

## PART 1 – GENERAL

### 1.1 RELATED DOCUMENTS

- A. Drawings and Divisions 00 and 01, apply to this Section.

### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. This Section includes vibration isolators, vibration isolation bases, vibration isolation roof curbs.
  - 2. This Section includes seismic restraint requirements for suspended pipes, ducts, and mechanical equipment with and without vibration isolation.

### 1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.
- D. SEI/ASCE 7: American Society of Civil Engineers; Minimum Design Loads for Buildings and Other Structures.

### 1.4 CODES AND STANDARDS

- A. Codes and Standards shall be the current version adopted by the Authority Having Jurisdiction.

### 1.5 PERFORMANCE REQUIREMENTS

- A. Design seismic and vibration isolation systems, including drawings, calculations, and material specifications prepared according to current IBC and SEI/ASCE 7 (2005) for obtaining approval from authorities having jurisdiction. Seismic and vibration systems shall be selected for the approved Project equipment, piping and ductwork components.
- B. Wind-Restraint Loading:
  - 1. Basic Wind Speed: <Insert value>.
  - 2. Minimum 10 lb/sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.
- C. Seismic-Restraint Loading:
  - 1. Site Class as Defined in the IBC: [A] [B] [C] [D] [E] [F].
  - 2. Assigned Seismic Use Group as Defined in the IBC: [I] [II] [III].
    - a. For Seismic Use Group I and II use the following:

- 1) Component Importance Factor: 1.5 for all life safety systems and equipments required to function after an earthquake and all mechanical equipment that would impede egress from building. All systems and equipment that contain hazardous content. All other systems, equipment, piping and ductwork shall be  $I_p=1.0$ .
  - b. For Seismic Use Group III: use the following:
    - 1) Component Importance Factor: 1.5 for all life safety systems and equipments required to function after an earthquake and all systems, and equipment, needed for continued operation of the facility or whose failure could impair the continued operation of the facility.
  3. Component Response Modification Factor ( $R_p$ ) and Component Amplification Factor ( $A_p$ ): From SEI/ASCE 7 (2005), Table 13.6-1, Seismic Coefficients for Mechanical and Electrical Components.
  4. Seismic Design Category: [A] [B] [D] [E] [F].
- D. Reports and Certificates: Equipment manufacturers, provide submittals of the following:
1. Mechanical Seismic Qualification Certificates: For all required equipment specified in Divisions 23, accessories, and components from manufacturer.
    - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      - 1) For Seismic User Group I and II: The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
      - 2) For Seismic User Group III: The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
    - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
    - c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
  2. Field quality-control reports

## 1.6 SUBMITTALS

- A. General: See Section 23 05 00 for general requirements of Product Data, Shop Drawings, Reports and Certificates, and Operation and Maintenance data submittals.
1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
  2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
    - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by OSHPD.

- b. Annotate to indicate application of each product submitted and compliance with requirements.
  3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Product Data: Provide submittals of the following:
  1. Vibration isolators.
  2. Anchor Bolts, Washers, and Bushings
  3. Restrained Vibration Isolation Roof Curb Rails.
  4. Seismic Restraint Devices
  5. Vibration Isolation Equipment Bases.
- C. Shop Drawings: In addition to requirements set forth in Section 23 05 00, shop drawings for the listed systems shall also include detailing of riser supports, vibration isolation base details, seismic-restraint systems, and suspended elements. Provide submittals of the following piping systems within the entire building:
  1. For Vibration Isolated Elements:
    - a. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
    - b. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
    - c. Seismic-Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate layout, quantity, diameter, anchor depth of embedment and, if mounted on housekeeping pads, indicate anchor minimum edge distance requirements.
    - d. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
  2. For Suspended Elements: Prior to installation, submit seismic restraint manufacturer's layout of all required bracing locations on contractor shop drawings. Layout to be signed and sealed by a qualified professional engineer. Layout to include manufacturer's bracing legend indicating:
    - a. Type of braced element.
    - b. Seismic restraint hardware call-out.
    - c. Minimum required vertical support rod diameter.
    - d. Maximum allowable brace spacing.
    - e. Brace reaction at full design load.
    - f. Minimum required seismic restraint anchorage.
    - g. Installation detail drawing number.
    - h. Anchorage installation detail drawing number.
- D. Design Calculations: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic [and wind] forces required to select vibration isolators, seismic [and wind] restraints, and for designing vibration isolation bases.
  - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
  - b. To support selection and arrangement of seismic [and wind] restraints. Include calculations of combined tensile and shear loads.
  - c. Pre-approval and Evaluation Documentation: By OSHPD, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

#### 1.7 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located 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. This professional engineer shall develop a Quality Assurance Plan.
- B. Testing Agency Qualifications (Owner will engage): An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- C. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- D. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- E. Any device that provides seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, showing maximum seismic-restraint ratings. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

#### 1.8 FIELD QUALITY CONTROL

- A. Provide a Quality Assurance Plan that complies with SEI/ASCE 7, Appendix 11A for the following mechanical systems or equipment.
  1. Flammable, combustible, or highly toxic piping systems and their associated mechanical units in Seismic Design Categories C, D, E, or F.
  2. Installation of HVAC ductwork that will contain hazardous materials in Seismic Design Categories C, D, E, or F.
  3. Installation of vibration isolation systems where the maximum clearance (air gap) between the equipment support frame and restraint is less than or equal to 1/4-inch.
  4. Installation of seismic restraint systems for Seismic Use Group II and III.

- B. The Contractor shall submit a written Contractor's statement of responsibility to the regulatory authority having jurisdiction and the Owner prior to the commencement of work. The Contractor's statement of responsibility shall contain the following:
1. Acknowledgement of awareness of the special requirements contained in the Quality Assurance Plan.
  2. Acknowledgement that control will be exercised to obtain conformance with the design documents approved by the authority having jurisdiction.
  3. Procedure for exercising control within the Contractor's organization, the method and frequency of reporting, and the distribution of the reports.
  4. Identification and qualifications of the person exercising such control and their position in the organization.
- C. The Owner shall employ a special inspector to observe the construction of all seismic systems in accordance with the Quality Assurance Plan.

## PART 2 – PRODUCTS

### 2.1 VIBRATION ISOLATORS

- A. Vibration Isolation: Subject to compliance with requirements, provide products by the manufacturers specified.
1. Amber/Booth Company, Inc.
  2. Kinetics Noise Control, Inc.
  3. Korfund/Vibration Mountings and Controls, Inc.
  4. Mason Industries, Inc.
  5. Or Approved Equal
- B. Type V-1, Elastomeric Isolator Pads: Oil- and water-resistant neoprene or natural rubber, molded with a nonslip, ribbed or waffle-pattern steel load distribution plates of sufficient stiffness for uniform loading over pad area, factory cut to sizes that match requirements of supported equipment.
1. Basis of Design: Mason.
  2. Material: Standard neoprene.
  3. Durometer Rating: 40.
  4. Thickness: 5/16 inch thick.
  5. Isolator shall be loaded to limit surface pressure to a maximum of 50 psi.
- C. Type V-2, Elastomeric Isolator Pads: Oil- and water-resistant neoprene or natural rubber molded with a nonslip, ribbed or waffle-pattern steel load distribution plates of sufficient stiffness for uniform loading over pad area factory cut to sizes that match requirements of supported equipment.
1. Basis of Design: Mason.
  2. Material: Standard neoprene.
  3. Durometer Rating: 50.
  4. Thickness: 3/4-inch thick.
  5. Isolator shall be loaded to limit surface pressure to a maximum of 50 psi.
- D. Type V-3, Elastomeric Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to

equipment and baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Basis of Design: Mason.
  2. Durometer Rating: 40 to 50, unless a higher or lower rating is necessary to meet the load and deflection requirements.
- E. Type V-4, Restrained Elastomeric Mounts: All-directional elastomeric mountings with seismic restraint. Color-code to identify capacity range.
1. Basis of Design: Mason.
  2. Materials: Steel housing containing two separate and opposing, molded, bridge-bearing neoprene elements that prevent central threaded sleeve and attachment bolt from contacting the casting during normal operation.
  3. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO, M251.
  4. Durometer Rating: 30 to 60, as required to meet load requirements.
- F. Type V-5, Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Basis of Design: Mason.
  2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, neoprene isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psi. Provide resilient isolation washers and bushings at baseplate anchor bolts.
  7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- G. Type V-6, Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
1. Basis of Design: Mason.
  2. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  5. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
  6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- H. Type V-7, Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
1. Basis of Design: Mason.
  2. Housing: Steel housing to provide all-directional seismic restraint.

3. Base: Factory drilled for bolting to structure with 1/4-inch thick neoprene pad attached to baseplate.
  4. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel before contacting a resilient collar. Snubbing in all modes with adjustment to limit upward, downward, and horizontal travel to a maximum rating of 1.0g.
  5. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  6. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  7. Isolator to be equipped with leveling bolts that must be rigidly bolted to the equipment with height-saving brackets.
  8. Isolator to be installed with neoprene washers and bushings at baseplate anchor bolts.
- I. Type V-8, Elastomeric Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with steel housings for hanger rods. Molded element shall include a neoprene bushing to prevent rod from contacting the hanger box. Color-code or otherwise identify to indicate capacity range.
1. Basis of Design: Mason.
  2. Durometer Rating: 40 to 50, unless a higher or lower rating is necessary to meet the load and deflection requirements.
- J. Type V-9, Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Basis of Design: Mason.
  2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Elastomeric Elements: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
  7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- K. Type V-10, Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop and deflection scale.
1. Basis of Design: Mason.
  2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Elastomeric Elements: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

7. Adjustable Vertical Stop: Steel washer encapsulated in a molded neoprene rebound washer on lower threaded rod.
  8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- L. Type TR-1, Thrust Restraint: Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop. Include rod and angle-iron brackets for attaching to equipment.
1. Basis of Design: Mason.
  2. Frame: Steel, fabricated for connection to threaded rods.
  3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.
- M. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick, 60 durometer neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psi and for equal resistance in all directions.
1. Basis of Design: Mason.
- N. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes separated by a minimum of 1/2-inch- thick, 60-durometer neoprene. Factory set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.
1. Basis of Design: Mason.

## 2.2 ANCHOR BOLTS, WASHERS, AND BUSHINGS

- A. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer rating of 50 with a flat washer face.
1. Basis of Design: Mason.
  2. 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.
  3. 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.
- B. 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 ASTM E 488. Minimum length of eight times diameter.



1. Basis of Design: Hilti Kwik Bolt TZ Mechanical Anchor for seismic restraints.
2. Basis of Design: Hilti Undercut HDA anchors for direct attachment to equipment 10 hp and greater.

### 2.3 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

- A. Type RC-1, Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand 125-mph wind impinging laterally against side of equipment. Design restraints to meet seismic requirements of Authorities Having Jurisdiction.
  1. Basis of Design: Mason.
- B. Lower Support Assembly: Sheet-metal "Z" section containing adjustable and removable steel springs that support upper floating frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist wind and seismic forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.
- C. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch- thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
  1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
    - a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
    - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
    - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
    - d. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  2. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
    - a. Material: Standard neoprene.
    - b. Durometer Rating: 50.
    - c. Number of Layers: 1 minimum.
- D. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
- E. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

### 2.4 SEISMIC-RESTRAINT DEVICES

- A. Seismic Restraint for Suspended Elements: Subject to compliance with requirements, provide products by the manufacturers specified.
  - 1. International Seismic Application Technology (ISAT).
  - 2. Kinetics Noise Control, Inc.
  - 3. Korfund/Vibration Mountings and Controls, Inc.
  - 4. Mason Industries, Inc.
  - 5. Tolco.
  - 6. Or Approved Equal.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in OSHPD pre-approval.
  - 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.
- C. Type S-1, Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
  - 1. Basis of Design: Mason.
  - 2. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and female-wedge or stud-wedge type.
  - 3. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer rating of 50.
- D. Type S-2, Suspended Elements:
  - 1. Design Requirements: Seismic restraint hardware to be furnished in manufacturer's pre-assembled "kits" labeled for installer cross reference with manufacturer's layout performed on contractor shop drawings. Kits to be labeled as to "kit number," "trade" and "floor." Kits to include:
    - a. All required seismic bracketry correctly sized for attachment to vertical support rods.
    - b. Rod stiffeners as required based on rod diameter and length.
    - c. Correct anchorage hardware for connection to concrete deck, structural steel, or wood structural members.
    - d. Complete installation instructions.
  - 2. Rigid seismic restraint brace arm assemblies: Designed for strut nut attachment to minimum 12 gage steel channel with pregalvanized zinc finish per ASTM A525, solid, punched or short slot per engineering calculations.
    - a. Basis of Design: Pre-engineered brackets with OSHPD pre-approval. Hinged seismic brackets.
    - b. Assembly: Brackets to be provided from manufacturer with integral 1/2" hex bolts and strut nuts.
  - 3. Cable seismic restraint brace arm assemblies: Minimum 7 x 19 pre-stretched galvanized steel aircraft cable appropriately sized for the system load.
    - a. Basis of Design: Pre-engineered brackets with OSHPD pre-approval.

- b. Design Requirements: Hinged seismic brackets.
  - c. Assembly: Brackets factory pre-tied to made-to-length aircraft cable, with integral method for length adjustment by installer.
4. Cast-In Place Deck Inserts: For vertical supports and seismic restraint anchorage.
- a. Basis of Design: Pre-engineered inserts with OSHPD pre-approval.
  - b. Design Requirements: For form pour slabs, for metal decks with concrete, internally threaded to accept threaded rod diameters, with an OSHPD approval or other enforcement agency approval. Coordinate installation locations with manufacturer's lay out of seismic restraint locations on contractor's shop drawings.

## 2.5 VIBRATION ISOLATION EQUIPMENT BASES

- A. Type B-1, Steel Base: Factory-fabricated, welded, structural-steel bases with pre-drilled anchor bolt holes.
- 1. Basis of Design: Mason.
  - 2. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Bases shall be sized to accommodate supports for suction and discharge elbows.
  - 3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
  - 4. Height Saving Brackets: Factory-welded steel L brackets on frame for outrigger isolation mountings.
  - 5. Frame to be manufactured of beams or channels of minimum section depth equal to 10-percent of the longest span between support isolators, as indicated on the drawings.
  - 6. Frame to provide a rigid, distortion free mounting base for supported equipment, which allows no excessive differential motion between driving or driven equipment components.
  - 7. Isolation materials manufacturer to coordinate the isolator locations for each piece of equipment as required.
- B. Type B-2, Inertia Base: Factory-fabricated, bolted steel bases ready for field-applied, cast-in-place concrete.
- 1. Basis of Design: Mason.
  - 2. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor rails. Include supports for suction and discharge elbows for pumps.
  - 3. Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
  - 4. Height Saving Brackets: Factory-welded steel corners bolted to frame for isolation mountings.
  - 5. Frame to be manufactured with a minimum section depth equal to 8-percent of the longest span between support isolators, as indicated on the drawings.
  - 6. Steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete.
  - 7. Base to be equipped with equipment anchor bolts fixed into position and housed in a steel bolt sleeve, allowing minor bolt location adjustment.

8. Base to include reinforced concrete with 1/2-inch reinforcing bars at a maximum of 8 inches on center.
9. Weight of base to be not less than twice that of all the equipment it supports.

## 2.6 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
  1. Epoxy Powder coating or electro-galvanized isolation on springs and housings. Zinc plate all bolts, nuts and washers.

## PART 3 – EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic [- and wind]-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by OSHPD.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: 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. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
  1. Install seismic snubbers on HVAC 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 inch.
  3. Install seismic-restraint devices using methods approved by OSHPD.
- C. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral braces a maximum of 40 feet o.c., and longitudinal braces a maximum of 80 feet o.c.
3. Brace a change of direction longer than 2 feet.

D. Ductwork Restraints:

1. Comply with requirements of SMACNA "Seismic Restraint Manual Guidelines for Mechanical Systems."
2. Use Seismic Hazard Level A.

E. Attachments to Structure:

1. Install cables so they do not bend across edges of adjacent equipment or building structure.
2. Install seismic-restraint devices using anchor bolts that meet building code requirements for testing and approval.
3. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and oversize mounting hole.
4. 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.
5. If specific attachment to structure is not indicated, anchor bracing to structure at flanges of beams at upper chords of bar joists, or at concrete members. Obtain approval of the structural engineer prior to installation.

F. 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 pre-stressed 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.

### 3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install V or U Type flexible loops 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 as indicated on the drawings. Comply with requirements in Division 23 Section "Hydronic Piping" for piping flexible connections.

### 3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.

- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

### 3.6 HVAC VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

EQUIPMENT DESCRIPTION	MARK	VIBRATION ISOLATOR TYPE	MINIMUM DEFLECTION (INCHES)	BASE/ CURB TYPE	SEISMIC RESTRAINT DEVICE TYPE	NOTES
<b>HYDRONIC PUMPS</b>						
HYDRONIC PUMPS	P-X	N/A	N/A	N/A	N/A	
HYDRONIC PUMPS						
HYDRONIC PUMPS	P-X	V-2	0.11	N/A	N/A	
HYDRONIC PUMPS	P-X	V-2	0.11	N/A	N/A	
HYDRONIC PUMPS	P-X	V-9	1.5	N/A	S-2	
HYDRONIC PUMPS	P-X	V-5	0.75	B-2	S-1	
HYDRONIC PUMPS	P-X	V-5	1.5	B-2	S-1	
<b>AIR EQUIPMENT</b>						
AIR EQUIPMENT		V-2	0.22	N/A	N/A	
AIR EQUIPMENT		V-5	0.75	B-2	S-1	
AIR EQUIPMENT		V-5	1.5	B-2	S-1	
AIR EQUIPMENT		V-5	0.75	B-2	S-1	
AIR EQUIPMENT		V-5	1.5	B-2	S-1	
AIR EQUIPMENT		V-2	0.11	N/A	N/A	
<b>BOILERS</b>						
BOILERS	B-X	V-2	0.25	N/A	N/A	
BOILERS	B-X	V-5	1.5	B-1	S-1	
<b>CENTRIFUGAL AND SCREW WATER CHILLERS</b>						
CENTRIFUGAL AND SCREW WATER CHILLERS	CH-X	V-2	0.25	N/A	N/A	
CENTRIFUGAL AND SCREW WATER CHILLERS	CH-X	V-6	1.5	N/A	N/A	
<b>RECIPROCATING WATER CHILLERS</b>						
RECIPROCATING WATER CHILLERS	CH-X	V-4	0.25	N/A	N/A	

EQUIPMENT DESCRIPTION	MARK	VIBRATION ISOLATOR TYPE	MINIMUM DEFLECTION (INCHES)	BASE/ CURB TYPE	SEISMIC RESTRAINT DEVICE TYPE	NOTES
RECIPROCATING WATER CHILLERS	CH-X	V-6	1.5	N/A	N/A	
<b>PACKAGED COOLING TOWERS</b>						
PACKAGED COOLING TOWERS	CT-X	V-2	0.11	N/A	N/A	
PACKAGED COOLING TOWERS	CT-X	V-6	2.5	B-1	N/A	
<b>FLUID COOLERS AND EVAPORATIVE CONDENSERS</b>						
<b>CONDENSING UNITS</b>						
CONDENSING UNITS	CV-X	V-1	0.035	N/A	N/A	
CONDENSING UNITS	CV-X	V-2	0.11	N/A	N/A	
<b>AIR-COOLED CONDENSERS</b>						
AIR-COOLED CONDENSERS		V-1	0.035	N/A	N/A	
AIR-COOLED CONDENSERS		V-2	0.11	N/A	N/A	
<b>ROOFTOP UNITS</b>						
ROOFTOP UNITS	RTU-X	RC-1	1.5	RC-1	N/A	
<b>AIR-CONDITIONING UNITS</b>						
AIR-CONDITIONING UNITS	ACU-X	V-2	0.11	N/A	N/A	
AIR-CONDITIONING UNITS	ACU-X	V-7	1.0	N/A	N/A	
AIR-CONDITIONING UNITS	ACU-X	V-9	1.0	N/A	S-2	
<b>FAN-COIL UNITS</b>	FCU-X	V-9	1.0	N/A	S-2	
<b>UNIT HEATERS AND CABINET HEATERS</b>						
UNIT HEATERS AND CABINET HEATERS		V-9	0.75	N/A	S-2	

EQUIPMENT DESCRIPTION	MARK	VIBRATION ISOLATOR TYPE	MINIMUM DEFLECTION (INCHES)	BASE/ CURB TYPE	SEISMIC RESTRAINT DEVICE TYPE	NOTES
<b>AIR TERMINALS</b>						
AIR TERMINALS		V-8	0.4	N/A	S-2	
AIR TERMINALS		V-9	0.75	N/A	S-2	
AIR TERMINALS		N/A	N/A	N/A	N/A	
<b>FANS</b>						
ROOFTOP EXHAUST FAN		V-2	0.11	N/A	N/A	
FANS						
FANS		V-2	0.25	N/A	N/A	
FANS		V-7	0.75	N/A	N/A	
FANS		V-9	0.75	N/A	S-2	
FANS						
FANS		V-7	0.75	B-1	N/A	
FANS		V-7	2.5	B-1	N/A	
FANS		V-9	2.5	B-1	S-2	
FANS						
FANS		V-5	1.5	B-2	S-1	
FANS		V-5	2.5	B-2	S-1	
FANS						
FANS		V-4	0.25	B-1	N/A	
FANS		V-7	0.75	B-1	N/A	
FANS		V-9	0.75	B-1	S-2	
FANS						
FANS		V-7	1.5	B-1	N/A	
FANS		V-7	2.5	B-1	N/A	
FANS		V-9	2.5	B-1	S-2	
FANS						
FANS		V-5	1.5	B-2	S-1	
FANS		V-5	2.5	B-2	S-1	
<b>AIR HANDLING UNITS</b>						
AIR HANDLING UNITS		V-7	0.75	N/A	N/A	
AIR HANDLING UNITS		V-7	0.75	N/A	N/A	
AIR HANDLING UNITS						
AIR HANDLING UNITS		V-7	0.75	N/A	N/A	3
AIR HANDLING UNITS		V-7	2.5	N/A	N/A	3



EQUIPMENT DESCRIPTION	MARK	VIBRATION ISOLATOR TYPE	MINIMUM DEFLECTION (INCHES)	BASE/ CURB TYPE	SEISMIC RESTRAINT DEVICE TYPE	NOTES
AIR HANDLING UNITS						
AIR HANDLING UNITS		V-7	0.75	B-1	N/A	3
AIR HANDLING UNITS		V-5	2.5	B-2	S-1	3
<b>ROOFTOP PENTHOUSE UNITS</b>						
PIPING ATTACHED TO VIBRATING EQUIPMENT	N/A	V-9	1.0	N/A	N/A	4

A. Vibration Isolator and Seismic Restraint Schedule Notes:

1. Seismic restraints are required for all systems and equipment. Seismic restraints for equipment without scheduled seismic snubbers shall be provided by the anchor bolts, vibration isolators, or devices as specified for suspended elements.
2. Provide vibration isolators and seismic restraints for all equipment as specified, including, but not limited to, the specific equipment marks listed above. Where a piece of equipment is included on the project but is not listed above, provide vibration isolators and seismic restraints as specified and as described for similar equipment.
3. Internal vibration isolators, snubbers, and bases for custom air handling units and custom exhaust fans shall be provided and installed at the fan manufacturer's factory, except concrete for inertia bases will be field installed as specified in this section.
4. Provide vibration isolators as indicated for suspended piping attached to any piece of vibrating equipment 5 horsepower or larger within mechanical rooms or within 50 feet of equipment, whichever provides the greater length. For piping supported from the floor, provide isolators similar to those used on the equipment. Applicable vibrating equipment includes items that are not internally isolated such as chillers, pumps, and air compressors.
5. The indicated equipment will be provided with internal vibration isolators.

**END OF SECTION**