



Member of the FM Global Group



American National Standard for Seismic Sway Braces for Pipe, Tubing and Conduit

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Foreword

This standard is intended to be used to evaluate components and performance of seismic sway brace equipment.

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Table of Contents

1. INTRODUCTION	1
1.1 Purpose	1
1.2 Scope	1
1.3 Basis for Requirements.....	1
1.4 Basis for ANSI Specification	1
1.5 System of Units.....	2
1.6 Applicable Documents	2
1.7 Definitions.....	2
2. GENERAL INFORMATION	5
2.1 Product Information	5
2.2 Application Requirements.....	5
2.3 Requirements for Samples for Examination	5
3. GENERAL REQUIREMENTS	6
3.1 Review of Documentation.....	6
3.2 Physical or Structural Features – Rigid Brace Assemblies	6
Figure 3.2.2A Typical Brace Layout, Horizontal Pipe	6
Figure 3.2.2B Typical Brace Layout, Vertical Pipe	7
3.3 Materials.....	8
3.4 Markings.....	8
3.5 Manufacturer's Installation Instructions.....	8
3.6 Calibration.....	9
3.7 Test Facilities.....	9
3.8 Tolerances.....	9
4. PERFORMANCE REQUIREMENTS	9
4.1 Examination	10
4.2 Cyclic Testing (Component Testing)	10
Figure 4.2 – Building Attached Subassembly, 30° Orientation.....	10
Figure 4.2.2 Force History Plot (Component Testing)	11
Figure 4.2.3A – Building-Attached Component with Overhead Attachment to Floor or Beam	12
Figure 4.2.3B – Building-Attached Component with Side Attachment to Wall or Beam.....	13
4.3 Additional Tests	14
5. REPORTING REQUIREMENTS	15
5.1 Final Report	15
5.2 Samples.....	15
5.3 Test Method	15
5.4 Horizontal Load Ratings	16
5.5 Calibration of Equipment.....	16
5.6 Review and Signatures.....	16
APPENDIX A: Units of Measurement	17
APPENDIX B: Tolerances.....	18

1. INTRODUCTION

1.1 Purpose

This standard states the examination criteria for rigid seismic sway brace components for pipe, tubing and conduit.

1.2 Scope

- 1.2.1 This standard encompasses the design and performance requirements for rigid seismic sway bracing components used to brace pipe, tubing and conduit.
- 1.2.2 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. Although used in testing, the brace member that is attached between the building-attached component and the piping-attached component is used in testing, but not included within the scope of the standard.
- 1.2.3 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 Approval Standard.
- 1.2.4 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.
- 1.2.5 Seismic sway brace components are designed to attach to pipe, tubing or conduit from Nominal Pipe Size (NPS) 1 to 12 in (DN25 – 300) nominal pipe size.

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.
- 1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of seismic sway bracing components. Seismic sway bracing components having characteristics not anticipated by this standard may be tested if demonstrated performance is equal, or superior, to that required by this standard, or if the intent of the standard is met.

Alternatively, seismic sway bracing components that meet all of the requirements identified in this standard may not be acceptable if other conditions that adversely affect performance exist or if the intent of this standard is not met. It is the sole discretion of the testing laboratory.

1.4 Basis for ANSI Specification

- 1.4.1 Certification is based upon satisfactory evaluation of the product and the manufacturer. 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 by FM Approvals; and as far as practical,
 - The durability and reliability of the product.
- 1.4.2 A satisfactory review of the manufacturer's installation instructions for the seismic sway brace components or assemblies is required. The evaluation shall be performed to ensure that the document is accurate and complete.

1.5 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. Appendix A lists the selected units and conversions to SI units for measures appearing in this standard. Conversion of U.S. customary units is in accordance with the Institute of Electrical and Electronics Engineers (IEEE)/American Society for Testing Materials (ASTM) SI 10-2002, *American National Standard for Use of the International System of Units (SI): The Modern Metric System*.

1.6 Applicable Documents

This standard is used in conjunction with the following standards, test methods, and practices.

American Iron and Steel Institute (AISI), 25 Massachusetts Avenue NW, Suite 800, Washington, DC 20001,
www.steel.org
AISI S100-Feb 2010, *North American Specification for the Design of Cold Formed Steel Structural Members*

American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016, www.asme.org
ASME B36.10M-2004, *Welded and Seamless Wrought Steel Pipe*

American Society for Testing and Materials (ASTM International), 100 Bar Harbor Drive, West Conshohocken, PA, 2003, DOI: 10.1520/C0033-03A, www.astm.org
ASTM A153/A153M - 09, *Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*
ASTM B633-07, *Standard Specification for Electrodeposited Coatings of Zinc on Iron or Steel*
ASTM SI10 - 2002, *IEEE/ASTM SI 10 American National Standard for Use of the International System of Units (SI): The Modern Metric System*

FM Global, Corporate Offices, 270 Central Avenue, Johnston, RI 02919, www.fmglobal.com
P. K. Malhotra, Paul Senseny, Antonio Braga and Roger Allard, "Test protocol for sprinkler-pipe seismic-brace components," *Earthquake Spectra*, Volume 19, No 1, pp 87-109, February 2003.
FM Global Property Loss Prevention Data Sheets

International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, Case postale 56, CH-1211 Geneva 20, Switzerland, www.iso.org

International Electrotechnical Commission (IEC), 3, rue de Varembe, P. O. Box 131, 1211 Geneva 20, Switzerland, www.iec.ch
ISO/IEC 17025-2005 (R2010), *General Requirements for the Competence of Testing and Calibration Laboratories*

Occupational Safety & Health Administration (OSHA), 200 Constitution Avenue, NW, Washington, DC 20210, www.osha.gov
OSHA Code of Federal Regulations 29 CFR part 1910, *Occupational Safety and Health Standards*
OSHA Directive Number CPL1-03 titled: NRTL Program Policies, Procedures and Guidelines

1.7 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 of: steel pipe, strip steel, angle steel, strut, etc. For the purposes of this standard, the brace member is considered rigid.

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 $\sin(\Theta)$ (See Section 4.2.2.6).

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 4.2.2.5)

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). Resistance Factors are less than 1.0 and load factors in LRFD load combinations are commonly greater than 1.0. 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. Safety Factors are greater than 1.0 and the load factors in ASD load combinations are typically 1.0 or less. Additional information related to factors used in the determination of Allowable Stress Design may be found in AISI Standard S100, *North American Specification for the Design of Cold Formed Structural Steel Members*.

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-2004. 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. Approved 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-2004. 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. Approved 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-2004. 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. Approved 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-2004. 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. Approved 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.