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An American National Standard

Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies[1]

This standard is issued under the fixed designation E2837; 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.

INTRODUCTION

Wall continuity is required by various model codes at *joint openings*, which are linear voids, gaps, openings, or other discontinuities between or bounded by a *rated wall assembly* and *nonrated horizontal assemblies*, to ensure that the protected *joint opening* has the same fire resistance rating as the *rated wall assembly*. The *joint opening* at the termination at the top of the *rated wall assembly* below the *nonrated horizontal assembly* must be protected by a *continuity head-of-wall joint system*, which has a fire resistance rating, in order to maintain continuity established by the *rated wall assembly*. This test method is not required when the *rated wall assembly* contacts *nonrated horizontal assemblies* when there is no *joint opening*. Normally such joint openings are denoted as "linear" because the length is normally greater than their width, which is defined by a typical ratio of at least 10:1 as in practice. *Joint openings* are present in buildings as a result of: *(1)* Design to accommodate various movements induced by thermal differentials, seismicity, and wind loads and exists as a clearance separation. *(2)* Acceptable dimensional tolerances between two or more building elements, for example, between non-loadbearing walls and roofs. *(3)* Inadequate design, inaccurate assembly, repairs or damage to the building. There are many unique applications for joint systems in buildings. To address this issue there are different types of *continuity head-of-wall joint systems*. It is not possible to test all fire-resistive joints systems using the same test apparatus or method of test, for example, Test Method E2307 employs the ISMA test apparatus. A *continuity head-of-wall joint system* is a particular type of fire-resistive joint system that provides fire resistance to prevent passage of fire from compartment to compartment within the building at the *joint opening* between a *rated wall assembly* and a *nonrated horizontal assembly*. A *continuity head-of-wall joint system* is a unique building construction detail not addressed by other fire test methods such as Test Method E1966 that tests joint systems installed between two assemblies that are fire resistance rated.

1. Scope

1.1 This fire-test-response test method measures the performance of a unique fire resistive joint system called a *continuity head-of-wall joint system*, which is designed to be used between a *rated wall assembly* and a *nonrated horizontal assembly* during a fire resistance test.

1.2 This fire-test-response standard does not measure the performance of the following:

1.2.1 The *rated wall assembly*, which is already established by other test methods, such as Test Method E119, or

1.2.2 The *nonrated horizontal assembly*, which would be established by other test methods such as Test Method E119.

NOTE 1—Typically, rated wall assemblies obtain a fire resistance rating after being tested to Test Method E119, NFPA 251, UL 263, CAN/ULC-S101, or other similar fire resistive test methods.

1.3 This fire-test-response standard is not intended to evaluate the connections between *rated wall assemblies* and *nonrated horizontal assemblies* unless part of the continuity head-of-wall joint system.

[1] This test method is under the jurisdiction of ASTM Committee E05 on Fire Standards and is the direct responsibility of Subcommittee E05.11 on Fire Resistance.

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1.4 The fire resistive test end point is the period of time elapsing before the first performance criteria is reached when the *continuity head-of-wall joint system* is subjected to one of two time-temperature fire exposures.

1.5 The fire exposure conditions used are either those specified by Test Method E119 for testing assemblies to standard time-temperature exposures or Test Method E1529 for testing assemblies to rapid-temperature rise fires.

1.6 This test method specifies the heating conditions, methods of test, and criteria to establish a fire resistance rating only for a *continuity head-of-wall joint system.*

1.7 Test results establish the performance of *continuity head-of-wall joint systems* to maintain continuity of fire resistance of the *rated wall assembly* where the *continuity head-of-wall joint system* interfaces with a *nonrated horizontal assembly* during the fire-exposure period.

1.8 Test results shall not be construed as having determined the *continuity head-of-wall joint system*, *nonrated horizontal assembly* and the *rated wall assembly's* suitability for use after that fire exposure.

1.9 This test method does not provide quantitative information about the *continuity head-of-wall joint system* relative to the rate of leakage of smoke or gases or both. However, it requires that such phenomena be documented and reported when describing the general behavior of *continuity head-of-wall joint systems* during the fire resistive test but is not part of the conditions of compliance.

1.10 Potentially important factors and fire characteristics not addressed by this test method include, but are not limited to:

1.10.1 The performance of the *continuity head-of-wall joint system* constructed with components other than those tested.

1.10.2 The cyclic movement capabilities of *continuity head-of-wall joint systems* other than the cycling conditions tested.

1.11 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.

1.12 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.13 *This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment of the materials, products, or assemblies under actual fire conditions.*

1.14 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

1.15 Fire testing is inherently hazardous. Adequate safeguards for personnel and property shall be employed in conducting these tests.

1.16 *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]

E84 Test Method for Surface Burning Characteristics of Building Materials

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

E1529 Test Methods for Determining Effects of Large Hydrocarbon Pool Fires on Structural Members and Assemblies

E1966 Test Method for Fire-Resistive Joint Systems

E2226 Practice for Application of Hose Stream

E2307 Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus

2.2 *NFPA Standard:*[3]

NFPA 251 Standard Methods of Tests of Fire Endurance of Building Construction and Materials

2.3 *ISO Standards:*[4]

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

ISO 10295-2 Fire tests for building elements and components – Fire testing of service installations – Part 2: Linear joint (gap) seals

2.4 *Underwriters Laboratories Standards:*[5]

UL 263 Fire Tests of Building Construction and Materials

UL 2079 Standard for Tests for fire Resistance of Building Joint Systems

UL 1479 Standard for Fire Tests of Through-Penetration Firestops

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

[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] National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269-9101.

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

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

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

3. Terminology

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

3.2 For definitions of term used in this test method and associated with building issues, refer to the definitions contained in Terminology E631.

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

3.4 *Definitions of Terms Specific to This Standard:*

3.4.1 *continuity, n*—maintaining the fire resistance rating of the *rated wall assembly* and the protected *joint opening* to the underside of the *nonrated horizontal assembly* by use of a *continuity head-of-wall joint system*, which achieves the same or greater fire resistance rating as the *rated wall assembly*.

3.4.1.1 *Discussion*—This maintenance is achieved using materials or devices, or both, installed to extend and continue the fire resistance rating of the wall assembly to the underside of the *nonrated horizontal assembly* above.

3.4.2 *continuity head-of-wall joint system, n*—materials or devices, or both, installed to resist the spread of fire for a prescribed period of time through the *joint opening* between a fire-resistance *rated wall assembly* below and *nonrated horizontal assembly* above.

3.4.3 *joint opening, n*—the space between a *rated wall assembly* and the *nonrated horizontal assembly* above, which is either a void space or gap, or which is filled either partially or completely by a material, other than the wall material.

3.4.4 *maximum joint width, n*—the greatest width, size, or distance to which the *continuity head-of-wall* joint system is specified to open.

3.4.4.1 *Discussion*—The *maximum joint width* equals the *nominal joint width* plus the extension of the *continuity head-of-wall joint system* from the *nominal joint width position*.

3.4.5 *minimum joint width, n*—the narrowest width, size, or distance to which the *continuity head-of-wall joint system* is specified to close.

3.4.5.1 *Discussion*—The *minimum joint width* equals the *nominal joint width* minus the compression of the *continuity head-of-wall joint system* from the *nominal joint width* position.

3.4.6 *movement cycle, n*—the change between the *minimum joint width* and the *maximum joint width* of a *continuity head-of-wall joint system*.

3.4.7 *nominal joint width, n*—the specified opening width, size, or distance of a *joint opening* that is selected for test purposes.

3.4.7.1 *Discussion*—The *nominal joint width* is typically the joint width that exists in the building at the time the *continuity head-of-wall joint system* is installed.

3.4.8 *nonrated horizontal assembly, n*—a ceiling, floor, or roof assembly that is not fire resistance rated such as determined in accordance with Test Methods E119 or E1529.

3.4.9 *rated wall assembly, n*—an interior wall or partition having a period of fire resistance determined in accordance with Test Methods E119 or E1529.

3.4.10 *splice, n*—the connection or junction within the length of a *test specimen*.

3.4.11 *test assembly, n*—the complete assembly of the *test specimen* together with its *rated wall assembly* and *nonrated horizontal assembly*.

3.4.12 *test specimen, n*—a fire-resistive wall *continuity head-of-wall joint system* of a specific material(s), design, and width.

4. Summary of Test Method

4.1 This test method describes the following test sequence and procedure:

4.1.1 The *test specimen*, the *rated wall assembly* and *nonrated horizontal assembly* shall be conditioned before *movement cycle* testing and fire resistive testing.

NOTE 2—The *movement cycle* testing is based on Test Method E1399. This test is not designed to address all types of movement. It does however provide some indication of the ability of the *test specimen* to accommodate some movement without incurring damage.

4.1.2 When the *test specimen* requires movement capability, which is defined as when the *maximum joint width* does not equal the minimum joint width, the *test specimen* shall be subjected to the *movement cycle* test before being fire resistive tested.

4.1.3 When desired, apply a superimposed load to the *test assembly*.

4.1.4 During the fire test, the integrity of the *test specimen* is determined by use of a cotton pad.

4.1.5 After the fire test, subject the *test assembly* to a hose stream test.

5. Significance and Use

5.1 This test method evaluates the following under the specified test conditions:

5.1.1 The ability of a *test specimen* to undergo movement without reducing its fire resistance rating, and

5.1.2 The duration for which a *test specimen* will contain a fire and retain its integrity during a predetermined fire resistive test exposure.

5.2 This test method provides for the following measurements and evaluations where applicable:

5.2.1 Ability of the *test specimen* to *movement cycle*.

5.2.2 Ability of the *test specimen* to prohibit the passage of flames and hot gases.

5.2.3 Transmission of heat through the *test specimen*.

5.2.4 Ability of the *test specimen* to resist the passage of water during a hose stream test.

5.3 This test method does not provide the following:

5.3.1 Any information about the *rated wall assembly* because its performance has already been determined.

TABLE 1 Conditions of Test Specimen Cycling

Movement Type	Minimum Cycling Rates (cpm)	Minimum Number of Movement Cycles
Type I — Thermal	1	500
Type II — Wind Sway	10	500
Type III — Seismic	30	100
Type IV — Combined	30	100
Movement followed by:	10	400

5.3.2 Evaluation of the degree by which the *test specimen* contributes to the fire hazard by generation of smoke, toxic gases, or other products of combustion.

5.3.3 Measurement of the degree of control or limitation of the passage of smoke or products of combustion through the *test specimen*.

5.3.4 Measurement of flame spread over the surface of the *test specimen*.

NOTE 3—The information in 5.3.1 – 5.3.4 may be determined by other suitable fire resistive test methods. For example, 5.3.4 may be determined by Test Method E84.

5.4 In this procedure, the *test specimens* are subjected to one or more specific tests under laboratory conditions. When different test conditions are substituted or the end-use conditions are changed, it is not always possible by, or from, this test method to predict changes to the characteristics measured. Therefore, the results are valid only for the exposure conditions described in this test method.

6. Apparatus

6.1 *Cycling Apparatus*—Equipment (or device) capable of being used to induce movement of a *test specimen* and meeting the required cyclic rate and number of cycles selected from Table 1.

NOTE 4—Terms used for movement are indicative of the cyclic rate in expansion and contraction of the *test specimen* and not of the magnitude or direction of movement.

6.2 *Furnace*—An enclosed heating system or device capable of controlling a fire to the time-temperature curve in Test Methods E119 or E1529. An example of a vertical furnace with a test frame is shown in Fig. 1.

6.3 *Furnace Thermocouples:*

6.3.1 When testing to the time-temperature curve in Test Method E119, use thermocouples in accordance with Test Method E119.

6.4 When testing to the time-temperature curve in Test Method E1529, use furnace thermocouples in accordance with Test Method E1529.

6.5 *Pressure-sensing Probes*—Use tolerances are ±0.5 % of dimensions shown in Fig. 2 or Fig. 3.

6.5.1 The pressure-sensing probes shall be either:

6.5.1.1 A T-shaped sensor as shown in Fig. 2, or

6.5.1.2 A tube sensor as shown in Fig. 3.

6.6 *Unexposed Surface Thermocouples:*

6.6.1 The wires for the unexposed thermocouple in the length covered by the thermocouple pad are not to be heavier than No. 18 AWG (0.82 mm^2) and are to be electrically insulated with heat-resistant and moisture-resistant coatings.

6.7 *Thermocouple Pads:*

6.7.1 The thermocouple pads used to cover each unexposed surface thermocouple on the unexposed side of the *test specimen* or *test assembly* shall be made of materials that meet the requirements specified in Test Method E119.

6.7.1.1 For test specimens having a *maximum joint width* of less than 6 in. (152 mm) the length and width of the square pad shall measure 2 ± 0.04 in. (50 ± 1 mm).

6.7.1.2 For test specimens having a *maximum joint width* equal to or greater than 6 in. (152 mm) the length and width of the square pad shall measure 6 ± 0.12 in. (152 ± 3 mm).

6.7.1.3 When the *maximum joint width* of the *test specimen* is less than the specified pad size, reduce the width of the pad to match the maximum joint width, subject to a minimum dimension of ¾ in. (18 mm). The pad length shall be as specified and parallel to the *test specimen* length. If the modified thermocouple pad cannot be placed on the contour of the surface, then no thermocouple is required at that location.

6.7.1.4 When necessary, deform the thermocouple pad to follow the non-planar surface profile of the *test specimen*.

6.8 *Differential Pressure Measurement Instruments:*

6.8.1 The differential pressure measurement instrument shall be:

6.8.1.1 A manometer or equivalent transducer.[6]

6.8.1.2 Capable of reading in graduated increments of no greater than 0.01 in H_2O (2.5 Pa) with a precision of not less than ±0.005 in. H_2O (±1.25 Pa).

6.8.1.3 Dimensions in Fig. 2 and Fig. 3 are stated in inches for inch-pound units and the SI units in parentheses are stated in millimeters.

6.9 *Cotton Pads*—The cotton pads used to detect hot gases on the unexposed side of the *test specimen* or *test assembly* shall be made of materials that meet the requirements specified in Test Method E119.

6.10 *Loading System*—When desired, use equipment, or a device, capable of inducing a desired load upon the *test specimen*.

6.11 *Hose Stream Delivery System*—Use the equipment referenced in Practice E2226.

7. Test Assembly

7.1 The *test assembly* shall be representative of the construction with respect to materials, workmanship, and details.

7.2 *Continuity Head-of-Wall Joint System:*

7.2.1 Where the *maximum joint width* is not greater than 4 in. (102 mm) make the *test specimen* at least 4 ft (1219 mm) in length.

7.2.2 For a *maximum joint* width greater than 4 in. (102 mm), make the *test specimen* a minimum length equal to ten times the *maximum joint width* or the distance between structural supports passing through the *rated wall assembly*, whichever is greater, but not exceeding 12 ft (3.65 m).

[6] Supporting data is available from ASTM International Headquarters. Request RR:E05:1001.

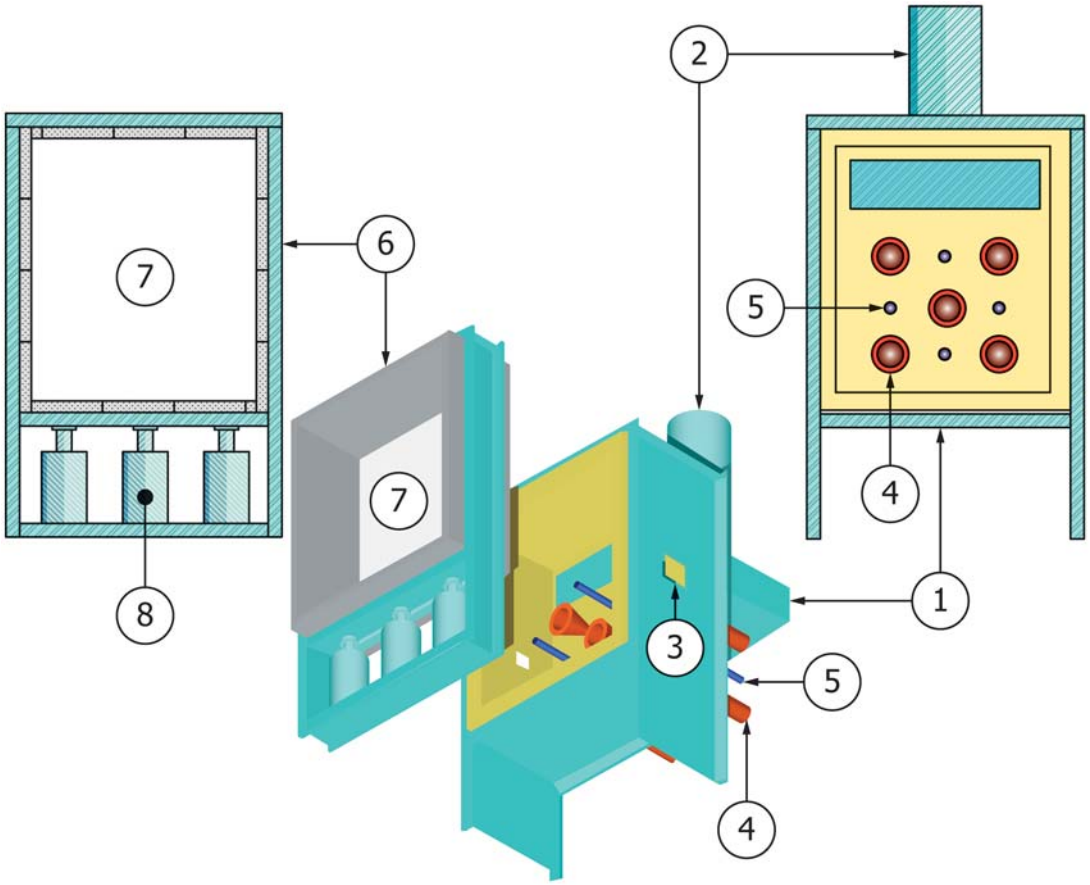

FIG. 1 Example of Vertical Furnace and Test Frame

1 = Vertical Furnace
2 = Exhaust Flue
3 = View Ports
4 = Gas Burners
5 = Thermocouple Tubes
6 = Test Frame
7 = *Test Assembly* Location
8 = Loading Jacks (when required)

7.2.3 Install the *test specimen* at the *nominal joint width* according to the manufacturer's specified procedure for conditions representative of those found in building construction.

7.2.4 Test each *test specimen* with manufactured and field *splices*. When the technique of the manufactured splice is the same as the field splice, test only one *splice*. The minimum distance between a *splice* and the nearest side wall of the test frame shall be 1.5 times the thickness of the *rated wall assembly* or 12 in. (305 mm), whichever is greater. The minimum separation between *splices* within a test specimen shall be 36 in. (914 mm).

7.2.5 Test all *test specimens* at their *maximum joint width*.

7.2.6 Test asymmetrical *test specimens* from both sides unless it is documented that the side with the lower fire resistance rating is being tested.

NOTE 5—The verb "document" in 7.2.6 is as defined by Merriam-Webster as follows "to provide with factual or substantial support for statements made or a hypothesis proposed; especially: to equip with exact references to authoritative supporting information."

7.3 *Test Assembly:*

7.3.1 The *test assembly* shall be installed in a test frame. Refer to Fig. 1 and Fig. 4.

7.3.2 The *rated wall assembly* shall have a known fire resistance rating in accordance with Test Methods E119 or E1529.

7.3.3 The minimum length of the *rated wall assembly* to be tested shall be as required by 7.2.

7.3.4 The minimum height of the *rated wall assembly* shall be 4 ft (1.2 m).

7.3.5 The *nonrated horizontal assembly* shall have the same approximate width as the *rated wall assembly*.

7.3.6 The *nonrated horizontal assembly* shall extend a minimum of 12 in. (305 mm) beyond each face of the *rated wall assembly*.

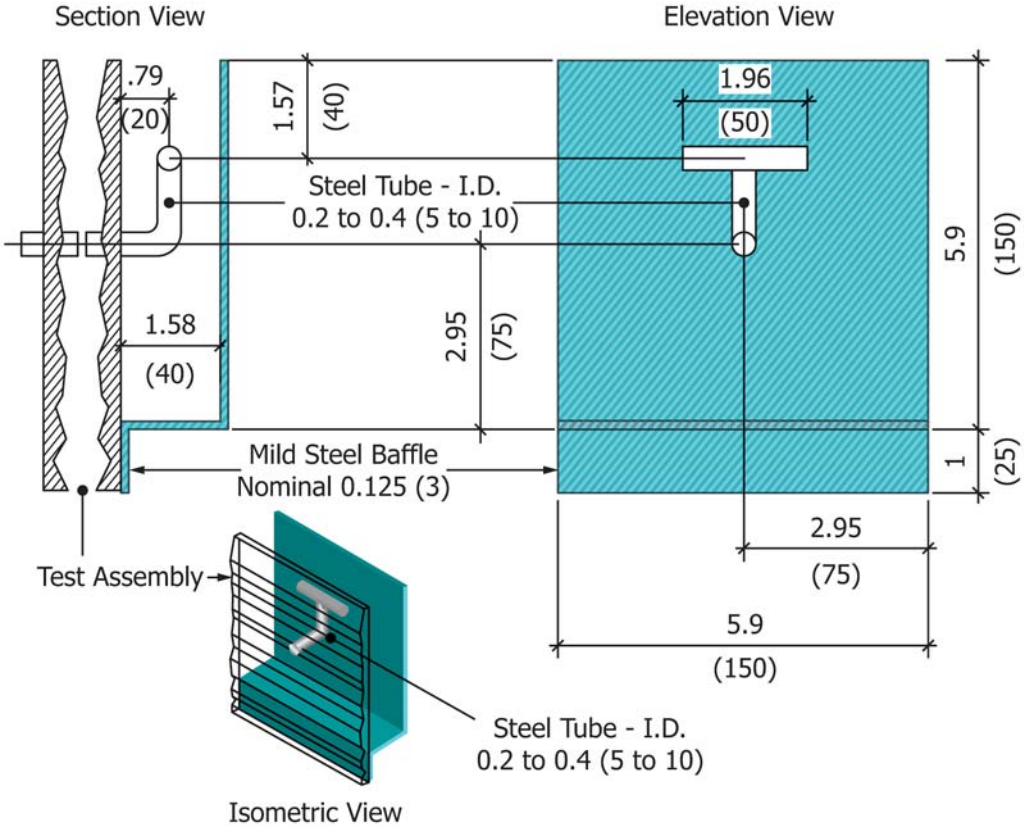

FIG. 2 "T" Shaped Pressure Sensing Probe

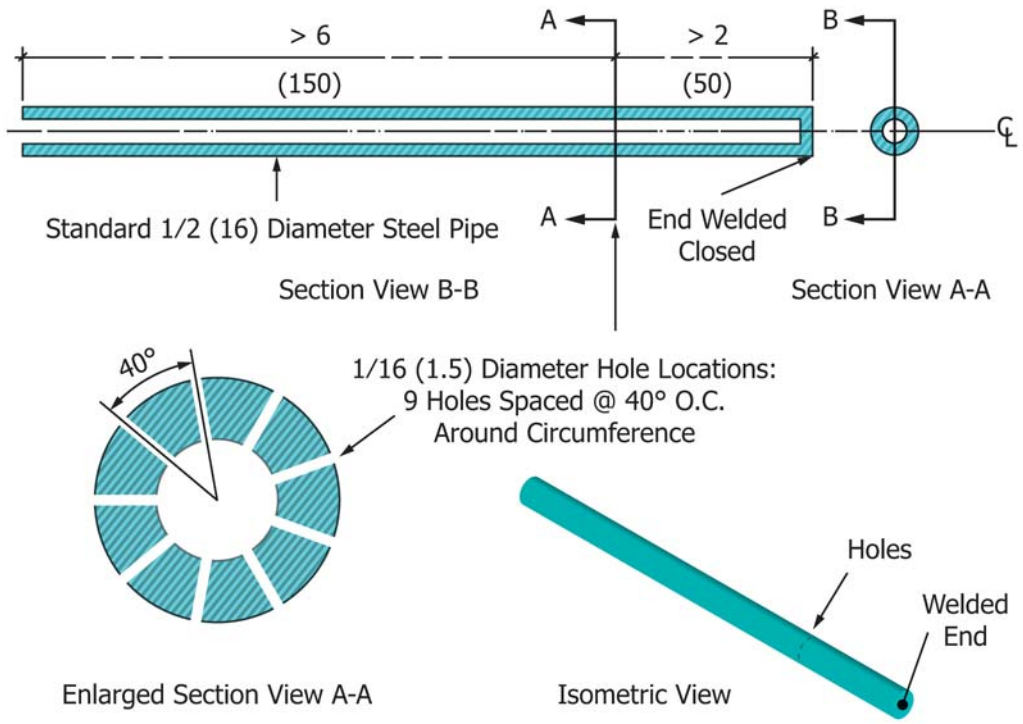

FIG. 3 Tube Type Pressure Sensing Probe

7.3.7 Two standard methods A and B are described. These methods are not intended to restrict testing other field conditions or constructions. These methods are not intended to prohibit the use of sound engineering practices to determine, document, and test the method or condition with the lower fire resistance rating (worse case test scenario) and apply the lower

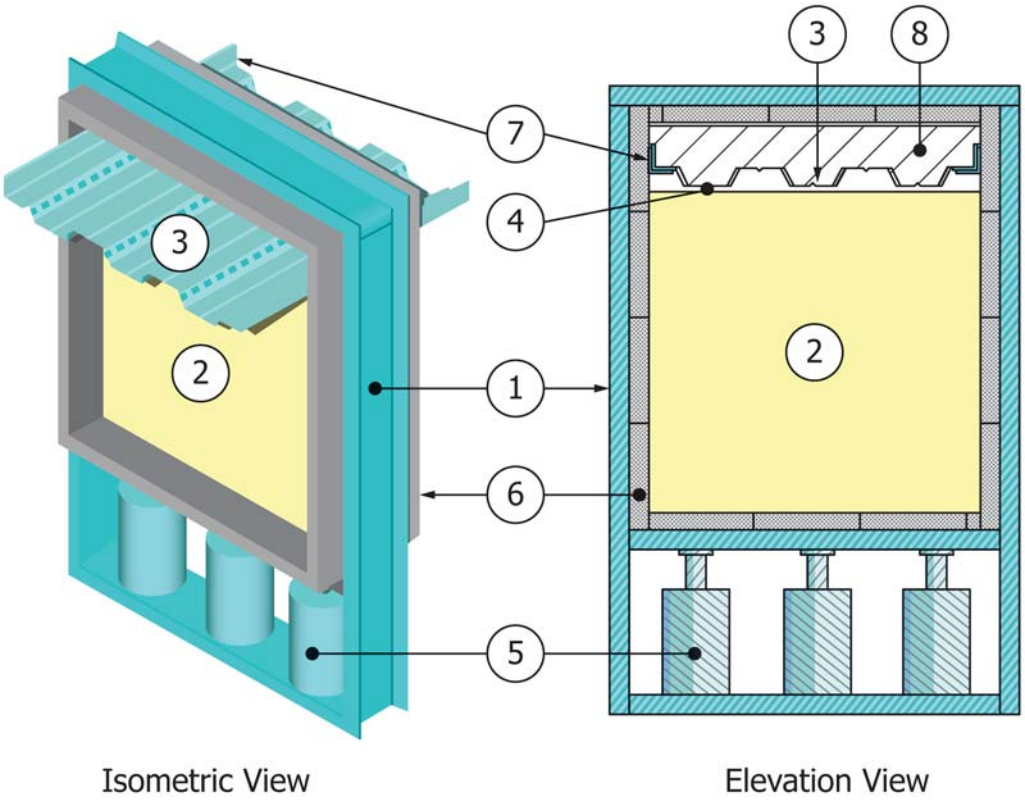

FIG. 4 Example of Vertical Test Frame and Test Assembly

1 = Test Frame
2 = *Rated Wall Assembly*
3 = *Nonrated Horizontal Assembly* in Two-Sided Rigid Support Rails or 4-Sided Rigid Support Frame
4 = *Joint Opening*
5 = Loading Jacks (when required)
6 = Test Frame Mounting Area
7 = Two-Sided Rigid Support Rails or 4-Sided Rigid Support Frame Typically Attached to Test Frame
8 = Laboratory Installed Insulating Gasket as Needed

fire resistance rating to other field conditions or constructions deemed more fire resistive than the tested method.

7.3.8 *Method A*—Is intended for use when the corrugation of steel decking or the orientation of the grain or fibers of materials, for example, wood, gypsum board, etcetera, run perpendicular ±5° to the *rated wall assembly*.

7.3.8.1 The *nonrated horizontal assembly* shall be supported by 2-sided rigid support rails oriented perpendicular to the *rated wall assembly* using a nominal 4 in. (102 mm) horizontal leg, as shown in Fig. 5. There shall be no attachment between the support rails and the nonrated horizontal assembly during the fire test. The width of the *nonrated horizontal assembly* shall be 1 in. (25 mm) less than the length of the *rated wall assembly* and shall be centered and free floating between the two sided rigid support rails.

7.3.8.2 Before the application of the hose stream test, the *nonrated horizontal assembly* shall be secured in place to the two-sided rigid support rails to resist the hose stream.

7.3.9 *Method B*—Is intended for use when the corrugation of steel decking or the orientation of the grain or fibers of materials, for example, wood, gypsum board, etcetera, run parallel ± 5° to the *rated wall assembly*.

7.3.9.1 The *nonrated horizontal assembly* shall be supported by a 4-sided rigid support frame using a nominal 4 in. (102 mm) horizontal leg, as shown in Fig. 6. There shall be mechanical attachment between the support frame and the *nonrated horizontal assembly*. The length and width of the *nonrated horizontal assembly* shall be equal to the length and width within a tolerance of +0, -1⁄16 in. (+0, -1.6 mm) of the dimensions of the 4-sided rigid support frame and secured to it on all four sides.

7.3.9.2 Before the application of the hose stream test, the *nonrated horizontal assembly* shall be secured in place to the rigid support rails to resist the hose stream.

NOTE 6—*Method A*—The *nonrated horizontal assembly* positioned in the two-sided rigid support rails is intended to accommodate expansion of the *nonrated horizontal assembly* during testing without hindrance and allow deflection (concave deformation) of the *nonrated horizontal assembly* towards the *test specimen*. *Method B*—The *nonrated horizontal assembly* positioned in the 4-sided rigid support frame limits expansion of the *nonrated horizontal assembly* during testing and allows deflection

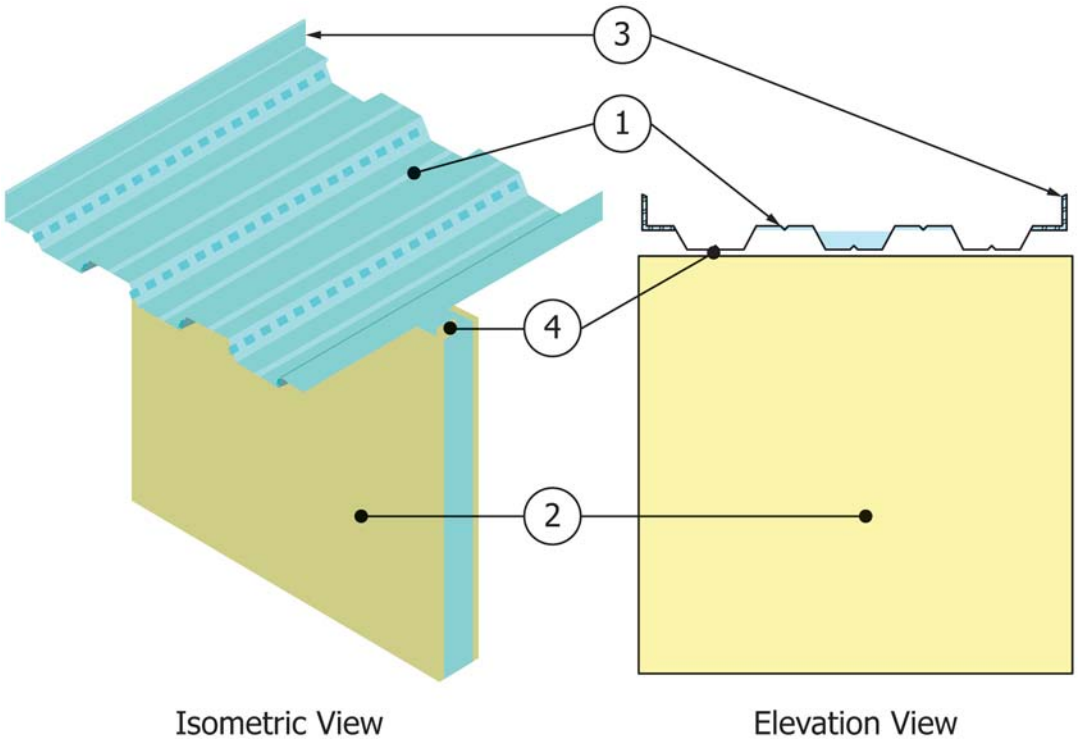

FIG. 5 Example of Method A Configuration (Isometric and Front Views)

1 = *Nonrated Horizontal Assembly*
2 = *Rated Wall Assembly*
3 = Two-Sided Rigid Support Rails
4 = *Joint Opening*

(convex camber) of the *nonrated horizontal assembly* away from the *test specimen*. In both Methods A and B, the two-sided rigid support rails and the 4-sided rigid support frame are not mechanically connected to the *rated wall assembly*. Rather, the two-sided rigid support rails and the 4-sided rigid support frame are typically attached to the test frame, which is intended to allow independent movement of the *nonrated horizontal assembly* and the *rated wall assembly*.

8. Preparation of Apparatus

8.1 *Furnace Thermocouples:*

8.1.1 *Test Method E119*—Make the exposed length of the pyrometer tube and thermocouple in the furnace chamber not less than 12 in. (305 mm).

8.1.2 *Test Method E1529*—Mount a minimum length of 20 diameters of the sheathed junction end of the thermocouple parallel to the surface of the *test specimen*.

8.2 *Furnace Thermocouple Locations:*

8.2.1 Uniformly distribute the furnace thermocouples employed to measure the temperature of the furnace to give the average temperature in the vicinity of the *test specimen*. Reference 6.3.

8.2.2 Position the furnace thermocouples before the start of the fire resistive test. If a furnace thermocouple will come in contact with or will touch the *test assembly* during the test, reposition that furnace thermocouple to avoid any contact with the *test assembly*.

8.2.3 Place the junction of each furnace thermocouple 6 ± 1 in. (152 ± 25 mm) from the exposed surface of the *rated wall assembly*.

8.2.4 Place not less than three furnace thermocouples for a *rated wall assembly* measuring 16 ft^2(1.5 m^2) and less. Place not less than five furnace thermocouples for a *rated wall assembly* larger than 16 ft^2 (1.5 m^2).

8.3 *Furnace Pressure:*

8.3.1 Make the minimum vertical distance between pressure sensors one-half the height of the furnace chamber. Locate the pressure sensors where they will not be subjected to direct impingement of convection currents. Make tubing connected to each pressure sensor horizontal both in the furnace and at its egress through the furnace wall such that the pressure is relative to the same elevation from the inside to the outside of the furnace.

9. Calibration and Standardization

9.1 Test Method E119 does not contain a calibration procedure.

9.2 When testing to the time-temperature curve in Test Method E1529, follow the calibration procedure in Test Method E1529.

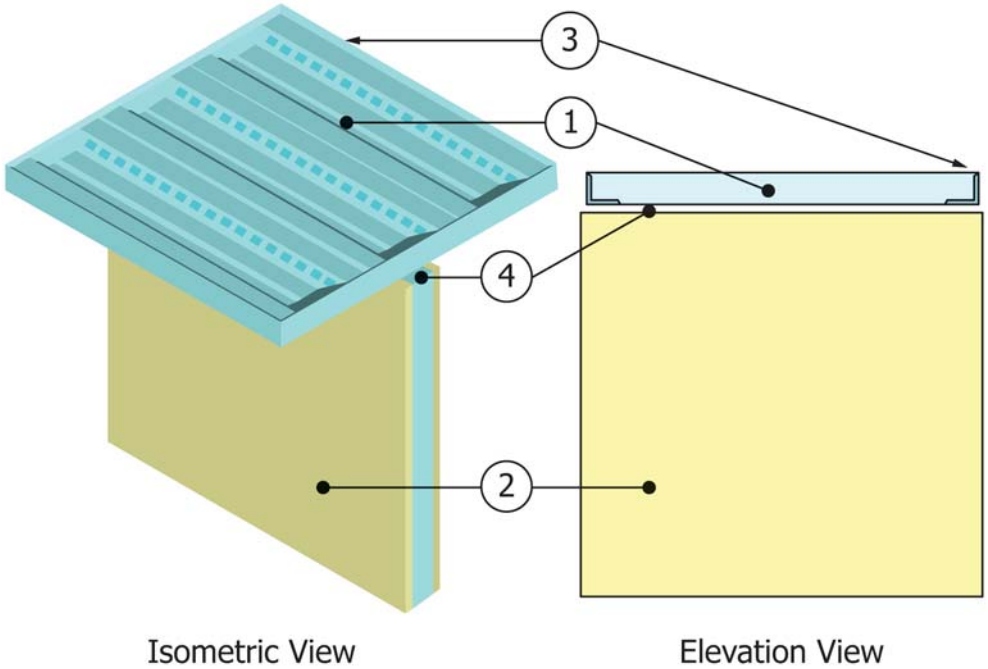

FIG. 6 Example of Method B Configuration (Isometric and Front Views)

1 = *Nonrated Horizontal Assembly*
2 = *Rated Wall Assembly*
3 = 4-Sided Rigid Support Frame
4 = *Joint Opening*

10. Conditioning

10.1 When testing to the time-temperature curve in E119, condition the *test assembly* in accordance with Test Method E119.

10.2 When testing to the time-temperature curve in Test Method E1529, condition the *test assembly* in accordance with Test Method E1529.

11. Movement Cycle Test Procedure

11.1 When the *test specimen* requires movement capability, it shall be movement cycled before being fire resistance tested.

11.2 Prior to the fire exposure, subject test specimens that meet the criteria of 11.1 to a *movement cycle* test. Use appropriate cycling apparatus. Reference 6.1.

11.3 The test sponsor selects the movement type desired for the *movement cycle* test from Table 1.

11.4 Install each *test specimen* at its nominal gap, recess or separation dimension. Cycle each *test specimen* in accordance with the cyclic rate and number of movement cycles for the movement type selected from Table 1.

11.5 Do not allow alterations or modifications which will enhance the thermal performance of the *test specimen* during or after the *movement cycle* test.

11.6 Examine the *test specimen* after the *movement cycle* test. Note, photograph, document, and report any indication of stress, deformation or fatigue of the *test specimen*.

12. Fire-Resistance Test Procedure

12.1 *Test Assembly:*

12.1.1 Seal the *test assembly* against the furnace with an insulating gasket between the *test assembly* and the furnace. Reference 6.2 and Fig. 4. Tightly seal the open ends of the *test specimen* against air flow. Throughout the test, periodically check the seals at the ends of the *test specimen* and repair them, as necessary, to prevent air flow.

12.1.2 Protect the test equipment and *test assembly* from any condition of wind or weather that influences test results. Measure the ambient air temperature at the beginning of the test; it is not to be less than 50°F (10°C). Measure the velocity of air moving horizontally across the unexposed surface of the *test assembly* immediately before the test begins; it is not to exceed 4.4 ft/s (1.3 m/s) as determined by an anemometer placed at right angles to the unexposed surface. When mechanical ventilation is employed during the test, do not direct an air stream across the surface of the *test assembly*.

12.2 *Unexposed Surface Temperatures:*

12.2.1 Provide unexposed surface thermocouples, reference 6.5, in conformance with the type required by the selected time-temperature curve. Measure the temperatures of the unexposed surface (surface of *test specimen* opposite the exposure to furnace fire) with thermocouples placed under thermocouple pads, reference 6.6. Position the wire leads of the thermocouple under the pad and make them contact the unexposed *test specimen* surface, parallel with the longitudinal direction of the *test specimen*, for not less than 1 in. (25 mm).

Place the hot junction of the thermocouple approximately under the center of the pad. Firmly secure the pad against the thermocouple.

12.2.2 Do not place unexposed surface thermocouples closer to the furnace edge than 1.5 times the thickness of the *rated wall assembly* or 12 in. (305 mm), whichever is greater.

12.2.3 Locate unexposed surface thermocouples on the *test specimen* as follows:

12.2.3.1 Place one unexposed surface thermocouple on each *splice* of each *test specimen*, at the midpoint of the *splice*.

12.2.3.2 Place a minimum of one unexposed surface thermocouple per linear yard along the centerline of the *test specimen*, but not less than two unexposed surface thermocouples per *test specimen* excluding the *splice* thermocouple.

12.2.3.3 Place a minimum of one unexposed surface thermocouple on the *test specimen* at the junction between the *rated wall assembly*.

12.2.3.4 Place a minimum of one unexposed surface thermocouple within 1 in. of the junction between the *test specimen* and the *nonrated horizontal assembly*.

12.2.4 When, in the opinion of the laboratory, potential weak spots on the *test specimen* are identified attach additional unexposed surface thermocouples to these locations. An example of a weak spot is any irregularity, such as a crack or tear that has occurred to the *test specimen* during the *movement cycle* test or the installation process.

12.2.5 Do not locate thermocouples over fasteners (such as screws, nails or staples) that will be obviously higher or lower in temperature than at a more representative location if the aggregate area of the fasteners on the unexposed surface is less than 1 % of the area within any 6-in. (152-mm) diameter circle, unless the fasteners extend through the *test specimen*.

12.3 Simultaneously start the furnace, measuring devices and data acquisition equipment.

12.4 Maintain the fire environment within the furnace in accordance with the standard time-temperature curve shown in Test Method E119 or the rapid temperature rise curve shown in Test Method E1529.

12.5 *Furnace Control:*

12.5.1 *Test Method E119 Time-Temperature Curve*—Control the furnace such that the area under the time-temperature curve, obtained by averaging the results from the furnace thermocouple readings, is within 10 % of the corresponding area under the standard time-temperature curve for fire resistive tests of 1 h or less duration, within 7.5 % for those over 1 h and not more than 2 h, and within 5 % for tests exceeding 2 h in duration.

12.5.2 *Test Method E1529 Time-Temperature Curve*—Control the furnace such that the area under the time-temperature curve of the average of the gas temperature measurements is within 10 % of the corresponding curve developed in the furnace calibration for tests of ½ h or less duration, within 7.5 % of those over ½ h and not more than 1 h, and within 5 % for tests exceeding 1 h.

12.6 Measure and record unexposed and furnace temperature readings at intervals not exceeding 1 min throughout the fire test.

12.7 *Furnace Pressure:*

12.7.1 Calculate the differential pressure between the exposed and unexposed surfaces of the *test assembly* based on measurements taken at the specified locations and elevations, and based on the linear pressure gradient of the furnace.

12.7.2 Determine the linear pressure gradient of the furnace by the difference in measured pressure of at least two pressure sensors separated by a vertical distance in the furnace.

12.7.3 Operate the furnace such that a minimum pressure of 0.01 in. H_2O (2.5 Pa) is established at the lowest point of the *test specimen*.

12.7.4 Read and record the differential pressures at intervals not exceeding 1 min throughout the test. Reference 6.7.

12.7.5 After the initial 10 min of fire exposure, control the furnace pressure (at the locations specified) so that it will not be less than 0.01 in. H_2O (2.5 Pa) for the last 25 % of the fire exposure time period and an aggregate time period exceeding:

12.7.5.1 Ten percent of the fire exposure for fire resistive tests of 1 h or less duration,

12.7.5.2 Seven and one-half percent of the fire exposure for fire resistive tests longer than 1 h but not longer than 2 h, and

12.7.5.3 Five percent of the fire exposure for fire resistive tests exceeding 2 h in duration.

12.8 Make and record observations of the exposed and unexposed surfaces of the *test assembly* throughout the test. At a maximum of 15 min time intervals, record observations, such as deformation, spalling, cracking, burning, and production of smoke. Measure and record downward or lateral deflection.

12.9 When a crack or hole is observed on the unexposed side of the *test specimen* during the fire test, verify the integrity of the *test specimen* in accordance with Section 13. Note and record the location, time, and results of each cotton pad application.

12.10 Continue the test until failure occurs or until the *test specimen* has satisfied all the applicable requirements in 15.2 for the desired fire resistance rating.

12.11 For the purpose of obtaining additional performance data, if desired, continue the test beyond the time that the fire resistance rating is determined.

13. Integrity Test Procedure

13.1 Evaluate the integrity of the *test specimen* during the fire resistive test for passage of flame and hot gasses using a cotton pad in a wire frame provided with a handle. Reference 6.9.

13.2 Apply the cotton pad as specified in Test Method E119.

14. Hose Stream Test Procedure

14.1 *Requirements:*

14.1.1 Within 10 min after the end of the fire resistive test, subject test specimens to the impact, erosion, and cooling effects of a hose stream.

14.1.2 Conduct the hose stream test on a duplicate *test assembly* which has been conditioned, subjected to the *movement cycle* test, and subjected to a fire resistive test equal to one-half of the *test specimen* exposure but not more than 60 min.

14.1.3 As an option and in lieu of the duplicate *test assembly* in 14.1.2, conduct the hose stream test on the original *test assembly* after it has completed its full fire resistive test.

14.1.4 *Application:*

14.1.5 Use water pressure required in Practice E2226 for the hourly fire rating achieved.

14.1.6 Locate the nozzle orifice as required in Practice E2226.

14.1.7 Apply the hose stream in accordance with Practice E2226.

14.1.8 Maintain the hose stream on the *test assembly* for the duration of application in accordance with Practice E2226.

14.1.9 The rectangular area of the *rated wall assembly* in which the *continuity head-of-wall joint system* is mounted is to be considered as the exposed area, as the hose stream must traverse this calculated area during application of the hose stream.

15. Conditions of Compliance

15.1 *Integrity Test:*

15.1.1 No occurrence of flaming on the underside of the *nonrated horizontal assembly* on the unexposed side.

15.1.2 No occurrence of flaming on or through the *test specimen* on the unexposed side.

NOTE 7—The conditions in 15.1.1 and 15.1.2 typically occur when the *nonrated horizontal assembly* has failed or is about to fail.

15.1.3 No occurrence of ignition of the cotton pad when applied in accordance with Section 13.

15.2 *Movement Cycle Test*—When a *movement cycle* test is conducted, the *test specimen* shall have completed at least the minimum number of *movement cycles* using at least the minimum cyclic rate for the movement type selected.

15.3 *Hose Stream Test:*

15.3.1 During the hose stream test, the *test specimen* shall not develop any opening that allows a projection of water from the stream beyond its unexposed side.

15.4 *F Rating:*

15.4.1 A *test specimen* shall have met the requirements for the F-Rating when it remains in the *joint opening* during the fire resistance test, the hose stream test, and the following conditions are met.

15.4.1.1 The *test specimen* shall have withstood the fire resistance test for the rating period equal to the *rated wall assembly* by preventing flaming on the unexposed side of the *test specimen* and on the underside of the *nonrated horizontal assembly* on the unexposed side.

15.5 *T Rating:*

15.5.1 A *test specimen* shall have met the requirements for the T rating when it remains in the *joint opening* during the fire resistance test and hose stream test and the following conditions are met.

15.5.1.1 The transmission of heat through the *test specimen* during the rating period shall not have been such as to raise the temperature of any thermocouple on the unexposed surface more than 325°F (181°C) above its initial temperature.

15.5.1.2 The Conditions of Compliance of the F-Rating are met.

15.5.1.3 For a maximum joint width greater than 4 in. (102 mm), the average temperature rise of the thermocouples on the unexposed face of the *test specimen* and its *rated wall assembly* is not more than 250°F (139°C) above the initial temperature.

15.6 When Test Method E119 is used and the indicated fire resistance rating is 60 min or more, it shall be increased or decreased by the following correction to compensate for significant variation of the measured furnace temperature from the standard time-temperature curve provided that the conditions of 12.6 are met. The correction is expressed by the following formula:

$$C = 2I(A - A_S)/3(A_S + L) \quad (1)$$

where:

C = correction to the indicated fire resistance period in the same units as I,

I = indicated fire resistance period in min,

A = area under the actual time-temperature curve for the first three fourths of the indicated fire resistance period in °F · min (°C · min),

A_S = the area under the standard time-temperature curve for the first three fourths for the same part of the indicated fire resistance period in °F · min (°C · min), and

L = lag correction in the same units as A and A_s, 3240°F · min (1800°C · min), when furnace thermocouples specified in 6.3.1 are used.

16. Report

16.1 *General Information*—Include:

16.1.1 All information recorded or documented, or both, during the tests, and

16.1.2 The test date and a project number.

16.1.3 As a minimum, the following about the laboratory or test facility:

16.1.3.1 Name and location, and

16.1.3.2 A description of the furnace used and, if any, the test frame.

16.2 *Test Assembly and Test Specimen Information*—Include a unique designation for each *continuity head-of-wall joint system* tested. When more than one *continuity head-of-wall joint system* is tested, supply separate information for each of the following:

16.2.1 Drawings of the *rated wall assembly* and the *nonrated horizontal assembly* detailing dimensions, materials and composition.

16.2.2 The curing time, if any, for any components of each *test specimen*.

16.2.3 The moisture content and the distribution of moisture within the *test assembly*.

16.2.4 The shape and dimensions of recesses created in the *rated wall assembly* to secure any part of the *test specimen*.

16.2.5 All installation procedures provided by the test sponsor, details of the equipment used and photographs of the installation procedure.

16.2.6 The method used to *splice* the *test specimen*, including the tests sponsor's instructions and photographic documentation of the installation.

16.2.7 A description of each *test specimen* that is tested. Include the test sponsor's installation or fabrication instructions or both, and photographic documentation of the installation.

16.3 *Movement Cycling Test*—When movement cycling is conducted, include the following information:

16.3.1 The nominal joint width of the joint, gap, recess or separation,

16.3.2 The maximum joint width of the joint, gap, recess or separation,

16.3.3 The minimum joint width of the joint, gap, recess or separation,

16.3.4 The movement type selected from Table 1,

16.3.5 The minimum number of cycles completed,

16.3.6 The cyclic rate (cpm) used,

16.3.7 Whether or not the information in 16.3.5 and 16.3.6 satisfies the requirements of 16.3.4,

16.3.8 Clearly state the F-Rating and T-rating of each *test specimen*, and

16.3.9 Photographs of each *test specimen* tested during and after the *movement cycle* test.

16.4 *Fire-Resistance Test*—For each *test specimen* tested, include the following:

16.4.1 Length and maximum joint width of the joint, gap, recess or separation used in the fire resistive test,

16.4.2 The time at which the acceptance criteria for the F-rating and T-rating were exceeded, expressed in elapsed minutes,

16.4.3 The unexposed surface temperatures,

16.4.4 Report the furnace temperatures and the pressure data,

16.4.5 When applied, report the recorded measurement of the superimposed load applied to the *test specimen*, method of application, and a photographic documentation of its placement, and

16.4.6 Report any observations made of the exposed and unexposed surfaces, such as deformation, spalling, cracking, burning, and production of smoke.

16.5 *Hose Stream Test*—Report the performance of each *test specimen* after being subjected to the hose stream test. Clearly state whether each *test specimen* passed or failed.

17. Precision and Bias

17.1 *Movement Cycle Test*—No information is presented about either the precision or bias of this test method for measuring the response of a *test specimen* to a standard *movement cycle* test under controlled laboratory conditions because no material having an acceptable reference value has been determined.

17.2 *Fire Resistance Test*—Precision and bias of this test method for measuring the response of *test specimens* to heat and flame under controlled laboratory conditions are essentially as specified in Test Method E119 or E1529.

17.3 *Integrity Test*—No information is presented about either the precision and bias of this test method for measuring the response of *test specimens* to the integrity test under controlled laboratory conditions since the test is non-quantitative.

17.4 *Hose Stream Test*—No information is presented about either the precision and bias of this test method for measuring the response of *test specimens* to a standard hose stream under controlled laboratory conditions since the test is non-quantitative.

18. Keywords

18.1 construction gap; continuity head-of-wall system; control joint; cycling ; expansion joint; fire; fire resistance; fire resistive joint systems; fire separating elements; gaps; hose stream; joint; linear openings; movement; recess; separation; void

APPENDIXES

(Nonmandatory Information)

X1. INTRODUCTION

X1.1 Preface

X1.1.1 During the development of this test method several philosophical issues were expressed and various engineering principles put forth for discussion. This test method is based on the broadest consensus of these issues and discussions. The words in italics are terms defined in Section 3 of this test method.

X1.1.2 This appendix provides a brief discussion of several significant items that were considered. This information is intended to present the basis for including some items in this test method as well as discussion of conflicting points of view.

X1.1.3 This is not the first test method to address the *continuity* issue. Test Method E1966[7] is a test method that provides a head-of-wall test application of a fire-resistive joint system to address *continuity*. For more information on the history of fire-resistive joint systems refer to the Appendix in Test Method E1966. The purpose of this appendix is to document some points of view and the reasoning discussed during the development of this test method, which was created in response to a request by industry, to address a "unique"

[7] This reference also applies to UL 2079, CAN/ULC S115, ISO 10295-2 and other similar tests for fire resistance.

head-of-wall application. Joint system material manufacturers, architects, designers, and contractors requested a process to comply with the model building codes[8] requirement for *continuity* of fire barriers, which includes *rated wall assemblies*, to extend from the "Top of the floor/ceiling assembly below to the underside of the floor or roof slab or deck above." The *continuity* where a joint system is located between a *rated wall assembly* and a fire-resistance-rated floor, floor/ceiling, or roof assembly is not covered by this test method, because there is Test Method E1966 that is intended to fire test the joint system intended for use in this head-of-wall application. The need for this test method arises when the *continuity* of a *rated wall assembly* interfaces below a *nonrated horizontal assembly* by means of a *continuity head-of-wall joint system*.

X1.1.4 Hundreds, maybe thousands, of different *nonrated horizontal assemblies* are possible. *Nonrated horizontal assemblies* have not been fire tested or fire-resistance-rated in accordance with Test Method E119[9], which always yields a fire-resistance-rating no matter how short or long the duration. There are no published fire-resistance-ratings for *nonrated horizontal assemblies*. Their fire performance is unknown, meaning it can be substantially less than 30 min or considerably greater depending upon their construction.

X1.2 Test Method's Historical Context and Background

X1.2.1 The 2009 International Building Code (IBC) requires *continuity* of the *rated wall assembly* to the underside of the *nonrated horizontal assembly* above but does not specifically state that the joint system must be fire-resistance-rated. However, an ASTM E1966 joint system sealing a *joint opening* located between the *rated wall assembly* and a fire-resistance-rated floor, floor/ceiling, or roof assembly is called a head-of-wall, meaning it is a continuation of the *rated wall assembly*. This test method provides a means to test the continuation of the *rated wall assembly to a nonrated floor, floor/ceiling or roof assembly*.

X1.2.2 The Metal Building Manufacturers Association (MBMA) reported there were numerous instances where Authorities Having Jurisdiction (AHJ) requested documentation about *continuity*. *Joint openings* are created within building subdivisions where *rated wall assemblies* continue upward to the underside of *nonrated horizontal assembly*. These joint openings must be sealed by means of a *continuity head-of-wall joint system*, which must be fire-resistance-rated. Based on this request for documentation, Underwriters Laboratories (UL) originally tested a *continuity head-of-wall joint system* between a *rated wall assembly* and a *nonrated horizontal assembly*. Design Listings HW-D-0488, HW-D-0489, and HW-D-0490 were published on August 16, 2007 based on that testing. These Design Listings were subsequently removed because a reference test method was not available for evaluating a *nonrated horizontal assembly* as part of the *test assembly*. These head-of-wall Design Listings were re-published on February 11, 2008 with only a fire-resistance-rated roof-ceiling assembly referenced to comply with Test Method E1966 provisions.

X1.2.3 Some fire-resistive joint system material manufacturers stated that over the years thousands of engineering judgments (EJ) were written based on the head-of-wall application because there was no test method directly related to testing a *continuity head-of-wall joint system* between *rated wall assemblies* and *nonrated horizontal assemblies*. These engineering judgments were used to address the *continuity* issue. Using test data from Test Method E1966 alone may not address all the issues evaluated by this test method. Refer to X2.3.1 within this appendix for an example of one such issue. This test method will assist in reducing the number of engineering judgments written on the *continuity head-of-wall joint systems*. The number of Design Listings and the information needed to write engineering judgments for *continuity head-of- wall joint systems* will also increase as testing to this test method increases.

X1.3 Scope

X1.3.1 Previous drafts of this test method had text inferring a broader application of these test protocols. However, there was a compromise reached, the text was modified, and the application was restricted. The intent of this test method is to address only the *continuity head-of-wall joint system* sealing the *joint opening* between a *rated wall assembly* and a *nonrated horizontal assembly* but does not address the performance of the *rated wall assembly* or the *nonrated horizontal assembly*. The introduction of this test method states that it does not address connections or junctions of building elements where there is no *joint opening*.

X1.3.2 In order to fire test and compare systems, assemblies, components, and products under a uniform protocol, many test methods, for example, Test Method E119, require additional support, brackets, or connections that are not part or representative of the product or assembly's field construction. This requirement is also true of many of the fire resistive test methods, such as Test Method E814[10], which states "Support the extended portion of through-penetrating items on the unexposed side so as to minimize relative movement between the through-penetrating item and the restraining frame in which the *test assembly* is mounted." This test method may require similar additions to the *nonrated horizontal assembly* for laboratory testing purposes.

[8] For example, the 2009 International Building Code®.

[9] This reference also applies to UL 263, NFPA 251, CAN/ULC S101, ISO 834 and other similar tests for fire resistance.

[10] This reference also applies to UL 1479, CAN/ULC S115, ISO 10295-1 and other similar tests for fire resistance.

X2. POINTS OF VIEW

X2.1 There was a considerable difference of opinion among participants in the development of this test method. Essentially, there were three major opinions expressed by various groups. All of these groups participated in the six years of discussions developing this test method. Each group made significant contributions to this test method.

X2.2 One group felt the building codes should not permit the intersection of a non-rated horizontal assembly and a rated wall assembly creating a joint that requires a fire rating because of the unpredictable fire behavior of a non-rated assembly that forms one of the building elements that create the joint boundaries. This test method tests and fire rates a joint which is dependent upon the performance of a *nonrated horizontal assembly*. The nonrated horizontal assembly may not remain in place during an actual fire and permits a false sense of security and is simply a method to enable code officials to allow this type of construction. However, the majority of Task Group members developing this test method believe that ASTM International's obligation is to provide Authorities Having Jurisdiction (AHJ), such as building officials and fire marshals, with tools, such as test methods, specifications and guides, for them to use in determining compliance with building code and fire code provisions, such as *continuity*.

X2.3 Another group felt that existing fire-resistive joint system test method, Test Method E1966, should be modified to accommodate this construction. This option may be implemented at a later date through a merger of this test method and Test Method E1966.

X2.3.1 A question related to X2.3 is whether using a Test Method E1966 joint system would satisfy the application being addressed by the scope of this document. There is a fundamental difference between Test Method E1966 and this test method. The joint system tested to Test Method E1966 is bounded by two fire resistance rated assemblies. These building elements are designed and fire-resistance-rated to resist heat transfer. This test method has a *nonrated horizontal assembly*, for example, steel roof, which is not fire-resistance-rated to resist heat transfer through the nonrated horizontal assembly. However, the issue here is the effect of lateral heat transfer that could impose a more significant thermal load on the joint system than with the same joint system tested to Test Method E1966. Also, the fire-resistance-rated assemblies are more likely to have less deflection and deformation than ones that are not fire-resistance-rated, for example, the steel roof. The joint system tested and fire-resistance-rated to Test Method E1966 may not have the movement capabilities required to maintain the seal between the building elements in this test method, for example, *rated wall assembly* and *nonrated horizontal assembly*.

X2.4 Yet another group felt that development of a new method was the only alternative to address this unique construction's issues, for example, significant movement of some assemblies that would likely occur during the fire testing. The majority of participants developing this test method believed that this option was the best approach at this time. This approach was also supported by the majority of major fire-resistive joint system material manufacturers who will be testing their products to this test method.

X3. RESULTING CONSENSUS

X3.1 A settlement of differences was reached by each side making concessions. The resulting test method addressed several issues.

X3.2 This test method subjects *nonrated horizontal assemblies*, which are not fire-resistance-rated, to a fire test. When an assembly is not fire-resistance-rated it is not intended for use in fire-resistance-rated applications. X1.3.1 states, "The intent of this test method is to address only the joint system sealing the *joint opening* between a *rated wall assembly* and a *nonrated horizontal assembly* and not to address the performance of the *rated wall assembly* or the *nonrated horizontal assembly*." However, the performance of the *continuity head-of-wall joint system* is dependent upon the performance of the *nonrated horizontal assembly* as noted in X2.3.1 as well as the *rated wall assembly*.

X3.3 Conditions of restraint of assemblies used by the laboratory, which are documented according to Section 16.1.3.2, simulate some elements of the anticipated planes of movement of the non-rated horizontal assembly tested, but will not likely completely simulate the complexity of movement of a full scale test assembly. Section X1.3.2 discusses laboratory additions that are not part or representative of the product or assembly's field construction but that are required for the laboratory to conduct the fire test.

X3.4 This test method addresses a *rated wall assembly* terminating below a *nonrated horizontal assembly* separated by a *joint opening* that is sealed with a *continuity head-of-wall joint system*, which is to be fire-resistance-rated to ensure *continuity*.

X3.5 Many of the participants of the group referenced in X2.2 were opposed to unexposed surface thermocouples being placed on the *rated wall assembly* because it already achieved a fire-resistance-rating. The compromise was to remove the unexposed thermocouples from both the *rated wall assembly* and the *nonrated horizontal assembly* because this test method does not measure their performance as stated in Section 1.2. Therefore, thermocouple placement is different than Test

Method E1966, which tests using two adjacent fire-resistance-rated assemblies. This test method uses the same number and relative location of unexposed surface thermocouples on the *continuity head-of-wall joint system* as Test Method E1966 but does not place unexposed thermocouples on the *rated wall assembly* and the *nonrated horizontal assembly* because of this compromise.

X3.6 The fire-resistance rating of the *continuity head-of-wall joint system* between the intersecting assemblies must be at least equal to that of the *rated wall assembly* and may be greater than the rating of a *nonrated horizontal assembly* if it were measured. A similar situation exists in Test Method E2307, which fire tests the joint system in a different orientation between a rated horizontal assembly and a nonrated curtain wall assembly.

X4. INFLUENCES ON FIRE TEST PERFORMANCE

X4.1 As referenced in Test Method E119 and Test Method E1966's Significance and Use sections, as well as many other test methods used to determine fire resistance, the *test assembly* may not be representative of its reaction to fire in a field condition. The *test assembly*'s movement in response to fire in this test method may not be representative of field conditions. This is due to many variables, for example, height and length of the *test assembly*, test frame restraints, etc. Allowable movement of some joint systems may be significantly different than designed and not representative of field conditions. The *continuity head-of-wall joint system* is tested at its *maximum joint width* as stated in 7.2.5. The *test assembly* may allow more deformation of the *nonrated horizontal assembly* creating a more severe test condition. Conversely as with all fire tests, refer to X4.4; the *test assembly* is usually smaller than field construction. This may increase the stiffness of the *test assembly* and decrease possible deformation.

X4.2 Normal degradation of nonrated horizontal assembly, such as excessive deformation or consumption of the *nonrated horizontal assembly*, may not yield a test failure provided that the test method's Conditions of Compliance (Section 15) are met, which includes no "flaming on the unexposed side of the *test specimen* and on the underside of the *nonrated horizontal assembly* on the unexposed side," which is a common fire test requirement.

X4.3 Fire tests may not always predict the real performance of the actual construction. Test Method E119 tests columns, beams and wall, floor/ceiling and roof assemblies. The size requirements are often much less than as constructed in the field. A non-loadbearing or bearing wall assembly is only required to be 100 ft^2 (9.3 m^2) with neither its length nor height less than 9 ft (2.7 m). A load bearing floor assembly is only required to be 180 ft^2 (16.7 m^2) with neither dimension less than 12 ft (3.7 m). Yet, these test assemblies are used to accept field construction of walls and floors that are much higher, wider, and longer. Beams are only required to be tested at least 12 ft (3.7 m) long. These reductions in size alter the performance that may be experienced in field constructions. Test Method E119's Significance and Use section states, "The test provides a relative measure of the fire-test-response of comparable building elements under these fire exposure conditions. The exposure is not representative of all fire conditions because conditions vary with changes in the amount, nature and distribution of fire loading, ventilation, compartment size and configuration, and heat sink characteristics of the compartment. Variation from the test conditions or specimen construction, such as size, materials, method of assembly, also affects the fire-test response. For these reasons, evaluation of the variation is required for application to construction in the field." However, Test Method E119 and this test method offer assistance to design professionals. Some fire tests address a single element, (damper, penetrating item, door, etc.) and the size of the *test assembly* fire-resistance-rated per Test Method E119 is even smaller, for example, a Test Method E814 firestop system can be tested in a 3-ft^2 (0.9 m^2) horizontal assembly, which is not loaded. Test Method E1966 set a length to width ratio that is followed in this test method. Testing of joint systems between fire-resistance-rated assemblies permits the same simplifications, such as reducing the size of the adjacent assemblies and not requiring the application of superimposed loads, which may limit dynamic deformations (kinking, sagging). However, the test method allows the application of superimposed loads when required by the test sponsor. Refer to 4.1.3, 6.10, and 16.4.6. Applying a superimposed load may increase the fire-resistance-rating of the *continuity head-of-wall joint system*. Some *continuity head-of-wall joint systems* use fibrous insulation as a component. When these materials are installed they have a given mass and density. Applying a superimposed load during the fire test may cause the *nonrated horizontal assembly* to deflect downward, increasing the compression of the fibrous insulation. Since the mass of the fibrous insulation remains the same and the volume it occupies is decreased, its density will increase. Typically, increasing the fibrous insulation's density increases its fire resistance because the heat transmission through it is decreased.

X4.4 This test method may yield a fire-resistance-rating for the *continuity head-of-wall joint system* that is greater than the *nonrated horizontal assembly*, which does not have a published fire-resistance-rating. The intent of this test method is to ensure continuity between the *continuity head-of-wall joint system* being tested and the *rated wall assembly*, which has a fire-resistance-rating. To comply with the *continuity* provision of the model building codes, the *continuity head-of-wall joint system* must have a fire-resistance-rating at least equal to the *rated wall assembly*.

X4.5 The laboratory's test frame construction and installation of the *nonrated horizontal assembly* into it may create a combination that allows the *continuity head-of-wall joint*

system to stay-in-place beyond the anticipated point of failure of the *nonrated horizontal assembly* as defined by the test method. However, the laboratory's requirements to fire test products and assemblies cannot be construed as being representative of typical field construction, which is addressed in X4.3. These limitations are true of all fire test standards to some extent.

X4.6 The hose stream requirements, detailed in 14.1 in this test method, are the same as those requirements in Section 14.1 of Test Method E1966, which is a joint system between the intersection of two fire-resistance-rated assemblies.

X4.7 This test method requires that the test report include drawings of the *rated wall assembly* and the *nonrated horizontal assembly* detailing dimensions, materials and composition, which would include structural members whether unprotected or protected. This test method also requires the test frame be described. The effect of unprotected supporting structural members may not be reflective of a field construction as discussed in X4.3.

X4.8 Test Method E119, Test Method E814, Test Method E1966, and similar test methods that measure fire resistance do not measure the limitation of the passage of smoke or products of combustion through the *test assembly* or *test specimen*. Cooper has published one discussion of this issue.[11] Neither does this test method measure the limitation of the passage of smoke nor products of combustion through the *continuity head-of-wall joint systems*. However, UL 2079 provides a measurement of air leakage through a fire-resistive joint system, which is sometimes used for this purpose. In addition, this test method uses a cotton pad test to detect hot gases, which are products of combustion, on the unexposed side of the *test specimen* or *test assembly* as referenced in 6.9. The objective of this cotton pad test is to evaluate the potential for igniting combustible material that might be placed in contact with the unexposed surface.

[11] Cooper, L. Y., "The Need and Availability of Test Methods for Measuring the Smoke Leakage Characteristics of Door Assemblies," Fire Safety, Science, and Engineering, Test Method STP 882, T. Z. Harmathy, Ed., Test Method, 1985, pp. 310–329.