

Examination Standard

Seismic Sway Braces for
Pipe, Tubing and Conduit

Class Number 1950
August 2023



Member of the FM Global Group

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Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

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1 INTRODUCTION

1.1 Purpose

- 1.1.1 This standard states testing and certification requirements for rigid seismic sway brace components and assemblies for pipe, tubing and conduit.
- 1.1.2 Testing and certification criteria may include performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance program.

1.2 Scope

- 1.2.1 This standard encompasses the design and performance requirements for rigid seismic sway brace components used to brace pipe, tubing and conduit (i.e. building attached components and piping attached components).

For rigid seismic sway braces, the general requirements for seismic sway bracing components apply to the components that are attached to the structural element and the components that are attached to the pipe, tube or conduit. The brace member that connects the building-attached component and the piping-attached component is used in the testing, but not included within the scope of the standard. However, sway brace assemblies which include the brace member as a permanent, integral component of the product are within the scope of the standard.

The brace member is to be designed for the tension and compression axial load applied and any eccentricity of axial force. However, the attachment nominal strength will be affected by the brace material and wall or leg thickness at the connection to the brace member, which can contribute to the limitations of the load rating of the attachment.

The evaluation of building-attached components is based on the premise that the component would either break, or deform in excess of the allowed limits, prior to either the failure of the attachment fastener, or the deflection of the structural member (e.g. beam). Therefore, the attachment fastener and structural members are not considered to be within the scope of this examination standard.

- 1.2.2 The evaluation of piping-attached components is based on the premise that the component would break, deform in excess of allowed limits, or lose its grip on the pipe.
- 1.2.3 Seismic sway brace components are designed to attach to pipe, tubing or conduit from Nominal Pipe Size (NPS) 1 to 12 inch (DN25 – 300).
- 1.2.4 In the case of rigid seismic sway brace assemblies, the general requirements and performance requirements apply to the entire assemblies.

1.3 Basis for Requirements

- 1.3.1 The requirements of this standard are based on experience, research and testing, and/or the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions, and/or loss control specialists was also considered. The underlying details and assumptions that define the basis for the research and development of this examination standard are contained in the Earthquake Spectra article *Test protocol for sprinkler-pipe seismic-brace components*.

- 1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of seismic sway bracing components for the purpose of obtaining certification.

1.4 Basis for Certification

Certification is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

- 1.4.1 Examination and tests on production samples shall be performed to evaluate:

- the suitability of the product;
- the performance of the product as specified by the manufacturer and required for certification;
- the durability and reliability of the product.

- 1.4.2 An examination of the manufacturing facilities and audit of quality control procedures may be made to evaluate the manufacturer's ability to consistently produce the product which is examined and tested, and the marking procedures used to identify the product. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme to ensure ongoing compliance.

1.5 Basis for Continued Certification

The basis for continual certification may include, but is not limited to, the following based upon the certification scheme and requirements of the certification agency:

- production or availability of the product as currently certified;
- the continued use of acceptable quality assurance procedures;
- compliance with the terms stipulated by the certification;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory surveillance audits conducted as part of the certification agency's product surveillance program.

1.6 Effective Date

The effective date of this certification standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this standard is eighteen (18) months after the publication date of the standard for compliance with all requirements.

1.7 System of Units

Units of measurement used in this standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10.

1.8 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the cited edition applies.

ANSI/IEEE/ASTM SI 10, *American National Standard for Metric Practice*

ASME B36.10M, *Welded and Seamless Wrought Steel Pipe*

ASTM B633, *Standard Specification for Electrodeposited Coatings of Zinc on Iron or Steel*

1.9 Definitions

For purposes of this standard, the following terms apply:

Accepted – This term refers to installations acceptable to the authority enforcing the applicable installation rules. Acceptance is based upon an overall evaluation of the installation. Acceptance is not a characteristic of a product. It is installation specific. A product accepted for one installation may not be acceptable elsewhere.

Allowable Strength - Used in Allowable Stress Design (ASD), the allowable strength is the horizontal nominal strength (R_{Hn}) divided by a safety factor (Ω).

Allowable Stress Design (ASD) - Allowable Stress Design (a.k.a. Allowable Strength Design) is a method of comparing the allowable strength of a component to the required strength under ASD load combinations.

Attachment Fastener – The fastener used to connect the building-attached component to the structural member.

Brace Member – This is the component between the building-attached component and the piping-attached component. This is usually made from steel pipe, strip steel, angle steel, strut, etc. For the purposes of this standard, the brace member is considered rigid.

Conduit – For the purposes of this standard conduit refers to the product being braced; that is, pipe, tubing or conduit.

Corrosion Resistant – Having resistance to corrosion equal to or exceeding that of carbon steel coated per electro-deposit process with zinc coating thickness of a minimum of 5 μm .

Design Strength - Used in Load and Resistance Factor Design (LRFD), the design strength is the nominal strength (R_n) multiplied by a resistance factor (ϕ).

Horizontal Nominal Strength (R_{Hn}) - For the tested brace orientation (Θ), the horizontal nominal strength (R_{Hn}) is the nominal strength (R_n) multiplied by the Sin (Θ) (See Section 4.2.4.2)

Lightwall Pipe – Lightwall pipe is characterized by having a combination of outside diameter and wall thickness not suitable for cut grooving or threading. Lightwall pipe shares the same outside diameter dimensions as Schedule 40 pipe, however the wall thickness of Lightwall pipe ranges between that of Schedule 5 and 10 and can vary from manufacturer to manufacturer. The normal end connections for Lightwall pipe are: welded, roll grooved, and plain end. This pipe is also commonly referred to in industry as “Flow” pipe or “Schedule 7” pipe. There is no national or international standard for this product at this time.

Load at Failure - This term relates to the actual load at which the test sample is observed to fail either by actual mechanical fracture or by exceeding a predetermined limit for displacement.

Load and Resistance Factor Design (LRFD) - Load and Resistance Factor Design (a.k.a. strength design) is a method of comparing the design strength of a component to the required strength under LRFD load combinations.

Load Rating - This term refers to the horizontal load rating assigned to a component as the result of testing and analysis. The horizontal load rating may be expressed with factors to account for different angles of installation. The horizontal load rating may also be expressed in terms of Allowable Stress Design, or in terms of Load Resistance Factor Design.

Nominal Strength (R_n) - The nominal strength (R_n) is the lowest load at failure for the series of tests (see Section 4.2.4.2)

Pipe – For the purposes of this standard Pipe and/or Piping refers to the product being braced; that is pipe, tubing or conduit.

Resistance Factor (ϕ) - The Resistance Factor (ϕ) (a.k.a. Strength Reduction Factor) is used in Load and Resistance Factor Design (LRFD). Additional information related to factors used in the determination of Load and Resistance Factor Design may be found in AISI Standard S100, North American Specification for the Design of Cold Formed Structural Steel Members.

Rod Stiffener – This term refers to a product that is attached directly to the all-thread hanger rod in order to provide an increased measure of resistance to buckling when subjected to axial compressive loading.

Safety Factor (Ω) - Used in Allowable Stress Design (ASD), this is a factor, by which the horizontal nominal strength (R_{Hn}) is divided to account for deviations of the horizontal nominal strength from the actual strength, deviations in assumed loads, and for the manner and consequence of failure.

Schedule 40 Pipe – Schedule 40 pipe refers to a historically accepted combination of outside diameter and wall thickness that has been subsequently published in national standard ASME B36.10M. Other national and international standards also make reference to Schedule 40 pipe but may or may not reflect the same dimensions for a given nominal pipe size. Certified end connections are threaded, welded, rolled or cut groove, or plain end.

Schedule 30 Pipe – Schedule 30 pipe refers to a historically accepted combination of outside diameter and wall thickness that has been subsequently published in national standard ASME B36.10M. Other national and international standards also make reference to Schedule 30 pipe but may or may not reflect the same dimensions for a given nominal pipe size. Certified end connections are welded, rolled groove, or plain end.

Schedule 10 Pipe – Schedule 10 pipe refers to a historically accepted combination of outside diameter and wall thickness that has been subsequently published in national standard ASME B36.10M. Other national and international standards also make reference to Schedule 10 pipe but may or may not reflect the same dimensions for a given nominal pipe size. Certified end connections are welded, rolled groove, or plain end.

Schedule 5 Pipe – Schedule 5 pipe refers to a historically accepted combination of outside diameter and wall thickness that has been subsequently published in national standard ASME B36.10M. Other national and international standards also make reference to Schedule 5 pipe but may or may not reflect the same dimensions for a given nominal pipe size. Certified end connections are welded, roll grooved, mechanically swaged fittings.

Seismic Sway Brace – Rigid Brace Style – An assembly consisting of two components (as described below), interconnected by a rigid brace member, intended to minimize the differential movement between the sprinkler system piping and the structure to which it is attached, during an earthquake.

Building-Attached Component – A component of a seismic sway brace intended to provide a means of attachment to a structural element of a building.

Piping-Attached Component – A component of a seismic sway brace intended to provide a means of attachment to the pipe, tube or conduit.

Seismic Sway Brace – Two-Way Brace and Four-Way Brace – For risers and overhead sprinkler piping, there are two sway bracing designs; two-way and four-way. Two-way braces are designed to resist either longitudinal or lateral movement with respect to the axis of the pipe. Lateral movement is normal to longitudinal movement and is generally regarded as horizontal. Four-way sway bracing resists differential movement in all horizontal directions.

Tubing – For the purposes of this standard tubing refers to the product being braced; that is pipe, tubing or conduit.