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.

With this section, include Section 230529, Hangers and Supports for HVAC Piping and Equipment, edited as appropriate.

SECTION 230545 - SEISMIC RESTRAINTS FOR HVAC PIPING AND EQUIPMENT

1. GENERAL
	* + 1. DESCRIPTION
				1. This section describes seismic restraints for piping, ductwork, conduit, tanks, and equipment, including clamps, rods, channels, struts, anchor bolts, nuts, and accessories.
			2. RELATED WORK SPECIFIED ELSEWHERE
				1. Section 230529, Hangers and Supports for HVAC Piping and Equipment
			3. REFERENCES
				1. AISC: American Institute of Steel Construction

AISC Steel Construction Manual

* + - * 1. ASTM: American Society for Testing and Materials

ASTM A36: Standard Specification for Carbon Structural Steel

* + - * 1. AWS: American Welding Society

AWS D1.1: Structural Welding Code – Steel

* + - * 1. OSSC: Oregon Structural Specialty Code
			1. SUBMITTALS
				1. Product Data: For all products specified herein.
				2. Shop Drawings: Comply with the requirements of the Quality Assurance article of this section. Shop drawings shall be stamped and signed by a professional structural engineer licensed in the state of Oregon.
				3. Calculations: Seismic calculations indicating restraint loadings resulting from the design seismic forces presented in the Quality Assurance article of this section. Include proper anchorage details and when applicable, include consideration of the types of concrete. Calculations shall be stamped and signed by a professional structural engineer licensed in the state of Oregon.
				4. Certifications: Certification of seismic restraint’s and building structural member’s capability to safely accept loads resulting from seismic forces calculated in the previous paragraph. Tests in three planes clearly showing ultimate strength and appropriate safety factors, performed by independent laboratories, stamped, and signed by a professional structural engineer licensed in the state of Oregon or calculations by a professional structural engineer licensed in the state of Oregon are acceptable.
			2. QUALITY ASSURANCE
				1. The seismic restraint and anchorage of permanent equipment and associated systems listed below to building structure shall be designed to resist the total design seismic force prescribed in the OSSC.

Floor- or roof-mounted equipment.

Suspended or wall-mounted equipment.

Vibration-isolated equipment.

Potentially hazardous or life-safety piping systems 1 inch or larger throughout the building.

Piping 1 1/4 inches nominal diameter and larger located in mechanical equipment rooms.

Piping 2 1/2 inches nominal diameter and larger.

Ductwork 6 square feet and larger in cross sectional area.

Round ductwork 28 inches in diameter and larger.

Electrical conduit 2 1/2 inches trade size and larger.

Any piece of equipment that is not floor mounted with a weight greater than or equal to 25 pounds.

* + - * 1. Except for those which would individually require bracing, pipes, ducts, and conduit supported by a trapeze need not be braced if connections to the pipe/duct/conduit or directional changes do not restrict movement of the trapeze. If this flexibility is not provided, bracing shall be required when the combined operating weight of all elements supported by the trapeze is 10 pounds per foot or greater.
				2. All seismic restraints, including anchors to building structure, shall be designed by a registered professional structural engineer licensed in the state of Oregon. Design shall include:

Number, size, capacity, and location of anchors for floor- or roof-mounted equipment. For curb-mounted equipment, provide design of attachment of both the unit to the curb and the curb to the structure. For units weighing greater than 2500 pounds, or curbs more than 10 feet long, provide calculations substantiating that the curb can accept the prescribed seismic forces.

Number, size, capacity, and location of seismic restraint devices and anchors for vibration-isolation and suspended equipment. Provide calculations and test reports verifying the horizontal and vertical ratings of the seismic restraint devices.

Number, size, capacity, and location of braces and anchors for suspended piping, ductwork, conduit, and cable trays on as-built plan drawings.

Select a single seismic restraint system pre-designed to meet the requirements of the OSSC such as the 1999 Mason Industries Seismic Restraint Guidelines for Suspended Piping, Ductwork and Electrical Systems.

Details or designs from separate seismic restraint guidelines are not acceptable. Installation not addressed by the selected system shall be designed, detailed, and submitted alone with the as-built plan drawings.

Indicate maximum seismic loads on the drawings at each brace location. Drawings shall bear the stamp and signature of the registered professional structural engineer licensed in the state of Oregon who designed the layout of the braces.

* + - * 1. Supports, Hangers, and Anchors: Comply with the requirements of Section 230529 except anchor (expansion) bolts used for connection Level 3 shall have expansion anchor capacities equal to 50 percent of the ICC research report values.
1. PRODUCTS
	* + 1. MATERIALS
				1. Seismic Bracing: Steel fabrication, in accordance with AISC Steel Construction Manual, with structural steel shapes of ASTM A36 steel. Weld in accordance with AWS D1.1. Design and sizes shall be as required. Fastenings, bracing, and assembly shall be selected by a professional structural engineer licensed in the state of Oregon. Design calculations shall show that the maximum stress in any structural steel member will not exceed 18,000 psi.
				2. Channel type elements shall be No. 12 gauge formed steel; 1 5/8-inch square prime painted or chromate dip finish. Use spring-in nuts with grooves.
				3. Bolting accessories shall be machine bolts with semi-finished nuts.
2. EXECUTION
	* + 1. INSTALLATION
				1. Equipment and tanks shall be braced or anchored to conform to the requirements listed under the Quality Assurance article of this section.
				2. Ductwork and piping shall be seismically braced to conform to the requirements listed under the Quality Assurance article of this section.
				3. Provide pipeline seismic flexible connectors where piping crosses building earthquake joints. Arrange piping and connectors for the amount of motion required. Provide vent and drain valves for all liquid filled systems.
				4. Provide ductwork seismic flexible connectors where ductwork crosses building earthquake joints. Arrange ductwork and connectors for the amount of motion required.
				5. Attach seismic restraints to structural members of the building which are capable of withstanding the design load of the seismic restraint. Ensure load capacity of the structural members is greater than or equal to the capacity of the seismic restraint.
				6. Seismic restraints shall not introduce stresses in piping caused by thermal expansion or contraction.

END OF SECTION 230545