Designation: E2750 – 13ε1

An American National Standard

Standard Guide for Extension of Data from Penetration Firestop System Tests Conducted in Accordance with ASTM E814[1]

This standard is issued under the fixed designation E2750; 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.

ε[1] NOTE—The title of this guide was corrected editorially in February 2013.

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 Method 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 E119, E1966 and E2307.

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 standard guide is under the jurisdiction of ASTM Committee E05 on Fire Standards and is the direct responsibility of Subcommittee E05.11 on Fire Resistance.

Current edition approved Jan. 1, 2013. Published February 2013. Originally approved in 2011. Last previous edition approved in 2011 as E2750-11. DOI: 10.1520/E2750-13E01.

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

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 Guide 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

2.2 *Other Standards:*

ACI 216 Fire Resistance of Concrete[3]

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 E814 and 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 Method E119 and Test Method E814 including those pertaining to conditions of acceptance.

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 Guide 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 E814 or E119 under positive furnace pressure as specified in E814.

[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.

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

5.6 *Angled Penetrations*—Where the penetrating item is indicated as a metallic pipe, conduit, tube, duct or cable, and the firestop system consists of a fill material (such as sealants, putty, or mortar) and a packing material, the penetrant may pass through the opening in the wall or floor assembly at an angle, provided the annular space is maintained on both sides of the wall or floor assembly. 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 Guide 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.

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 4—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 5—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 6—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 7—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 pentrant 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 8—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 sytem 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 9—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 10—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 11—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 12—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.

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

6.15 *Penetrating Non-structural or Service Support Members (including, but not limited to, service support members, struts, threaded rods, cables and wires, etc.):*

NOTE 13—Laboratory through-penetration firestop system listings refer to structural elements as “service support members”.

6.15.1 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:

6.15.1.1 The distance from the edge of the non-structural or structural member to the edge of the penetration opening must be within the tested range.

6.15.1.2 The non-structural or structural member size must be within the tested range.

6.15.1.3 Structural members with applied coatings such as fireproofing must be fire tested.

6.16 *Mixed Penetrating Items:*

6.16.1 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:

6.16.1.1 The distance between penetrants of different types shall be within the tested range.

NOTE 14—Different penetrant types are enumerated in 1.7.

6.16.1.2 The rules in 6.7 through 6.15 for independent penetrants should be applied to each individual type of penetrant in the mixed system.

6.16.1.3 The mix of penetrants allowed within one opening shall not exceed the number and types that were tested.

6.16.1.4 It is permissible to reduce the number or types of penetrants that were tested without reducing the *F*-rating.

6.16.1.5 Maximum and minimum annular space, applied to every penetrant, must be within the tested range.

7. Keywords

7.1 extension of data; fire resistance; firestop; firestopping; through penetration firestops

APPENDIXES

(Nonmandatory Information)

X1. HARMATHY'S TEN RULES OF FIRE ENDURANCE[4]

X1.1 These ten rules developed by T.Z. Harmathy form the initial basis for the consideration of the extensions of data from fire tests included in this guide. However, there are exceptions to some of these general rules.

X1.1.1 *Rule 1*—The " thermal" fire endurance of a construction consisting of a number of parallel layers is greater than the sum of the "thermal" fire endurance characteristics of the individual layers when exposed separately to fire.

X1.1.2 *Rule 2*—The fire endurance of a construction does not decrease with the addition of further layers.

X1.1.3 *Rule 3*—The fire endurance of constructions containing continuous air gaps or cavities is greater than the fire endurance of similar constructions of the same weight, but containing no air gaps or cavities.

X1.1.4 *Rule 4*—The further an air gap or cavity is located from the exposed surface, the more beneficial is its effect on the fire endurance.

X1.1.5 *Rule 5*—The fire endurance of a construction cannot be increased by increasing the thickness of a completely enclosed air layer.

X1.1.6 *Rule 6*—Layers of materials of low thermal conductivity are better utilized on that side of the construction on which fire is more likely to happen.

X1.1.7 *Rule 7*—The fire endurance of an unsymmetrical construction depends upon the direction of heat flow.

X1.1.8 *Rule 8*—The presence of moisture, if it does not result in explosive spalling, increases fire endurance.

X1.1.9 *Rule 9*—Load-supporting elements, such as beams, girders and joists, yield higher fire endurance when subjected to fire endurance tests as parts of floor, roof or ceiling assemblies than they would when tested separately.

X1.1.10 *Rule 10*—The load-supporting elements (beams, girders, joists, etc.) of a floor, roof or ceiling assembly can be replaced by such other load-supporting elements which, when tested separately, yielded fire endurance not less than that of the assembly.

[4] Harmathy, T. Z., "Ten Rules of Fire Endurance Ratings," *Fire Technology*, Vol 1, May 1965, pp. 93-102.

X2. RATIONALE (COMMENTARY)

X2.1 The "fire resistance" requirement is employed in North American building codes to regulate the division of a building into fire compartments by physical barriers (called fire separations) which resist the spread of fire from one compartment to another. It is also employed to regulate building elements that maintain the structural integrity of these fire separations.

X2.2 For many years, building codes have provided for the establishment of fire resistance ratings by subjecting model construction assemblies, representative of the construction to be employed, to a test as presently described by Test Methods E119. Fire resistance ratings are also developed from information provided in the building codes, using a collection of data concerning generic materials, based upon the performance of these materials in various assemblies when subjected to the requirements of the standard fire resistance test.

X2.3 It has also become the practice to assess the theoretical fire performance of construction assemblies from reasoning based on data obtained from the standard fire resistance test. Such assessment has thus far been confined to assemblies obtained by substituting elements having a different form, mass or dimension. It has entailed an engineering evaluation of the effect of substitution on the results of the fire test.

X2.4 This guide covers various aspects of the design of structures for fire resistance. The purpose of this guide is to elaborate upon the principles involved in the extension of data obtained from fire resistance tests and to enable a potential user

to correctly identify whether a proposed design modification will result in a higher, lower, or similar fire resistance rating compared to that of the original assembly tested.

X2.5 Other documents should be developed or referred to which address procedures for quantified interpolation and extrapolation of data obtained from standard fire resistance tests and procedures for theoretical design of structures for fire resistance based on material properties.

X2.5.1 The International Organization for Standardization has published ISO/TR 12470, Fire resistance tests – Guidance on the application and extension of results.

X2.6 Extension of data without the certification body or listing agency's review and concurrence means the modified system will not be considered as listed or certified.

X3. APPENDIX INFORMATION REGARDING FIRE RESISTANCE OF FLOOR, WALL AND ROOF ASSEMBLIES

X3.1 *Principles Pertaining to Fire Resistance of Floor or Roof Assemblies*:

X3.1.1 The provisions in this section are applicable only as they affect the transfer of heat through concrete.

NOTE X3.1—Considerations involving structural fire resistance are addressed in Guide E2032.

X3.1.2 Since temperature rise is the governing acceptance criteria, it is assumed that the structural design requirements of the slab are met and adequate concrete cover is provided to the steel reinforcement (prestressing and reinforcing bars).

X3.1.2.1 Decreasing the concrete unit weight or increasing the equivalent thickness of the slab will not decrease the fire resistance of the assembly.

NOTE X3.2—ACI 216.1, Fire Resistance of Concrete, provides additional guidance.

X3.2 *Steel Floor or Form Units*:

X3.2.1 For beams in tested specimens with roofs incorporating insulation on steel decks protected by a ceiling protective membrane, increasing the spacing between beams can reduce the fire resistance.

X3.2.2 An increase in metal thickness of the steel roof, floor, or form units does not reduce the fire resistance.

X4. PRINCIPLES PERTAINING TO FIRE ENDURANCE OF WALL ASSEMBLIES

X4.1 *Conditions of Acceptance*—Individual fire resistance classifications for walls are determined in accordance with Test Method E119.

NOTE X4.1—For a bearing wall or partition, see "Tests of Bearing Walls and Partitions" in Test Method E119. For a nonbearing wall or partition, see "Tests of Nonbearing Walls and Partitions" in Test Method E119.

X5. STUD FRAMED WALLS

X5.1 In non-load bearing walls, an increase in stud spacing can reduce the fire resistance as a result of impaired membrane stability.

X5.2 In load-bearing walls, stud spacing shall not be modified without an engineering analysis.

X5.3 An increase in the depth, or material thickness, or both, of a stud does not reduce the fire resistance.

X5.4 Closer fastener spacing does not reduce the fire resistance.