

SECTION 220548 – VIBRATION & SEISMIC CONTROLS FOR PLUMBING SYSTEMS

First Edition 5-16-2017

(Engineer shall edit specifications and blue text in header to meet project requirements. This includes but is not limited to updating Equipment and/or Material Model Numbers indicated in the specifications and adding any additional specifications that may be required by the project. Also turn off all “Underlines”.)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 22.

1.2 SUMMARY

- A. This section includes the requirements for vibration and seismic control using the following: **<Edit for project>**
 - 1. Elastomeric isolation pads.
 - 2. Elastomeric isolation mounts.
 - 3. Open-spring isolators.
 - 4. Pipe-riser resilient supports.
 - 5. Resilient pipe guides.
 - 6. Elastomeric hangers.
 - 7. Spring hangers.
 - 8. Equipment bases.
 - 9. Restraint channel bracing.
 - 10. Restraint cables.
 - 11. Resilient lateral guides.
 - 12. Seismic-restraint accessories.
 - 13. Mechanical anchor bolts.
 - 14. Adhesive anchor bolts.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product comply with the following:
 - 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 vibration isolation device and seismic-restraint component required.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by [an

- evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction].
- b. Annotate to indicate application of each product submitted and compliance with requirements.
- B. Shop Drawings: Shop Drawings shall include the following information:
1. Detail fabrication and assembly of equipment bases.
 2. Detail fabrication including anchorages and attachments to structure and to supported equipment.
- C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device. <Delete paragraph 'C' if not required>
1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
 3. 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 was examined for excessive stress and that none exists.
 4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacing's. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors. <Delete if not required>
 - d. Preapproval and Evaluation Documentation: By <an agency acceptable to authorities having jurisdiction>, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

- D. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for fire protection system piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

<Retain "Coordination Drawings" Paragraph for situations where limited space necessitates maximum utilization for efficient installation of different components or if coordination is required for installation of products and materials by separate installers. Preparation of coordination drawings requires the participation of each trade involved in installations within the limited space.>

1.4 INFORMATIONAL SUBMITTALS

1. Qualification Data: For [professional engineer] [and] [testing agency].
2. Welding certificates.
3. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Include a copy of the approved submittal for each product and material along with any applicable maintenance data in the project operation and maintenance manual.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

Retain "Welding Qualifications" Paragraph below if shop or field welding is required. If retaining, also retain "Welding certificates" Paragraph in "Informational Submittals" Article.

- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, 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.

1.7 WARRANTY/GUARANTEE

- A. See Division 22, Specification Section “Basic Mechanical Requirements – Plumbing” for warranty and guarantee requirements.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- A. Product Design and Selection: All products shall be designed and selected, for the intended use, in accordance with the details on the drawings and the requirements of this specification.
- B. Acceptable Manufacturers: For the specified products acceptable manufactures are as follows:
 - 1. Elastomeric Isolation Pads and Mounts:
 - a. Amber/Booth.
 - b. Korfund Dynamics.
 - c. Peabody Noise Control, Inc.
 - d. Mason Industries, Inc.
 - e. Vibration Mountings & Controls, Inc.
 - 2. Open Spring Isolators:
 - a. Amber/Booth.
 - b. Korfund Dynamics.
 - c. Peabody Noise Control, Inc.
 - d. Mason Industries, Inc.
 - e. Vibration Mountings & Controls, Inc.
 - 3. Elastomeric Hangers:
 - a. Amber/Booth.
 - b. Korfund Dynamics.
 - c. Peabody Noise Control, Inc.
 - d. Mason Industries, Inc.
 - e. Vibration Mountings & Controls, Inc.
 - 4. Spring Hangers:
 - a. Amber/Booth.
 - b. Korfund Dynamics.
 - c. Peabody Noise Control, Inc.
 - d. Mason Industries, Inc.

- e. Vibration Mountings & Controls, Inc.
- 5. Restraint Channel Bracing:
 - a. Cooper B-Line, Inc.
 - b. Hilti, Inc.
 - c. Mason Industries, Inc.
 - d. Unistrut.
- 6. Restraint Cables:
 - a. Kinetics Noise Control, Inc.
 - b. Loos & Co., Inc.
 - c. Vibration Mountings & Controls, Inc.
- 7. Seismic Restraint Accessories:
 - a. Cooper B-Line, Inc.
 - b. Kinetics Noise Control, Inc.
 - c. Mason Industries, Inc.
 - d. TOLCO.
- 8. Anchor Bolts:
 - a. Cooper B-Line, Inc.
 - b. Hilti, Inc.
 - c. Kinetics Noise Control, Inc.
 - d. Mason Industries, Inc.

2.2 GENERAL PRODUCT REQUIREMENTS

- A. Equipment Design and Selection: Vibration and seismic controls shall be designed and selected, for the intended use, in accordance with the requirements of this specification.

2.3 PERFORMANCE REQUIREMENTS <Coordinate hangers and support systems with structural engineer.>

- A. Seismic-Restraint Loading:<Delete this section if not applicable> <if applicable edit for project requirements>

- 1. Site Class as Defined in the IBC: [A] [B] [C] [D] [E] [F].
- 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: [I] [II] [III].
 - a. Component Importance Factor: [1.0] [1.5].
 - b. Component Response Modification Factor: [1.5] [2.5] [3.5] [5.0].
 - c. Component Amplification Factor: [1.0] [2.5].
- 3. Design Spectral Response Acceleration at Short Periods (0.2 Second):
- 4. Design Spectral Response Acceleration at One (1) Second Period:

5. Rated strengths, features, and applications shall be as defined in reports by <an agency acceptable to authorities having jurisdiction>.
 - a. 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 are subjected.

2.4 ELASTOMERIC ISOLATION PADS (NP)

A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements provide products by one (1) of the following:
 - a. Amber/Booth. Type NR
 - b. Korfund Dynamics. Type KD
 - c. Peabody Noise Control, Inc. Type NPS
 - d. Mason Industries, Inc. Type WSW
 - e. Vibration Mountings & Controls, Inc. Series Shear Flex
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Waffle pattern.

2.5 ELASTOMERIC ISOLATION MOUNTS (DNP)

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Amber/Booth. Type RV
 - b. Korfund Dynamics. Type F
 - c. Peabody Noise Control, Inc. Type RD
 - d. Mason Industries, Inc. Type ND
 - e. Vibration Mountings & Controls, Inc. Series RD
2. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.6 OPEN-SPRING ISOLATORS (FSN)

A. Freestanding, Laterally Stable without any housing, Open-Spring Isolators:

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Amber/Booth. Type SW
 - b. Korfund Dynamics. Type WSL
 - c. Peabody Noise Control, Inc. Type FDS
 - d. Mason Industries, Inc. Type SLF
 - e. Vibration Mountings & Controls, Inc. Series A
2. Outside Spring Diameter: Not less than 80% of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50% of the required deflection at rated load.
4. Lateral Stiffness: More than 80% of rated vertical stiffness.
5. Overload Capacity: Support 200% of rated load, fully compressed, without deformation or failure.
6. Spring element in isolator shall either be set in Neoprene cup and have steel washer to distribute load evenly over Neoprene: or, isolator shall be mounted on unit Double Neoprene Pad (DNP) isolator. If DNP isolator is used, provide rectangular bearing plate of sufficient size to load pad uniformly in range of 40 psi to 50 psi. If spring isolator is supplied with Neoprene friction pad, use stainless steel, aluminum or galvanized steel plate between friction pad and DNP isolator.
7. If isolator is to be fastened to building structure and unit DNP isolator is used under bearing plate, neoprene grommets shall be provided for each bolt hole in base plate. Bolt holes shall be properly sized to allow for grommets. Hold-down bolt assembly shall include washers to distribute load evenly to grommet. Bolts and washers are to be galvanized.
8. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.7 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two (2) steel tubes separated by a minimum one half (1/2) inch-thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.

2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.8 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum one half (1/2) thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.9 ELASTOMERIC HANGERS (HN)

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Amber/Booth. Type BRD-A
 - b. Korfund Dynamics. Type H
 - c. Peabody Noise Control, Inc. Type RH or FH
 - d. Mason Industries, Inc. Type HD
 - e. Vibration Mountings & Controls, Inc. Type RHD or RFD
2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.10 SPRING HANGERS (HS)

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Amber/Booth. Type BSS-A
 - b. Korfund Dynamics. Type VSP-30
 - c. Peabody Noise Control, Inc. Type SH
 - d. Mason Industries, Inc. Type 30
 - e. Vibration Mountings & Controls, Inc. Type SH

2. Isolation hangers shall consist of free-standing laterally stable steel spring set into Neoprene cup, contained within steel housing.
3. Neoprene cup shall be manufactured with grommet (or other means) to prevent hanger rod from contacting hanger housing. Provide steel washer in Neoprene cup to evenly distribute load onto Neoprene.
4. Spring diameter and hanger housing lower hole sizes shall be large enough to permit hanger rod to swing through 30-degree arc before contracting housing.
5. Spring elements shall have minimum additional travel to solid equal to 50% of actual deflection.

2.11 SPRING HANGERS (HSN)

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Amber/Booth. Type BSWR-A
 - b. Korfund Dynamics. Type VSX-30
 - c. Peabody Noise Control, Inc. Type SRH or RFH
 - d. Mason Industries, Inc. Type 30N
 - e. Vibration Mountings & Controls, Inc. Type SH
2. Isolation hangers shall consist of free-standing, laterally stable steel spring and Neoprene or glass fiber element in series, contained within steel housing.
3. Provide Neoprene neck busing (or other means) where hanger rod passes through hanger housing to prevent rod from contacting hanger housing.
4. Spring diameter and hanger housing lower hole sizes shall be large enough to permit hanger rod to swing through 30-degree arc before contracting housing.
5. Spring elements shall have minimum additional travel to solid equal to 50% of actual deflection, and Neoprene element shall have 0.30 inch minimum static deflection.

2.12 RESTRAINT CHANNEL BRACINGS <Coordinate with structural engineer for requirements.>

A. Manufacturers: Subject to compliance with requirements, provide products by (1) one of the following:

1. Cooper B-Line, Inc.
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Unistrut.

B. Description: MFMA-4, shop- or field-fabricated bracing 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; rated in tension, compression, and torsion forces.

2.13 RESTRAINT CABLES <Coordinate with structural engineer for requirements.>

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1. Kinetics Noise Control, Inc.
 - 2. Loos & Co., Inc.
 - 3. Vibration Mountings & Controls, Inc.
- B. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.14 SEISMIC-RESTRAINT ACCESSORIES <Coordinate with structural engineer for requirements.>

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Kinetics Noise Control, Inc.
 - 3. Mason Industries, Inc.
 - 4. TOLCO.
- B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections, reinforcing steel angle clamped to hanger rod.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- D. 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.
- E. 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.
- F. Resilient Isolation Washers and Bushings: One (1) piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.15 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hilti, Inc.
 - 3. Kinetics Noise Control, Inc.
 - 4. Mason Industries, Inc.
- 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.

2.16 ADHESIVE ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1. Hilti, Inc.
 - 2. Kinetics Noise Control, Inc.
 - 3. Mason Industries, Inc.
- B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC 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 ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- 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 an agency acceptable to authorities having jurisdiction.

- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings 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 is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION <Coordinate with structural engineer for requirements.>

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Architectural Specification Sections "Cast-in-Place Concrete." and/or "Miscellaneous Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Comply with requirements in Architectural Specification Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- D. 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 inch.
 - 3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- E. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of forty (40) feet o.c., and longitudinal supports a maximum of eighty (80) feet o.c.
 - 3. Brace a change of direction longer than twelve (12) feet.
- F. Install cables so they do not bend across edges of adjacent equipment or building structure.
- G. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.
- H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolts and mounting hole in concrete base.

- I. 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.
- J. 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.
- K. 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. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 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 in Division 22 Specification Section "Domestic and Laboratory Water Piping Systems and Specialties" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: [Owner will engage] [Engage] a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four (4) of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90% of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 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.

END OF SECTION 220548