Designation: E3037 – 20

Standard Test Method for Measuring Relative Movement Capabilities of Through-Penetration Firestop Systems[1]

This standard is issued under the fixed designation E3037; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers testing procedures for through-penetration firestop systems. This test method is intended for the following uses:

NOTE 1—Refer to Test Method E814 for definition of "through-penetration firestop system."

1.1.1 To determine relative movement capability in two separate and distinct planes of movement for different types of through-penetration firestop systems,

1.1.2 To standardize a comparison of movement capability by establishing standardized test conditions, in order to allow the type of through-penetration firestop system's movement capabilities to be examined,

1.1.3 To provide the user with information on amplitudes of relative movement between the penetrating items and the *substrate* (concrete-based or gypsum-based).

NOTE 2—Amplitude is the measure of change over a single cycle.

1.2 This test method is intended to be used only as part of a specification or acceptance criteria due to the limited movements tested, and limited number of variables examined.

1.3 This test method uses standardized configurations for the test specimen. Test results will not be representative of all possible through-penetration firestop systems.

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 *The text of this standard references notes, comments, and footnotes which provide explanatory material. These notes, comments, and footnotes (excluding those in tables and figures) shall not be considered requirements of this standard.*

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* Some specific hazards statements are given in Section 7 on Safety Hazards.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E119 Test Methods for Fire Tests of Building Construction and Materials

E176 Terminology of Fire Standards

E631 Terminology of Building Constructions

E814 Test Method for Fire Tests of Penetration Firestop Systems

E1399/E1399M Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems

2.2 *ISO Standards:*[3]

ISO 834 Fire-resistance tests -- Elements of building construction

ISO 10295-1 Fire tests for building elements and components -- Fire testing of service installations -- Part 1: Penetration seals

2.3 *UL Standards:*[4]

UL 263 Standard for Fire Tests of Building Construction and Materials

ANSI/UL 1479 Standard for Fire Tests of Penetration Firestops

[1] This test method is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.21 on Serviceability.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

[4] Available from Underwriters Laboratories (UL), 2600 N.W. Lake Rd., Camas, WA 98607-8542, http://www.ul.com.

2.4 *ULC Standards:*[5]

CAN/ULC-S101 Standard Methods of Fire Endurance Tests of Building Construction and Materials

CAN/ULC-S115 Standard Method of Fire Tests of Firestop Systems

2.5 *Other Standards:*

EN 1366 Fire resistance tests for service installations[6]

FEMA 461 Interim Testing Protocols for Determining the Seismic Performance Characteristics of Structural and Nonstructural Components[7]

IMO FTP Code International Code for the Application of Fire Test Procedures[8]

3. Terminology

3.1 For definitions of terms used in this test method and associated with building issues, refer to the definitions contained in Terminology E631. For definitions of terms used in this test method and associated with fire issues, refer to the definitions contained in Terminology E176.

3.2 When there is a conflict between Terminology E631 and Terminology E176 definitions, Terminology E176 definitions shall apply.

3.3 *Definitions of Terms Specific to This Standard:*

3.3.1 *allowable movement, n*—the cyclic displacement length measured and recorded from a given test series prior to the one for which failure of the through-penetration firestop system was observed.

3.3.2 *annular space, n*—the distance, measured in a straight line, between the outer most portion of the penetrating item and the inside periphery of the opening in the test assembly.

3.3.3 *cyclic movement, n*—the periodic change between the extremes of movement in one plane in an automatically mechanically controlled system.

3.3.4 *penetrating item, n*—the continuous item that traverses from one side of a wall or floor or roof to the opposite side through the opening in the assembly.

3.3.4.1 *Discussion*—Examples of penetrating items include cables, conduits, ducts, pipes.

3.3.5 *substrate, n*—the material of the wall assembly or roof assembly that the through-penetration passes through.

3.3.6 *test specimen, n*—the penetrating item or items, the test assembly through which the penetrating items are arranged to pass, and the materials or devices, or both, that seal the opening in the through-penetration firestop system being tested.

3.3.7 *type of through-penetration firestop system, n*—the unique combination of penetrating item type (for example, metal pipe, plastic pipe, cabling), substrate type (concrete-based or gypsum-based), and firestop material or device, including their method of installation.

3.3.8 *y-direction, n*—the direction of movement parallel to the surface of the test assembly.

3.3.9 *z-direction, n*—the direction of movement perpendicular to the surface of the test assembly.

4. Summary of Test Method

4.1 A rectangular test assembly is made from concrete or gypsum board according to the targeted application. The penetrating item and firestop materials are chosen to represent the type of through-penetration firestop system for which movement data is desired.

NOTE 3—A simplified example of such a test assembly is shown schematically in Fig. 1.

4.2 Two independent tests are conducted for each combination of through-penetration firestop system type and test assembly. One of the tests cycles the penetrating item in the direction perpendicular to the plane of the test assembly. A second independent test is conducted to cycle the through-penetration firestop system in the direction parallel to the plane of the test assembly. The cycling tests continue to the magnitude requested by the test sponsor, as adjusted by ongoing observations during the test.

4.3 The cyclic movement tests are followed by a fire resistance test of each test assembly, as described in 9.11, to establish the fire resistance rating of each such assembly.

5. Significance and Use

5.1 This test method is intended to standardize the cyclic movement of a through-penetration firestop system prior to a fire resistance test. If the amplitude of movement in a design application can be predicted, then the numerical values of allowable movement can be used as one data point in helping to establish suitability of the through-penetration firestop system for the given application.

NOTE 4—The fire resistance rating of a through-penetration firestop system is established in accordance with a relevant fire test, as acceptable to the Authority Having Jurisdiction. Examples of such tests include Test Method E814, CAN/ULC-S115, UL 1479, and ISO 10295-1.

5.2 This test method will assist users, producers, building officials, code authorities, and others in understanding relative movement capabilities of representative test specimens of through-penetration firestop systems under standardized test conditions.

5.3 This test method is not intended to predict the absolute movement capabilities of all likely permutations of through-penetration firestop systems under all likely types of real-life movement.

5.4 This test method does not provide information on:

5.4.1 Durability of the through-penetration firestop system under actual service conditions, including the effects of cycled temperature on the through-penetration firestop system;

5.4.2 Rotational shear capabilities of the test specimen;

[5] Available from ULC Canada, 7 Underwriters Road, Toronto, Ontario, Canada M1R 3A9, http://canada.ul.com/ulcstandards.

[6] Available from European Committee for Standardization (CEN), Avenue Marnix 17, B-1000, Brussels, Belgium, http://www.cen.eu.

[7] Available from Federal Emergency Management Agency (FEMA), 500 C St., SW, Washington, DC 20472, http://www.fema.gov.

[8] Available from International Maritime Organization (IMO), 4 Albert Embankment, London SE1 7SR, United Kingdom, http://www.imo.org.

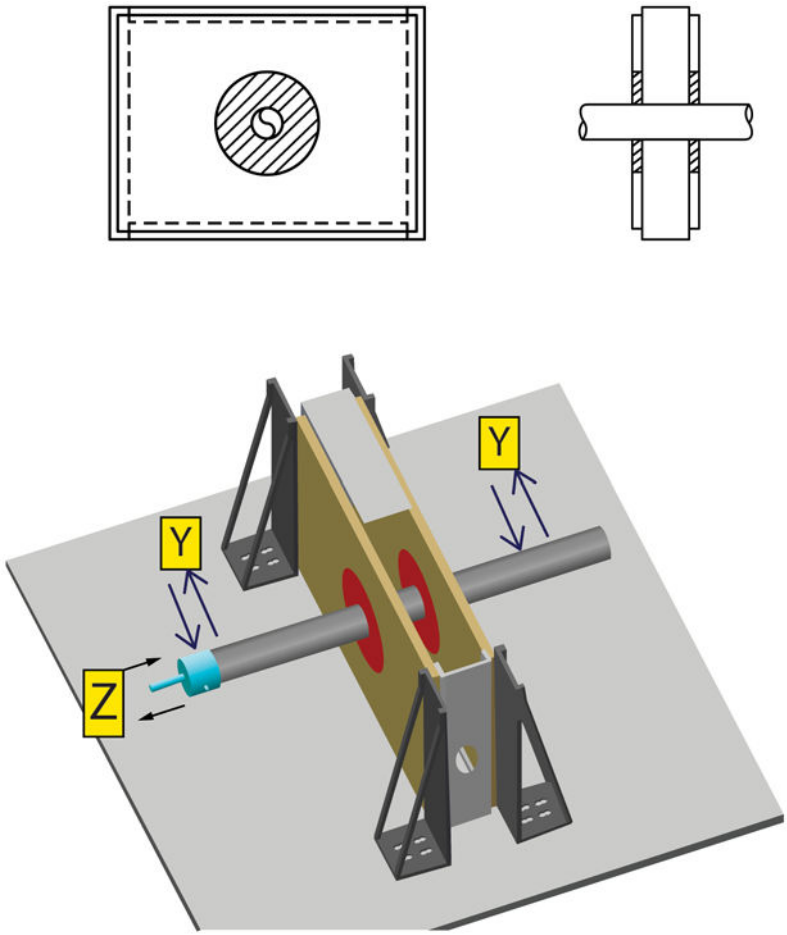

FIG. 1 Simplified Example of Test Assembly Used for Movement Testing, Y-direction and Z-direction of Cycle Movement Shown

5.4.3 Any other attributes of the test specimen, such as wear resistance, chemical resistance, air infiltration, water-tightness, and so forth; and

5.4.4 Compatibility of through-penetration firestop system components and the penetrating items.

5.5 This test method is only to be used as one element in the selection of a through-penetration firestop system for a particular application.

5.6 This is not a fire test standard. To determine the effect of cyclic movement on the fire resistance rating of a though-penetration firestop system, conduct a fire test in accordance with a fire resistance test method acceptable to the Authority Having Jurisdiction subsequent to this movement test.

6. Apparatus

6.1 *Testing Machine,* capable of a range of movement that includes the maximum z-direction and y-direction movement planned for the test. It shall be capable of continual repetitious movement between two specified dimensions, equipped with an automatic counter to record the relative movement between the penetrating item and the test assembly during the test.

6.2 *Measuring Device,* capable of an accuracy of 0.010 in. ± 0.005 in. (0.25 mm ± 0.013 mm).

NOTE 5—One example of a commonly used measuring device is the Linear Variable Differential Transformer (LVDT).

NOTE 6—If a load cell is connected to the displacement device, it might be damaged if the resistance to movement exceeds the rated capacity of the load cell.

6.3 *Mounting Plates,* or other apparatus suitable to install the test specimen and undergo the test procedures.

7. Safety Hazards

7.1 **Warning—**Take proper precautions to protect the observers in the event of any failure. If extreme pressures develop during this test, considerable energy and hazard are involved. In cases of failure, the hazard to personnel is less if a protective shield is used and protective eye wear worn. Do not permit personnel between the shield and equipment during the test procedure.

8. Test Specimens

8.1 *Test Assembly:*

8.1.1 A concrete substrate shall be 4.5 in. ± 0.50 in. (114 mm ± 13 mm) thick. The concrete used shall have a nominal density of 150 pcf (2403 kg/m^3) and a minimum compressive strength of 3000 psi (20.68 MPa).

NOTE 7—This dimension has been selected to provide a generic, representative test assembly that can provide meaningful data for a wide variety of conditions.