - 3. ISAT

1.3 PERFORMANCE REQUIREMENTS

- A. Provide vibration isolation on motor driven equipment over 0.5 hp, plus connected piping.
- B. Provide minimum static deflection of isolators for equipment as recommended by manufacturer.
- C. Consider upper floor locations critical unless otherwise indicated.
- D. Use concrete inertia bases for motors in excess of 40 hp and on base mounted pumps over 10 hp.
- E. Maintain room maximum sound levels, in Noise Criteria (NC) as defined by ANSI S1.8.

1.4 SUBMITTALS

- A. Submit data on all materials.
- B. Shop Drawings: Indicate equipment bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, material, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.



Guide Specification
Los Angeles World Airports

- C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating, materials and dimensional data.
- D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.
- E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions.
- F. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of hangers including attachment points.

1.6 WARRANTY

- A. Provide one year minimum.

PART 2 - PRODUCTS

2.1 INERTIA BASES

- A. Manufacturers:
 - 1. **Mason Industries, Inc.**
 - 2. **Amber/Booth Company / a VMC Group Company.**
 - 3. **Vibrex / M.W. Sausse & Company, Inc.**
- B. Structural Bases:
 - 1. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.
 - 2. Construction: Welded structural steel with gusset brackets, supporting equipment and motor with motor slide rails.
- C. 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, reinforced as required.
 - 3. Connecting Point: Reinforced to connect isolators and snubbers to base.
 - 4. Concrete: Reinforced 2,500 psi concrete minimum.
 - 5. Minimum thickness shall be:



Motor Size (hp)	Minimum Thickness (in)
5-15	6
20-50	8
60-75	10
100-250	12
300-500	18

2.2 VIBRATION ISOLATORS

A. Manufacturers:

1. **Mason Industries, Inc.**
2. **Amber/Booth Company / a VMC Group Company**
3. **Vibrex / M.W. Sausse & Company, Inc.**

B. Vibration Isolator Types:

1. **Type A:** Spring isolators shall incorporate the following:
 - a. Minimum diameter of 0.8 of the loaded operating height.
 - b. Corrosion resistance where exposed to corrosive environment with:
 - 1) Springs cadmium plated or electro-galvanized.
 - 2) Hardware cadmium plated.
 - 3) All other metal parts hot-dip galvanized.
 - c. Reserve deflection (from loaded to solid height) of 50 percent of rated deflection.
 - d. Minimum 1/4 inch thick neoprene acoustical base pad on underside, unless designated otherwise.
 - e. Designed and installed so that ends of springs remain parallel and all springs installed with adjustment bolts.
 - f. Non-resonant with equipment forcing frequencies or support structure natural frequencies.
 - g. Spring isolators to be Mason Type SLF, or as approved.
 - h. This isolator must be accompanied by seismic isolator Type II.
2. **Type B:** Spring isolators shall be same as Type A, except:
 - a. Provide built-in vertical limit stops with minimum 1/4 inch clearance under normal operation.
 - b. Tapped holes in top plate for bolting to equipment when subject to wind load.
 - c. Capable of supporting equipment at a fixed elevation during equipment erection. Installed and operating heights shall be identical.
 - d. Adjustable and removable spring pack with separate neoprene pad isolation.
 - e. Housing shall be designed to accept 1.0g of acceleration.



- f. Mason Type SLR.
- 3. **Type C:** Spring hanger rod isolators shall incorporate the following:
 - a. Spring element seated on a steel washer within a neoprene cup incorporating a rod isolation bushing.
 - b. Steel retainer box encasing the spring and neoprene cup.
 - c. Requires seismic restraint Type III.
 - d. Mason Type HS.
- 4. **Type F:** Combination spring/elastomer hanger rod isolators to incorporate the following:
 - a. Spring and neoprene isolator elements in a steel box retainer. Neoprene of double deflection type. Single deflection is unacceptable. Spring seated in a neoprene cup with extended rod bushing.
 - b. Characteristics of spring and neoprene as describe in Type A and Type E isolators.
 - c. Requires seismic restraint Type III.
 - d. Mason Type 30N.
- 5. **Type J:** Rail type spring isolators:
 - a. Rail type spring isolators shall provide steel members of sufficient strength to prevent flexure with equipment operation.
 - b. Springs shall be the same as Type A with seismic restraint Type II or seismic restraint Type I or IV isolation.
 - c. Mason Type ICS.
- 6. **Type K:** Pipe anchors:
 - a. Vibration isolator manufacturer shall provide an all directional acoustical pipe anchor, consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum half inch thickness of heavy duty neoprene and duck or neoprene isolation material.
 - b. Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction.
 - c. Allowable loads on the isolation material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction.
 - d. Mason Type ADA.

2.3 FLEXIBLE CONNECTORS

- A. Elastomer Type FC-1:
 - 1. Manufactured of nylon tire cord and EPDM both molded and cured with hydraulic presses.



2. Straight connectors shall have two spheres reinforced with a molded-in external ductile iron ring between spheres.
 3. Elbow shall be long radius reducing type.
 4. Rated 250 psi at 170 degrees F dropping in a straight line to 170 psi at 250 degrees F for sizes 1-1/2 inch to 12 inch elbows. Elbows shall be rated no less than 90 percent of straight connections.
 5. Sizes 10 inches to 12 inches to employ control cables with neoprene end fittings isolated from anchor plates by means of 1/2 inch bridge bearing neoprene bushings.
 6. Minimum safety factor, 4 to 1 at maximum pressure ratings.
 7. Submittals shall include test reports.
 8. Mason Type MFTNC Superflex.
- B. Flexible Stainless Hose, Type FC-2:
1. Braided flexible metal hose.
 2. 2 inch pipe size and smaller with male nipple fittings.
 3. 2-1/2 inch and larger pipe size with fixed steel flanges.
 4. Suitable for operating pressure with 4 to 1 minimum safety factor.
 5. Length as required.
 6. Mason Type BSS.

2.4 VIBRATION ISOLATION EQUIPMENT BASES

- A. Manufacturers:
1. **Amber/Booth Company / a VMC Group Company**
 2. **Mason Industries, Inc.**
 3. **Vibrex / M.W. Sausse & Company, Inc.**
- B. Type B1: Integral Structural Steel Base
1. Reinforced, as required, to prevent base flexure at start up and misalignment of drive and driven units. Centrifugal fan bases complete with motor slide rails. Drilled for drive and driven unit mounting template.
 2. Mason Type M, WF.
- C. Type B2: Concrete Inertia Base
1. Concrete inertia bases shall be formed in a structural steel perimeter base, reinforced as required to prevent flexure, misalignment of drive and driven unit or stress transferal into equipment. The base shall be complete with motor slide rails, pump base elbow supports, and complete with height saving brackets, reinforcing, equipment bolting provisions and isolators.
 2. Minimum thickness of the inertia base shall be according to the following tabulation:



Motor Size (hp)	Minimum Thickness(in)
5-15	6
20-50	8
60-75	10
100-250	12
300-500	18

3. Mason Type K, BMK.

2.5 SEISMIC RESTRAINT DEVICES

- A. Type I: Spring Incorporating Seismic Restraint
 1. Shall comply with general characteristics of spring isolators.
 2. Shall have vertical restraints and are capable of supporting equipment at fixed elevation during equipment erection. Vertical restraint shall be separate from equipment load support.
 3. Shall incorporate seismic snubbing restraint in all directions at specified acceleration loadings.
 4. Mason Type SSLR.
- B. Type II: Stationary Seismic Restraint
 1. Each corner or side seismic restraint shall incorporate minimum 5/8" thick pad limit stops. Restraints shall be made of plate, structural members or square metal tubing in a welded assembly, incorporating resilient pads. Angle bumpers are not acceptable. System to be field bolted to deck with minimum 1.0 g acceleration capacity.
 2. Seismic spring mountings as described above are an acceptable alternative providing all seismic loading requirements are met.
 3. Mason Industries Type Z 1011, Type Z 1225.
- C. Type III: Cable Seismic Restraint,
 1. Metal cable type with approved end fastening devices to equipment and structure. System to be field bolted to deck or overhead structural members or deck with aircraft cable and clamps as per ISAT guidelines.
- D. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.
 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- E. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to



- building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- F. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
 - G. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
 - H. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
 - I. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
 - J. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
 - K. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ICC-ES per ACI 318 appendix D which are qualified for seismic zones. Minimum length of eight times diameter.
 - L. Adhesive Anchor Bolts: Adhesive anchor bolts are not permitted where seismic restraint is required. Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ICC-ES per ACI 318 appendix D which are qualified for seismic zones.

2.6 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.



PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install isolation for motor driven equipment.
- B. Bases:
 - 1. Set steel bases for 1 inch clearance between housekeeping pad and base.
 - 2. Set concrete inertia bases for 2 inch clearance between housekeeping pad and base.
- C. Adjust equipment level.
- D. Install spring hangers without binding.
- E. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- F. 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.
- G. Provide pairs of horizontal limit springs on fans with more than 6.0 inch static pressure, and on hanger supported, horizontally mounted axial fans.
- H. Provide resiliently mounted equipment and piping with seismic snubbers. Provide each inertia base with minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 0.05 inch maximum clearance. Provide other snubbers with clearance between 0.15 inch and 0.25 inch.
- I. 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 three 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 1/2 static deflection of isolated equipment.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners to receive them and where required to prevent buckling of hanger rods due to seismic forces.



- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches.
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.
4. All equipment whether isolated or not, shall be bolted to structure to allow for minimum 0.5g of acceleration. Bolt points and diameter of inserts shall be submitted and verified as part of the contractor's submission for each piece of equipment and certified by a licensed civil or structural engineer.
5. All structurally suspended overhead equipment isolated or non-isolated shall be four point independently braced within Type III seismic restraining system.
6. Where base anchoring is insufficient to resist seismic forces, supplementary restraining such as seismic restraint system Type III shall be used above systems center of gravity to suitably resist "g" force levels. Vertically mounted tanks may require this additional restraint.
7. All anchor bolts and tie-ins to structure shall be designed per the Airport Structural Design Standards.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet at turns of more than 4 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.
4. Install Seismic Restraining System Type III: Taut for overhead suspended non-isolated equipment, piping and slack with 1/2 inch cable deflection for isolated systems.
5. Seismically restrain all piping with Type III restraining system in accordance with guideline as outlined below.
6. Seismic restraints are not required for the following (this does not apply to any life safety or high hazard equipment):
 - a. Gas piping less than 1 inch I.D.
 - b. Piping in Boiler and Mechanical Equipment rooms less than 1-1/4 inch I.D.
 - c. All other piping less than 2-1/2 I.D.



- d. All piping suspended by individual hangers 12 inches in length or less from the top of the pipe to the bottom of the support for the hanger.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for component.
- E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- F. 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.
- G. 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.
- H. Drilled-in Anchors:
 - 1. 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.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. 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.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 SEISMIC RESTRAINTS FOR NON-ISOLATED EQUIPMENT

- A. All ceiling suspended piping not excluded by diameter or distance required from support: Seismic Restraint Type III.
- B. All ceiling mounted equipment: Seismic Restraint Type III.
- C. All floor mounted equipment, including but not limited to tanks, domestic water heaters, etc.: Seismic Restraint Type V.



3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements for piping flexible connections.

3.6 FIELD QUALITY CONTROL

- A. Inspect isolated equipment after installation and submit report. Include static deflections.
- B. After start-up, final corrections and balancing of systems take octave band sound measurements over full audio frequency range in areas adjacent to plumbing equipment rooms, duct and pipe shafts, and other critical locations. 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.
- C. Furnish services of testing agency to take noise measurement. Use meters meeting requirements of ANSI S1.4.

3.7 PLUMBING VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

- A. Supported or Suspended Equipment:
 - 1. Pads:
 - a. Material: Neoprene.
 - b. Thickness: ½ inch.

Type of Equipment	Below Grade		Above Grade	
	Isolation Type	Deflection	Isolation Type	Deflection
Heat Exchangers	D	0.4 inch	B and Base Type B-1	1 inch
Pumps up to 15 HP	D-J	0.4 inch	B or SR Type I and Base Type J	1 inch
All Piping	Type I and SR Type III	1 inch	Type I and SR Type III	2 inches
Piping Flexible Connectors for Pumps	FC-1	--	FC-1	--

END OF SECTION 22 05 48