

## SECTION 13 48 00.00 10

SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT  
10/07

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325 (2005) Manual of Steel Construction

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION  
(SMACNA)

SMACNA Seismic Restraint Mnl (1998; Addendum 2000, 2nd Ed) Seismic  
Restraint Manual: Guidelines for  
Mechanical Systems

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04 (2007) Seismic Design for Buildings

## 1.2 SYSTEM DESCRIPTION

## 1.2.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the mechanical equipment and systems listed below. Structural requirements shall be in accordance with Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

## 1.2.2 Mechanical Equipment

Mechanical equipment to be seismically protected shall include the following items to the extent required on the drawings or in other sections of these specifications:

Water Heaters	Water Chemical Piping
Refrigerant Piping	Air and Refrigerant Compressors
Pumps with Motors	Air Handling Units
Process Filters	Pollution Control Equipment
RO Equipment	Ducts
Decarbonator Tank	Unit Heaters
Storage Tanks for Chemical and Water	Exhaust and Return Fans
	Sodium Hypochlorite Generation System

## 1.2.3 Mechanical Systems

The following mechanical systems shall be installed as required on the drawings and other sections of these specifications and shall be

seismically protected in accordance with this specification:

All Piping Inside the Building Except as Specifically Stated  
Below Under "Items Not Covered By This Section".  
Chilled Water Distribution Systems Outside of Buildings  
Fuel Piping Outside of Buildings  
All Water Supply Systems  
Storm and Sanitary Sewer Systems  
All Process Piping  
Heat Distribution Systems (Supply, Return, and Condensate Return)  
Outside of Buildings  
Condenser Water Piping Outside the Building  
Pneumatic Tube Distribution System  
Cold Storage Refrigeration Systems  
Fuel Storage Tanks  
Water Storage Tanks

#### 1.2.4 Contractor Designed Bracing

The Contractor shall design the bracing in accordance with [UFC 3-310-04](#) and additional data furnished by the Contracting Officer. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. [UFC 3-310-04](#) uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas shall be required. Loadings determined using [UFC 3-310-04](#) are based on strength design; therefore, [AISC 325](#) Specifications shall be used for the design. See Submittal requirements for [calculations](#). The bracing for the following mechanical equipment and systems listed in Articles 1.2.2 and 1.2.3 of this specification shall be developed by the Contractor.

#### 1.2.5 Items Not Covered By This Section

##### 1.2.5.1 Items Requiring No Seismic Restraints

Seismic restraints are not required for the following items:

- a. Gas piping less than [1 inch](#) inside diameter.
- b. Piping in boiler and mechanical equipment rooms less than [1-1/4 inches](#) inside diameter.
- c. All other piping less than [2-1/2inches](#) inside diameter.
- d. Rectangular air handling ducts less than [6 square feet](#) in cross sectional area.
- e. Round air handling ducts less than [28 inches](#) in diameter.
- f. Piping suspended by individual hangers [12 inches](#) or less in length from the top of pipe to the bottom of the supporting structural member where the hanger is attached, except as noted below.
- g. Ducts suspended by hangers [12 inches](#) or less in length from the top of the duct to the bottom of the supporting structural member, except as noted below.

In exemptions f. and g. all hangers shall meet the length requirements. If the length requirement is exceeded by one hanger in the run, the entire run

shall be braced. Interior piping and ducts not listed above shall be seismically protected in accordance with the provisions of this specification.

### 1.3 EQUIPMENT REQUIREMENTS

#### 1.3.1 Rigidly Mounted Equipment

Equipment that requires rigid mounting as determined by Manufacturer, to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in [UFC 3-310-04](#). Each item of rigid equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, duct, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

#### 1.3.2 Nonrigid or Flexibly-Mounted Equipment

Equipment that does not requires rigid mounting as determined by Manufacturer, shall be constructed and assembled to resist a horizontal lateral force of 2 times the operating weight of the equipment at the vertical center of gravity of the equipment.

### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section [01 33 00 SUBMITTAL PROCEDURES](#):

#### SD-02 Shop Drawings

[Coupling and Bracing; G, AE](#)  
[Flexible Couplings or Joints; G, AE](#)  
[Equipment Requirements; G, AE](#)  
[Contractor Designed Bracing; G, AE.](#)

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

#### SD-03 Product Data

[Equipment Requirements; G, AE.](#)

#### SD-05 Design Data

[Calculations; G, AE](#)

Structural calculations for bracing members, their connections and equipment anchorages shall be stamped and signed by a registered Civil or Structural Engineer currently licensed in the State of California. Calculations shall also verify the capability of structural members to which the bracing is attached

for carrying the load from the brace. Design criteria is as stated on Drawing G-10, Structural Construction Notes.

### SD-07 Certificates

#### Flexible Ball Joints.

Flexible ball joints shall be certified to be suitable for the service intended by the manufacturer. Information verifying experience at not less than 3 locations of 2 years' satisfactory operation in a similar application shall be submitted.

## PART 2 PRODUCTS

### 2.1 FLEXIBLE COUPLINGS

Flexible couplings shall have same pressure and temperature ratings as adjoining pipe.

### 2.2 FLEXIBLE BALL JOINTS

Flexible ball joints shall have cast or wrought steel casing and ball parts capable of 360-degree rotation with not less than 15-degree angular movement.

### 2.3 FLEXIBLE MECHANICAL JOINTS

a. Mechanical couplings for steel or cast iron pipe shall be of the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the ground, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.

b. Sleeve-type couplings shall be used for joining plain-end pipe sections. The coupling shall consist of one steel middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets.

### 2.4 MANUFACTURED BALL JOINTS

Manufactured ball joints shall be as recommended by the manufacturer for the intended use, and shall be approved by the Contracting Officer before installation.

### 2.5 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

## PART 3 EXECUTION

### 3.1 COUPLING AND BRACING

Coupling installation shall conform to the details shown on the drawings. Provisions of this paragraph apply to all piping within a 5 foot line around outside of building unless buried in the ground. Piping grouped for

support on trapeze-type hangers shall be braced at the most frequent interval as determined by applying the requirements of this specification to each piping run on the common support. Bracing components shall be sized as required for the total load carried by the common supports. Bracing rigidly attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

### 3.2 BUILDING DRIFT

Joints capable of accommodating seismic displacements shall be provided for vertical piping between floors of the building, where pipes pass through a building seismic or expansion joint, or where rigidly supported pipes connect to equipment with vibration isolators. Horizontal piping across expansion joints shall accommodate the resultant of the drifts of each building unit in each orthogonal direction. For threaded piping, swing joints made of the same piping material shall be provided. For piping with manufactured ball joints the seismic drift shall be 0.015 feet per foot of height above the base where the seismic separation occurs; this drift value shall be used in place of the expansion given in the manufacturer's selection table.

### 3.3 FLEXIBLE COUPLINGS OR JOINTS

#### 3.3.1 Building Piping

Flexible couplings or joints in building piping shall be provided at bottom of all pipe risers for pipe larger than 3-1/2 inches in diameter. Flexible couplings or joints shall be braced laterally without interfering with the action of the flexible coupling or joint. Cast iron waste and vent piping need only comply with these provisions when caulked joints are used. Flexible bell and spigot pipe joints using rubber gaskets may be used at each branch adjacent to tees and elbows for underground waste piping inside of building to satisfy these requirements.

#### 3.3.2 Underground Piping

Underground piping and 4 inch or larger conduit, except heat distribution system, shall have flexible couplings installed where the piping enters the building. The couplings shall accommodate 76 inches of relative movement between the pipe and the building in any direction. Additional flexible couplings shall be provided where shown on the drawings.

### 3.4 PIPE SLEEVES

Pipe sleeves in interior non-fire rated walls shall be sized as indicated on the drawings to provide clearances that will permit differential movement of piping without the piping striking the pipe sleeve. Pipe sleeves in fire rated walls shall conform to the requirements in Section 07 84 00 FIRESTOPPING.

### 3.5 SPREADERS

Spreaders shall be provided between adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 4 inches apart. Spreaders shall be applied at same interval as sway braces at an equal distance between the sway braces. If rack type hangers are used where the pipes are restrained from contact by mounting to the rack, spreaders are not required for pipes mounted in the rack. Spreaders shall be applied to surface of bare pipe.

### 3.6 SWAY BRACES FOR PIPING

Sway braces shall be provided to prevent movement of the pipes under seismic loading. Braces shall be provided in both the longitudinal and transverse directions, relative to the axis of the pipe. The bracing shall not interfere with thermal expansion requirements for the pipes as described in other sections of these specifications.

#### 3.6.1 Transverse Sway Bracing

Transverse sway bracing for steel and copper pipe shall be provided as specified in Section 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT. All runs (length of pipe between end joints) shall have a minimum of two transverse braces. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

#### 3.6.2 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided at 40 foot intervals unless otherwise indicated. All runs (length of pipe between end joints) shall have one longitudinal brace minimum. Sway braces shall be constructed in accordance with the drawings. Branch lines, walls, or floors shall not be used as sway braces.

#### 3.6.3 Vertical Runs

Run is defined as length of pipe between end joints. Vertical runs of piping shall be braced at not more than 10 foot vertical intervals. Braces for vertical runs shall be above the center of gravity of the segment being braced. All sway braces shall be constructed in accordance with the drawings. Sway braces shall attach to the structural system and shall not be connected to branch lines, walls, or floors.

#### 3.6.4 Clamps and Hangers

Clamps or hangers on uninsulated pipes shall be applied directly to pipe.

### 3.7 SWAY BRACES FOR DUCTS

#### 3.7.1 Braced Ducts

Bracing details and spacing for rectangular and round ducts shall be in accordance with UFC 3-310-04 procedures. However, the design seismic loadings for these items shall not be less than loadings obtained using the procedures in UFC 3-310-04.

#### 3.7.2 Unbraced Ducts

Hangers for unbraced ducts shall be attached to the duct within 2 inches of the top of the duct in accordance with SMACNA Seismic Restraint Mnl. Unbraced ducts shall be installed with a 6 inch minimum clearance to vertical ceiling hanger wires.

-- End of Section --