

SECTION 21 05 48

VIBRATION AND SEISMIC CONTROLS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SECTION INCLUDES

- A. Seismic restraints for Fire Protection piping, components, and equipment.
- B. For equipment and situations not addressed in this section, Section 230548 takes precedence.

1.03 RELATED REQUIREMENTS

- A. Section 01 45 33 - Code-Required Special Inspections and Procedures.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Section 23 05 48 - Vibration And Seismic Controls For HVAC Piping And Equipment
- D. Section 21 05 00 Common Work Results for Fire Suppression

1.04 DEFINITIONS

- A. Fire Suppression Component: Where referenced in this section in regards to seismic controls, applies to any portion of the fire suppression system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.05 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2014.
- C. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- D. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
- E. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.
- F. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.
- G. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.
- H. FM 1950 - Examination Standard for Seismic Sway Braces for Pipe, Tubing and Conduit ; 2023.
- I. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2020).
- K. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. UL 203A - Standard for Sway Brace Devices for Sprinkler System Piping; Current Edition, Including All Revisions.
- N. FM DS 2-8

1.06 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Seismic Controls:
 - a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
 - b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 30 00.

1.07 PERFORMANCE REQUIREMENTS

- A. Seismic Restraint Loading:
 - 1. Site Class as defined in the ICC (IBC).
 - 2. Occupancy Category as defined in the ICC (IBC).
 - 3. Seismic Design Category as defined in the ICC (IBC).
 - 4. Design Spectral Response Acceleration at Short Periods (0.2 Second).
 - 5. Least radius of gyration for rigid bracing shall not be less than $l/r=200$.
 - 6. See drawings for seismic design criteria.

1.08 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 - 1. Seismic Controls: Include seismic load capacities.
- D. Shop Drawings - Seismic Controls:
 - 1. Include dimensioned plan views and sections indicating proposed fire suppression component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
 - 2. Identify mounting conditions required for equipment seismic qualification.
 - 3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements as evaluated by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.
 - 4. Indicate proposed arrangement of distributed system trapeze support groupings.
 - 5. Indicate proposed locations for distributed system flexible fittings and/or connections.
 - 6. Indicate locations of seismic separations where applicable.
 - 7. Include point load drawings indicating design loads transmitted to structure at each attachment location.
- E. Seismic Design Data:

1. Compile information on project-specific characteristics of actual installed fire suppression components necessary for determining seismic design forces required to design appropriate seismic controls.
 2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.
- F. Certification for seismically qualified equipment; identify basis for certification.
- G. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.
- H. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- I. Evidence of qualifications for seismic controls designer.
- J. Evidence of qualifications for manufacturer.
- K. Manufacturer's detailed field testing and inspection procedures.
- L. Field quality control test reports.

1.09 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located or NICET Level III and with minimum five years experience designing seismic restraints for nonstructural components.
- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- E. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- F. 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 not available, submittals based on independent testing are preferred.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SEISMIC CONTROL REQUIREMENTS

- A. Design and provide fire suppression component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor fire suppression components.
- B. Seismic Design Criteria: Obtain from project Structural Engineer of Record.
- C. Component Importance Factor (I_p): Fire suppression components to be assigned a component importance factor (I_p) of 1.5 unless otherwise indicated.
- D. Seismic Qualification of Equipment:
1. Provide special certification for fire suppression equipment furnished under other sections and assigned a component importance factor (I_p) of 1.5, certifying that equipment will remain operable following a design level earthquake.

2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
 3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
 4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.
- E. Seismic Restraints:
1. Provide seismic restraints for fire suppression components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
 2. Seismic Restraint Exemptions, All Seismic Design Categories:
 - a. Fire Suppression Piping Exemptions, All Seismic Design Categories:
 - 1) Lateral sway bracing for piping individually supported within 6 inches (150 mm) of the structure measured between the top of pipe and the point of attachment to the structure, where all conditions for exception specified in NFPA 13 are met.
 - 2) Lateral sway bracing for branch lines smaller than 2-1/2 inches (65 mm) in diameter, where branch line restraint is provided in accordance with NFPA 13.
 3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
 - a. ASHRAE (HVACA).
 - b. FEMA 412.
 - c. FEMA 413.
 - d. FEMA 414.
 - e. FEMA E-74.
 4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
 5. Seismic Restraint Systems:
 - a. Arrange restraint elements to avoid obstruction of sprinklers in accordance with NFPA 13.
 - b. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
 - c. Use only one restraint system type for a given fire suppression component or distributed system (e.g., piping) run; mixing of cable and rigid restraints on a given component/run is not permitted.
 - d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain fire suppression component in all lateral directions; consider bracket geometry in anchor load calculations.
 - e. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported fire suppression component weight.
 - f. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
- F. Seismic Attachments:
1. Comply with support and attachment requirements of NFPA 13.
 2. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
 3. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.

4. Do not use power-actuated fasteners.
5. Do not use friction clips (devices that rely on mechanically applied friction to resist loads) except where listed for such use. Beam clamps may be used for supporting sustained loads where provided with restraining straps, but not for sway bracing attachments as prohibited by NFPA 13.
6. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
7. Concrete Housekeeping Pads:
 - a. Increase size of pad as required to comply with anchor requirements.
 - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.
- G. Seismic Interactions:
 1. Include provisions to prevent seismic impact between fire suppression components and other structural or nonstructural components.
 2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
 3. Comply with minimum clearance requirements between other equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.
- H. Seismic Relative Displacement Provisions:
 1. Use suitable fittings or flexible connections, in accordance with NFPA 13, to accommodate:
 - a. Relative displacements at connections between components, including distributed systems (e.g., piping); do not exceed load limits for equipment utility connections.
 - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
 - c. Design displacements at seismic separations.
 - d. Anticipated drifts between floors.
 2. Provide clearance around fire suppression system piping extending through walls, floors, platforms, and foundations in accordance with NFPA 13.

2.02 SEISMIC RESTRAINT SYSTEMS

- A. Manufacturers:
 1. Subject to compliance with requirements, provide products by one of the following, as appropriate:
 - a. Seismic Restraint Systems:
 - 1) Eaton Corporation; TOLCO: www.eaton.com.
 - 2) AFCON: www.afcon.org
 - 3) Substitutions: See Section 01 60 00 - Product Requirements.
 2. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.
- B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
- C. Where required by NFPA 13, provide products listed as complying with UL 203A or FM 1950.
- D. Rigid Restraints: Use steel pipe for structural element; suitable for both compressive and tensile design loads.
 1. Material: Schedule 40 pipe or other calcualted rigid bracing element.
- E. General Requirements for Restraint Components:
 1. Products to be listed in accordance with the requirements of NFPA 13.
 2. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES or an agency acceptable to the Authority 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

will be subjected. Follow manufacturer's maximum design loads reduced as appropriate.

3. Size: Based on the lesser of bracing element capacity or anchor load taking into account brace geometry.
4. Mechanical Anchor Bolts: Drilled-in, 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 E488/E488M. Minimum length of eight times diameter.
5. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl 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 E488/E488M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 CODE-REQUIRED SPECIAL INSPECTIONS

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 01 45 33 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
 1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
 2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Seismic special inspections include, but are not limited to:
 1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with certificate of compliance.
 2. Verification of required clearances between other equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.
- D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
- E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Comply with the requirements of NFPA 13.
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Secure fasteners according to manufacturer's recommended torque settings.

- E. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- F. Seismic Controls:
 - 1. Comply with the requirements of ASCE 7, FEMA E-74, NFPA 13, and applicable local building codes.
 - 2. Seismic Restraint Systems:
 - a. Provide seismic bracing.
 - b. Provide end of line restraint.
 - c. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
 - d. Install restraints within permissible angles in accordance with seismic design.
 - e. When used, install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.
- D. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.05 ATTACHMENTS

- A. Statement of special inspections.

END OF SECTION

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