**INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS**

**UNIFORM EVALUATION SERVICES**

**EVALUATION CRITERIA FOR SEISMIC CABLE RESTRAINTS**

**EC 037-2018**

**(Adopted \_\_\_\_ 2018)**

1. **INTRODUCTION**
	1. **Purpose:**

The purpose of this evaluation criteria is to establish requirements for *tension only* *seismic cable restraints* to be recognized in an evaluation report independently reviewed and issued by a certification body under the International Building Code® (IBC) and the International Residential Code® (IRC).

This evaluation criteria serves as a guide for code officials, producers, distributors, architects, engineers, contractors, installers, inspectors and users; to promote understanding regarding design, materials, manufacture and installation; and to provide for identification of installations complying with this evaluation criteria.

 The provisions of this evaluation criteria are not intended to prevent the use of any alternative set of requirements provided any such alternative requirements are proven to be at least equivalent to the conditions set forth in this document, or the applicable code.

* 1. **Scope:**

This evaluation criteria applies to tension only *seismic cable restraints* made from steel wire ropes or cables and fittings, as permitted by ASCE 19 Appendix E. Section 104.11 of the IBC is applicable since the codes and standards do not clearly present procedures for qualifying all fitting styles and lacks seismic testing methods appropriate for *seismic cable restraints*. As an option, systems consisting of the *seismic cable restraints* may be evaluated. Fittings that are alternatives to those offered as examples in Section E5.3 of ASCE 19 may be considered provided conformance to this evaluation criteria is achieved. *Seismic cable restraints* complying with this evaluation criteria are limited to support of *non-structural components* for resisting earthquake induced loads only.

The certification body issuing the evaluation report shall be accredited as complying with ISO/IEC Standard 17065 by an accreditation body conforming to ISO/IEC 17011 that is a signatory to the International Accreditation Forum (IAF) Multilateral Recognition Agreement (MLA). The scope of accreditation shall include metal building products.

1. **DEFINITIONS:**

For terms not defined in this section, applicable codes, or referenced standards shall have the ordinary accepted definition for the context for which they are intended.

* 1. **Non-structural Component:** A part of an architectural, mechanical, plumbing or electrical system within or without a building or non-building structure (ASCE 7).
	2. **Seismic Cable Restraints:** An assembly of steel wire rope or aircraft cable and cable fittings used as a *single-directional*, single-axis, multi-angle restraint to restrain the *non-structural components* against earthquake loads. The cable fittings form loops in the cable or rope for connection to other building components and the structure.
	3. **Load Rating:** The design strength, in tension, of the *seismic cable restraint* or assembly for resisting earthquake forces, which is presented for Allowable Stress Design or Load Resistance Factor Design.

* 1. **Single-Directional:** A type of restraint that resists a load on one axis in only one direction in tension.
	2. **Tension Only:** A type of restraint that resists a load on one axis in only tensile direction i.e. *seismic cable restraint*.
1. **REFERENCED STANDARDS**

Standards shall be applied consistent with the specific edition of the code(s) for which the Evaluation Report is prepared unless otherwise approved by UES.

# International Code Council

* + - International Building Code, (IBC), 2018, 2015, 2012, 2009
		- International Residential Code, (IBC), 2018, 2015, 2012, 2009

# Other Applicable Codes and Standards:

# ANSI/ASHRAE 171-2017: Method of Testing for Rating Seismic and Wind Restraints, ASHRAE

# ANSI/FM 1950-2016: American National Standard for Seismic Sway Braces for Pipe, Tubing & Conduit, FM Approvals

# FM 1950-2013: Approval Standard for Seismic Sway Braces for Pipe, Tubing & Conduit, FM Approvals

# FM 1950-2010: Approval Standard for Seismic Sway Braces for Automatic Sprinkler Systems

* ASTM A931:Standard Test Method for Tension Testing of Wire Ropes and Strand, ASTM International
* ASTM A1007:Standard Specification for Carbon Steel Wire for Wire Rope, ASTM International

# ASTM A1023: Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes, ASTM International

# EN 10244-2:2009: Steel wire and wire products ― Non-ferrous metallic coatings on steel wire. Part 2: Zinc or zinc alloy coatings, Comite Europeen de Normalisation

# EN 12385-4:2008-06: Stranded Ropes for General Lifting Applications, Comite Europeen de Normalisation

# ASCE/SEI 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures, American Society of Civil Engineers

# ASCE/SEI 19-16: Structural Applications of Steel Cables for Buildings, American Society of Civil Engineers

# NFPA 13: Standard for the Installation of Sprinkler Systems, National Fire Protection Association

# ISO/IEC 17011:2004 – Conformity Assessment – General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies, International Organization for Standardization

# ISO/IEC 17020:2012 – Conformity Assessment – Requirements for the Operation of Various Types of Bodies Performing Inspection, International Organization for Standardization

# ISO/IEC 17025:2005 – General Requirements for the Competence of Testing and Calibration Laboratories, International Organization for Standardization

# ISO/IEC 17065:2012 -- Conformity assessment -- Requirements for Bodies Certifying Products, Processes and Services, International Organization for Standardization

1. **BASIC INFORMATION**
	1. **Description:** The following information and data shall be submitted for review and evaluation for recognition of *seismic cable restraints* in an evaluation report:
		1. **Product Description:**

Description of system and components shall include dimensions, manufacturing method, constituent materials, surface finishes, coatings, fabrication techniques, physical properties, chemical properties, and other material specifications. Cables with non-metallic cores are beyond the scope of this criteria.

* + 1. **Installation Instructions:**

The instructions shall include methods for field preparation and assembly, identification, limitations, and additional requirements.

* + 1. **Packaging and Identification:**

Packaging to include labels with the necessary provisions to ensure the correct field identification of wire rope size and *seismic cable restraint* assembly design strength associated with that model.

Color coded identification tags and color coded wire ropes complying with Section E7.4 of ASCE 19 are some of the examples of such provisions. The identifying marks, evaluation report number’ and other identification methods of the certification body shall be included on the labels.

* 1. **Test Reports:** Test reports, submitted to the certification body, shall consist of:
		1. A description of the test procedures, test results, observations, tested assemblies, load measurements, and photographs of specimens and typical failures.
		2. A description of the test specimens.
		3. Information as set forth in the referenced test standard.
	2. **Testing Laboratories:** Laboratories shall be accredited as complying with ISO/IEC Standard 17025. The laboratory’s scope of accreditation shall include the applicable test procedures or standards. The laboratory’s accreditation shall be issued by an accreditation body conforming to ISO/IEC 17011 and that is a signatory of the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA).
	3. **Product Sampling:** The test specimens shall be sampled or verified by an accredited inspection agency or testing laboratory. The sampled product shall be representative of the production ongoing after the sampling has taken place. The product specifications shall be within the tolerance limits reported in the quality documentation and the relevant standards.
1. **TESTING AND PERFORMANCE REQUIREMENTS**
	1. **Cable or Wire Rope:**
		1. Steel Cable and wire rope shall have steel cores and comply with Table 7 of ASTM A1023 or EN12385-4 and applicable requirements in Appendix E of ASCE 19. The test report shall report results of investigation and testing to establish compliance with these referenced standards.
		2. Wires shall be galvanized in accordance with ASTM A1007 or EN-10244-2.
		3. Pre-stretched cable or wire shall comply with Sections E.4 and E7.3 of ASCE 19 and the applicable cable or wire rope specification. The pre-stretching force shall the lesser of that provided in Section E4.2 of ASCE 19 and the cable or wire rope specification.

* 1. **End Fittings and Intermediate Fittings:** Testing demonstrating compliance with Section E3.3.2 of ASCE 19 for a fitting and cable combination shall be replaced by testing in accordance with Section 5.3 of this evaluation criteria.
	2. ***Seismic Cable Restraint* Testing:**
		1. For each test of a *seismic cable restraint* or assembly, the minimum number of replicate specimens is four.
		2. Requirements related to test set-up, apparatus and loading procedure shall comply as prescribed by the applicable testing standard. The fittings in the *seismic cable restraints* shall be within the load path.
		3. Static testing of the *seismic cable restraints* or assemblies containing *seismic cable restraints* shall be in accordance with ASTM A931.
		4. Seismic testing of the *seismic cable restraints* or assemblies containing *seismic cable restraints* shall be in accordance with Section 13.2.5 of ASCE 7. Testing in accordance with cyclic load testing standards for seismic sway bracing, such as ASHRAE Standard 171 or FM 1950 shall be deemed to comply with the requirements of ASCE 7 and this evaluation criteria. Only one of the selected testing standards shall be used for the complete performance testing of the *seismic cable restraints* or assemblies.
		5. *Seismic Cable restraint* assemblies with the characteristics not anticipated by this evaluation criteria may be tested if demonstrated performance is equal, or superior, to that required by this or relevant standards, or if the intent of this evaluation criteria or the referenced cyclic load testing standards is met.
	3. ***Load Ratings*:**
		1. The test results from Section 5.3 of this evaluation criteria shall be evaluated in accordance with the same testing standard used for the performance testing of the *seismic cable restraint* or assembly.
		2. The *load ratings* shall be reported as ASD or LRFD.
		3. ASD Factor of Safety and LRFD Resistance Factors for the respective *load ratings* based on cyclic loading test shall be used in accordance with applicable testing standard. For all editions of FM 1950, the ASD safety factor (Ω) shall be less than 2.0 and the LRFD Resistance Factor (ϕ) shall be no greater than 0.70.
		4. The cyclic load tests shall be conducted in accordance with Section 5.3.4 of this criteria. The LRFD l*oad rating* (Ru**)** shall be determined in accordance with Section 5.4.3 of this criteria**.**
		5. The static tension tests shall be conducted on the *seismic* *cable restraints* in accordance with Section 5.3.3 of this evaluation criteria to determine the peak load (Rs). Rs shall be taken as the lowest individual failure load at failure, i.e., not the mean of the results.
		6. The adjusted test result (R­Red) to this Static Peak Load (Rs) shall be compute by Eq.1:

$R\_{Red}=∅R\_{s} $ (Eq. 1)

Where:

R­Red = Adjusted static LRFD load

Rs = The static tension peak load determined in accordance with Section 5.4.5 of this evaluation criteria.

 ϕ = 0.65

* + 1. The *Load Rating* for a s*eismic cable restraint* shall be the lesser of LRFD *Load Rating* from cyclic test (Ru) and adjusted peak load from a static tension test (RRed).
		2. Deformations to be reported in the evaluation report shall be the lesser of that corresponding to the LRFD *Load Ratings* and shall be determined from analysis of the test results; or the deformation limits stated in the testing standard. Optionally, deformations corresponding to the ASD *Load Ratings* may be determined and be reported.
1. **QUALITY CONTROL**
	1. Quality documentation complying with the UES Minimum Requirements for Listee’s Quality Assurance System (UES-010) or equivalent as determined by the certification agency shall be submitted. A complete description shall be provided of the quality management system used in the factory to manufacture the *seismic cable restraints*, if applicable.
	2. Inspections of manufacturing facilities are required for this product by either the certification body or an accredited inspection agency. Inspections by inspection agencies accredited for metal products in accordance with ISO/IEC 17020 by an accreditation body recognized as conforming to ISO/IEC 17011 and that is a signatory of the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA) are permitted.
	3. Special Inspections for installation of the *seismic cable restraints* used for seismic resistance shall comply with applicable requirements in IBC Chapter 17.
2. **EVALUATION REPORT RECOGNITION**

Evaluation reports shall include the following information:

* 1. The manufacturer’s name, product name of proprietary components, and the basic information set forth in Section 4.1 of this evaluation criteria.
	2. The *load ratings* determined in accordance with Section 5.4 of this evaluation criteria.
	3. Deformation limits as set forth in Section 5.4 of this evaluation criteria.
	4. Statements on design requirements in accordance with Sections 903, 1603, and 1613 of the IBC, Chapter 13 of ASCE 7, Appendix E of ASCE 19, and for support of fire protection sprinkler systems, Chapter 9 of NFPA 13.
	5. Statements limiting use of *seismic cable restraints* to support of *non-structural components* for resistance to earthquake induced loads only.
	6. Inspection requirements as set forth in Section 6.3 of this evaluation criteria.
	7. Statements that the following are beyond the scope of the evaluation report:
		1. Use of *seismic cable restraints* for resisting loads other than earthquake induced.
		2. Design of attachments, except those included the testing of assemblies.
		3. Use of *seismic cable restraints* where ambient temperatures exceed 200°F (93°C) as set forth in Section E3.3.1.1 of ASCE 19, unless design for such conditions is addressed. In accordance with Section 2.5 of ASCE 7, design for exposure to extraordinary events need not be considered.
		4. Use where in areas where weather protection is not provided and areas where a corrosion atmosphere exists