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Standard Guide for Understanding and Using Information Related to Installation of Firestop Systems¹

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INTRODUCTION

This guide should² increase the awareness of information and approaches associated with installing *firestop systems*. Various building trades (also known as construction trades) create *openings* (breaches or penetrations) in *fire-separating elements* to accommodate the installation of existing or future *penetrating items* such as pipes, ducts, wires, etc. The materials and methods of construction used to seal and protect *openings* created in *fire-separating elements* must not reduce its existing fire-resistance rating. Multiple building trades are sometimes involved with the process of restoring the fire-resistance rating of the *fire-separating element*. Often the building trade (for example, firestop contractor) responsible for restoring the fire-resistance rating of the *fire-separating element* did not create the *opening*. This guide is intended to help identify and alleviate problems as well as misunderstandings associated with the installation of *firestop systems*. This guide is intended to provide information to those that create the *opening*, install the *penetrating item* through the *opening*, install *firestop materials* for the *opening*, and those charged with the inspection of the *firestop system* during and after installation. This guide proposes a series of options or instructions that offer direction without recommending a definite course of action for the installation of *firestop systems*.

1. Scope

[ASTM E3157-23](https://standards.iteh.ai/catalog/standards/sist/13e0e29f-1d55-4d28-a581-ebcc05873f8f/astm-e3157-23)

<https://standards.iteh.ai/catalog/standards/sist/13e0e29f-1d55-4d28-a581-ebcc05873f8f/astm-e3157-23>

1.1 This guide is a compendium of information related to installing *firestop systems* in *fire-separating elements*. This guide is intended to be used to increase industry knowledge of national and international testing requirements, code prerequisites, and other supplemental tests that may be specified, which can affect the installation and performance of *firestop systems*.

1.2 This guide relates to the use of *firestop systems* tested, or evaluated, to Test Method E814 and other test methods addressing the same specific subject matter, such as CAN/ULC-S115; EN 1366-3; IMO Resolution MSC.307(88), FTP Code; IEEE 634; ISO 10295-1; UL 1479; etc.

1.3 This guide also addresses the use of *firestop systems* tested or evaluated to Test Methods E119 or other test methods that use a *firestop system* as a component of a typically larger test assembly, such as AS 1530.4; BS 476-21; BS 476;³ CAN/ULC-S101; ISO 834;⁴ NFPA 251; UL 263; etc.

1.4 This guide discusses the installation of *firestop systems* in *membrane penetrations* and *through penetrations*. The installation

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² "Should" is used to indicate that a provision is not mandatory but is recommended as good practice.

³ In this guide, BS 476-21 and BS 476-22 are collectively referred to as BS 476.

⁴ In this guide, ISO 834-1, ISO 834-4, ISO 834-5, ISO 834-6, ISO 834-8, and ISO 834-9 are collectively referred to as ISO 834.

is typically performed by a firestop contractor (also known as a firestop installer or an installer). However, the quality of the installation is based on the information provided to the firestop contractor as well as the expertise and competence of the firestop contractor. A lack of information in the test report, *listing*, *manufacturer's instructions*, or project documents can be the cause of a deficient installation.

1.5 The term “*firestop system*” refers to and includes both a *membrane-penetration firestop system* and *through-penetration firestop system*.

1.6 Information in this guide is applicable to *firestop systems* that accommodate single or multiple *penetrating items*.

1.7 This guide does not address the design aspects of locating and defining the dimensions of an *opening*; or the method to create the *opening*; or the inspection of the *penetrating item* prior to *firestop material* installation. However, locating and defining the dimensions of an *opening* and the method to create the *opening* are critical to a *firestop system's* installation.

1.8 This guide does not address all the test methods needed to address proper performance of all *firestop systems* or *firestop materials*.

NOTE 1—For example, IEEE 848 provides information on the ampacity derating of cables that are protected by *firestop systems* using IEEE 835 as baseline information.

1.9 This guide does not address all the test methods needed to address proper performance of *firestop systems* in all installations. For a specific application of a *firestop system* one or more of the following are consulted when available:

1.9.1 The *firestop system's* test report or *listing*;

1.9.2 The *manufacturer's instructions* when they are not in conflict with the *firestop system's* test report or *listing*; or

1.9.3 A *judgment* with justifiable technical rationale prepared based on a *firestop system's* test report or *listing*.

1.10 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.

1.11 *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.*

1.12 *This guide offers an organized collection of information or a series of options and does not recommend a specific course of action. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word “Standard” in the title of this document means only that the document has been approved through the ASTM consensus process.*

1.13 Fire standards, other than ASTM standards, are referenced in this document. The following caveat applies to all fire standards referenced in this guide. *Fire testing is inherently hazardous. Adequate safeguards for personnel and property shall be employed in conducting these tests.*

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:⁵

⁵ 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.

- C717 Terminology of Building Seals and Sealants
- E84 Test Method for Surface Burning Characteristics of Building Materials
- E119 Test Methods for Fire Tests of Building Construction and Materials
- E136 Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C
- E176 Terminology of Fire Standards
- E631 Terminology of Building Constructions
- E814 Test Method for Fire Tests of Penetration Firestop 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
- E2032 Practice for Extension of Data From Fire Resistance Tests Conducted in Accordance with ASTM E 119
- E2174 Practice for On-Site Inspection of Installed Firestop 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
- E2393 Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers
- E2750 Guide for Extension of Data from Penetration Firestop System Tests Conducted in Accordance with ASTM E814
- E2785 Test Method for Exposure of Firestop Materials to Severe Environmental Conditions
- E2786 Test Methods for Measuring Expansion of Intumescent Materials Used in Firestop and Joint Systems
- E2837 Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies
- E2923 Practice for Longevity Assessment of Firestop Materials Using Differential Scanning Calorimetry
- E3021/E3021M Guide for Evaluating the Relative Effectiveness of Building Systems to Resist the Passage of Products of Combustion Based on the Aggregation of Leakage Rates
- E3037 Test Method for Measuring Relative Movement Capabilities of Through-Penetration Firestop Systems
- E3038 Practice for Assessing and Qualifying Candidates as Inspectors of Firestop Systems and Fire-Resistive Joint Systems
- 2.2 *ACI Standard:*⁶
- ACI /TMS 216.1 Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies
- 2.3 *Standards Australia:*⁷
- AS 1530.4 Methods for fire tests on building materials, components and structures – Part 4: Fire-resistance tests of elements of construction
- AS 4072.1 Components for the protection of openings in fire-resistant separating elements – Part 1: Service penetrations and control joints
- 2.4 *BSI Standards:*⁸
- BS 476-20 Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles)
- BS 476-21 Fire tests on building materials and structures. Methods for determination of the fire resistance of loadbearing elements of construction³
- BS 476-22 Fire tests on building materials and structures. Method for determination of the fire resistance of non-loadbearing elements of construction³
- 2.5 *SCC Standards:*⁹
- CAN/ULC-S101 Standard Methods of Fire Endurance Tests of Building Construction and Materials
- CAN/ULC-S102 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
- CAN/ULC-S115 Standard Method of Fire Tests of Firestop Systems
- 2.6 *CEN Standards:*¹⁰
- EN 1366-3 Fire resistance tests for service installations – Part 3: Penetration seals
- EN 1366-4 Fire resistance tests for service installations – Part 4: Linear joint seals
- EN 13501-1 Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests
- 2.7 *GA Standard:*¹¹
- GA-225 Repair of Fire-Rated Gypsum Panel Product Systems

⁶ Available from American Concrete Institute (ACI), 38800 Country Club Dr., Farmington Hills, MI 48331-3439, <http://www.concrete.org>.

⁷ Available from Standards Australia, GPO Box 476, Sydney NSW 2001, Australia, <http://www.standards.org.au>.

⁸ Available from British Standards Institution (BSI), 389 Chiswick High Rd., London W4 4AL, United Kingdom, <http://www.bsigroup.com>.

⁹ Available from Standards Council of Canada (SCC), 55 Metcalfe Street, Suite 600, Ottawa, ON K1P 6L5, Canada, <https://www.scc.ca/>.

¹⁰ Available from European Committee for Standardization (CEN), CEN-CENELEC Management Centre, Rue de la Science 23, B - 1040, Brussels, Belgium, <https://www.cenelec.eu/>.

¹¹ Available from Gypsum Association, 962 Wayne Ave., Suite 620, Silver Spring, MD 20910, <https://www.gypsum.org>.

2.8 ICC Standard:¹²

ICC International Building Code¹³(IBC¹³), 2018 Edition

2.9 IEEE Standards:¹⁴

IEEE 634 Standard Cable-Penetration Fire Stop Qualification Test

IEEE 835 Standard Power Cable Ampacity Tables

IEEE 848 Standard Procedure for the Determination of the Ampacity Derating Factor for Fire-Protected Cable Systems

2.10 IMO Standards:¹⁵

IMO Resolution A.753 Guidelines for the Application of Plastic Pipes on Ships

IMO Resolution MSC.307(88) International Code for Application of Fire Test Procedures (FTP Code)

IMO Safety of Life at Sea (SOLAS)

2.11 ISO Standards:¹⁶

ISO 834-1 Fire-resistance tests — Elements of building construction — Part 1: General requirements⁴

ISO 834-4 Fire-resistance tests — Elements of building construction — Part 4: Specific requirements for loadbearing vertical separating elements⁴

ISO 834-5 Fire-resistance tests — Elements of building construction — Part 5: Specific requirements for loadbearing horizontal separating elements⁴

ISO 834-6 Fire-resistance tests — Elements of building construction — Part 6: Specific requirements for beams⁴

ISO 834-8 Fire-resistance tests — Elements of building construction — Part 8: Specific requirements for non-loadbearing vertical separating elements⁴

ISO 834-9 Fire-resistance tests — Elements of building construction — Part 9: Specific requirements for non-loadbearing ceiling elements⁴

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

ISO 17065 Conformity assessment — Requirements for bodies certifying products, processes and services

2.12 NFPA Standards:¹⁷

NFPA 70¹⁸ National Electrical Code¹⁸ (NEC¹⁸)

NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems

NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

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

NFPA 255 Standard Method of Test of Surface Burning Characteristics of Building Materials

2.13 UL Standards:¹⁹

UL 263 Standard for Fire Tests of Building Construction and Materials

UL 723 Standard for Test for Surface Burning Characteristics of Building Materials

UL 1479 Standard for Fire Tests of Penetration Firestops

3. Terminology

3.1 *Definitions*—For definitions of general terms related to fire used in this guide, refer to Terminology E176. For convenience and direct application in this guide, the existing definitions for a number of general concepts related to *firestop systems* are as follows:

3.1.1 *authority having jurisdiction (AHJ), n*—the designated authority, or their duly authorized representative, charged with the administration and enforcement of the local fire code or building code, or both. **E2174**

3.1.2 *authorizing authority (AA), n*—the designated person, or organization, or their duly authorized representative, charged with the administration and enforcement of the provisions of this inspection document. **E2174**

3.1.2.1 Discussion—

Examples of the AA include the responsible architect, engineer, building owner, or their representative.

¹² Available from International Code Council (ICC), 500 New Jersey Ave., NW, 6th Floor, Washington, DC 20001, <http://www.iccsafe.org>.

¹³ A registered trademark of International Code Council.

¹⁴ Available from Institute of Electrical and Electronics Engineers, Inc. (IEEE), 445 Hoes Ln., Piscataway, NJ 08854-4141, <http://www.ieee.org>.

¹⁵ Available from International Maritime Organization (IMO), 4, Albert Embankment, London SE1 7SR, United Kingdom, <http://www.imo.org>.

¹⁶ Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <https://www.iso.org>.

¹⁷ Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, <http://www.nfpa.org>.

¹⁸ A registered trademark of National Fire Protection Association.

¹⁹ Available from Underwriters Laboratories (UL), 14301 SE 1st Street, Suite 140, Vancouver, WA 98684, <http://www.ul.com>.

3.1.3 *fire-resistive joint system, n*—a device or designed feature that provides a fire separating function along continuous linear openings, including changes in direction, between or bounded by *fire-separating elements*. **E1966**

3.1.4 *firestop industry inspector, n*—the individual or company possessing the credentials set forth in Practice **E3038**, and who is authorized by the AHJ or AA, or both, to conduct an inspection under Practices **E2174** and **E2393**, or both. **E3038**

3.1.5 *firestop system, n*—a specific combination of *penetrating item* or items, the specific construction that is penetrated, and the materials or devices, or both, that seal the *opening* provided to accommodate one or more items that penetrate into or through a fire-resistance rated assembly. **E814**

3.1.5.1 *Discussion*—

The materials and devices used to seal the *opening* around *penetrating items* are sometimes referred to as “firestops.” Note that it is not “firestops” that are tested by Test Method **E814**, but rather “*firestop systems*.” Due to the complex interaction during a fire between the penetrant, the penetrated assembly, the materials, or devices, or combinations thereof, used to seal the penetration, and the specific size and shape of the *opening*, it is not possible to simply test the “firestop” to develop fire resistance data.

3.1.5.2 *Discussion*—

The term *firestop system* refers to and includes both a *membrane-penetration firestop system* and a *through-penetration firestop system*. (See also *firestop device, fill material, firestop material, firestop sealant, and forming material*.)

3.1.6 *judgment, n*—an evaluation of a field condition which does not conform to an existing tested and listed system. **E2174**

3.1.6.1 *Discussion*—

There are documents that assist in producing sound *judgments* with justifiable technical rationale. For example, Guide **E2750** provides information to extend the results from fire tests conducted in accordance with Test Method **E814**. Guide **E2750** limits the extension of data to a single aspect because when more than one aspect is assessed, the technical rationale becomes much more complicated. *Judgment* is also defined in Practice **E2393**.

3.1.7 *membrane-penetration firestop system, n*—a *firestop system* that seals the *opening* provided to accommodate one or more items that penetrate the membrane on only one side of a fire-resistance rated assembly. **E814**

3.1.7.1 *Discussion*—

Examples of *penetrating items* include cables, conduits, ducts, pipes, and electrical boxes.

3.1.7.2 *Discussion*—

In the ICC International Building Code,¹³ a “*membrane-penetration firestop system*” is defined as “an assemblage consisting of a fire-resistance rated floor-ceiling, roof-ceiling, or wall assembly, one or more *penetrating items* installed into or passing through the breach in one side of the assembly and the materials or devices, or both, installed to resist the spread of fire into the assembly for a prescribed period of time.”

3.1.8 *through-penetration firestop system, n*—a *firestop system* that seals the *opening* around *penetrating items* that pass through the entire fire-resistance rated assembly. **E814**

3.1.8.1 *Discussion*—

Examples of *penetrating items* include cables, cable trays, conduits, ducts, and pipes.

3.1.8.2 *Discussion*—

In the ICC International Building Code,¹³ a “*through-penetration firestop system*” is defined as “an assemblage consisting of a fire resistance-rated floor, floor-ceiling, or wall assembly, one or more *penetrating items* passing through the breaches in both sides of the assembly and the materials or devices, or both, installed to resist the spread of fire through the assembly for a prescribed period of time.”

3.1.9 For definitions of general terms related to building construction used in this guide, refer to Terminology **E631**.

3.1.10 For definitions of general terms related to building seals and sealants used in this guide, refer to Terminology **C717**.

3.1.11 When there is a conflict between terms in Terminology **E631** and Terminology **C717**, the terms in Terminology **E631** prevail.

3.1.12 When there is a conflict between terms in Terminology **E176** and Terminology **E631** or Terminology **C717**, the terms in Terminology **E176** prevail.

3.1.13 Terms specifically defined in 3.1 and 3.2, whenever used as intended for this document, are italicized for ease of identification and reference.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *Discussion*—A number of concepts are discussed in this guide to help establish a link with the terminology used within some building codes and other national and international test standards. This includes, but is not limited to, *annular space, fire barrier, fire-separating element, horizontal assembly, membrane penetration, membrane-penetration firestop system, through penetration*, and *through-penetration firestop system*.

3.2.2 *annular space, n*—the void around the *penetrating item* within an *opening*.

3.2.2.1 *Discussion*—

Annular space is defined in the ICC International Building Code¹³ as “the *opening* around the *penetrating item*.”

3.2.3 *cable fill ratio, n*—the amount of cross-sectional area of a cable sleeve device that is occupied by a cable(s).

3.2.3.1 *Discussion*—

The calculation of the *cable fill ratio* is based on the outside diameter of the cable(s) and the cable sleeve device’s inside diameter.

3.2.4 *fill material, n*—a certified *firestop material* that is placed in an *annular space* to fill all or part of the *annular space*.

3.2.4.1 *Discussion*—

Certified products usually have a *listing* label applied to them as “identification applied to the product that includes the name of a quality assurance agency indicating that a representative sample of the product or material has been tested and evaluated by the quality assurance agency,” which is the definition in Practice E2174 and Practice E2393.

3.2.5 *fire barrier, n*—an interior wall or partition that has a fire-resistance rating determined in accordance with Test Methods E119 or a standardized test method with similar intent.

3.2.5.1 *Discussion*—

Fire barrier is defined in the ICC International Building Code¹³ as “a fire-resistance-rated wall assembly of materials designed to restrict the spread of fire in which continuity is maintained.” Sometimes other industry terms are used in lieu of fire-resistance-rated wall assembly, such as fire walls, fire partitions, smoke barriers, demising wall, etc.

3.2.6 *fire-separating element, n*—either a *fire barrier* or a *horizontal assembly*.

3.2.6.1 *Discussion*—

Fire-separating element is defined in European building codes that cite ISO 10295-1 as the “floor, wall or other separating element of construction having a period of fire resistance determined in accordance with ISO 834-1.” Test Method E1966 defines a *fire-separating element* as “*n*—floors, walls, and partitions having a period of fire resistance determined in accordance with Test Methods E119 or E1529.”

3.2.7 *firestop device, n*—a mechanism designed to serve the special purpose of sealing around a *penetrating item* and perform the special function of resisting heat transfer, flaming and hot gases through it or the *penetrating item*.

3.2.7.1 *Discussion*—

Firestop devices are *firestop materials* and are available in many types: for example, collars, grommets, plugs, raceways, covers, and others. A “*firestop device*” has the type and quantity of *firestop material* pre-measured, thus eliminating some ambiguity that otherwise occurs with the manual measurements of *firestop materials*, such as with liquid sealant-based *firestop systems*.

3.2.8 *firestop material, n*—any component, excluding the *opening, annular space, fire-separating element*, and *penetrating items*, that is used in the *firestop system*.

3.2.8.1 *Discussion*—

Firestop materials include the following: *fill material, firestop device, firestop sealant, forming material, packing material*, and *preformed firestop product*. *Firestop materials* also include subsets of the preceding defined terms including, but not limited to, the following: backing material (9.4.1), bond breakers (9.5.1), firestop collars (11.1), wrap strips (12.2), cable sleeve devices (13.2), firestop pillow (14.2), firestop brick (14.2), composite sheet (15.2), firestop putty (16.3), mortar (17.3), and firestop foam (18.3).

3.2.9 *firestop sealant, n*—a *firestop material* used to cover a surface or fill a void, or both, which is intended to prevent passage of a flame, heat, liquid, or gas.

3.2.10 *forming material, n*—specific certified product that is part of the *firestop system*.

3.2.10.1 *Discussion*—

Typically, *forming materials* include, but are not limited to, mineral wool and ceramic fiber. These specific *firestop materials* are often deemed noncombustible by building codes using Test Method E136. When noncombustible *forming material* is required, a combustible material should not be used even if it is certified because its fire performance may not be equal to the tested material.

3.2.11 *horizontal assembly, n*—a ceiling, floor, or roof assembly that has a fire-resistance rating as determined in accordance with Test Methods E119 or a standardized test method with similar intent.

3.2.11.1 *Discussion*—

Horizontal assembly is defined in the ICC International Building Code¹³ as “a fire-resistance-rated floor or roof assembly of materials designed to restrict the spread of fire in which continuity is maintained.”

3.2.12 *listing, n*—a publicly available document created by a technically qualified, independent, third-party agency that provides the requirements of an application of a specific *firestop system*, which was tested or assessed, and meets the requirements of Test Method E814 or another applicable *firestop system* test method.

3.2.12.1 *Discussion*—

A *listing* is published by an organization acceptable to the *authority having jurisdiction (AHJ)* and it is concerned with the description of *firestop systems* and *firestop materials*, which are properly tested. The significance of a *listing* is dependent on the country issuing the *listing*. In some countries, a *listing* signifies that periodic and ongoing inspections of manufacturing facilities are conducted to determine whether the *firestop materials* maintain their quality under controlled manufacturing conditions. In other countries, a *listing* signifies that the manufacturer has attested (certified) to the materials and process used in the manufacturing process of the *firestop materials* tested as part of a *firestop system*. In addition, some countries require ongoing documentation supporting the original attestation: either limited manufacturing or on-site inspections, or both. *Listings* for *firestop systems* are sometimes described by different nomenclatures: such as “Design Numbers” by Intertek; “System Numbers” by UL, etc. Typically, the agency creating the *listing* will be recognized under ISO 17065 as a Certification Body, which ensures that the agency has the competence and impartiality needed to be a technically qualified and independent third-party.

3.2.13 *manufacturer’s instructions, n*—one or more documents, which provide the conditions, limitations, and specific procedures to properly use a *firestop material* during a *firestop system* installation, prepared by the producer of the *firestop material(s)*.

3.2.13.1 *Discussion*—

In many cases, the *manufacturer’s instructions* are an intrinsic part of the published *listing* and are therefore not repeated in the *listing*, but are nevertheless just as important as other details that are stated in the *listing*.

3.2.14 *membrane penetration, n*—an *opening* only made into one side of a *fire-separating element*.

3.2.14.1 *Discussion*—

“*Membrane penetration*” is defined in the ICC International Building Code¹³ as “a breach in one side of a floor-ceiling, roof-ceiling, or wall assembly to accommodate an item installed into or passing through the breach.”

3.2.15 *opening, n*—a hole made through or into a *fire-separating element*.

3.2.15.1 *Discussion*—

When installing a *firestop system*, an *opening* is typically made to accommodate a *penetrating item* or a *firestop material*, or both. The concept of “*opening*” is used in the definition of *firestop system* but is not specifically defined in Test Method E814. The concept of *opening* includes both *membrane penetrations* and *through penetrations*. *Opening* as defined and used herein is also sometimes referred to as a “breach” or “penetration” in some building codes. Breach is not defined in the ICC International Building Code¹³ but is used in the IBC¹³ definitions related to *firestop systems*, some of which are cited or noted herein. However, the term *penetration* is used in other international codes and is defined in ISO 10295-1 as “an aperture²⁰ within a *fire-separating element* usually present to accommodate the passage of a service through that element.”

3.2.16 *packing material, n*—a generic product that is part of the *firestop system*.

3.2.16.1 *Discussion*—

A *packing material* is typically used in the same manner as a *forming material*. The only difference is that *forming material* is a

²⁰ An opening, hole, or gap.

certified product referenced by a specific trade name and manufacturer in the *listing*. The generic product classification of *packing material* is based on a generic product description in the *listing*. *Packing materials* include, but are not limited to, mineral wool and backer rod.

3.2.17 *penetrating item, n*—any part of an electrical, mechanical, plumbing, HVAC, or telecommunication service; a structural element (for example, beam or column); or any other element that the *opening* surrounds and is part of the *firestop system*.

3.2.17.1 *Discussion*—

The concept of “*penetrating item*” is not specifically defined in Test Method E814 but it is referenced in the definitions of *firestop system*, *membrane-penetration firestop system* and *through-penetration firestop system*, with the latter citing some examples. Within this guide, the concept of *penetrating item* includes, but is not limited to, cables, conduits, ducts, and pipes, as well as recessed boxes/fixtures and structural elements, such as columns and beams.

3.2.18 *preformed firestop product, n*—the part of *firestop system* that does not require any curing time.

3.2.18.1 *Discussion*—

Preformed firestop products are *firestop materials* that include, but are not limited to, precast devices, cable pathway devices, wrap strips, firestop collars, firestop pillows, firestop blocks, and composite sheets, but not including firestop putties. A “*preformed firestop product*” has the type and quantity of *firestop material* pre-measured, thus eliminating some ambiguity that otherwise occurs with the manual measurements of *firestop materials*, such as with liquid sealant-based *firestop systems*.

3.2.19 *through penetration, n*—an *opening* that passes through a *fire-separating element*.

3.2.19.1 *Discussion*—

“*Through-penetration*” is defined in the ICC International Building Code¹³ as, “a breach in both sides of a floor, floor-ceiling, or wall assembly to accommodate an item passing through the breaches.”

4. Significance and Use

4.1 The information contained in this guide is general in nature because of: the great number of commercially available *firestop systems* globally; the quantity and variety of internationally published *firestop system’s listings*; worldwide variations in building and fire code requirements; and the many conditions and applications associated with a *firestop system’s* use.

4.2 This guide provides general information and guidance that is primarily used by firestop contractors and *firestop industry inspectors* of a *firestop system*. However, this guide should also be used by others, such as architects, engineers, specifiers, etc. Some of the information referenced in this guide provides resources for additional information not contained in the manufacturer’s installations, the *firestop system’s* test report, and *listing*. Information contained in this guide also allows a single source for a general comparison of *firestop materials* used during the installation of *firestop systems*.

4.3 This guide discusses general procedures, such as substrate cleaning and priming, as well as installation of the components of a *firestop system*.

NOTE 2—The term “substrate” has a particular meaning in engineering. A substrate is defined as the “basic surface on which a material adheres, for example, paint or laminate.”²¹

4.4 This guide explains the general properties and functions of various *penetrating items* and *firestop materials*.

4.5 This guide presents general guidelines for the application of the various materials used in the installation of a *firestop system* for a specific application, and environmental conditions and effects that are known to potentially affect a *firestop system’s* installation.

4.6 This guide is intended to be read completely at least once, and each of the Sections 1 through 19 should be read in their entirety to avoid misunderstanding and misapplication.

²¹ McGraw-Hill Dictionary of Scientific and Technical Terms, Fifth Edition, 1994.

4.7 This guide may²² also provide some value to users of IMO Safety of Life at Sea (SOLAS) and other International Maritime Organization (IMO) documents, including the IMO FTP Code, on fire testing *firestop systems*, also known as “penetration systems.”

4.8 This guide is not an all-inclusive document. It is intended to address common sources for planning, preparation, and installation of *firestop systems*. References to other documents made herein contain important information and details that provide more in-depth knowledge of *firestop systems* and their installation.

4.9 This guide does not provide all of the specific information that is typically described in test reports, *listings* or *judgments* with justifiable technical rationale for specific applications of *firestop systems*.

4.10 This guide is not a *firestop system*’s installation manual.

NOTE 3—The *firestop system*’s manufacturer should be consulted about applications for their *firestop materials*, including their proper storage, use, and installation.

4.11 This guide does not provide detailed information about the *firestop system*’s inspection process or provide specific information about *firestop industry inspector*’s qualifications and competence.

NOTE 4—Practice E2174 provides a method for on-site inspection of *firestop systems*. The ICC International Building Code¹³ references Practice E2174 under requirements for special inspections. Practice E3038 provides information for assessing and qualifying candidates as *firestop industry inspectors* of *firestop systems* based on the candidate’s competence.

4.12 Except as discussed in 6.8, this guide does not provide information about “blank openings,” which involve an *opening* that is sealed with *firestop materials* but does not have any *penetrating items*.

4.13 Test reports, *listings*, and *judgments* with justifiable technical rationale do not normally contain all the information needed related to the aging, environmental, mechanical, and physical properties of the *firestop system*; or the longevity, durability, and performance of the *firestop system*. This guide offers some resources to ascertain this supplemental information because these characteristics can affect the *firestop system*’s installation and performance.

NOTE 5—Some information related to these performance characteristics of *firestop systems* or *firestop materials* is also found in: Test Method E2785, which tests for exposure of *firestop materials* to environmental conditions; Test Methods E2786, which measures expansion of intumescent materials used in *firestop systems*; and Practice E2923, which measures the relative movement capabilities of *through-penetration firestop systems*. Still, other performance characteristics of the *firestop system* can be specified that are not contained in *firestop system*’s test report or *listing* may also be required, such as surface flammability and smoke attributes determined by Test Method E84 or other similar standards (for example, CAN/ULC-S102, EN 13501-1, NFPA 255, UL 723, etc).

5. Overview of Contents in this Guide

5.1 This guide provides an international compendium of general information regarding *firestop systems* and *firestop materials*. It will save time in searching for the individual sources and compiling the information. In addition, many sources of supplementary information are cited regarding the *firestop system* or *firestop materials*, or both. Many additional sources to periphery installation information are referenced. All of this information should be useful to verify that the proper *firestop system* was designed, specified, selected, installed, and inspected.

5.2 This guide establishes common terminology for the firestop industry that should be applied internationally because most of these definitions are based on international standards and codes. These common definitions should help to increase international understanding of *firestop systems*.

5.3 This guide illustrates how a *firestop system* sometimes has to perform a multitude of functions: for example, fire resistance, water resistance, air leakage resistance, surface flammability resistance, smoke generation resistance, movement compatibility, environmental resistance, sound resistance, etc. This guide recommends planning procedures to help verify a proper *firestop system*

²² “May” is used to indicate that a provision is optional.

installation, which helps avoid poor performance of an installed *firestop system*. This guide increases life safety and knowledge by increasing the industry’s awareness of these many other functions that a *firestop system* sometimes has to perform simultaneously when properly installed. When these functions are obtained from differing test methods described in test reports and *listings*, conflicts between the installations of *firestop materials* should be discussed and resolved prior to installation of the *firestop system*.

5.4 This guide provides a summary of the various *firestop systems* and *firestop materials*, as well as their uses. These précises provide a quick reference for general comparison, which should assist in expediting selection of an alternate *firestop system* when field conditions have changed during the building’s construction.

5.5 This guide offers general information for preparation of the *opening* and substrates, as well as general instructions regarding the storage and use of *forming materials* and *packing materials*. This information provides the firestop contractor and others a general reference document.

5.6 This guide also presents some “tricks-of-the-trade” and observations when preparing for and conducting the installation of a *firestop system*. These annotations should assist in reducing the installation time and help avoid compatibility conflicts between installation materials and the *firestop materials* being used together.

6. General Information

6.1 *Firestop systems* are used throughout the world and are identified by other terms in other industries (for example, “penetration systems”-systems”). Therefore, it is important to have a basic understanding of general information that could affect the installation of *firestop systems*. This guide may also help those purchasing an installed *firestop system* understand the amount of time and supplemental materials that the firestop contractor has to provide in order to achieve a quality installation.

6.2 *Firestop systems* are composed of parts. The first part is a *fire-separating element*. The second part is an *opening* created through or into a *fire-separating element*. When the *opening* is only into one side of the *fire-separating element*, the *firestop system* needed is called a *membrane-penetration firestop system*. When the *opening* is completely through the *fire-separating element*, the *opening* is called a *through-penetration* and the *firestop system* needed is called a *through-penetration firestop system*. When the *opening* is not completely through but into one side of the *fire-separating element*, the *opening* is called a membrane-penetration and the *firestop system* needed is called a *membrane-penetration firestop system*. The next extremely important part of a *firestop system* is at least one *penetrating item* (for example, electrical, mechanical, plumbing, telecommunication, or other service; or a structural element (for example, beam column, etc.) that passes through or into the *opening*. The last part of a *firestop system* is the application of one or more *firestop materials*.

6.3 Understanding relevant terminology is also critical in comprehending the *firestop system*’s test report or *listing* to verify proper *firestop system* installations. Test Method E814 and the other North American test methods use the terms F-Rating and T-Rating to describe limitations ascribed to flaming and temperature limitations, respectively, on the unexposed surface of the *firestop system*. However, most other countries use the terms integrity and insulation to determine flaming and temperature limitations, respectively.

6.4 In addition, UL 1479 has an optional L-Rating to assess air leakage as well as an optional W-Rating to evaluate water resistance. Some in the industry refer to this optional L-Rating test as smoke leakage or cold smoke leakage. CAN/ULC-S115 also has an optional L-Rating. However, no other test methods for *firestop systems* include these optional performance ratings: L-Rating and W-Rating. The test report or *listing*, or both, should specially state an L-Rating for the *firestop system* to be considered as smoke resistant. The test report or *listing*, or both, should specially state a W-Rating to be considered as water resistant.

NOTE 6—Throughout most of the world, *firestop system* and *fire-resistive joint system* requirements for fire performance are denoted in separate test methods. CAN/ULC-S115 is a unique standard in that it references both *firestop systems* and *fire-resistive joint systems* called joint *firestop systems* in one standard. However, this guide only addresses a *firestop system* as defined in CAN/ULC-S115.

6.5 To verify proper *firestop system* installations, the origin of the documents related to installation is extremely important. Sometimes *judgments* with justifiable technical rationale are used as the basis of *firestop system* installations when the test report or *listing* does not address the specific project application of a *firestop system*. Since *judgments* with justifiable technical rationale are one of the installation sources, their origin is very important to verify that the *firestop system* installation is in compliance with the project and code requirements. Often a *judgment* with justifiable technical rationale is used in lieu of *firestop system*’s test report

or *listing*, or both. Therefore, it is important to know that fire test standards for *firestop systems* used in other countries are similar but not identical. For example, all fire test standards for *firestop systems* require a positive furnace pressure. However, the degree of positive pressure varies greatly between the requirement in the United States and other countries. This is important information when *firestop system's* test reports and *listings* are assessed to create *judgments*. This is also true of other conditions of these test standards used to fire test *firestop systems*.

6.6 Some *listings* declare that the *manufacturer's instructions* be followed for installation of the *firestop system*. It is possible that the *manufacturer's instructions* have changed from the time of fire testing and publication of the *listing*. Therefore, to assure the *manufacturer's instructions* are unchanged or still applicable, the *manufacturer's instructions* should be verified with the manufacturer or agency publishing the *listing* before beginning the *firestop system* installation process. Ideally this verification process should take place when a *firestop system* is being specified to avoid project delays once the work is awarded. The *manufacturer's instructions* should also bear revision dates, which will assist in the verification process.

6.7 North American *firestop system* test methods (for example, Test Method E814, UL 1479, and CAN/ULC-S115), contain a requirement for a hose stream test. In the United States, the application of the hose stream is basically conducted in compliance with Practice E2226. Other international test standards for fire testing *firestop systems* do not mandate or include a hose stream test. Using a *judgment* with justifiable technical rationale in the United States, based on fire testing without the hose stream test, could affect the intended performance of an installed *firestop system*.

6.8 “Blank openings” are not part of this guide because these types of *openings* do not have *penetrating items*, which is a necessary part of a *firestop system*. However, much of this guide contains helpful information about the *opening* and the installation of *firestop materials*. Sometimes a blank *opening* is actually a *fire-resistive joint system*, which should be tested in accordance with Test Method E1966, Test Method E2307, Test Method E2837, or similar test standards.

6.9 Fire testing to Test Method E814, or similar test standards, does not replicate every project's environment and installation conditions. In the laboratory, the *firestop system* has been subject to the laboratory's environmental and installation conditions. This laboratory environment could be different from that of the field installation of a *firestop system*.

6.10 Fire testing to Test Method E814, or similar test standards, provide a comparative measure of the fire performance of *firestop systems*. Testing *firestop systems* is based on a standardized fire exposure called a time-temperature curve. This practice is used worldwide and standardized fire tests are the basis of many building codes. However, this standardized fire 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. Any variation from the test conditions or *firestop system*, such as size, materials, or method of assembly, can affect the fire-test-response. Therefore, every real-world fire that an installed *firestop system* can encounter is not represented by any fire test. The real-world fire can be less, or more, severe in intensity or duration, or both.

6.11 Test methods try to limit the number of variables (fire exposure, thermocouples, temperature measurements, etc.) encountered in a fire test. Fire tests conducted by a laboratory use the materials and construction designated by the test sponsor for the *fire-separating element*.

6.12 Fire testing the test assembly is intended to assess materials, workmanship, and details such as dimensions of parts, and built under conditions representative of those applied in building construction and operation. However, these variables in actual construction are enormous. Therefore, the *fire-separating element* on a particular project tested with a *firestop system* is not typically representative of every construction for every project. For example, concrete type and mix used in building construction varies considerably. The *fire-separating element's* construction could be standardized using standardized materials and construction practices to allow for a broader application of the test report and *listing*. Using a standardized generic concrete type (for example, siliceous, carbonate, sand-lightweight, or lightweight) at a thickness slightly less than needed for the prescribed fire-resistance rating would potentially qualify other concrete types. These types of evaluations should be conducted by qualified individuals using general principles contained in ACI 216 and Practice E2032 and can reduce the construction variables to a reasonable number.

6.13 Sometimes the specified project conditions change. This situation sometimes requires changing the specified *firestop system*. This guide can be used as a general reference to ascertain whether the installation of another *firestop system* may be compatible with the changed condition. For example, the original *opening* was to be relatively small; have only one *penetrating item*; and be sealed with a *firestop sealant*. However, well after construction has commenced, the building owner instructs the architect that the building is intended to have the ability for retrofitting to satisfy each building occupant's special electrical, mechanical, plumbing,