****
USACE / NAVFAC / AFCEC **UFGS-23 05 48.19 (February 2025)**

Preparing Activity: USACE **Superseding**
UFGS-23 05 48.19 (May 2018)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2025
****

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 05 48.19

SEISMIC BRACING FOR MECHANICAL SYSTEMS

02/25

-- End of Section Table of Contents --

****

USACE / NAVFAC / AFCEC | **UFGS-23 05 48.19 (February 2025)**

Preparing Activity: USACE | **Superseding UFGS-23 05 48.19 (May 2018)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2025

****

SECTION 23 05 48.19

SEISMIC BRACING FOR MECHANICAL SYSTEMS
02/25

****

NOTE: This guide specification covers the requirements for seismic protection of mechanical equipment, ductwork, building piping, and exterior utilities. Mechanical equipment seismic protection coverage within this specification is supplemental to the Equipment Bracing requirements with section 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

****

PART 1 GENERAL

****

NOTE: Refer to section 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS, PART 1 GENERAL editor note for the three options to provide seismic protection design for a project.

****

1.1 REFERENCES

****

NOTE: This paragraph is used to list the

publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

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 SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-22	(2022; Supp 1 2023; Supp 2 2023) Minimum Design Loads and Associated Criteria for Buildings and Other Structures

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C105/A21.5	(2018) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C116/A21.16	(2015) Protective Fusion-Bonded Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray Iron Fittings
AWWA C153/A21.53	(2019) Ductile-Iron Compact Fittings for Water Service
AWWA C213	(2022) Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings

ASTM INTERNATIONAL (ASTM)

ASTM A536	(2024) Standard Specification for Ductile Iron Castings
ASTM D1785	(2021) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120

ASTM D2665 (2014) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

ASTM F891 (2024) Standard Specification for Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

FEMA P-414 (January 2004) Installing Seismic Restraints for Duct and Pipe

NSF INTERNATIONAL (NSF)

NSF/ANSI/CAN 61 (2024) Drinking Water System Components - Health Effects

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

SMACNA 1981 (2008) Seismic Restraint Manual Guidelines for Mechanical Systems, 3rd Edition

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01 (2023; with Change 2, 2024) Structural Engineering

UFC 3-301-02 (2023) Design of Risk Category V Structures, National Strategic Military Assets

VIBRATION ISOLATION AND SEISMIC CONTROL MANUFACTURERS ASSOCIATION (VISCMA)

VISCMA 412 (2014) Installing Seismic Restraints for Mechanical Equipment

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

****

NOTE: Designer should verify that specified details do not interfere with the performance of the cathodic protection system (when used) or of the vibration isolation systems.

For systems and equipment in RC V buildings that have a performance objective higher than non-mission critical (NMC), the designer should show a "G" classification for the items under SD-02 Shop Drawings in the SUBMITTALS paragraph. The Engineer of Record (EOR) should review the details of these essential systems and assess their impact on the structural supporting system of the essential building. This also includes Designated Seismic Systems that must remain operational after an

earthquake.

Design done by the Contractor must be in accordance with UFC 3-301-01 (UFC 3-301-02 for RC V facilities). Requirements for Contractor Designed Bracing are covered by specification section 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS which must be used in conjunction with this specification.

****

Apply the requirements for seismic protection measures described in this section, Section 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS, and on the drawings to the mechanical equipment and mechanical systems both inside and outside of the building along with exterior utilities and systems listed below. Where there is a conflict between the specifications and the drawings, the specifications will take precedence.

1.2.2 Mechanical Equipment

****

NOTE: The designer must ensure that the list below includes all mechanical items to be braced. Delete the items which are not part of the project and add items which are not included in the list.

The lists should be broken out as follows:

For mechanical equipment, components and systems in Risk Category V structures, the designer should provide three separate lists of equipment and systems; non-Mission Critical (NMC), Mission Critical Level 1 (MC-1 equipment and components must be fully operational immediately after a seismic event), or Mission Critical Level 2 (MC-2 equipment and components must be repairable and operable within 3 days after a seismic event).

For mechanical equipment, components, and systems in Risk Category I, II, III, or IV structures, two separate lists of nonstructural systems/components must be provided; components/systems with Ip = 1.0 and components/systems with Ip = 1.5 (Designated Seismic Systems).

The lists must be specific where more than one list is required.

****

Mechanical equipment restraints must be in accordance with the requirements for equipment restraints specified in section 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS. Mechanical equipment to be seismically protected must include the following items to the extent required on the drawings or in other sections of these specifications:

[Equipment/Components with Ip = 1.0]

Boilers and furnaces	Storage Tanks for Oil and Water
Water Heaters	
Expansion Air Separator Tanks	Valves and Fittings for Piping
Heat Exchangers	Steam-fed Kitchen Appliances
Water Chiller Units	Thermal Storage Units
Cooling Towers, Evaporative Coolers, and Fluid Coolers	Air and Refrigerant Compressors
Computer Room Air Conditioners	Air Handling Units
Pumps with Motors	Lab Scrubbers
Large Commercial Dryers	Pollution Control Equipment
Gas Dryers	Split System DX Units
Flash Tanks	Unit Heaters
Accumulator Tank	Exhaust, Return and Misc. Fans
Gas Cylinders	Solar Heating and Hot Water Units
Bridge Cranes and Monorails	Pumps
Air Terminal Units	Unitary HVAC Systems
Humidifiers	Fan Coil Units
Stacks	Instrumentation and Control for HVAC
Duct Mounted Coils	Duct Silencers

[Equipment/Components with Ip = 1.5 (Designated Seismic Systems)
Insert edited list here similar to one above for Ip = 1.0]
[Non-Mission Critical (NMC) Equipment/Components in Risk Category V
Insert edited list here similar to one above for Ip = 1.0]
[Mission Critical Level 1 (MC-1) Equipment/Components in Risk Category V
Insert edited list here similar to one above for Ip = 1.0]
[Mission Critical Level 2 (MC-2) Equipment/Components in Risk Category V
Insert edited list here similar to one above for Ip = 1.0]

1.2.3 Mechanical Systems

****
NOTE: The designer must ensure that the list below includes all piping and mechanical systems which are to be installed or modified. Delete the items which are not part of the project and add items which are not included in the list.
****

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

[Mechanical systems with Ip = 1.0]

a. All Piping and Ducts Inside the Building Except as Specifically Stated Below Under "Items Not Covered By This Section".

b. Chilled Water Distribution Systems Outside of Buildings.

c. Steam, Water, Oil, Gas and Fuel Piping Outside of Buildings.

d. All Water Supply Systems Outside of Buildings.

e. Storm and Sanitary Sewer Systems Outside of Buildings.

f. All Process Piping Outside of Buildings.

g. Heat Distribution Systems (Supply, Return, and Condensate Return) Outside of Buildings.

h. Condenser Water and Refrigerant Piping Outside the Building.

i. Pneumatic Tube Distribution System Outside of Buildings.

j. Cold Storage Refrigeration Systems Outside of Buildings.

k. Fuel Storage Tanks Outside of Buildings.

l. Water Storage Tanks Outside of Buildings.

m. Ductwork Outside of Buildings.

n. Stacks.

o. [_____]

[Mechanical systems with Ip = 1.5 (Designated Seismic Systems)
Insert edited list here similar to one above for Ip = 1.0]
[Non-Mission Critical (NMC) Mechanical Systems in Risk Category V
Insert edited list here similar to one above for Ip = 1.0]
[Mission Critical Level 1 (MC-1) Mechanical Systems in Risk Category V
Insert edited list here similar to one above for Ip = 1.0]
[Mission Critical Level 2 (MC-2) Mechanical Systems in Risk Category V
Insert edited list here similar to one above for Ip = 1.0]

[1.2.4 Contractor Designed Supports and Attachments

****

NOTE: Retain this paragraph when the Contractor will design the bracing. The designer will refer and modify the listings above or will list below the equipment and systems to receive seismic bracing. Delete this paragraph when all bracing details and locations are indicated on the drawings and calculations are included in the Design Analysis.

****

The supports and attachments for the mechanical equipment designated in paragraph Mechanical Equipment must be developed by the Contractor complying with the requirements of 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS. Submit design calculations as required by 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS.

Design and provide seismic supports and attachments for mechanical systems listed in paragraph Mechanical Systems in accordance with ASCE 7-22 Chapter 13 and as modified by UFC 3-301-01[UFC 3-301-02]. Refer to 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS paragraph GENERAL REQUIREMENTS for Structural Design Criteria.

[Provide documentation of an independent design review for mission critical (MC) component or systems bracing design. Documentation must be signed by the independent reviewer who must also be a registered structural engineer.]

]1.2.5 Items Not Covered By This Section

1.2.5.1 Fire Protection Systems

Install seismic protection of piping for fire protection systems as specified in Sections 21 30 00 FIRE PUMPS, 21 13 13 WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION, 21 13 16 DRY PIPE SPRINKLER SYSTEMS, FIRE PROTECTION, 21 13 18 PREACTION SPRINKLER SYSTEMS, FIRE PROTECTION, and 21 13 24.00 10 AQUEOUS FILM-FORMING FOAM (AFFF) FIRE PROTECTION SYSTEM.

1.2.5.2 Items Requiring No Seismic Restraints

Seismic restraints are not required where specifically identified as exempt based on Seismic Design Category (SDC), component Importance Factor (Ip), and other applicable factors indicated within ASCE 7-22, Chapter 13 section Mechanical and Electrical Components. Provide listing of mechanical equipment exempt from seismic restraint requirement within the Design Calculations submittal package submitted in accordance with specification 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS.

1.3 SUBMITTALS

****

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a “G” to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for

Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy and Air Force projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Flexible Couplings or Joints

Coupling And Bracing

SD-03 Product Data

Flexible Couplings Or Joints; G, [_____]

Equipment Restraint; G, [_____]

PART 2 PRODUCTS

2.1 GENERAL DESIGN REQUIREMENTS

Submit detailed seismic restraint drawings for mechanical equipment, duct systems, piping systems and any other mechanical systems. Include calculations, catalog cuts, templates, and erection and installation details, as appropriate, for the items listed below. Indicate thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction. A registered professional engineer must stamp the calculations and verify the capability of structural members to which bracing is attached for carrying the load from the brace. Include drawing for [Mission Critical Equipment and] Designated Seismic System Equipment indicating the equipment location in the facility, sufficient to be used for the installation. Design must be based on actual equipment and system layout. Design must include calculated dead loads, static seismic loads and capacity of materials utilized for the connection of the equipment or system to the structure. Analysis must detail anchoring methods.

****

NOTE: Appropriate materials for structural supports must be used in corrosive environments. Dissimilar metals must be isolated.

****

2.2 EQUIPMENT RESTRAINT

****

NOTE: Seismic Bracing does not guarantee that the equipment itself is rugged enough to survive earthquake shaking. When a piece of equipment is required to remain operational after an earthquake, include paragraph Special Testing for Seismic Resisting Equipment. Roof mounted equipment is especially vulnerable due to building sway during seismic event.

****

Equipment must be rigidly or flexibly mounted as indicated on the drawings and in accordance with 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS depending on vibration isolation requirements.

Roof mounted equipment such as cooling towers and condensers, both vibration isolated and nonisolated, must have support members designed and anchored to building structural steel or concrete as required for seismic restraint and wind loads.

2.3 FLEXIBLE JOINTS

****

NOTE: Designer should include reference to other specification sections containing provisions for pipe pressure and temperature ratings, if deemed necessary.

****

Flexible joints must have same pressure and temperature ratings as adjoining pipe. Braided hoses must not be used where there is torsional or axial movement unless manufacturer allows it.

2.3.1 Braided Hose Expansion Joint

Braided hose expansion joint(s) must be installed in the locations indicated on the drawings and as required to accommodate any thermal expansion, contraction or seismic movement of the piping system. Joints must consist of two parallel sections of corrugated metal hose, compatible braid, and 180 degree return bend with inlet and outlet connections. Field fabricated loops are not acceptable. Braided hose expansion joint(s) must be installed in the locations indicated on the drawings and as required to accommodate any thermal expansion, contraction or seismic movement of the piping system. Joints must consist of two parallel sections of corrugated metal hose, compatible braid, and 180 degree return bend with inlet and outlet connections. Field fabricated loops must not be acceptable. Braided hose in a 60 degree flexible V loop arrangement must be used for small diameter pipe connections to coils in variable-air-volume (VAV)terminal units and fan coil units installed in suspended ductwork whether braced or unbraced.

All braided hose expansion joints must be manufactured in accordance with the documented manufacturers weld procedure specifications. The procedure qualification record must be used to document the execution of this procedure and must follow the general "guidelines" of ASME BPVC SEC IX.

Each individual welder must conform to the in-house procedure qualification record and be qualified prior to each production lot. The testing of each individual welder must be documented in a welding procedure qualification record.

****

NOTE: Designer would typically select Type 304 stainless steel for most applications including chilled water, condenser water, heating hot water and steam. Bronze with applicable certifications would typically be selected for potable water and fuel oil service. Type 316 and 321 stainless steel would typically be selected for highly corrosive fluids or surrounding environment.

****

2.3.1.1 Corrugated Hose

Corrugated hose must be [Type [304] [321] [316] stainless steel] [bronze]. Braid must be [Type 304 stainless steel for any series 300 stainless steel hose] [bronze for any bronze hose]. Fittings materials of construction and end fitting type must be consistent with pipe material and equipment/ pipe connection fittings. Copper fittings must not be attached to stainless steel hose.

2.3.1.2 Flexible Hose Expansion Loops

Flexible hose expansion loops must have a factory supplied, hanger / support lug located at the bottom of the 180 degree return. [Flexible hose expansion loop(s) must be furnished with a plugged FPT to be used for a drain or air release vent.] Flexible hose expansion loop(s) must be rated with an operating pressure which is the same as the adjoining pipe. The operating pressure must be based on burst pressure with a 4 to 1 safety factor. [For steam service, the operating pressure must be based on burst pressure with a 8 to 1 safety factor.]

****

NOTE: Flexible expansion joint suitable for liquids under pressure compatible with material and pressure rating of joint.

****

2.3.2 Double Ball Flexible Expansion Joint

Install flexible expansion joints manufactured of ductile iron conforming to the material requirements of ASTM A536 and AWWA C153/A21.53 in the locations indicated on the drawings. Provide foundry certification of material upon request. Each flexible expansion joint must be pressure tested prior to shipment against its own restraint to a minimum of 350 psi (250 psi for flexible expansion joints 2 inch and 30 inches diameter and larger.) A minimum 2:1 safety factor, determined from the published pressure rating, must apply. Factory Mutual Approval for the 3 inch through 12 inch sizes is required. Each flexible expansion joint must consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 20°, 2" - 12"; 15°, 14" - 36"; 12°, 42"-48" and 4-inches minimum expansion. Additional expansion sleeves must be available and easily added or removed at the factory or in the field. Both standardized mechanical joint and flange end connections must be available.

2.3.2.1 Internal Surfaces

Line all internal surfaces (wetted parts) with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of AWWA C213. Sealing gaskets must be constructed of EPDM. The coating must meet NSF/ANSI/CAN 61.

2.3.2.2 Exterior Surfaces

Coat exterior surfaces with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of AWWA C116/A21.16. Include appropriately sized polyethylene sleeves, meeting AWWA C105/A21.5, for direct buried applications.

****

NOTE: Flexible expansion joint gravity drain (non-pressurized) suitable for sanitary drain, waste and vent applications.

****

2.3.3 Double Ball Flexible Expansion Joint Gravity Drain (Non-Pressurized)

Flexible expansion joints gravity drain must be installed in the locations indicated on the drawings and must be manufactured of pvc. All connections whether solvent weld or mechanical must be restrained to allow movement to be transferred to expansion joint. Each ball must allow up to 15 degrees deflection.

End connection outside diameters must be compatible with ASTM D1785, ASTM D2665 and ASTM F891 PVC pipe and are to be solvent welded.

2.4 SUPPORTS AND ATTACHMENTS

Sway bracing materials and associated fasteners and anchors must be as specified in 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS

PART 3 EXECUTION

3.1 COUPLING AND BRACING

****

NOTE: Unless otherwise determined by the Contracting Officer, A-E designs must include complete seismic details showing coupling requirements. Government designer should furnish coupling details for Contractor designed systems if required by the project.

****

a. Submit detail drawings, as specified here and throughout this specification, along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals must be complete in detail; must indicate thickness, type, grade, class of metal, and dimensions; and must show construction details, reinforcement, anchorage, and installation with relation to the building construction.

b. Provide coupling installation conforming to the details shown on the

drawings. Provisions of this paragraph apply to all piping within a 1.5 m 5 foot line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers must be braced at the most frequent interval as determined by applying the requirements of this specification to each piping run on the common support.

c. Size bracing components as required for the total load carried by the common supports. Bracing rigidly attached to pipe flanges, or similar, must not be used where it would interfere with thermal expansion of piping.

d. Adjust isolators and restraints after piping systems has been filled and equipment is at its operating weight, following the manufacturer's written instructions.

e. Install cables at a 45-degree slope. Where interference is present, the slope may be minimum of 30 degrees or a maximum of 60 degrees per VISCMA 412.

3.2 BUILDING DRIFT

****

NOTE: Refer to Section 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS Structural Design Criteria under paragraph GENERAL REQUIREMENTS to determine the expected drift of the building. Insert the expected drift ratio (in terms of seismic drift per unit of story height) in the bracketed space below.

****

Provide joints capable of accommodating seismic displacements 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. Provide horizontal piping across expansion joints to accommodate the resultant of the drifts of each building unit in each orthogonal direction. For threaded piping, provide swing joints made of the same piping material. For piping with manufactured ball joints the seismic drift must be [_____] meters per meter feet per foot of height above the base where the seismic separation occurs; this drift value must 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

Provide flexible couplings or joints in building piping at bottom of all pipe risers for pipe larger than 90 mm 3-1/2 inches in diameter. Laterally brace flexible couplings or joints 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

****

NOTE: This paragraph may not be required for some Seismic Design Category structures. The designer will coordinate the requirements for seismic isolation of piping with the structural and civil design drawings to locate flexible connections as required.

The amount of annular space will depend on the stiffness of the foundation assembly and of the surrounding soil, and the distance between the foundation wall and the point outside the building where the pipe is considered to be restrained. The geotechnical engineer will determine the pipe length necessary to provide fixity. As an approximation, a value of 76 mm 3 inches would be necessary for a pipe penetration in a one-story basement in soft soil.

****

Install flexible coupling in underground piping and 100 mm 4 inch or larger conduit, except heat distribution system, where the piping enters the building. Provide couplings that accommodate [_____] mm inches of relative movement between the pipe and the building in any direction. Provide additional flexible couplings where shown on the drawings.

3.4 PIPE SLEEVES

****

NOTE: The designer will determine the amount of differential movement of piping at pipe sleeves passing through non-fire rated walls and partitions and will indicate on the drawings the amount of clearance required between the pipe and the sleeve based on deflection of the pipe between sway braces on either side of the wall.

The designer should avoid pipe penetrations through fire rated assemblies.

****

Size pipe sleeves in interior non-fire rated walls to provide clearances that will permit differential movement of piping without the piping striking the pipe sleeve. Pipe sleeves in fire rated walls must conform to the requirements in Section 07 84 00 FIRESTOPPING.

3.5 SPREADERS

****

NOTE: Refer to UFC 3-301-01 for guidance on separation between pipes and requirements for spreaders.

****

Provide spreaders between adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than [100][_____] mm [4][_____] inches apart. Apply spreaders 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.

Apply spreaders to surface of bare pipe and over insulation on insulated pipes utilizing high-density inserts and pipe protection shields in accordance with the requirements of Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.6 SWAY BRACES FOR PIPING

Provide sway braces to prevent movement of the pipes under seismic loading. Provide braces in both the longitudinal and transverse directions, relative to the axis of the pipe. Provide sufficient braces for equipment to resist a horizontal force as specified in UFC 3-301-01[UFC 3-301-02] without exceeding safe working stress of bracing components. Provide bracing that does not interfere with thermal expansion requirements for the pipes as described in other sections of these specifications. For seismic analysis of horizontal pipes, the equivalent static force should be considered to act concurrently with the full dead load of the pipe, including contents.

3.6.1 Transverse Sway Bracing

****

NOTE: Piping can be either rigid or flexible. Rigid piping has a period of vibration of 0.06 seconds or less. Piping systems with spacing between braces that exceeds allowable spacing for rigid piping will be deemed flexible and will be designed accordingly.

The designer should provide requirements for bracing PVC pipes.

****

Provide transverse sway bracing for steel and copper pipe at intervals not to exceed those shown on the drawings. All runs (length of pipe between end joints) must have a minimum of transverse bracing at each end. Provide transverse sway bracing for pipes of materials other than steel and copper at intervals not to exceed the hanger spacing as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.6.2 Longitudinal Sway Bracing

****

NOTE: Locate longitudinal sway braces on the drawings for systems subject to thermal expansion because indiscriminate placement of sway braces may interfere with expansion requirements.

****

Provide longitudinal sway bracing at 12 m 40 foot intervals unless otherwise indicated. All runs (length of pipe between end joints) must have one longitudinal brace minimum. Construct sway braces in accordance with the drawings. Do not use branch lines, walls, or floors as sway braces.

3.6.3 Vertical Runs

Run is defined as length of pipe between end joints. Do not brace vertical runs of piping at intervals greater than 3 meters 10 feet. Braces for vertical runs must be above the center of gravity of the segment being

braced. Flexible couplings should be provided at the bottoms of risers for pipes larger than 3.5 in. (89 mm) in diameter. Flexible couplings and expansion joints should be braced laterally and longitudinally unless such bracing would interfere with the action of the couplings or joints. When pipes enter buildings, flexible couplings should be provided to allow for relative movement between the soil and building. Construct all sway braces in accordance with the drawings. Attach sway braces to the structural system. Do not connect to branch lines, walls, or floors.

3.6.4 Clamps and Hangers

Apply clamps or hangers on uninsulated pipes directly to pipe. Insulated piping must have clamps or hangers applied over insulation in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

Hanger rod stiffener angle or strut bracing must be securely attached by a series of attachment clamps manufactured from a one piece metal stamping and must include all require attachment hardware and locking nuts. Attachment clamps made from aluminum or cast iron must not be used in seismic applications. Do not weld vertical braces to hanger rods.

3.7 SWAY BRACES FOR DUCTS

3.7.1 Braced Ducts

Provide bracing details and spacing for rectangular and round ducts in accordance with SMACNA 1981. However, the design seismic loadings for these items must not be less than loadings obtained using the procedures in UFC 3-301-01[UFC 3-301-02]. Bracing must not attach to duct joints. Use shortest screws possible when penetrating ductwork to minimize airflow noise inside duct.

3.7.2 Unbraced Ducts

Attach hangers for unbraced ducts to the duct within 50 mm 2 inches of the top of the duct with a minimum of two #10 sheet metal screws in accordance with FEMA P-414. Use shortest screws possible when penetrating ductwork to minimize airflow noise inside duct. Install unbraced ducts with a 150 mm 6 inch minimum clearance to vertical ceiling hanger wires.

3.8 EQUIPMENT

3.8.1 Equipment Support Requirements

Refer to 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS for requirements.

3.8.2 Controls

Ensure that controls for critical equipment that must remain operational after an earthquake are certified per 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS paragraph SPECIAL TESTING FOR SEISMIC-RESISTING EQUIPMENT and are served by emergency power as required.

3.9 ANCHORS

Refer to 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS for requirements.

3.10 SPECIAL TESTING FOR SEISMIC-RESISTING EQUIPMENT

Refer to 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS for requirements.

3.11 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS AND EQUIPMENT

Refer to 13 48 73 SEISMIC CONTROL FOR NONSTRUCTURAL COMPONENTS for requirements.

-- End of Section --