White Paper
WP309002EN
Effective May 2021
B-LINE SERIES

Defining branch line restraints – not sway braces, not hangers…what are they exactly?

Copyright 2015 Eaton. Personal use of this material is permitted. Permission from Eaton must be obtained for all other uses, in any current or future media, including reprinting/ republishing this material for advertising or promotional purposes, creating new collective works, for resale or redistribution to servers or lists, or reuse of any copyrighted component of this work in other works.

Helping clarify the role of branch line restraint in relation to NFPA 13 guidelines

Fire sprinkler systems are an important life safety system installed in many buildings. They protect not only lives, but billions of dollars in property. When an earthquake occurs, much of the damage that is left afterward is due to the devastating effect of uncontrolled fires. A critical component of any fire sprinkler system, installed in regions where earthquakes can occur, is a well designed and installed seismic bracing system. Bracing system performance can be ensured when compliance to the guidelines set by the National Fire Protection Association (NFPA) are followed.

As a component of a seismic bracing system a branch line restraint (BLR) performs a critical function. Its primary purpose is to prevent the movement of fire sprinkler branch lines which could cause damage to themselves, the structure or other nearby non-structural systems, such as air handling ducts, plumbing or electrical systems.

A BLR is different than a sway brace or a hanger when it comes to certification and testing. A BLR must be Underwriters Laboratories (UL) listed to perform its function, but its function is not clearly defined by National Fire Protection Association (NFPA) 13. Per NFPA 13 (2013) section 9.3.6.1 states, "A restraint is considered a lesser degree of resisting loads than bracing." This, in turn, has led to some confusion throughout the building and construction industry.

Figure 1. UL listed and FM Approved BLR Assembly for steel or CPVC

NFPA guidelines in relation to branch line restraints

NFPA 13 goes on to define exactly how to comply with this "lesser degree" requirement, by listing five standard installation practices (1-5 below) that are generally accepted. This leaves the door open for what is defined as "other approved means" (option 6 below).**

1) Listed Sway Brace Assembly
2) Wraparound U-Hook satisfying the requirements of 9.3.5.5.11
3) No. 12, 440 lb. (200 kg) wire installed at least 45 degrees from the vertical plane and anchored on both sides of the pipe.
4) CPVC hangers utilizing two points of attachment
5) Hanger not less than 45 degrees from vertical installed within 6 inches (152 mm) of the vertical hanger arranged for restraint against upward movement. This is provided the hanger is that the l/r does not exceed 400, and where the rod shall extend to the pipe or have a surge clip installed.
6) Other approved means

**Source; NFPA 13 (2013) Sec 9.3.6.1

At a glance, the first five practices seem straight forward, but what about the sixth? What are "other approved means?"

UL provides some insight to Authorities Having Jurisdiction (AHJ) on how to evaluate "other approved means?

Powering Business Worldwide

UL's "Outline of Investigation for Sway Brace Devices (UL 203A; rev 6 15 2011)" includes a section that addresses products that meet a lesser degree of performance than those that achieve a listing as a lateral or longitudinal sway brace fitting or structural attachment. This creates a new "sub-section" for UL listing called a "Restraint Device." Typically, these products will have loads in the range of approximately 300 lbs. or a lower l/r than its UL listed Sway Brace counterparts. The L/R or Slenderness Ratio refers to the allowable length of a rigid brace member. Limitations on length are imposed due to compressive force that acts on the BLR assembly. Loads are affected by the length of the brace member of the BLR/ Simply stated, the longer the brace member is, the lower the ability to sustain a load.

However, there is a proposed word of caution regarding UL listed restraint devices. They are stamped with the UL logo and are shown in the same file as manufacturer- approved "Sway Brace" products, but are not UL listed to perform the same function.

Generally, these UL listed "Restraint" products should not be used to brace main or cross main piping. They should only be used as branch line restraints as their listing indicates. Recent changes to the UL test procedure have resulted in many manufacturers having products there were previously listed as a "Sway Brace" to fall into the new category of "Restraint". This can create a problem when contractors install products that were previously UL listed as a lateral brace, but now are only listed as a restraint. If these products are installed for a purpose for which they are not listed, it is the same as installing a non-listed product. AHJ's should be aware of the latest UL listings during both the plan review and inspection processes.

Figure 2. UL listed Sway Brace Assembly

Testing Criteria

There are two tests to determine when a product meets the "other approved means" criterion per NFPA 13 (2013) section 9.3.6.1.

UL 203A test

A "Listed Restraint Assembly" is not one of the five prescribed methods for compliance within NFPA 13(2013) 9.3.6.1. As noted in the test criteria below, the load requirements and deformation requirements are much more relaxed than those of a listed sway brace device. The load requirements are also much less stringent than those required for a listing as a hanger. Therefore, this UL listing as a restraint device does not comply with any of the options 1-5 of section 9.3.6.1. The listing as a restraint must fall under the (6) "other approved means" method in NFPA 13, which is open to interpretation by the local authority having jurisdiction. Calculations that show the load requirements of the system design (similar to "zone of influence" calculations used with sway braces) should be required. Along with this, the capacity of the listed restraint assembly must show the assembly is capable of performing the task it is installed to do – to restrain a length of branch line piping.

UL Restraint Device Load Test

11.1 Restraint Devices shall withstand a minimum force of 300 pounds-force (1334 N) without a displacement of no more than 1/2 inch (12.4 mm) in tension and compression when installed in accordance with the manufacture's instructions.

11.2 Restraints Devices installed in accordance with the manufacture's installation instructions on the appropriate pipe are to be installed in a tension-compression test apparatus in a manner duplicating as closely as possible their intended field installation. Each assembly is then to be subjected to an increasing compressive load until a load of 300 pound-force (1334 N) or a greater force specified in the manufacturer's installation instructions is applied for one minute, in a, manner to evaluate the restraining feature, and the displacement measures. The load is then applied in tension and the displacement measured.

Factory Mutual Global (FM) 1950 test

Factory Mutual Global (FM) has a different set of criteria for the testing of sway brace devices versus branch line restraints. Much more sophisticated than the UL 203A test, the FM 1950 test uses a shaker table to test cyclical loading of the products in a sway brace or BLR assembly. This is similar to the forces the products would experience during an actual earthquake. During testing, assemblies are actually installed and tested as an assembly configuration.

FM 1950 makes no distinction between a "sway brace device" and a "restraint device" in its testing procedure. There is no minimum load to achieve during testing. A product is simply tested, and an approved load is assigned. FM Global publishes load values applicable to a range of brace angles. The products intended by a manufacturer to be used as a restraint can be identified by much lower loads than those products intended for the bracing of sprinkler main piping. Or, in some cases the name of the product itself might be the only clue.

Conclusion

Throughout the industry, there is general consensus on the notion that branch line restraints are critical components of a high performance and NFPA 13-compliant seismic bracing system. Contractors have five methods specified in NFPA 13 on how to install a functional restraint assembly and a sixth option that opens the door to "other approved means." UL has attempted to address the "other approved means" by developing a set of criteria that is measurably a "lesser degree of resisting loads than bracing" (NFPA 13; 2013, 9.3.6.1) and has allowed products to be listed in sway brace product files and bear the UL logo.

While this may cause some confusion for Authorities Having Jurisdiction (AHJ) on a product-specific listing, it is a good attempt to apply a specific set of test criteria to the NFPA 13 definition of a restraint. Similar to how requirements for sway bracing has evolved, it is likely that the requirements for Branch Line Restraints will continue to be redefined and expanded as NFPA 13 evolves through its revision cycles.

In the meantime, authorities need to understand exactly what is allowed by the five options in the current NFPA 13 standard as well as the UL testing and approval processes that manufacturers apply to their products. The manufacturers of products can only supply information about their products and the testing of their products. The manufacturer can offer that a product is listed or not, or approved or not, to perform certain functions as defined by those certifications. Contractors can design systems and have their submittals approved by the AHJ. After the systems are installed, contractors can only say that what they have installed is what was approved in the submittal or not.

If an installed product is not UL listed as a hanger or a sway brace, then it is the AHJ, not the manufacturer nor the contractor, who is responsible for defining whether or not the product is compliant with NFPA 13.

For more information on TOLCO seismic bracing, visit Eaton.com/tolco.

About Eaton

Eaton offers a broad range of data center and electrical enclosures, airflow management solutions and B-Line series support systems, seismic bracing solutions, electrical enclosures and wireways designed to save time and deliver a lower total installed cost. The products offered serve customers in commercial construction, oil and gas, mining, solar, communications and data centers, and other markets.

Eaton's electrical business is a global leader with expertise in power distribution and circuit protection; backup power protection; control and automation; lighting and security; structural solutions and wiring devices; solutions for harsh and hazardous environments; and engineering services. Eaton is positioned through its global solutions to answer today's most critical electrical power management challenges.

Eaton is a power management company with 2014 sales of $22.6 billion. Eaton provides energy-efficient solutions that help our customers effectively manage electrical, hydraulic and mechanical power more efficiently, safely and sustainably. Eaton has approximately 102,000 employees and sells products to customers in more than 175 countries. For more information, visit Eaton.com.

Sources

1. *NFPA 13 Automatic Sprinkler Systems Handbook - 2010 edition - Jim Lake*
2. *NFPA 13 Automatic Sprinkler Systems Handbook - 2013 edition - Matthew J. Klaus*
3. *UL 203A Outline for the investivation of Sway Braces for Sprinkler System Piping - 2012 edition*
4. *FM Global - Approval Standard for Seismic Sway Braces for Automatic Sprinkler Systems Class Number 1950 - 2011*

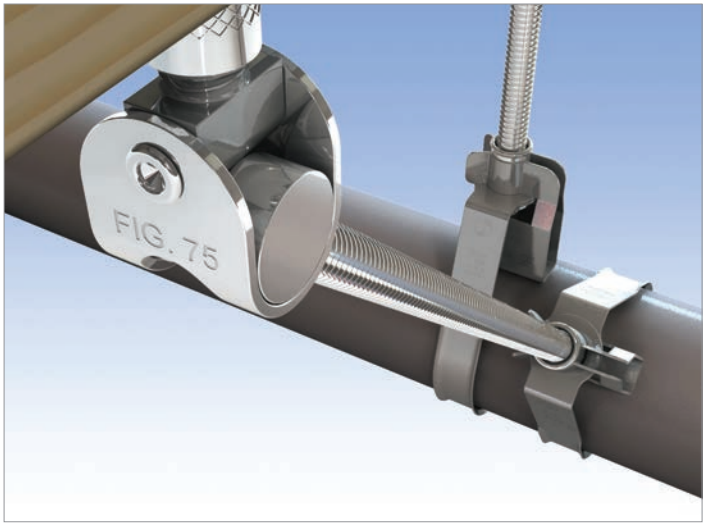

Figure 3. UL listed Branch Line Restraint Assembly

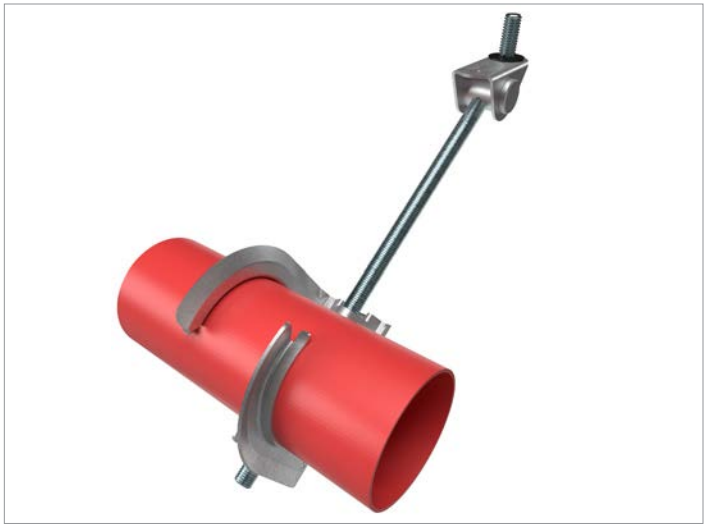

Figure 4. UL listed Seismic Brace Structural Attachment

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

© 2021 Eaton
All Rights Reserved
Printed in USA
Publication No. WP309002EN DBLR21
May 2021

B-Line Division
13201 Dahlia Street, Suite 200
Fontana, CA 92337
United States
Phone: 800-851-7415

Eaton.com/tolco

Eaton is a registered trademark.

All other trademarks are property of their respective owners.