This master should be used by designers working on Port of Portland construction projects and by designers working for PDX tenants (“Tenants”). Usage notes highlight a few specific editing choices, however the entire section should be evaluated and edited to fit specific project needs.

If this section is used, include the following sections in the contract documents, edited as appropriate: Section 230529, Hangers and Supports for HVAC Piping and Equipment; Section 230545, Seismic Restraints for HVAC Piping and Equipment.

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

1. GENERAL
	* + 1. DESCRIPTION
				1. This section describes isolation of mechanical equipment, piping, and ductwork.
			2. RELATED WORK SPECIFIED ELSEWHERE
				1. Section 230529, Hangers and Supports for HVAC Piping and Equipment
				2. Section 230545, Seismic Restraints for HVAC Piping and Equipment
				3. Section 233113, Low Pressure Ductwork
				4. Section 233114, Medium Pressure Ductwork
			3. REFERENCES
				1. ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers
			4. GUIDELINES
				1. Seismic Restraint: Conform with the requirements of Section 230545 and additional requirements specified herein for seismic restraint of vibration isolated equipment, ductwork, and piping.
				2. Values for calculating seismic design forces shall be as described in Section 230545.
			5. SUBMITTALS
				1. Shop Drawings: Submit shop drawings showing complete details of construction for steel and concrete bases including:

Equipment mounting holes.

Dimensions.

Isolation selected for each support point.

Details of mounting brackets for isolator.

Weight distribution for each isolator.

Details of seismic snubbers.

Code number assigned to each isolator.

* + - * 1. Product Data: Submit product data and calculation sheets for isolators, showing:

Size, type, load and deflection of each required isolator.

Percent of vibration transmitted based on the lowest disturbing frequency of the equipment.

* + - * 1. Installation Procedures: Submit procedures for setting and adjusting isolation devices.
				2. Package Equipment Calculations: Where buses, isolators and other equipment specified in this section are provided as part of packaged equipment, submit calculations certifying compliance with this section.
				3. Installation Report: Submit installation report as specified in Part 3 of this section.
				4. Structural Certifications: Submit calculations stamped and signed by a registered professional structural engineer licensed in the state of Oregon certifying mounting attachment points for isolators and seismic restraints will withstand forces calculated from values presented in Section 230545.
				5. Shop drawings and calculations shall be stamped and signed by a registered professional structural engineer licensed in the state of Oregon.
			1. QUALITY ASSURANCE
				1. Except for packaged equipment with integral isolators, a single manufacturer shall select and furnish all isolation required.
				2. Isolation performance requirements shall be as indicated on the drawings. All deflections indicated shall be minimum actual static deflections for specific equipment supported.
				3. Isolator Stability:

Size springs of sufficient diameter to maintain stability of the equipment being supported with minimum horizontal to vertical stiffness ratio not less than 1:1. Spring diameters shall be not less than 0.8 of the compressed height at rated load.

Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection.

* + - * 1. Maximum Allowable Vibration Levels: Peak vibration velocities shall not exceed 0.08 in/sec. If operating vibration velocities exceed this criteria, the equipment shall be repaired or replaced at no additional cost to the Port until approval of the equipment is given by the Port.
1. PRODUCTS
	* + 1. TYPE 1 - NEOPRENE WAFFLE PAD
				1. 1/4-inch-thick neoprene waffle pads with pattern repeating on 1/2-inch centers.
				2. Select Duro rating for maximum deflection at average load rating.
				3. Acceptable Manufacturers: Mason type “W,” Kinetics Noise Control, or equal.
			2. TYPE 2 - RESTRAINED DOUBLE DEFLECTION NEOPRENE
				1. Restrained double deflection neoprene mountings with minimum actual static deflection of 0.35 inches for equipment supported.
				2. Friction pad both top and bottom.
				3. Steel rails used above those mountings of equipment with overhang.
				4. Manufacturers: Mason type RCA, Kinetics Noise Control, or equal.
			3. TYPE 3 - SPRINGS
				1. Free-standing springs without housings.
				2. 1/4-inch neoprene acoustical friction pads between base plate and support.
				3. All mountings shall have leveling bolts.
				4. Springs mounted outboard of channels.
				5. Manufacturers: Mason type SLF, Kinetics Noise Control, units requiring limit stops similar to Mason type SLR or equal.
			4. TYPE 4 - SPRINGS WITH RESTRAINTS
				1. Same as springs except add seismic restraints.
				2. Seismic restraint an integral part of isolator.
				3. Isolator, snubber, and base shall be rated to withstand a minimum 1G seismic force in all directions.
				4. Manufacturers: Mason type SLR with seismic restraints, Kinetics Noise Control, or equal.
			5. TYPE B AND C - STRUCTURAL AND CONCRETE BASES WITH SPRINGS
				1. Integral structural steel or concrete base; rectangular or tee shaped as required.
				2. All perimeter members shall be WF beams with minimum depth equal to 8 percent of longest span of base between vibration isolators.
				3. Fan Bases: Mason WFSL with external height saving brackets, or equal.
				4. Manufacturers: Mason as indicated, Kinetics Noise Control, or equal.
			6. TYPE 6 - ISOLATING HANGERS
				1. Combination rubber-in shear and steel spring isolators installed on the hanger rods.
				2. Isolators shall have the proper deflection to allow the piping to deflect as a unit with the pump isolators.
				3. Hangers designed for 30-degree angular movement.
				4. Minimum deflection shall be 1 inch.
				5. Manufacturers: Mason PC30N, Kinetics Noise Control, or equal.
			7. ISOLATING SLEEVES
				1. Provide for all piping through walls and floors of mechanical rooms. Size for piping as required.
				2. Manufacturers: Potter-Roemer PR isolators or equal.
			8. SEISMIC RESTRAINTS
				1. Provide seismic restraints for all vibration isolated equipment, both supported and suspended, and all vibration isolated ductwork and piping. Refer to Section 230529, Section 230545, Section 233113, and Section 233114 for additional and specific requirements. The structural requirements for the restraints, including their attachment to the equipment or piping and the building structure, shall meet the following provisions:

Supported Equipment:

The seismic restraints shall consist of interlocking steel members restrained by shock absorbent neoprene materials compounded to bridge bearing specifications. The elastomeric materials shall be replaceable and shall be a minimum 3/4-inch-thick. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8 inch, nor more than 1/4 inch.

Each snubber shall be capable of restraint in all three mutually orthogonal directions.

Submittals shall include load versus deflection curves up to 1/2 inch on the x, y and z planes. Conduct tests in an independent laboratory or under the signed supervision of an independent registered engineer. The snubber assemblies shall be bolted to the test machine as the snubber is normally installed. Test reports shall certify that neither the neoprene elements nor the snubber body has sustained any obvious deformation after release of the load.

Suspended Equipment, Ductwork, and Piping:

Cable Method: The seismic restraint shall consist of a combination of stranded steel aircraft cable and the specified vibration isolation hanger with an added nut and neoprene and steel washer. The cable resists lateral and downward motion. The modified vibration hanger resists upward motion.

Cable attachment details, cable size, and the neoprene and steel washers shall be sized by the manufacturer and shall be indicated in the shop drawings.

Provide detailed shop drawings for approval in sufficient time to allow structural attachment work to be incorporated into the normal work sequence.

1. EXECUTION
	* + 1. GENERAL
				1. Do not install any equipment, duct, or pipe which makes rigid contact with the building other than at points of support. “Building” includes slabs, beams, studs, walls, etc.
				2. The installation or use of vibration isolators shall not cause any change of position of equipment or piping which would result in stresses to piping connections or misalignment of shafts or bearings. In order to meet this objective, equipment and piping shall be maintained in a rigid position during installation. Do not transfer the load to the isolator until the installation is complete and under full operational load.
			2. PREPARATION
				1. Treat all isolators, including springs, brackets, and housing, with a rustproof metal primer.
				2. Coat items exposed to weather with cadmium plating, galvanizing, or plastic coating.
			3. INSTALLATION
				1. General:

Install isolation where indicated on the drawings by type and location and where indicated below. For all other equipment with rotating parts or motors, isolation and minimum static deflections shall comply with the ASHRAE Handbook, HVAC Applications, Sound and Vibration Control.

Mark the assigned code number on the isolators and bases to assure placement in the proper location.

Anchor baseplates to floor. Provide rubber grommets and washers to isolate the bolt from the base plate. Under no circumstances shall the isolation efficiency be destroyed when bolting the isolators to the floor.

* + - * 1. Isolation of Pipe and Ductwork:

Install isolating hangers on all ductwork, hot and chilled water piping connected to air handling units or other rotating equipment in mechanical rooms and within 40 feet of equipment. Provide isolating hanger supports for each piece of isolated equipment outside of mechanical rooms and where indicated. Isolators within 25 feet of equipment shall have a static deflection of 1 inch. Beyond 25 feet, isolators shall have a static deflection of 1/2 inch.

Ductwork or piping supported from floor shall be isolated with Type 1 isolators.

* + - * 1. Air Handling Unit Housings:

Provide isolation pads between housing and curb.

Where housing is bolted to curb, isolate bolts with neoprene washers and bushings.

* + - * 1. Pump Bases:

Fill with concrete to provide base weight equal to two times combined pump, motor, pipe, and water weight.

Support heels of suction and discharge elbows from base.

Secure pump and heel supports with inserts and grout.

* + - 1. SEISMIC RESTRAINTS (VIBRATION ISOLATED EQUIPMENT, DUCTWORK AND PIPING)
				1. General: Install and adjust seismic restraints so that the equipment and piping vibration isolation is not degraded by the restraints.
				2. Supported Equipment:

Each vibration isolation frame for supported equipment shall have a minimum of four seismic snubbers mounted as close as possible to the vibration isolators and/or the frame extremities.

Take care so that a minimum 1/8-inch air gap in the seismic restraint snubber is preserved on all sides so that the vibration isolation potential of the isolator is not compromised. This requires that the final snubber adjustment be completed after the vibration isolators are properly installed and the installation is approved.

* + - * 1. Suspended Equipment, Ductwork, and Piping-Cable Method:

Install cables so that they do not carry any load. Install with a minimum amount of slack or sag.

The uplift and downward restraint nuts and washers for the Type HST hangers shall be adjusted so that there is a minimum 1/4-inch clearance.

Ductwork: All vibration isolated rectangular or oval ductwork with area of 6 square feet or greater and all vibration isolated round ductwork 28 inches diameter and larger shall be seismically restrained by the cable method.

Piping: All vibration isolated suspended piping 2-1/2 inches or larger, vibration isolated suspended piping in mechanical rooms 1-1/4 inches or larger, and vibration isolated suspended gas, hazardous, or life-safety piping 1 inch or larger shall be seismically restrained by the cable method.

* + - 1. ELECTRICAL COORDINATION
				1. Make all electrical connections to isolated equipment using flexible electrical conduit. Do not use conduit clamps or hangers between the flexible conduit and equipment. Provide non-stressed loop in conduit, unrestrained in all directions.
			2. FIELD QUALITY CONTROL
				1. Confirm that all isolation is installed correctly and submit report stating that isolators are installed as shown on shop drawings, isolators are free to work properly, and that installed deflections are as scheduled and as specified.

END OF SECTION 230548