



Designation: E 814 – 06

An American National Standard

Standard Test Method for Fire Tests of Through-Penetration Fire Stops¹

This standard is issued under the fixed designation E 814; 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.

This standard has been approved for use by agencies of the Department of Defense.

INTRODUCTION

Characteristically fire spreads from one building compartment to another by the collapse of a barrier, or by openings through which flames or hot gases may pass, or by transfer of sufficient heat to ignite combustibles beyond the barrier. Test Methods E 119 describe the method to be used to measure the fire-resistive performance of these barriers.

However, various techniques of providing for the distribution of services within a structure sometimes require that openings be made in fire-resistive walls and floors to allow the passage of such penetrating items as cables, conduits, pipes, trays, and ducts through to the adjacent compartment. Fire-stop material is installed into these openings to resist the spread of fire.

The performance of through-penetration fire stops should be measured and specified according to a common standard that describes the method of fire exposure and rating criteria.

1. Scope

1.1 This test method is applicable to through-penetration fire stops of various materials and construction. Fire stops are intended for use in openings in fire-resistive walls and floors that are evaluated in accordance with Test Methods E 119.

1.2 Tests conducted in conformance with this test method record fire-stop performance during the test exposure; but such tests shall not be construed to determine suitability of the fire stop for use after test exposure.

1.3 This test method also measures the resistance of fire stops to an external force stimulated by a hose stream. However, this test method shall not be construed as determining the performance of the fire stop during actual fire conditions when subjected to forces such as failure of cable support systems and falling debris.

1.4 The intent of this test method is to develop data to assist others in determining the suitability of the fire stops for use where fire resistance is required.

1.5 *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 materials, products, or assemblies under actual fire conditions.*

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.7 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 requirements of the standard.

2. Referenced Documents

2.1 *ASTM Standards:*²

E 119 Test Methods for Fire Tests of Building Construction and Materials

E 2226 Practice for Application of Hose Stream

3. Terminology

3.1 *Definition:*

3.1.1 *fire stop*—a through-penetration fire stop is a specific construction consisting of the materials that fill the opening around penetrating items such as cables, cable trays, conduits, ducts, and pipes and their means of support through the wall or floor opening to prevent spread of fire.

3.2 *Definitions of Terms Specific to This Standard:*

¹ This method is under the jurisdiction of Committee E05 on Fire Standards and is the direct responsibility of Subcommittee E05.11 on Construction Assemblies.

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



3.2.1 *test specimen*—the fire stop being tested.

3.2.2 *test assembly*—the wall or floor into which the test specimen(s) is (are) mounted or installed.

4. Summary of Test Method

4.1 This method of testing through-penetration fire stops exposes fire stops to a standard temperature-time fire, and to a subsequent application of a hose stream.

4.2 Ratings are established on the basis of the period of resistance to the fire exposure, prior to the first development of through openings, flaming on the unexposed surface, limiting thermal transmission criterion, and acceptable performance under application of a hose stream.

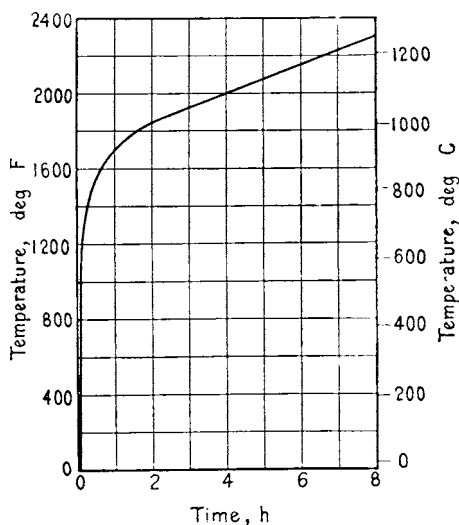
5. Significance and Use

5.1 This test method is used to determine the performance of a fire stop with respect to exposure to a standard time-temperature fire test and a hose stream test. The performance of a fire stop is dependent upon the specific assembly of materials tested including the number, type, and size of penetrations and the floors or walls in which it is installed.

5.2 Two ratings are established for each fire stop. An *F* rating is based upon flame occurrence on the unexposed surface, while the *T* rating is based upon the temperature rise as well as flame occurrence on the unexposed side of the fire stop. These ratings, together with detailed performance data such as the location of through-openings and temperatures of penetrating items are intended to be one factor in assessing performance of fire stops.

6. Control of Fire Tests

6.1 *Time-Temperature Curve*—The fire environment within the furnace shall be in accordance with the standard time-temperature curve shown in Fig. 1. The points on the curve that determine its character are:



NOTE—For a closer definition of the temperature-time curve, see Annex A1.

FIG. 1 Temperature-Time Curve

Ambient at 0 min
 1000°F (538°C) at 5 min
 1300°F (704°C) at 10 min
 1550°F (843°C) at 30 min
 1700°F (927°C) at 60 min
 1850°F (1010°C) at 120 min
 2000°F (1093°C) at 240 min
 2300°F (1260°C) at 480 min or over

6.2 Furnace Temperatures:

6.2.1 The temperature fixed by the curve shall be the average temperature obtained from the readings of thermocouples symmetrically disposed and distributed within the test furnace to show the temperature near all parts of the assembly. Use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² (9.29 m²) of floor surface, and not fewer than nine thermocouples per 100 ft² of wall specimen surface.

6.2.2 Enclose the thermocouples in sealed protection tubes of such materials and dimensions that the time constant of the protected thermocouple assembly lies within the range (see Note 1) from 300 to 400 s. The exposed length of the pyrometer tube and thermocouple in the furnace chamber shall be not less than 12 in. (300 mm). Use of other types of protection tubes or pyrometers is acceptable provided that temperature measurements obtained in accordance with Fig. 1 are within the limit of accuracy that applies for furnace temperature measurements.

NOTE 1—A typical thermocouple meeting these time-constant requirements may be fabricated by fusion-welding the twisted ends of No. 18 B and S gage (0.040 in.) (1.02 mm) Chromel-Alumel wires, mounting the leads in porcelain insulators and inserting the assembly so the thermocouple bead is 0.50 in. (13 mm) from the sealed end of a standard weight, nominal 1/2-in. iron, steel, or Inconel pipe. (Inconel is a trademark of Inco Alloys, Inc., 3800 Riverside Dr., P.O. Box 1958, Huntington, WV 25720.) The time constant for this and for several other thermocouple assemblies was measured in 1976. The time constant may also be calculated from knowledge of its physical and thermal properties. See Research Report RR:E05-1001, available from ASTM Headquarters.

6.2.3 For floors, place the junction of the thermocouples 12 in. (300 mm) away from the exposed face of the assembly. In the case of walls, place the thermocouples 6.0 in. (150 mm) away from the exposed face.

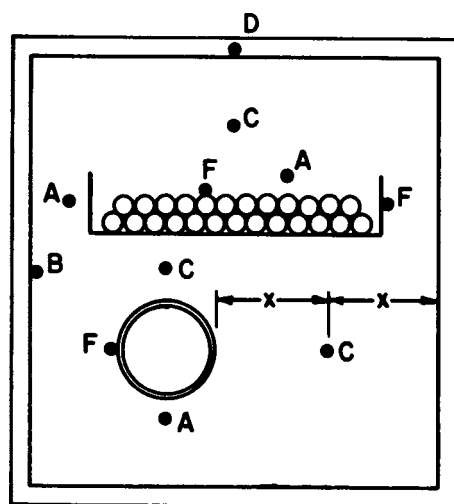
6.2.4 Read the temperature at intervals not exceeding 5 min during the first 120 min. Thereafter, the intervals shall not exceed 10 min.

6.2.5 The accuracy of the furnace control shall be such that the area under the temperature-time curve, obtained by averaging the results from the pyrometer or thermoelectric device readings, is within 10 % of the corresponding area under the standard temperature-time curve shown in Fig. 1 for fire tests of 60 min or less duration; within 7.5 % for those over 60 min and not more than 120 min; and within 5 % for tests exceeding 120 min in duration.

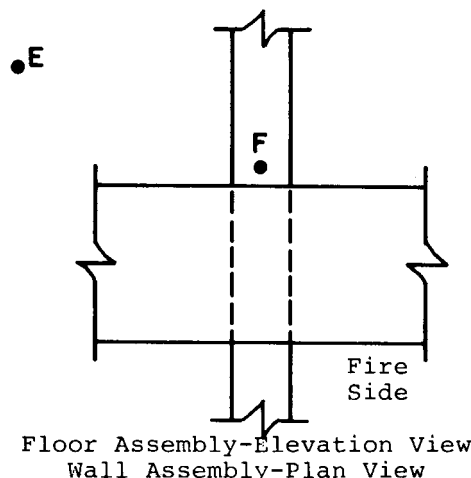
6.3 Unexposed Surface Temperatures:

6.3.1 Make at least one measurement at each of the following locations on the unexposed surface of the test sample and floor or wall assembly as shown in Fig. 2.

6.3.2 Additional temperature measurements are made at the discretion of the testing agency to obtain representative information on the performance of the fire stops.



Floor Assembly-Plan View
Wall Assembly-Elevation View



Floor Assembly-Elevation View
Wall Assembly-Plan View

Legend:

A—At a point on the surface of the fire stop 1 in. (25 mm) from one through-penetrating item for each type of penetrating item employed in the field of the fire stop. If the grouping of penetrating items through the test sample prohibits placement of the thermocouple pad, the thermocouple shall not be required.

B—At a point on the fire stop surface at the periphery of the fire stop.

C—At a minimum of three points on the fire stop surface approximately equidistant from a penetrating item or group of penetrating items in the field of the fire stop and the periphery.

D—At one point on any frame that is installed about the perimeter of the opening.

E—At one point on the unexposed surface of the wall or floor that is a minimum of 12 in. (305 mm) from any opening.

F—At one point on each type of through-penetrating item. If the through-penetrating item is insulated or coated on the unexposed side, the thermocouple shall be located on the exterior surface of the insulation or coating. If the coating or insulation does not extend the full length of the penetrating item on the unexposed side, an additional thermocouple shall be installed on the penetrating item 1.0 in. (25.4 mm) beyond the termination of the insulation or coating.

FIG. 2 Temperature Measurement Locations

6.3.3 Measure temperatures on the surface of the fire stop and assembly with thermocouples placed under flexible pads specified in **Annex A2**. The pads shall be held firmly against the surface and shall fit closely about the thermocouples. The thermocouple junction shall be located under the center of the pads. The thermocouple leads under the pads shall be not heavier than No. 18 B and S gage (0.040 in.) (1.02 mm) and shall be electrically insulated with heat-resistant moisture-resistant coverings.

6.3.4 Measure temperatures of each type and size of penetrating item with at least one thermocouple located 1.0 in. (25.4 mm) from the unexposed surface of the fire-stop material. The thermocouple bead shall be held firmly against the penetrating item. The thermocouple leads shall not be heavier than No. 22 B and S gage (0.025 in.) (0.635 mm) and shall be electrically insulated with heat-resistant and moisture-resistant coverings. The pads as described above shall be held firmly against the penetrating item and shall fit closely about the thermocouples.

6.3.5 Temperature readings shall be taken at intervals not exceeding 15 min until a reading exceeding 212°F (100°C) has been obtained at any one point. Thereafter, at the discretion of the testing body, the readings shall be taken more frequently, but the intervals need not be less than 5 min.

6.4 Differential Pressure:

6.4.1 The pressure differential between the exposed and unexposed surfaces of the test assembly, as defined in **3.2.2**, shall be measured at two points 0.78 in. (20 mm) from the exposed surface of the test assembly as follows:

6.4.1.1 **Walls**—At two points along the vertical center line. The two points shall be separated by a vertical distance that is equal to or greater than one-half of the height of the test assembly.

6.4.1.2 **Floors**—Two points along the longitudinal center line at a distance of $\frac{1}{4} \pm \frac{1}{8}$ from the center of the floor where L equals the length of the floor.

6.4.2 The pressure-measuring probes shall be a Tee-shaped probe or a tube probe and shall be manufactured from stainless steel or other suitable material.

6.4.3 Measure the pressure by means of a manometer or equivalent transducer. The manometer or transducer shall be capable of reading 0.01-in. H₂O (2.5-Pa) increments with a measurement precision of 0.005 in. H₂O (1.25 Pa).

6.4.4 The furnace shall be controlled such that the differential pressure between the exposed and the unexposed surfaces of the test assembly complies with either **6.4.4.1** or **6.4.4.2**.

6.4.4.1 **Standard Pressure Condition**—Except for the first 10 min. of the test, the furnace pressure shall be at least 0.01 in. wg (2.5 Pa) greater than the pressure on the unexposed side of the test assembly at the following locations:

(1) **Walls**—At the lowest elevation of the test specimen (see **Note 2**).

(2) **Floors**—At the location of the pressure-measuring probes.

NOTE 2—A supplementary pressure probe, in addition to the two probes specified in **6.4.1.1**, may be used to determine compliance with this requirement.

