



Standard Guide for Extension of Data from Penetration Firestop System Tests Conducted in Accordance with ASTM E814¹

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1. Scope

1.1 This guide covers the extension of results obtained from fire tests performed in accordance with Test Method E814 to applications that have not been tested. Test Method E814 evaluates the duration for which test specimens will contain a fire, retain their integrity, or both during a predetermined fire test exposure. Firestops are intended for use in fire-resistive walls and floors that are evaluated in conformance with Test Methods E119.

NOTE 1—Data obtained from firestops tested in accordance with Test Methods E119 with positive pressure can also be used.

1.2 This guide is based on principles involving the extension of test data using simple considerations. The acceptance of these principles and their application is based substantially on an analogous worst-case proposition.

1.3 These principles are only applicable to temperature conditions represented by the standard time-temperature curve described in Test Method E814, for systems falling within the scope of Test Method E814. This test method is a fire-test-response standard.

1.4 The types of building constructions which are part of this guide are as follows: floors, walls, partitions, floor/ceiling and roof/ceiling assemblies.

1.5 This guide applies to:

- 1.5.1 a single penetrating item, or
- 1.5.2 multiple penetrating items.

1.6 This guide does not apply to joints systems tested to Test Methods E119, E1966, E2307, and E2837.

1.7 Penetrating items can be one of the following: metallic pipe, non-metallic pipe, metallic tubing, non-metallic tubing, metallic conduit, non-metallic conduit, flexible metal conduit,

cables, cable trays, bus ducts, insulated pipes, insulated tubing, insulated conduit, insulated and non-insulated ducts, and structural members.

Metallic pipe, tubing or conduit	6.7
Insulated pipe, tubing or conduit	6.8
Non-metallic pipe, tubing or conduit	6.9 and 6.10
Flexible metal conduit	6.11.1.4 and 6.11.1.5
Cables	6.11
Cable tray	6.12
Bus duct	6.13
Non-insulated duct	6.14
Insulated duct	6.14.2
Non-structural or service support member	6.15
Mixed penetrations	6.16

1.8 Assemblies can be one of the following; concrete floors or walls, masonry walls, gypsum walls, wood floor/ceiling assemblies, concrete floor/ceiling assemblies, chase wall in floor/ceiling assemblies and fire-rated insulated walls.

Concrete floors or walls	6.1
Masonry walls	6.1
Gypsum board wall assemblies	6.2
Wood floor/ceiling assemblies	6.3
Floor/ceiling assembly with concrete floor	6.4
Chase wall intersecting a floor/ceiling assembly	6.5
Fire-resistance insulated walls	6.6

1.9 The extension of data using numerical calculations based on empirical data or theoretical models is not covered in this guide.

1.10 This guide does not cover the substitution of one proprietary material for another proprietary material, or materials for which fire-test data are not presently available.

1.11 This guide is used to predict or provide a quantitative measure of the fire hazard from a specified set of fire conditions involving specific materials, products, or assemblies. This assessment does not necessarily predict the hazard of actual fires which involve conditions other than those assumed in the analysis.

1.12 This guide 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 This guide 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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1.13 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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

1.15 *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

C168 Terminology Relating to Thermal Insulation

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

E1966 Test Method for Fire-Resistive Joint Systems

E2032 Practice for Extension of Data From Fire Resistance Tests Conducted in Accordance with ASTM E 119

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

E2837 Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies

2.2 Other Standards:

ACI 216 Fire Resistance of Concrete³

3. Terminology

3.1 Definitions:

3.1.1 For definitions used in this guide, refer to Terminologies in **E176**, **C168** and **E631**.

3.1.2 For definitions of terms specific to this standard, refer to Test Method **E814** and Practice **E2032**.

4. Significance and Use

4.1 The methods and procedures set forth in this guide relate to the extension of the fire test results to firestop systems that have not been tested.

4.2 Users of this guide must have knowledge and understanding of the provisions of Test Methods **E119** and Test Method **E814** including those pertaining to conditions of acceptance.

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

³ Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333-9094, <http://www.concrete.org>.

4.3 In order to apply some of the principles described in this guide, reference to the original fire test report will be necessary.

4.4 In Test Method **E814**, the specimens are subjected to specific laboratory fire test exposure conditions. Differences between the tested assembly and the as-built assembly impact the fire-test-response characteristics. Substitution of different test conditions also impacts the fire-test-response characteristics.

4.5 The extension of data is valid only for the fire test exposure described in Test Method **E814**.

4.6 This guide shall not be used to extrapolate the fire resistance rating to a higher value.

4.7 Limitations:

4.7.1 The extension of fire resistance data is to be used only for changes to the tested specimen that fall within normal and reasonable limits of accepted construction practices.

4.7.2 Conclusions derived from using this guide are valid only if the identified change is the only change in the construction or properties of the components.

4.7.3 Evaluation of changes to the fire-resistive assembly in which the firestop is installed is governed by the Extension of Data principles in Practice **E2032**.

4.8 The statements in this guide are based on a single change to a system.

NOTE 2—It is possible that multiple changes have a different cumulative effect than that of individual changes evaluated separately. The principles contained herein may provide useful information for the application of sound engineering principles to evaluate the effect of multiple differences between tested and installed firestops.

4.9 Extensions of data using this document shall be done by individuals possessing the following minimum qualifications and attributes:

4.9.1 an understanding of the Test Method **E814** test procedure,

4.9.2 an understanding of the fire behavior of firestop materials,

4.9.3 knowledge of the elements of the construction to be protected, and

4.9.4 an understanding of the probable behavior of the underlying construction and the recommended firestop system protecting it, were they to be subjected to testing in accordance with Test Method **E814**.

4.10 The person performing evaluations based on tested or listed firestops shall be one of the following:

4.10.1 the firestop manufacturer's knowledgeable and qualified technical personnel,

4.10.2 a registered professional engineer, or Fire Protection Engineer, knowledgeable in firestopping systems,

4.10.3 an independent testing agency or a listing agency, or

4.10.4 technical personnel with experience in firestopping.

5. General Principles

5.1 The principles in this section shall apply to all subsequent sections.

5.2 The rating criteria and conditions of acceptance as set out in Test Method **E814** shall be used in the evaluation of the effect of the change to the firestop system.

5.3 Conclusions derived from using this guide indicate only whether or not a change in the application or design of the firestop system “reduces” the fire resistance rating.

5.4 The firestop system is limited to the maximum dimensions of the opening in the assembly that have been fire tested according to Test Methods E814 or E119 under positive furnace pressure as specified in Test Method E814.

5.5 The firestop product(s) is limited to the product(s) fire tested.

5.6 *Angled Penetrations*—Where the uninsulated penetrating item in the individual design is indicated as a metallic pipe, conduit, tube, duct or cable, and the firestop system consists at minimum of a fill material (such as sealants, putty, or mortar), the penetrant may pass through the opening in the wall or floor assembly at any angle, provided the annular space is maintained on both sides of the wall or floor assembly and all other specifications in the design are satisfied. In all other cases, except where otherwise indicated in the system, the penetrating item shall penetrate the wall or floor assembly at a 90° angle.

6. Principles for Firestops

NOTE 3—Information regarding the fire resistance of the wall or floor assemblies can be found in Practice E2032 or ACI 216. See Appendix X3 for additional information.

6.1 Concrete or Masonry Assemblies:

6.1.1 Increase in thickness of the assembly will not decrease the fire resistance of the firestop. Exception: Where it is known or suspected that locating a material further from the fire or on the unexposed side of the assembly will reduce the *F*-rating.

6.1.2 Firestop systems tested in concrete floor assemblies can be used in concrete or masonry wall assemblies providing that they are installed symmetrically on both sides of the wall and consideration is given to the effect of the orientation on the penetrating items.

NOTE 4—The orientation of the penetrating item may create a more severe condition resulting in failure of the firestop system. As an example, penetrants containing multiple layers of cable or thin gauge sheet metal ductwork may represent a more severe condition in a wall orientation.

6.1.2.1 Firestop systems need not be installed on both sides of the wall assembly if they are symmetrical and equidistant from both surfaces.

6.1.3 Firestop systems fire tested in wall assemblies cannot be installed in floor assemblies unless fire tested according to Test Method E814 as a floor assembly.

6.1.4 Firestop systems can be used in concrete or masonry assemblies of equal or lower fire resistance as long as the Firestop system tested design is not modified in relation to firestop thickness, bonding and support, and is not modified in relation to the assembly thickness.

6.2 Gypsum Board Wall Assemblies:

6.2.1 Increase in the depth of studs or thickness or number of layers of gypsum board will not decrease the fire resistance of the firestop. Exception 1: Where the firestop materials are at different positions within the assembly relative to the heat source.

Exception 2: In assemblies where the active components on both sides of the assembly contribute to the test performance.

NOTE 5—Where it is known or suspected that locating a material further from the fire or on the unexposed side of the assembly will reduce the resistance to the test.

Exception 3: Where it is known that locating a material on the non-fire side of the assembly further from the fire will reduce the performance of the firestop.

6.2.2 Firestop systems cannot be used in assemblies of lower resistance ratings without fire testing.

Exception: A firestop system that is tested and listed for a symmetrical gypsum wall assembly that includes multiple layers of gypsum board per side, can be used to maintain the fire resistance rating of a gypsum wall assembly that includes fewer layers of gypsum board per side, as long as the sealant depth in the listed system, does not exceed the thickness of that reduced number of layers of gypsum board.

6.2.3 Symmetrical Installations:

6.2.3.1 The results of the fire resistance test are deemed to be applicable to a similar type of untested system providing the following are true.

(1) The maximum dimension of the opening is not increased.

(2) The total area of the opening is not increased.

(3) Neither the firestop product(s) or damming material is changed.

(4) The thickness of neither the firestop product(s) or damming material is decreased.

6.2.3.2 Refer to 6.1 for restrictions related to changes in the supporting construction.

6.3 Wood Deck Floor/Ceiling Assemblies:

6.3.1 The following changes, individually or in combination, would not reduce the *F*-rating, provided that: (1) the firestop is in the same position relative to the heat source, and (2) the firestop is at least in contact with the same material as tested;

6.3.1.1 Increase in the depth of joists or trusses,

6.3.1.2 Increase in thickness or number of layers of gypsum board,

6.3.1.3 Increase in the overall assembly thickness due to additional floor coverings or ceiling finishes.

Exception 1: In assemblies where there are firestop materials not part of the exposed side that is part of the tested or listed firestop configuration.

Exception 2: Where it is known or suspected that locating a material further from the fire or on the unexposed side of the assembly will reduce the resistance to the test.

6.3.2 Firestop systems cannot be used in assemblies of lower resistance ratings without fire testing. Exception: A firestop system that is tested and listed for a floor/ceiling assembly that includes multiple layers of gypsum board, can be used to maintain the fire resistance rating of a floor/ceiling assembly that includes fewer layers of gypsum board, as long as the sealant depth in the listed system, does not exceed the thickness of that reduced number of layers of gypsum board.

6.4 Floor/Ceiling Assembly with Concrete Floor:

NOTE 6—This section does not apply to floor/ceiling assemblies protected with direct applied fireproofing.

6.4.1 The following changes, individually or in combination, would not reduce the *F*-rating, provided that: (1) the firestop is in the same position relative to the heat source, and (2) the firestop is at least in contact with the same material as tested;

6.4.1.1 Increase in the depth of joists or trusses,

6.4.1.2 Increase in thickness or number of layers of gypsum board,

6.4.1.3 Increase in the overall assembly thickness due to additional floor coverings or ceiling finishes. Exception: In assemblies where there are firestop materials not part of the exposed side that is part of the tested or listed firestop configuration.

Exception: Where it is known or suspected that locating a material further from the fire or on the unexposed side of the assembly will reduce the resistance to the test.

6.4.2 Firestop systems should not be used in assemblies of lower resistance ratings without fire testing (that is, a 2-h floor/ceiling firestop system should not be used in a 1-h floor/ceiling assembly without fire testing).

6.5 Penetrants Contained Within Chase Walls:

6.5.1 Floor or floor/ceiling penetrations tested without a chase wall can be installed within a rated or non-rated chase wall without reducing the *F*-rating, provided the floor/ceiling assembly in which the firestop is installed is not changed or compromised in any way.

6.5.2 Wood Floor/ceiling penetrations tested without a chase wall can be installed within a rated wood framed chase wall having a fire resistance rating no less than that of the floor/ceiling assembly without reducing the *F*-rating, provided a double top plate of nominal 2-in. thick lumber is continuous with the lower membrane of the floor/ceiling assembly.

6.5.3 Any construction other than the 2 cases enumerated above should be tested to determine the *F*-rating.

6.6 Fire-resistance Rated Insulated Wall Assemblies:

6.6.1 Increase in the wall thickness will not decrease the fire resistance of the firestop. Exception 1: Where the firestop materials are at different position within the assembly relative to the heat source.

Exception 2: In assemblies where the active components on both sides of the assembly contribute to the test performance.

NOTE 7—Where it is known or suspected that locating a material further from the fire or on the unexposed side of the assembly will reduce the resistance to the test.

Exception 3: Where it is known that locating a material on the non-fire side of the assembly further from the fire will reduce the performance of the firestop.

6.6.2 Firestop systems cannot be used in assemblies of lower resistance ratings without fire testing (that is, a 2-h insulated wall firestop system cannot be used in a 1-h insulated wall assembly without fire testing).

6.6.3 Symmetrical Installations:

6.6.4 The results of the fire resistance test are deemed to be applicable to a similar type of untested system providing the following are true:

6.6.4.1 The maximum dimension of the opening is not increased,

6.6.4.2 The total area of the opening is not increased,

6.6.4.3 Neither the firestop product(s) or damming material is changed,

6.6.4.4 The thickness of neither the firestop product(s) or damming material is decreased.

6.7 Metallic Pipe, Conduit or Tubing Penetrating Items:

6.7.1 The fire resistance of a tested system is deemed applicable to a similar type of untested system when only one of the following changes is made:

6.7.1.1 Steel, cast iron pipes, steel conduit and EMT of the same nominal dimension is permitted to be installed based on results obtained with copper pipes and tubing.

NOTE 8—Aluminum penetrants shall be fire tested.

6.7.1.2 Maximum and minimum annular space must be within the tested range.

6.7.1.3 Penetrations with continuous point of contact must be tested.

6.7.1.4 Decreasing the penetrant size will not decrease the fire resistance rating.

6.7.1.5 The distance between multiple penetrants must be within the tested range.

6.7.1.6 The penetrant wall thickness can only be increased without reducing the fire resistance rating.

6.7.1.7 The number of penetrants in the opening can be reduced without decreasing fire resistance, subject to the limitation of 6.9.1.2 and 6.9.1.3.

6.8 Insulated Metal Pipe, Tubing or Conduit Penetrating Items:

6.8.1 The fire resistance of a tested system is deemed applicable to a similar type of untested system when only one of the following changes is made:

6.8.1.1 Changes in pipe, conduit or tubing types and properties shall be as permitted in 6.3.

6.8.1.2 The thickness of the penetrant insulation must be within the tested range.

6.8.1.3 The insulation material density can be increased without decreasing the *F*-rating.

6.8.1.4 Fibrous insulation can be mineral wool when fibrous glass is tested without decreasing the *F*-rating.

6.9 Non-metallic Pipe, Conduit and Tubing Penetrating Items:

6.9.1 The fire resistance of a tested system is deemed applicable to a similar type of untested system when only one of the following changes is made:

6.9.1.1 The penetrant wall thickness is not changed.

6.9.1.2 Penetrants that are tested can be used for both vented and closed application without reducing the *F*-rating.

6.9.1.3 The pressure required for the installed firestop system must be within the tested range.

6.9.1.4 The penetrant diameter must be within the tested range.

6.9.1.5 The type of plastic (PVC, etc.) cannot be changed without fire testing.

Exception: Test results obtained for vented PVC can be used to allow CPVC or rigid nonmetallic conduit in closed applications without reducing the *F*-rating.

6.9.1.6 The firestop material composition cannot be changed.

6.9.1.7 The ratio of penetrant cross-sectional area to firestop material cross-sectional area cannot be changed.

6.9.1.8 The number of penetrants in one opening must be within the tested range.

6.9.1.9 The separation between penetrants must be within the tested range.

6.9.1.10 The orientation of the firestop systems must not be changed.

6.10 *Other Types of Non-metallic Ppe, Conduit or Tubing (glass, fiberglass, with insulation, etc.):*

6.10.1 These types of penetrant materials must be fire tested to determine the interdependence between variables to establish a baseline for judgments.

NOTE 9—There is not enough test history to provide any guidelines for extension of data for these types of penetrants.

6.11 *Cable Penetrating Items:*

6.11.1 The fire resistance of a tested system is deemed applicable to a similar type of untested system when only one of the following changes is made:

6.11.1.1 The cross sectional area of the cable bundle must be within the tested range.

6.11.1.2 The size of the cable conductor can be equal to or less than the tested gauge without reducing the *F*-rating. The type of conductor must be as tested.

NOTE 10—The three types of conductors are copper, aluminum or glass fiber.

6.11.1.3 Fire testing of XLPE/PVC jacket/insulation applies to other cable and jacket/insulation material providing the cable jacket and insulation thickness is not increased.

6.11.1.4 Metal jacketed or plastic-coated metal-jacketed cable must be as tested.

NOTE 11—Metal jacketed cables are also referred to as Metal Clad (MC) cables or Armor Clad (AC) cables.

6.11.1.5 Testing done on metal-jacketed cable cannot be used for non-metal jacketed installations.

6.11.1.6 Non-Metal jacketed cable must be as tested.

6.11.1.7 The percent fill of cables must be within the tested range.

NOTE 12—Percent fill is calculated as the cross sectional area of cables divided by the cross-sectional area of the opening. The cable diameter used in this calculation is the outside diameter (cable including jacket).

6.11.1.8 Maximum and minimum annular space must be within the tested range.

6.11.1.9 Penetrations with continuous point of contact must be tested.

6.11.1.10 Testing done on copper conductors cannot be applied to aluminum conductors.

6.12 *Cables in Trays:*

6.12.1 Tray type and composition must be as tested.

6.12.2 Metal tray thickness can be increased without reducing the *F*-rating.

6.12.3 Tray dimensions can be decreased without reducing the *F*-rating.

6.12.4 Maximum and minimum annular space between the outside surface of the tray and the edge of the opening must be within the tested range.

6.12.5 The distance between multiple cable trays must be within the tested range.

6.13 *Bus Duct Penetrations:*

6.13.1 The fire resistance of a tested system is deemed applicable to a similar type of untested system when only one of the following changes is made:

6.13.1.1 Fire testing of vented bus ducts is not applicable to closed bus ducts, and vice versa.

6.13.1.2 The bus duct material must be as tested. Increasing its thickness does not decrease the *F*-rating.

6.13.1.3 The type of conductor must be as tested in the case of vented bus ducts.

NOTE 13—The four types of conductor are bare copper, coated copper, aluminum, or coated aluminum.

6.13.1.4 Bus duct dimensions can be decreased without reducing the *F*-rating.

6.13.1.5 Maximum and minimum annular space must be within the tested range.

6.13.1.6 The distance between multiple bus ducts must be within the tested range.

6.14 *Insulated and Non-insulated Metal Duct Penetrations:*

6.14.1 The fire resistance of a tested system is deemed applicable to a similar type of untested system when only one of the following changes is made:

6.14.1.1 The dimensions of the rectangular duct can be reduced without reducing the *F*-rating.

6.14.1.2 The dimensions of the round duct can be reduced without reducing the *F*-rating.

6.14.1.3 The dimensions of the oval duct can be reduced without reducing the *F*-rating.

6.14.1.4 The thickness of the duct can be increased without reducing the *F*-rating.

6.14.1.5 Maximum and minimum annular space must be within the tested range.

6.14.1.6 The duct support system can be increased with regards to material strength or thickness or both without reducing the *F*-rating. The duct material must be as tested.

6.14.1.7 The duct reinforcement can be increased with respect to thickness, strength or size without reducing the *F*-rating.

6.14.1.8 Testing without duct reinforcement would allow duct reinforcement to be used without reducing the *F*-rating.

6.14.2 *Insulated Metal Duct Penetrations:*

6.14.2.1 The dimensions of the exterior insulated rectangular duct can be reduced without reducing the *F*-rating.

6.14.2.2 The dimensions of the exterior insulated round duct can be reduced without reducing the *F*-rating.

6.14.2.3 The dimensions of the exterior insulated oval duct can be reduced without reducing the *F*-rating.

6.14.2.4 The thickness of the duct insulation must be within the tested range.

6.14.2.5 The insulation material density can be increased without decreasing the *F*-rating.