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An American National Standard

# Standard Guide for Extension of Data From Fire Resistance Tests Conducted in Accordance with ASTM E 119[1]

This standard is issued under the fixed designation E 2032; 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.

## 1. Scope

1.1 This guide covers the extension of fire resistance ratings obtained from fire tests performed in accordance with Test Method E 119 to constructions that have not been tested. Test Method E 119 evaluates the duration for which test specimens will contain a fire, retain their standard integrity, or both during a predetermined test exposure.

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 E 119. Test Method E 119 is a fire-test-response standard.

1.4 The types of building constructions which are the subject of this guide are categorized as follows: beams; floor and roof assemblies; columns; and walls and partitions. Floor and roof assemblies include such assemblies with ceiling protective membranes.

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

1.6 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.

1.7 This guide does not purport to be comprehensive in its treatment of non-proprietary modifications of tested constructions. Engineering evaluation or tests are recommended for assessing modifications not specifically covered in this guide.

1.8 The values given in SI units are regarded as standard.

1.9 *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.*

1.10 *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]

C 168 Terminology Relating to Thermal Insulation

C 553 Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

C 612 Specification for Mineral Fiber Block and Board Thermal Insulation

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

E 176 Terminology of Fire Standards

E 631 Terminology of Building Constructions

E 1264 Classification for Acoustical Ceiling Products

E 1513 Practice for Application of Sprayed Fire-Resistive Materials (SFRMs)

## 3. Terminology

3.1 *Definitions:*

3.1.1 For definitions used in this guide, refer to Terminologies E 176, C 168, and E 631.

3.1.2 *fire endurance*, *n*—a measure of the elapsed time during which a material or assemblage continues to exhibit fire resistance

3.1.3 *fire resistance*, *n*—the property of a material or assemblage to withstand fire or give protection from it.

3.1.3.1 *Discussion*—In this guide, it is characterized by the ability to confine a fire and continue to perform a given structural function.

[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.

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

3.1.4 *mineral fiber insulation*, *n*—insulation composed principally of fibers manufactured from rock, slag, or glass processed from molten state into fibrous form to comprise flexible batts or blankets, rigid or semi-rigid blocks and boards, or loose fill insulations, with or without binder.

3.1.4.1 *Discussion*—Mineral fiber blanket thermal insulations and mineral fiber block and board thermal insulations are classified into various types based upon the maximum use temperature, which can range from 204°C (400°F) to 982°C (1800°F), and the apparent thermal conductivity (See Specifications C 553 and C 612).

3.1.5 *unit weight*, *n*—as applied to concrete, weight per unit volume.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *acoustical ceiling panel*, *n*—a form of a prefabricated sound absorbing ceiling element used with exposed suspension systems (see Specification E 1264).

3.2.2 *acoustical ceiling tile*, *n*—a form of a prefabricated sound absorbing ceiling element used with concealed or semi-exposed suspension systems, stapling, or adhesive bonding (see Specification E 1264).

3.2.3 *beams*, *n*—all horizontally oriented structural members employed in building construction and known variously as beams, joists, or girders.

3.2.4 *ceiling protective membrane*, *n*—a ceiling membrane attached to or suspended from the structural members of the floor or ceiling assembly, usually by hanger wire or threaded rods, consisting of a grid suspension system with lay-in ceiling panels or a grid of steel furring channels to which the ceiling membrane is directly attached, intended to provide fire protection, acoustical and or aesthetic enhancements, or both.

3.2.5 *composite*, *n*—as applied to loadbearing elements, an interaction between structural components which is to be taken into account in the evaluation of load capacity.

3.2.6 *design load*, *n*—the intended maximum design load condition allowed by design under appropriate nationally recognized structural design criteria.

3.2.7 *directly applied fire resistive coating*, *n*—materials that are normally sprayed onto substrates to provide fire-resistive protection of the substrates.

3.2.7.1 *Discussion*—These coatings are called sprayed fire-resistive materials in Standard Practice E 1513 and related standards.

3.2.8 *equivalent thickness*, *n*—the calculated solid thickness of concrete or masonry for purposes of determining fire resistance ratings of barrier elements on the basis of heat transmission end-point criteria.

3.2.9 *insulation*, *n*—a material that is normally added to an assembly to provide resistance to heat flow for purpose of energy conservation.

3.2.9.1 *Discussion*—Insulation materials are also used to improve sound control or improve fire resistance.

3.2.10 *lightweight aggregate concrete*, *n*—concrete made with aggregates of expanded clay, shale, slag, or slate or sintered fly ash, and weighing 1360 to 1840 kg/m$^3$ (85 to 115 pcf).

3.2.11 *material, generic*, *n*—is one for which a nationally recognized Standard Specification exists.

3.2.12 *material proprietary*, *n*—is one whose fire performance characteristics are determined in consideration of a formulation or process of production that is proprietary.

3.2.13 *non-composite*, *n*—as applied to loadbearing elements, structural interaction between contiguous elements is assumed not to exist in the evaluation of load capacity.

3.2.14 *sand-lightweight concrete*, *n*—concrete made with a combination of expanded clay, shale, slag, or slate or sintered fly ash and natural sand and generally weighing between 1680 and 1920 kg/m$^3$ (105 to 120 pcf).

3.2.15 *specified load*, *n*—as applied to loadbearing elements, the test load applied to the element in a Test Method E 119 test.

3.2.15.1 *Discussion*—In Test Method E 119 testing, the specified load is generally the design load (see 3.2.6).

3.2.16 *test specimen*, *n*—the specific construction assembly that was tested in accordance with Test Method E 119.

3.2.17 *transfer*, *n*—the process of substituting a loadbearing element from one test specimen for the loadbearing element in another test specimen, or utilizing a loadbearing element from one test specimen for use in another test specimen that does not include a loadbearing element.

3.2.18 *ultimate capacity*, *n*—as applied to loadbearing elements, the actual maximum load carrying capacity of an element based on properties specific to the material constituting the element.

## 4. Significance and Use

4.1 The methods and procedures set forth in this guide relate to the extension of the fire resistance ratings obtained from particular fire tested specimens to constructions that have not been tested.

4.2 Users of this guide must have knowledge and understanding of the provisions of Test Method E 119 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 E 119, the specimens are subjected to specific laboratory fire test exposure conditions. Substitution of different test conditions or changes in the end use conditions have the ability to change the measured fire-test-response characteristics. Therefore, the extensions of data are valid only for the fire test exposure conditions described in Test Method E 119,.

## 5. General Principles

5.1 The same criteria or conditions of acceptance as set out in the Test Method E 119 and followed in the establishment of the fire resistance rating of the original test specimen shall be used in the evaluation of the effect of the modification or substitution of components in a test specimen.

5.1.1 The criteria or conditions of acceptance for the evaluation of modified test specimens shall likewise be in accordance with the appropriate sections of Test Method E 119.

5.2 Statements in this guide only indicate whether a change in the construction either “can reduce” or “does not reduce” the fire resistance rating.

5.3 *Limitations*:

5.3.1 The extension of fire resistance ratings is valid only for changes to the tested specimen that fall within normal and reasonable limits of standard construction practices.

5.3.2 Statements are valid only if the identified changes are the only changes in the construction or properties of the components.

5.3.3 It is possible that multiple changes have a different cumulative effect than that of individual changes applied separately.

5.3.4 Unless otherwise indicated, statements are only valid if the change identified does not change the specified load.

5.3.4.1 Provisions in this guide involving the ratio of specified load to design load assume that the safety factor (ratio of ultimate capacity to design load) inherent in the design procedure is constant.

5.3.4.2 Increasing the ratio of the maximum applied load (specified load, dead plus live load) to the design load of an element beyond that realized in the test specimen can reduce the fire resistance rating.

5.3.5 Provisions in this guide pertaining to concrete only apply to concrete with a compressive strength of 55.1 MPa (8000 psi) or less.

5.4 *Restrained/Unrestrained Specimens*:

5.4.1 The fire resistance rating of a beam, floor, or roof test specimen is related to either a restrained or unrestrained condition, or both. A restrained condition in a fire test is considered to be one in which the displacement or rotation due to fire induced thermal expansion of a load bearing element is resisted by forces external to the element. An unrestrained condition in a fire test is one in which the load bearing element is free to expand and rotate at its supports or is not subject to substantial thermal expansion and its resulting restraining forces.

5.4.2 Ratings of restrained beam, floor, or roof test specimens are intended for application to elements which are considered to be suitable for use in restrained building construction where the surrounding or supporting structure is capable of resisting substantial thermal expansion throughout the range of anticipated elevated fire conditions.

5.4.3 Ratings of unrestrained beam, floor or roof test specimens are intended for application to elements which are considered to be suitable for use in unrestrained and restrained building construction where the surrounding or supporting structure is or is not capable of resisting substantial thermal expansion throughout the range of anticipated elevated fire conditions.

5.4.3.1 The application of unrestrained classified beams, floors or roofs for use in building constructions with end restraint does not reduce the fire resistance rating.

NOTE 1—See Appendix X3 "Guide for Determining Conditions of Restraint for Floor and Roof Assemblies and for Individual Beams" in Test Method E 119 for assistance in determining the conditions of thermal restraint applicable to floor and roof constructions and individual beams in actual building construction.

5.5 *Composite and Non-Composite Design*:

5.5.1 Fire resistance ratings of beams and floors or roofs tested with composite design between the beam and the floor or roof is not reduced in actual building constructions designed for either composite or non-composite action.

5.5.2 Conversely, fire resistance ratings of beams and floors or roofs tested in non-composite design shall be limited to building constructions designed for non-composite action.

## 6. Principles Pertaining to Heat Transfer Characteristics of Concrete

6.1 The provisions in this section are applicable only as they affect the transfer of heat through concrete. Considerations involving structural fire resistance are addressed in other sections.

6.2 For concrete test specimens where temperature rise on the unexposed surface of a concrete slab (wall, floor, or roof) is the governing criterion, the following modifications do not reduce the fire resistance rating of the assembly:

6.2.1 Decrease in concrete unit weight;

6.2.2 Substitution of sanded light-weight aggregate concrete or light-weight aggregate concrete for normal weight concrete; also, substitution of carbonate aggregate for siliceous aggregate for either the coarse or the fine aggregate used in the concrete;

6.2.3 Decrease in the nominal maximum size of coarse aggregate within a given concrete aggregate type;

6.2.4 Increase or decrease in the compressive strength of the concrete;

6.2.5 Change in the type of portland cement, flyash or admixtures used in the concrete;

6.2.6 Changes in the type or amount of reinforcement;

6.2.7 Increase in the equivalent thickness of the slab for a given type of aggregate concrete; and

6.2.8 Change in slab design or restraint conditions, provided the equivalent thickness of slab does not decrease.

6.2.9 In slabs or constructions incorporating joints other than construction joints, changes in joint design provided that the substituted joint design has been tested in a Test Method E 119 test and met the required fire resistance rating.

6.2.10 For slabs containing hollow cores or air cavities, filling of cores or voids with non-combustible insulation material;

6.3 For temperature rise to be the governing criteria, it is assumed that the structural design requirements of the slab are met and adequate cover protection is provided to the steel reinforcement (prestressing and reinforcing bars).

## 7. Principles Pertaining to Protective Finish Systems

7.1 *Directly Applied Fire Resistive Coatings*:

7.1.1 The following modifications to directly applied fire resistive coatings can reduce the fire resistance rating:

7.1.1.1 A decrease in thickness;

7.1.1.2 A change in a critical aspect of the coating such as composition, formulation, density, etc. or system (use of adhesive, sealer or top coat; mechanical retention; etc); and

7.1.1.3 A change in the nature of the substrate (composition, orientation, shape, etc.) or condition (surface texture, surface finish, contamination, etc.).

7.1.2 Except for intumescent coatings, the following modifications to directly applied fire resistive coatings, do not reduce the fire resistance rating: