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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] 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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1.2.1 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.

1.4 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~~safety, health, and environmental 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
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.

[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.

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*.

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 Movement followed by:	30 10	100 400

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.

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.

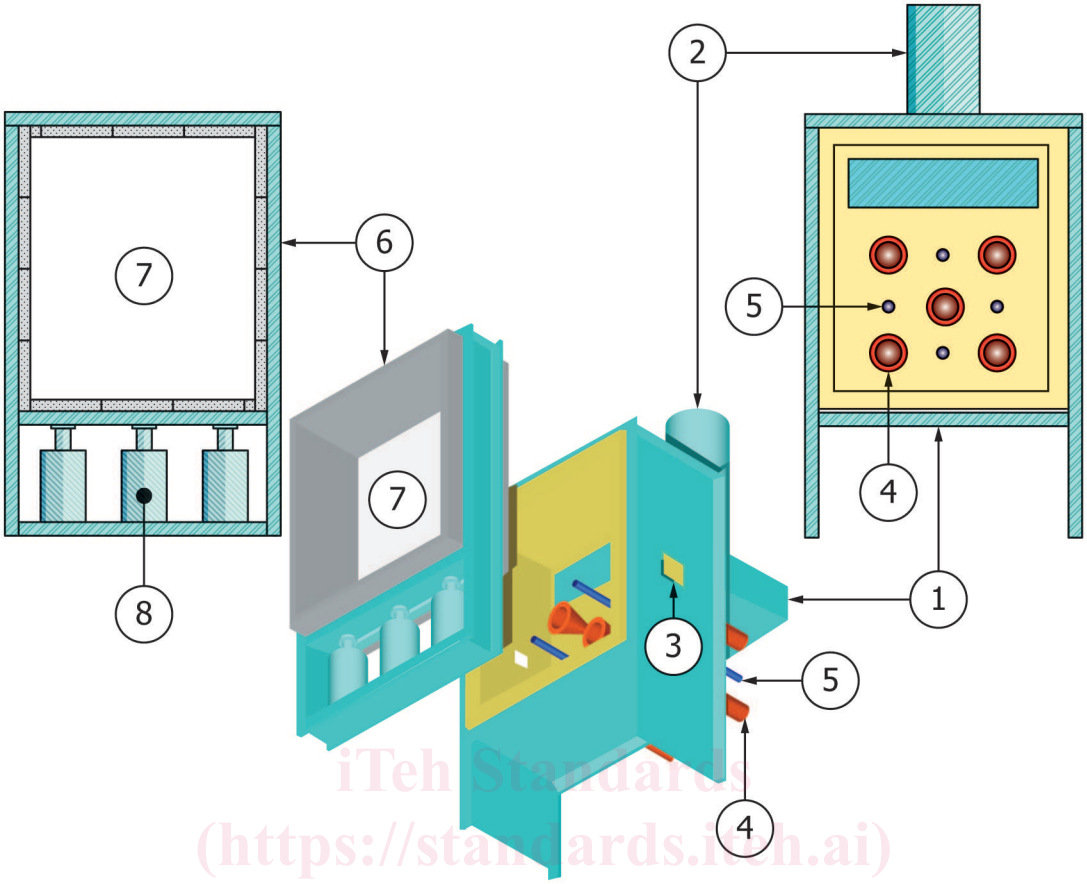

FIG. 1 Example of Vertical Furnace and Test Frame

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)

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.

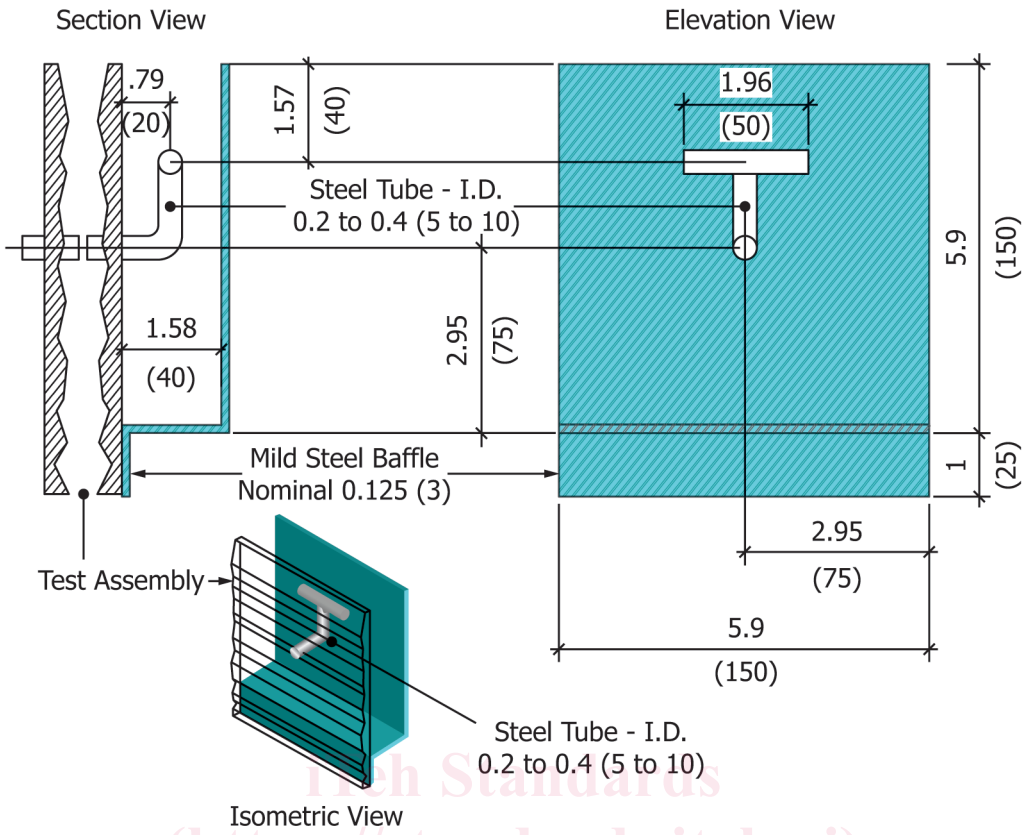

FIG. 2 "T" Shaped Pressure Sensing Probe

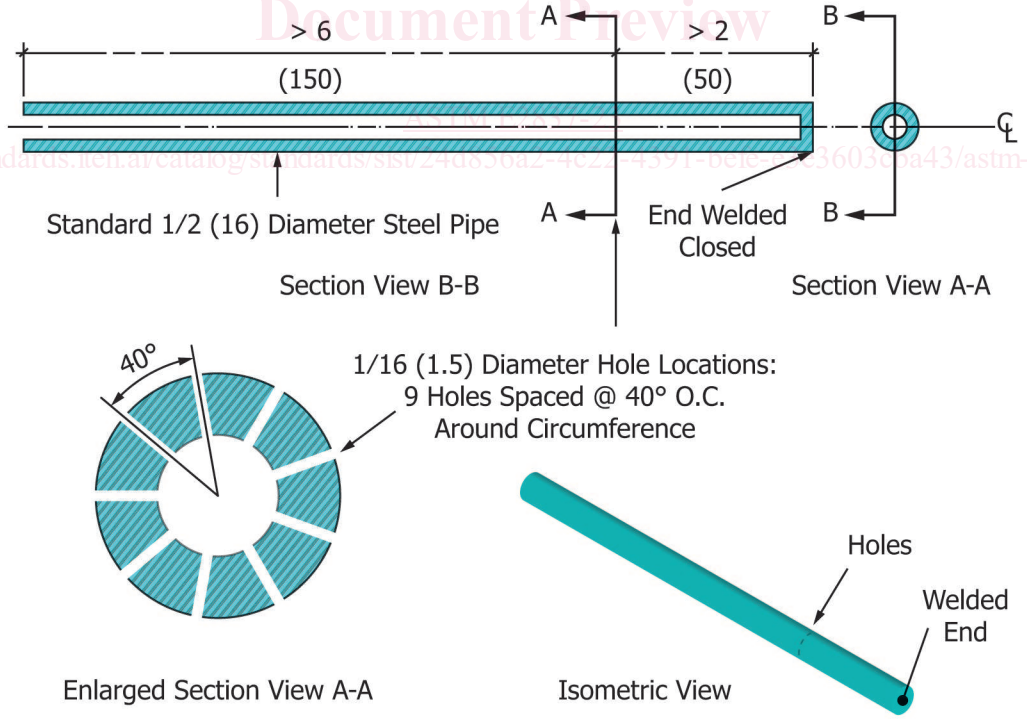

FIG. 3 Tube Type Pressure Sensing Probe

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).~~2 in. ± 0.04 in. (50 mm ± 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 in. ± 0.12 in. (152 mm ± 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~~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:*

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

7.2.1 Where the *maximum joint width* is not greater than ~~4 in. (102 mm)~~ 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).

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*.

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 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*.

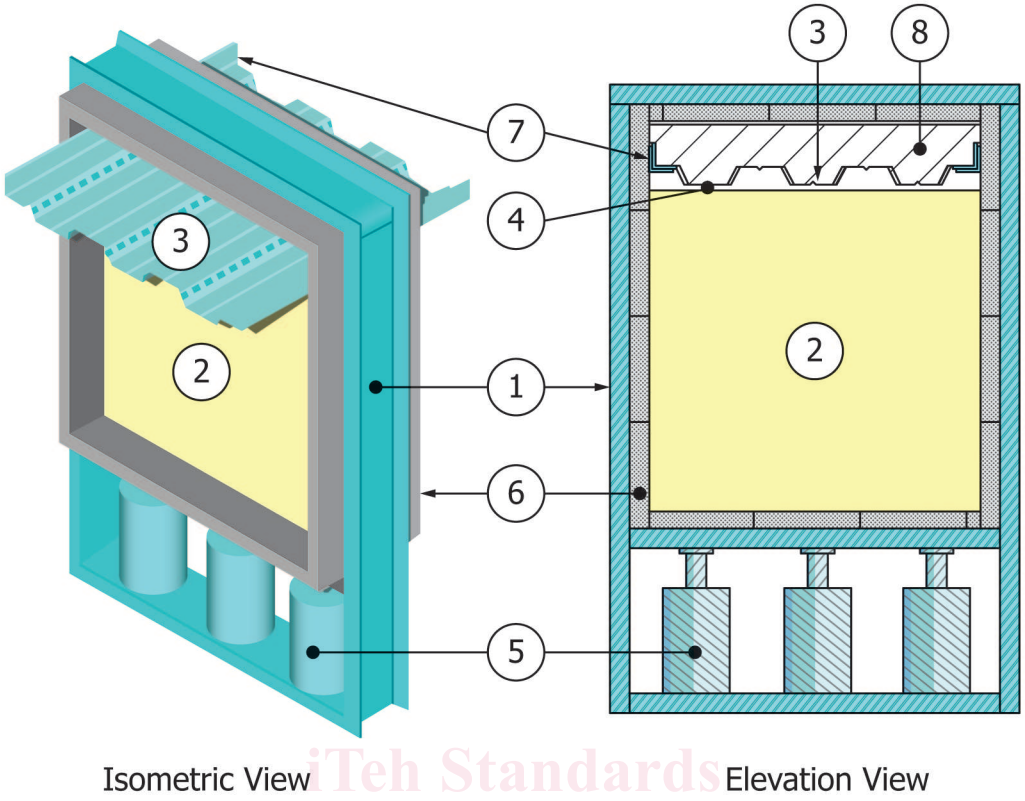

FIG. 4 Example of Vertical Test Frame and Test Assembly

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

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 (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:*

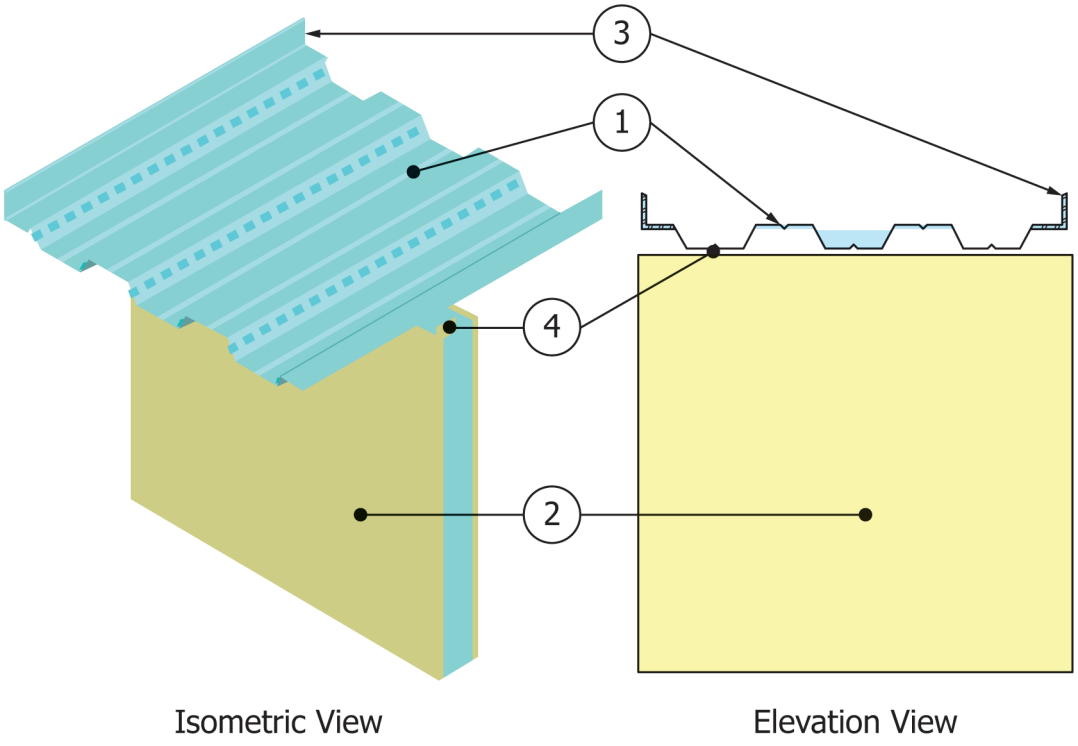

FIG. 5 Example of Method A Configuration (Isometric and Front Views)

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

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)~~ 6 in. ± 1 in. (152 mm ± 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:*