Report of the Committee on Fire Tests

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Alternates

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(Alt. to T. H. Talley)

Nonvoting

Robert H. Barker, American Fiber Manufacturers Assn., DC [M]
(Alt. to T. L. Jilg)
Tod L. Jilg, Hoechst Celanese Corporation, NC [M]
Rep. American Fiber Manufacturers Association
Rohit Khanna, US Consumer Product Safety Commission, MD [C]
Herman H. Spaeth, Novato, CA
(Member Emeritus)

Staff Liaison: **Steven E. Younis**

Committee Scope: This Committee shall have primary responsibility for documents on fire testing procedures, for reviewing existing fire test standards and recommending appropriate action to NFPA, for recommending the application of and advising on the interpretation of acceptable test standards for fire problems of concern to NFPA technical committees and members, and for acting in a liaison capacity between NFPA and the committees of other organizations writing fire test standards. This Committee does not cover fire tests that are used to evaluate extinguishing agents, devices, or systems.

This list represents the membership at the time the Committee was balloted on the text of this report. Since that time, changes in the membership may have occurred. A key to classifications is found at the front of the document.

The Technical Committee on **Fire Tests** is presenting seven Reports for adoption, as follows:

Report I: The Technical Committee proposes for adoption, a complete revision to NFPA 252, **Standard Methods of Fire Tests of Door Assemblies**, 1999 edition. NFPA 252-1999 is published in Volume 6 of the 2001 National Fire Codes and in separate pamphlet form.

NFPA 252 has been submitted to letter ballot of the **Technical Committee on Fire Tests**, which consists of 26 voting members. The results of the balloting, after circulation of any negative votes, can be found in the report.

Report II: The Technical Committee proposes for adoption, a complete revision to NFPA 260, **Standard Methods of Tests and Classifications System for Cigarette Ignition Resistance of Components of Upholstered Furniture**, 1998 edition. NFPA 260-1998 is published in Volume 6 of the 2001 National Fire Codes and in separate pamphlet form.

NFPA 260 has been submitted to letter ballot of the **Technical Committee on Fire Tests**, which consists of 26 voting members. The results of the balloting, after circulation of any negative votes, can be found in the report.

Report III: The Technical Committee proposes for adoption, a complete revision to NFPA 261, **Standard Method of Test for Determining Resistance of Mock-Up Upholstered Furniture Material Assemblies to Ignition by Smoldering Cigarettes**, 1998 edition. NFPA 261-1998 is published in Volume 6 of the 2001 National Fire Codes and in separate pamphlet form.

NFPA 261 has been submitted to letter ballot of the **Technical Committee on Fire Tests**, which consists of 26 voting members. The results of the balloting, after circulation of any negative votes, can be found in the report.

Report IV: The Technical Committee proposes for adoption, the withdrawal of NFPA 267, **Standard Method of Test for Fire Characteristics of Mattresses and Bedding Assemblies Exposed to Flaming Ignition Source**, 1998 edition. NFPA 267-1998 is published in Volume 6 of the 2001 National Fire Codes and in separate pamphlet form.

NFPA 267 has been submitted to letter ballot of the **Technical Committee on Fire Tests**, which consists of 26 voting members. The results of the balloting, after circulation of any negative votes, can be found in the report.

Report V: The Technical Committee proposes for adoption, a new document NFPA 274, **Standard Methods of Tests to Evaluate Fire Performance Characteristics of Pipe Insulation**.

NFPA 274 has been submitted to letter ballot of the **Technical Committee on Fire Tests**, which consists of 26 voting members. The results of the balloting, after circulation of any negative votes, can be found in the report.

Report VI: The Technical Committee proposes for adoption, a new document NFPA 290, **Standard for Fire Testing of Passive Protection Materials for Use on LP-Gas Containers.**

NFPA 290 has been submitted to letter ballot of the **Technical Committee on Fire Tests**, which consists of 26 voting members. The results of the balloting, after circulation of any negative votes, can be found in the report.

Report VII: The Technical Committee proposes for adoption, amendments to NFPA 705, **Recommended Practice for a Field Flame Test for Textiles and Films**, 1997 edition. NFPA 705-1997 is published in Volume 12 of the 2001 National Fire Codes and in separate pamphlet form.

NFPA 705 has been submitted to letter ballot of the **Technical Committee on Fire Tests**, which consists of 26 voting members. The results of the balloting, after circulation of any negative votes, can be found in the report.

NFPA 252

(Log #CP2)

252-1-(Entire Document) : Accept
SUBMITTER: Technical Committee on Fire Tests,
RECOMMENDATION: Adopt a complete revision of NFPA 252, Standard Methods for Fire Tests of Door Assemblies, 1999 edition, as shown at the end of this report. This revision includes restructuring the entire document to conform with the Manual of Style as follows:
1. Chapter 1 to contain administrative text only.
2. Chapter 2 to contain only referenced publications cited in the mandatory portions of the document.
3. Chapter 3 to contain only definitions.
4. All mandatory sections of the document must be evaluated for usability, adoptability, and enforceability language. Generate necessary committee proposals.
5. All units of measure in document are converted to SI units with inch/pound units in parentheses.
6. Appendices restructured and renamed as "Annexes."
SUBSTANTIATION: A complete revision of NFPA 252 is required in order to evaluate the standard in conjunction with current industry practices and perform editorial restructuring, to conform with the 2000 edition of the NFPA Manual of Style.
COMMITTEE MEETING ACTION: Accept
NUMBER OF COMMITTEE MEMBERS: 26
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 25
NOT RETURNED: 1 Griffith

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(Log #CP1)

252-2-(1-4 Definitions (GOT)) : Reject
SUBMITTER: Technical Committee on Fire Tests,
RECOMMENDATION: Adopt the preferred definitions from the NFPA Glossary of Terms for the following terms:
Fire Door Assembly. (preferred) NFPA 80, 1999 ed.
Any combination of a fire door, a frame, hardware, and other accessories that together provide a specific degree of fire protection to the opening.
Fire Door Assembly. (secondary) NFPA 252, 1999 ed.
A door assembly for which a fire protection rating is determined and that is intended for installation in door openings in fire-resistive walls.
SUBSTANTIATION: Adoption of preferred definitions will assist the user by providing consistent meaning of defined terms throughout the National Fire Codes.
COMMITTEE MEETING ACTION: Reject
COMMITTEE STATEMENT: This proposal was genterted in the name of the committee by internal NFPA process, but after review the Committee feels that the definitions currently within NFPA 252 more accurately reflect the intent of the Committee and this document.
NUMBER OF COMMITTEE MEMBERS:26
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 25
NOT RETURNED: 1 Griffith

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(Log #CP3)

252-3-(3-1.1) : Accept
SUBMITTER: Technical Committee on Fire Tests,
RECOMMENDATION: Delete the last sentence of 3.1.1 as follows:
~~A record of the materials and construction details to be used for the purpose shall be kept.~~
SUBSTANTIATION: The requirement is unclear as to the period of time to be kept, who shall keep the records, and the actual value of keeping the information. In some circumstances, the materials of construction being tested may not be known.
COMMITTEE MEETING ACTION:Accept
NUMBER OF COMMITTEE MEMBERS: 26
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 25
NOT RETURNED: 1 Griffith

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(Log #1)

252-4-(4-2.1) : Reject
SUBMITTER: Kate Steel, O'Keefe's, Inc.
RECOMMENDATION: Add text to read follows:
4-2.1
Where required by the conditions of acceptance, the fire door assembly shall be subjected to the impact, erosion and cooling effects of a standard hose stream. The hose stream test shall be conducted on a duplicate specimen pursuant to section 4-2.1.1. At the option of the test sponsor, the submitter may elect to have the hose stream test conducted on the same specimen subjected to the fire endurance test pursuant to section 4-2.1.2.
4-2.1.1. A duplicate specimen shall be subjected to a fire exposure test for a period equal to one-half of that indicated as the resistance period in the fire endurance test, but not for more than one hour. Within the 2 minutes immediately following the fire exposure test, the fire-exposed side of the duplicate specimen shall be subjected to a standard hose stream.
4-2.1.2. At the option of the test sponsor, w~~W~~ithin the 2 minutes immediately following the fire test specified in section 4-1, the fire-exposed side of the fire door assembly shall be subjected to ~~the impact, erosion, and cooling effects of~~ a standard hose stream.
Exception: For 20-minute fire protection-rated fire door assemblies, at the option of the test sponsor, the hose stream test shall not be required to be performed.
SUBSTANTIATION: This proposal proposes a primary and optional hose stream test method for door assemblies that provides the hose stream be applied to a duplicate specimen that has been tested for one half of the fire endurance rating period, consistent with the hose stream test method for wall assemblies under NFPA 251, and an optional program that allows the test sponsor to elect to have the hose stream conducted according to current method specified in NFPA 252, section 4-2.1 on the same specimen subjected to the fire endurance test at the end of the test period.
Door assemblies are currently subject to more stringent hose stream requirements than the wall assemblies in which they are installed. NFPA 251 does not even require the hose stream test for construction having a resistance period of less than one hour. For partitions rated one hour or more, NFPA 251 administers the hose stream to a duplicate specimen tested at one-half the rated time, up to a one-hour maximum. NFPA 252, however, provides the hose stream test is optional for 20-minute rated assemblies, but otherwise requires the hose stream be applied to the same test specimen immediately after the fire endurance test.
The practical effect of the conflicting hose stream test method in NFPA 252 is that a fire-rated door is subjected to the hose stream after a longer fire exposure period than a higher rated wall is exposed to when the hose stream test is administered per NFPA 251. For example, a 45-minute door, which is typically allowed in a 1-hour wall, is tested to a hose stream at the end of 45-minutes of fire exposure - whereas the wall in which it's installed is tested after only 30 minutes of fire exposure - half the fire endurance-rating period. Similarly, a 1-1/2-hour door protecting a 2-hour wall is subjected to a hose stream test after an additional 30 minutes of fire exposure than the wall has to endure, and a 3-hour door is exposed 2 hours longer than a 3-hour wall which is subjected to a hose stream after a maximum fire exposure of 1 hour.
There's no technical basis for applying the hose stream test to door assemblies at the end of the fire-rating period, but to walls at half the fire endurance period, particularly since walls usually have a higher rating than door assemblies protecting the openings. The justification for the lower door rating is that under normal conditions of use, the potential fire exposure in the vicinity of the door opening is lessened since there will be a clear opening on both sides of the opening for traffic purposes. Moreover, "since wall assemblies are put together at the site, their uniformity is not as certain as a fire door assembly that is factory assembled (e.g., undesigned penetrations tend to show up in wall assemblies). For this reason, any factor of safety that is tacitly called for in a wall assembly requirement should exceed that of a door assembly." NFPA 252, Appendix B-4.4.). Significantly, the opposite is the case here, as NFPA 251 prescribes a less stringent hose stream test method for walls, and this Technical Committee rejected a proposal several years ago to mandate testing the same specimen at the end of the fire test. There is no technical basis to justify a more stringent test for door assemblies, and given the acceptance of the duplicate specimen hose stream test method as adequate for walls, it follows that the test in NFPA 252 is unnecessarily excessive.
The rationale for applying the hose stream test to walls at half the fire endurance period is explained at length in the Gypsum Association position paper, "The Role of the Hose Stream in Test of Fire-Resistance" (September 25, 1994) (hereafter "GA Paper"). The reasoning traces back to the historical basis for the hose stream test in ASTM E119 (formerly C 19) which clarifies the test was not meant to assess suitability for use after a fire, but was "a means of investigating the stability of test subjects, including essential parts thereof, during the period in which they function effectively as fire barriers; this being the intent . . . the fire hose stream test shall be applied well in advance of the time when the fire resistance or the test subject had been taxed to its ultimate." (GA Paper, p. 6, citing ASTM C19 Secretary letter reply to re purpose of hose stream test.)
The test originated in recognition that fire barriers are subjected to "rough usage" caused by impact from overturned furniture or stock piles, falling debris, pressure waves from explosions, movement of fire-fighting personnel and equipment, or from actual application of the fire hose stream which causes both erosion and impact. The test "serves as an impact test, providing means of judging the probable effects of mechanical impacts of various kinds" and may have value in certain kinds of fire testing by yielding information on erosion phenomena and effects of sudden cooling. (Id., p. 7).
GA's Paper cites the debate over the hose stream test in the course of 100 years, and conclusions by experts that the hose stream serves no purpose in assessing fire resistance, and major actions have been taken in the past to lessen or eliminate the hose stream requirement, including (1) the ASTM C 19 (later E119) Committee adopted the duplicate test specimen test method and rejected the optional method of testing one specimen after the fire rating test period, (2) a substantial contingent of experts on the E-5 Committee expressed that the hose stream requirement should be eliminated entirely in connection with past proposed revisions to ASTM E119, (3) the hose stream was dropped from the British standard in the 1950's and was not included in

the modern international fire test standards for fire endurance (ISO 834).

Significantly, one of the recommendations that came out of the hose stream debate in 1994 was to conduct a technical review of the hose stream test in other fire test standards, such as ASTM E152 (hence NFPA 252), as, "It is likely the hose stream test has lost its relevance." (GA Paper, p. 11.) Although NFPA 252 added an exception in 1995 that made the hose stream test for 20-minute rated assemblies at the option of the test sponsor, there is no rational explanation for a more stringent hose stream test for doors at the end of the rating period, when NFPA 251 accepted the duplicate test specimen method for walls at one-half the rating period.

The 1995 edition of NFPA 252, Appendix B mentions for the first time that the "rapid cooling and thermal shock imposed by a hose stream test following the fire exposure test eliminates materials that are subject to failure under such conditions." Apparently the concern here is that when fire fighters arrive on the scene and apply fire hoses to suppress the fire, some door assemblies might fail and add to the fire risk, and the hose stream test would eliminate those assemblies. The justification for the hose stream test in this situation was analyzed by S. H. Ingberg and discredited as predicated on a sequence of consecutive events that have a remote probability of occurring: (1) the applications of a hose stream to construction exposed to fire causes damage making it vulnerable to fire-exposure; (2) the fire-fighting force leaves the scene or is driven away by fire; (3) the fire recurs in sufficient severity to overtax the damaged construction. He found the probability of all three events occurring to be "fairly remote," particularly since (3) is unlikely to occur after the amount of water that would be applied under (1) as required by the test procedure.

Ingberg indicates that this unlikely occurrence was the basis for omitting the hose stream test for columns in the present standard, and also the reason the revised British fire test standards do not require the hose stream for any type of construction. (GA Paper, pp. 7-8). Moreover, the hose stream test isn't reliable to classify assemblies that will withstand the application of an actual fire hose in the event fire fighters arrive on the scene, because it doesn't represent the real impact force and cooling effect delivered by a fire fighter's hose nozzle.

Finally, it is clear from the history of the hose stream that it was never intended to evaluate resistance to thermal stress or cooling effects resulting from exposure of assemblies to other sources of water that might be present in a real fire, prior to the arrival of fire services.1 The history of NFPA 252 affirms the primary purpose of the hose stream test is to evaluate the structural integrity of the assembly during a fire: "The application of water produces stresses in the assembly and provides a measure of structural capability. Weights were once used to provide a measure of the ability of an assembly to withstand impact. The hose stream is considered to be an improvement in uniformity and accuracy over weights." NFPA 252-1990 (last issued in 1994), Appendix A-13. The same explanation of the hose stream in relation to testing door assemblies is found in ASTM E152-81a, Appendix X1.13.

But regardless of the purpose of the hose stream test as a method of assessing the effects of mechanical impacts of various kinds, or as a measure of thermal stress resistance, it was never intended to evaluate suitability of use after fire exposure. The current hose stream test method in NFPA 252 is overly restrictive, and contrary to the intent that the hose stream part of the fire test be applied "well in advance of the time the test subject has been taxed to its ultimate." (GA Paper, p. 6) Section 4-2.1 should be test subject has been taxed to its ultimate." (GA Paper, p. 6) Section 4-2.1 should be revised to include the primary option for testing a duplicate specimen exposed to half the fire endurance-rating period, which has been established as appropriate to assess integrity of the assembly during the fire - not after it. It makes even less sense to impose a more stringent test on doors than walls, considering the different functions they serve.

When the fire services arrive and find the fire is still contained behind a 1-hour wall with access through a closed 45-minute fire door, the typical approach is to turn fire hoses on the door and break it down with an ax if necessary to gain access to the seat of fire and get water on the fire quickly. At the point active fire suppression efforts begin, the door ceases to function as a protective assembly, and its ability to withstand the hose stream is irrelevant, regardless of whether the test is applied at 45 minutes, 30 minutes or 22.5 minutes. The wall, on the other hand, continues to serve as a protective barrier after the door loses its value, yet the wall was tested to the hose stream after shorter fire exposure. Conversely, if the fire services arrive and find the wall is on fire, but the door is still in place, they will attack the fire with hoses and incidental failure or non-failure of the door at that point is insignificant. In any event, the effect a fire fighter's hose stream has on a door assembly is a question that arises well before 45-minutes, and there is no technical basis for applying the hose stream test at the end of the rating period, particularly given the average response time for active fire suppression efforts.

Therefore, the appropriate test method is to test a duplicate specimen at half the rating period, and this method should be recognized as the primary hose stream test. The alternative of conducting the hose stream test on the same specimen after the fire endurance test period should be allowed as an option for the test sponsor. The optional program is not a new concept, but rather has been accepted by ASTM E119 as an appropriate means of addressing the issue. (See GA Paper, p.3)

1 While some have argued that the hose stream is appropriate to measure resistance to thermal shock due to water from sprinkler activation or broken pipes, there is no support for that position in the general history of the hose stream test in ASTM E119 and NFPA 251, or in the explanatory materials included in past editions of NFPA 252 and ASTM E152-81a.

COMMITTEE MEETING ACTION: Reject

COMMITTEE STATEMENT: The wall assemblies are currently required to be tested to failure in load conditions with the opening protective having a fire protection rating less than the wall, justifying current requirements.

NUMBER OF COMMITTEE MEMBERS: 26

VOTE ON COMMITTEE ACTION:

AFFIRMATIVE: 24

ABSTENTION: 1

NOT RETURNED: 1 Griffith

EXPLANATION OF ABSTENTION:

KOFFEL: In accordance with Standards Council policy, I have abstained on Proposal 252-4 (Log #1).

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NFPA 252

Standard Methods of Fire Tests of Door Assemblies

2003 Edition

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

Information on referenced publications can be found in Chapter 2, Annex B, and Annex C.

Chapter 1 Administration

1.1 Scope. This standard prescribes standardized fire and hose stream test procedures that apply to fire door assemblies intended to be used to retard the spread of fire through door openings in fire-resistive walls.

1.2 Purpose.

1.2.1 The purpose of this standard is to prescribe specific fire and hose stream test procedures for fire door assemblies in order to standardize a method for determining the degree of fire protection provided by such assemblies in retarding the spread of fire (flame, heat, and hot gases) through door openings in fire-resistive walls.

1.2.2 The degree of fire protection measured in units of time is not an absolute value because all possible actual fire scenarios are not represented by the standard fire exposure described herein.

1.2.3 This standard allows different fire door assemblies to be compared with each other in order to evaluate their relative performance as measured against a standard fire exposure.

1.3 Application.

1.3.1 This standard is intended to evaluate the ability of a door assembly to remain in a wall opening during a prescribed fire test exposure, which is then followed by the application of a prescribed hose stream.

1.3.2 Tests conducted as described in these standard test methods measure the performance of fire door assemblies during the test exposure and develop data that enable regulatory bodies to require fire door assemblies for use in wall openings where fire protection is required.

1.3.3 The tests described in these standard test methods expose a specimen to a standard fire exposure that is controlled to achieve specified temperatures throughout a specified time period, which is then followed by the application of a specified standard hose stream. The fire exposure, however, is not representative of all fire conditions, which vary with changes in the amount, nature, and distribution of fire loading, ventilation, compartment size and configuration, and heat sink characteristics of the compartment. The fire exposure does, however, provide a relative measure of the performance of fire door assemblies under these specified fire exposure conditions. Similarly, the hose stream exposure is not representative of all applications of actual hose streams used by a fire department during fire suppression efforts.

1.3.4 Any variation from, or change to, the construction or conditions of the door assembly as tested can change the performance characteristics of the fire door assembly.

1.3.5 These tests shall not be construed as determining the suitability of fire door assemblies for continued use after exposure to real fires.

1.3.6 This standard shall not be used to provide the following:

(1) Full information regarding the performance of specific fire door assemblies where installed in walls constructed of materials other than those

tested
(2) Evaluation of the degree by which the fire door assembly contributes to the fire hazard by generation of smoke, toxic gases, or other products of combustion
(3) Measurement that determines a limit on the number and size of vision panels permitted or the number and size of lateral openings permitted between the door and frame
(4) Measurement of the fire door assembly's ability to control or limit the passage of smoke or similar products of combustion through the assembly
(5) Measurement that determines a specific temperature limit on the unexposed surface of the fire door assembly

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publication. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials*, 1999 edition.

2.3 Other Publication.

2.3.1 ANSI/UL Publication. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.

ANSI/UL 385, *Standard for Safety Play Pipes for Water Supply Testing in Fire-Protection Service*, 1994.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where the terms are not included, common usage of the terms shall apply.

3.2 NFPA Official Definitions.

3.2.1 Shall. Indicates a mandatory requirement.

3.2.2 Should. Indicates a recommendation or that which is advised but not required.

3.2.3 Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

3.3.1 Door Assembly. Any combination of a door, frame, hardware, and other accessories that is placed in an opening in a wall that is intended primarily for access or for human entrance or exit.

3.3.2 Fire Door Assembly. A door assembly for which a fire protection rating is determined and that is intended for installation in door openings in fire-resistive walls.

3.3.3 Opening. A through-hole in the fire door assembly that can be seen from the unexposed side while looking through the plane of the assembly from a perpendicular position.

3.3.4 Vision Panel. A glazing material installed in a fire door assembly to allow for viewing through the fire door assembly.

Chapter 4 Control of Fire Test

4.1 Temperature-Time Curve.

4.1.1 The temperature inside the furnace to which the fire door assembly is exposed during the fire test shall be controlled to conform to the standard temperature-time curve shown in Figure 4.1.1 for the duration of the fire test.

Figure 4.1.1 Temperature-Time Curve.
[Figure 2-1.1, 1999 edition of NFPA 252, no change]

4.1.2 At the start of the fire test, the temperature inside the furnace shall be ambient.

4.2 Furnace Temperatures.

4.2.1 The temperature of the furnace shall be determined by the average temperature obtained from the readings of not less than nine thermocouples symmetrically disposed and distributed within the furnace to measure the temperature near all parts of the fire door assembly.
4.2.1.1 The thermocouples shall be protected in one of the following ways:
(1) By sealed porcelain tubes having a 19-mm (3/6-in.) outside diameter and a 5-mm (1/8-in.) wall thickness
(2) By sealed 15-mm (1/4-in.) nominal diameter wrought-steel or wrought-iron pipe of standard weight where base-metal thermocouples are used
(3) By enclosure in protective tubes of such materials and dimensions that the time constant of the protected thermocouple assembly lies within a range of 5.0 minutes to 7.2 minutes

4.2.1.2 The exposed length of the thermocouple protection tube in the furnace chamber shall be not less than 304.8 mm (12 in.).

4.2.1.3 The junction of the thermocouples shall be 152 mm (6 in.) from the exposed face of the fire door assembly or from the test wall in which the assembly is installed.

4.2.2 The furnace temperature shall be measured and recorded at intervals not exceeding 1 minute during the fire test.

4.2.3 The furnace temperature shall be controlled so that the area under the temperature-time curve, obtained by averaging the results from the furnace temperature readings, is within the following percentages of the corresponding area under the standard temperature-time curve shown in Figure 4.1.1:
(1) 10 percent for fire tests of 1 hour or less
(2) 7.5 percent for fire tests longer than 1 hour and not longer than 2 hours
(3) 5 percent for fire tests longer than 2 hours

4.3 Unexposed Surface Temperatures. Temperatures of the unexposed surface of the fire door shall be recorded during the first 30 minutes of the fire test and shall be determined in accordance with 4.3.1 through 4.3.3.

4.3.1 Unexposed surface temperatures shall be measured at not fewer than three points on the door surface, with at least one thermocouple for each 1.5 m^2 (16 ft^2) of the door.

4.3.1.1 Thermocouples shall not be located over reinforcements extending through the door, over vision panels, or within 305 mm (12 in.) of the edge of the door.

4.3.2* Unexposed surface temperatures shall be measured with thermocouples placed under thermocouple pads that meet the requirements specified in 4.3.4.

4.3.2.1 The pads shall be held against the surface of the door.

4.3.2.2 The thermocouple leads shall be positioned under the pad for a length of not less than 89 mm (5 1/2 in.), with the hot junction under the center of the pad.

4.3.2.3 The thermocouple leads under the pads shall not be heavier than 0.82 mm^2 (No. 18 AWG) and shall be electrically insulated with heat-resistant and moisture-resistant coatings.

4.3.3 Unexposed surface temperatures shall be measured at intervals not exceeding 1 minute.

4.3.4 Thermocouple pads shall meet the following requirements or otherwise shall be demonstrated to be equivalent by comparative tests in accordance with NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials*:
(1) Length and width, 152 mm ± 3.2 mm (6 in. ± 1/8 in.)
(2) Thickness, 10.2 mm ± 1.3 mm (0.04 in. ± 0.05 in.)
(3) Thermal conductivity [at 65°C (150°F)], 0.55 ± 0.0039 W/m · K (0.38 ± 0.027 Btu·in./hr·ft^2·°F)

Chapter 5 Fire Door Assembly

5.1 Construction and Size.

5.1.1 The design, construction, materials, workmanship, hardware, and size of the fire door assembly, which can consist of single doors, doors in pairs, special-purpose doors (e.g., Dutch doors, double-egress doors), or multisection doors, shall represent those for which a fire protection rating is desired. A record of the materials and construction details to be used for the purpose shall be kept.

5.1.2 A floor structure shall be provided as part of the opening in the test wall.

5.1.2.1 The floor structure shall be of noncombustible material and shall project into the furnace for a distance that is not less than twice the thickness of the fire door or to the limit of the frame, whichever is greater.

5.1.2.2 A floor structure shall not be required to be part of the opening in the test wall where the floor structure interferes with the operation of the door.

5.2 Mounting.

5.2.1 Swinging doors shall be mounted to swing into the furnace chamber.

5.2.2 Sliding and Rolling Doors. Sliding and rolling doors shall be mounted on the exposed side of the opening in the test wall that encloses the furnace chamber.

5.2.3 Slide-type elevator doors shall be permitted to be mounted on the unexposed side of the opening in the test wall that encloses the furnace chamber.

5.2.4 Access-type door assemblies and chute-type door assemblies shall be mounted with one door arranged to swing into the furnace chamber and another door arranged to swing away from the furnace chamber.

5.2.5 Dumbwaiter doors and service-counter doors shall be mounted on the exposed side of the opening in the test wall that encloses the furnace chamber.

5.2.6 Door frames shall be evaluated when mounted to verify that the doors open either away from or into the furnace chamber, at the discretion of the testing authority, to obtain representative information on the performance of the construction under test.

5.2.7 Surface-mounted hardware (fire-exit devices) for use on fire doors shall be evaluated under conditions where it is installed on one door arranged to swing into the furnace chamber and on another door arranged to swing away from the furnace chamber.

5.2.8 The fire door assembly shall be installed in the test wall opening in the manner in which it is intended to be used.

5.2.8.1 Such mounting as described in 5.2.7 shall not prevent unrestricted operation of the fire door.

5.2.8.2 Clearances shall be provided in accordance with Section 5.3.

5.3 Clearances.

5.3.1 Clearances for swinging doors installed in the test wall opening shall be permitted to have a tolerance up to 1.6-mm (–1/16 in.) tolerance as follows:

(1) 3 mm (1/8 in.) along the top
(2) 3 mm (1/8 in.) along the hinge and latch jambs
(3) 3 mm (1/8 in.) along the meeting edges of doors in pairs
(4) 10 mm (3/8 in.) at the bottom edge of a single swinging door
(5) 6 mm (1/4 in.) at the bottom edge of a pair of doors

5.3.2 Clearances for horizontal sliding doors installed in the test wall opening and not mounted within guides shall be as follows with a 3-mm (1/8-in.) tolerance:

(1) 13 mm (1/2 in.) between the door and the test wall surfaces
(2) 10 mm (3/8 in.) between the door and the floor structure
(3) 6 mm (1/4 in.) between the meeting edges of center-parting doors

5.3.2.1 A maximum overlap of 102 mm (4 in.) of the door over the test wall opening at the sides and top shall be provided.

5.3.3 Clearances for vertical sliding doors installed in the test wall opening and mounted within guides shall be as follows with a 3-mm 1/8-in.) tolerance:

(1) 13 mm (1/2 in.) between the door and the test wall surfaces along the top or bottom door edges, or both, with guides mounted directly to the wall surface
(2) 5 mm (3/16 in.) between the meeting edges of biparting doors
(3) 5 mm (3/16 in.) between the door and the floor structure

5.3.4 Clearances for horizontal slide-type elevator doors installed in the test wall opening shall be as follows with a 3-mm (1/8-in.) tolerance:

(1) 10 mm (3/8 in.) between the door and the test wall surfaces
(2) 10 mm (3/8 in.) between multisection door panels
(3) 10 mm (3/8 in.) at the bottom edge of a panel

5.3.4.1 Multisection door panels shall overlap 19 mm (3/4 in.).

5.3.4.2 Door panels shall overlap the test wall opening 19 mm (3/4 in.) at sides and top.

5.4 Test Wall.

5.4.1 The test wall in which the fire door assembly is mounted and tested shall have the strength and fire resistance to retain the assembly throughout the fire and hose stream tests.

5.4.2 The test wall shall be constructed of materials representative of the wall construction in which the fire door assembly is intended to be installed.

5.4.3 When used, wall anchors shall be compatible with the test wall in which the fire door assembly is installed.

Chapter 6 Conduct of Tests

6.1 Fire Test.

6.1.1 Duration. The fire test shall be conducted until the desired fire protection rating period is reached or until failure to meet any of the performance criteria specified in Chapter 7 occur.

6.1.2 Furnace Pressure. The vertical pressure distribution within the furnace shall be measured and controlled in accordance with 6.1.1 through 6.1.6.

6.1.2.1 The vertical pressure distribution within the furnace shall be measured by at least two pressure-sensing probes separated by a minimum vertical distance of 1.8 m (6 ft) inside the furnace.

6.1.2.2 A calculation of the neutral pressure plane (zero differential pressure) location shall be made based on the vertical separation and pressure differences between the pressure-sensing probes.

6.1.2.3 The pressure-sensing probes shall be as shown in either Figure 6.1.2.3(a) or Figure 6.1.2.3(b).

Figure 6.1.2.3(a) Static Pressure-Sensing Probe Dimensions. [Figure 4-1.2.2(a) from the 1999 edition of NFPA 252]

Figure 6.1.2.3 (b) Pressure-Sensing Probe. [Figure 4-1.2.2(b) from the 1999 edition of NFPA 252]

6.1.2.4 The pressure-sensing probes shall be located within 152 mm (6 in.) of the vertical centerline of the furnace opening.

6.1.2.5 The pressure at each location shall be measured using a differential pressure instrument capable of reading in graduated increments no larger than 5 Pa (0.01 in. wg) with a precision of not more than +1.25 Pa (+0.005 in. wg).

6.1.2.6 The differential pressure measurement instrument shall be located to minimize stack effects caused by vertical runs of pressure tubing between the pressure-sensing probes and the differential pressure measurement instrument locations.

6.1.2.7 Control of the furnace pressure shall be established beginning no later than 5 minutes after the start of the test and shall be maintained throughout the remainder of the fire test period.

6.1.2.7.1 When the fire test is to be conducted under positive pressure, the neutral pressure plane in the furnace shall be established at 1016 mm (40 in.) or less above the bottom of the door.

6.1.2.7.2 When the fire test is to be conducted so that the furnace pressure is as close to neutral as possible, the neutral pressure plane shall be established at the top of the door ±25 mm (±1 in.).

6.1.2.8 The furnace pressure shall be measured and recorded throughout the fire test at intervals not exceeding 1 minute.

6.2 Hose Stream Test.

6.2.1* Within the 2 minutes immediately following the fire test, the fire-exposed side of the fire door assembly shall be subjected to the impact, erosion, and cooling effects of a standard hose stream.

6.2.2* For 20-minute fire protection–rated fire door assemblies, at the option of the test sponsor, the hose stream test shall not be required to be performed.

6.2.3 The standard hose stream shall be delivered through a 64-mm (21/2-in.) hose discharging through a national standard play pipe in accordance with ANSI/UL 385, *Standard for Safety Play Pipes for Water Supply Testing in Fire-Protection Service.*

6.2.3.1 The play pipe shall have an overall length of 762 mm (30 in.) and shall be equipped with a 28.7-mm (1 1/8-in.) discharge tip of the standard-taper, smooth-bore pattern without shoulder at the orifice.

6.2.3.2 The play pipe shall be fitted with a 64-mm (2 1/2-in.) inside diameter by 155-mm (6-in.) long nipple mounted between the hose and the base of the play pipe.

6.2.3.3 The pressure tap for measuring the water pressure at the base of the play pipe shall be normal to the surface of the nipple and centered on its length and shall not protrude into the water stream.

6.2.3.4 The water pressure shall be measured with a pressure gauge having a minimum range of 0 kPa to 344.8 kPa (0 psi to 50 psi) graduated in increments not greater than 13.8 kPa (2 psi).

6.2.4 The tip of the play pipe shall be located 6 m (20 ft) from the fire door assembly.

6.2.4.1 The lengthwise centerline of the play pipe shall be aligned perpendicular to the plane of the fire door assembly.

6.2.4.2 The lengthwise centerline of the play pipe shall be permitted to deviate not more than 30 degrees from the line perpendicular to the center of the fire door assembly.

6.2.4.3 Where the play pipe so deviates from the perpendicular line described in 6.2.4.2, the required distance from the tip of the play pipe to the center of the fire door assembly shall be reduced by 0.31 m (1 ft) for each 10 degrees of deviation from the perpendicular line.

6.2.5 The hose stream shall be directed around the periphery of the fire door assembly, starting upward from either bottom corner.

6.2.5.1 When the hose stream has traversed the periphery of the fire door assembly and is approximately 0.31 m (1 ft) from reaching the starting point, the hose stream shall be applied in vertical paths approximately 0.31 m (1 ft) apart until the entire width has been covered, and then in horizontal paths approximately 0.31 m (1 ft) apart until the entire height has been covered.

6.2.5.2 If the required duration of the hose stream test has not been reached after this procedure has been performed, the procedure shall then be reversed and followed until the required duration has been met.

6.2.5.3 Reversals in the direction of the hose stream shall be made within 0.31 m (1 ft) outside of the perimeter edge of the fire door assembly.

6.2.6* The minimum water pressure measured at the base of the play pipe shall be as specified in Table 6.2.6.

Table 6.2.6 Water Pressure at Base of Play Pipe and Duration of Application for Hose Stream

	Duration of Water Pressure at Base of Play Pipe		Application for Exposed Area	
Desired Rating	**kPa**	**psi**	**sec/ m^2**	**sec/ ft^2**
3 hr and over	310	45	32	3.0
1 1/2 hr and over and less than 3 hr	207	30	16	1.5
1 hr and over and less than 1 1/2 hr	207	30	10	0.9
Less than 1 hr	207	30	6	0.6

6.2.7 Exposed Area.

6.2.7.1 The hose stream shall be applied over the exposed area of the fire door assembly in accordance with the criteria specified in Table 6.2.6.

6.2.7.2 The exposed area shall be calculated using the outside dimensions of the fire door assembly including the door frames.

Chapter 7 Performance Criteria

7.1 General.

7.1.1 The fire door assembly shall meet the performance criteria specified in this chapter during both the fire test and the hose stream test unless otherwise indicated.

7.1.2 The fire door assembly shall remain in the test wall opening.

7.1.3 The fire door assembly shall not develop any openings in the door assembly, except as permitted by 7.1.3.1 through 7.1.3.3.

7.1.3.1 Openings created by glazing material breakage in the central area of each individual glazed light in any vision panel shall not exceed 5 percent of the area of the glazed light during the hose stream test.

7.1.3.2 Separation shall be permitted between meeting edges of pairs of doors in accordance with 7.3.1, 7.3.4, and 7.3.10.

7.1.3.3 Clearances shall be permitted at the bottom edges of doors in accordance with 7.3.1 through 7.3.4.

7.1.4 No flaming shall occur on the unexposed surface of the door assembly during the first 30 minutes of the fire test except that intermittent flames not greater than 152 mm (6 in.) in length shall be permitted to occur for periods not to exceed 10 seconds.

7.1.5 After 30 minutes of the fire test, some intermittent flames not greater than 152 mm (6 in.) in length shall be permitted to occur along the edges of doors for periods not to exceed 5 minutes.

7.1.6 For doors having a fire test duration of 45 minutes or greater, flames not greater than 152 mm (6 in.) in length shall be permitted to occur on the unexposed surface area of the door during the last 15 minutes of the fire test, provided that the flames are contained within a distance of 38 mm (1 1/2 in.) from a vertical door edge, within 76 mm (3 in.) from the top edge of the door, and within 76 mm (3 in.) from the top edge of the frame of a vision panel.

7.1.7 Hardware.

7.1.7.1 Where hardware is evaluated for use on fire doors, it shall keep the door in the closed position for a fire test duration of not less than 3 hours, and the latch bolt shall remain projected and intact.

7.1.7.2 The hardware shall not be required to be operable following the tests.

7.2 Swinging Doors.

7.2.1 For swinging doors, any portion of the edges adjacent to the door frame shall not move from its original position in a direction perpendicular to the plane of the doors for a distance greater than the door thickness during the fire test or greater than 1 1/2 times the door thickness during the hose stream test.

7.2.2 For swinging doors mounted in pairs, any portion of the meeting edges of each of the doors shall not move from its original position in a direction perpendicular to the plane of the doors for a distance greater than the door thickness away from the adjacent door edge.

7.2.3 Swinging doors mounted in pairs, incorporating an astragal, shall not separate in a direction parallel to the plane of the doors by more than 3/4 in. (19 mm) along the meeting edges or a distance equal to the throw of the latch bolt at the latch location.

7.2.4 Swinging doors mounted in pairs, without an overlapping astragal, for a fire test duration of 1 1/2 hours or less, shall not separate along the meeting edges by more than 10 mm (3/8 in.).

7.2.5 A single swinging door shall not separate from the door frame by more than 13 mm (1/2 in.) at the latch location.

7.2.6 Door frames to be evaluated with doors shall remain fastened to the test wall on all sides and shall not develop openings between the frame and the doors or between the frame and the adjacent test wall.

7.3 Sliding Doors.

7.3.1 Sliding doors mounted on the face of the test wall shall not move away from the wall more than 73 mm (2 7/8 in.).

7.3.2 Sliding doors mounted in guides shall not release from the guides, and the guides shall not loosen from the fastenings.

7.3.3 The bottom bar of rolling steel doors shall not separate from the floor structure by more than 19 mm (3/4 in.).

7.3.4 The meeting edges of center-parting horizontal sliding doors and biparting vertical sliding doors shall not separate from each other by a distance greater than the door thickness measured in a direction perpendicular to the plane of the doors.

7.3.5 The meeting edges of center-parting horizontal sliding doors and biparting vertical sliding doors, without an overlapping astragal, for a fire test duration of 1 1/2 hours or less, shall not separate from each other in a direction parallel to the plane of the doors by more than 10 mm (3/8 in.).

7.3.6 The meeting edges of center-parting horizontal sliding doors, incorporating an astragal, shall not separate from each other in a direction parallel to the plane of the doors by more than 19 mm (3/4 in.) or a distance equal to the throw of the latch bolt at the latch location.

7.3.7 The bottom edge of service-counter doors or single-slide dumbwaiter doors shall not separate from the sill by more than 10 mm (3/8 in.).

7.3.8 Astragal.

7.3.8.1 A resilient astragal, where provided, shall not develop openings during the fire test.

7.3.8.2 Not more than 5 percent of the area of the astragal shall be permitted to develop openings during the hose stream test.

7.3.9 The lap edges of horizontal slide-type elevator doors, including the lap edges of multisection doors, shall not move from the test wall or adjacent door surfaces so as to develop a separation of more than 73 mm (2 7/8 in.).

7.3.10 The meeting edges of center-parting horizontal slide-type elevator door assemblies, for a fire test duration of 1 1/2 hours or less, shall not separate from each other by more than 32 mm (1 1/4 in.) as measured in any horizontal plane.

Chapter 8 Report

8.1 Results.

8.1.1 Results shall be reported in accordance with the performance of the fire door assembly subjected to the tests as prescribed in these test methods.

8.1.2 The report shall include, but shall not be limited to, the following information:
(1) A description of the construction details and materials used to construct the test wall in which the fire door assembly is mounted for testing
(2) The temperature measurements of the fire test furnace plotted on a comparative graph showing the standard temperature-time curve
(3) The temperature measurements of the unexposed surface of the fire door assembly
(4) The pressure differential measurements made between the furnace and the unexposed side of the fire door assembly and the calculation that determines the position of the neutral pressure plane with respect to the bottom of the fire door assembly during the fire test
(5) All observations of the reactions of the fire door assembly that have an influence on its performance during both the fire and hose stream tests
(6) Flaming on the unexposed surface of the door or passing through the fire door assembly
(7) The magnitude and direction of the movement of any portion of the edges of the door from the original position
(8) A description of the fire door assembly, including fasteners and attachments and other hardware, as they appear after the fire test and the hose stream test
(9) The materials and construction of the fire door assembly, details of installation including hardware, door frame, and wall anchors, hangers, guides, trim, finish, and clearance or lap, in order to ensure positive identification and duplication of the fire door assembly in all respects
(10) The actual duration of the fire test

8.1.3 The fire protection rating of the fire door assembly that successfully meets the performance criteria specified in Chapter 7 shall also be reported.

8.1.3.1 The fire protection rating shall be based on, and shall not be greater than, the duration of the fire test and shall be assigned in accordance with one of the following:
(1) 20 minutes
(2) 30 minutes
(3) 3/4 hour
(4) 1 hour
(5) 1 1/2 hours
(6) 3 hours
(7) Hourly increments for ratings over 3 hours

8.1.3.2 Where the fire protection rating is 30 minutes or longer, a correction shall be applied for variation of the furnace exposure time from that prescribed in 4.2.3 in those cases where it affects the fire protection rating.

8.1.3.2.1 The correction described in 8.1.3.2 shall be done by multiplying the indicated duration by 2/3 of the difference in area between the curve of the average furnace temperature and the standard temperature-time curve for the first 3/4 of the test duration and then dividing the product by the difference in area between the standard temperature-time curve and a baseline of 20°C (68°F) for the same portion of the test, increasing the latter area by 30°C/hr (54°F/hr) [1800°C/min (3240°F/min)] to compensate for the thermal lag of the furnace thermocouples during the first part of the test.

8.1.3.2.2 For fire exposures in the test higher than the standard temperature-time curve, the indicated fire protection rating shall be increased by the amount of the correction and shall be decreased similarly for fire exposure below the standard temperature-time curve.

8.1.3.2.3 The correction shall be expressed by the following formula:

$$C = \frac{2I(A - A_S)}{3(A_S + L)}$$

where:

C = correction in the same unit as I
I = indicated fire protection rating
A = area under the curve of the indicated average furnace temperature for the first 3/4 of the indicated rating period
A_s = area under the standard temperature-time curve for the same part of the indicated fire protection rating
L = lag correction in the same units as A and A_s [30°C/hr (54°F/hr)] [1800°C/min (3240°F/min)]

8.1.4 The results of the hose stream test shall be documented.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.4.1.1 See Table A.4.1.1.

A.4.3.2 Material that is currently in use as a thermocouple pad is Ceraform 126®. Ceraform 126® is a registered trade name of Manville Speciality Group, P.O. Box 5108, Denver, CO 80217.
Specific product information is being provided for informational purposes only and has not been independently verified, certified, or endorsed by NFPA or any of its Technical Committees.

A.6.2.1 Additional information on the hose stream application can be found in Section B.13.

A.6.2.2 The elimination of the hose stream test for some 20-minute-rated assemblies is based on their field application.

A.6.2.6 In Table 6.2.6, the exposed area is permitted to be calculated using the outside dimensions of the test specimen, including a frame, hangers, tracks, or other parts of the assembly, if provided, but normally not including the wall into which the specimen is mounted. Where multiple test specimens are mounted in the same wall, the rectangular or square wall area encompassing all of the specimens is considered the exposed area, since the hose stream has to traverse this area during its application.

Annex B Commentary

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 Introduction. This commentary has been prepared to provide the user of NFPA 252 with background information on the development of the standard and its application in the fire protection of buildings. It also provides guidance in the planning and performance of fire tests and in the reporting of results. No attempt has been made to incorporate all of the available information on fire testing in this commentary. The serious student of fire testing is strongly urged to examine the referenced documents for a better appreciation of the history of fire-resistant design and the intricate problems associated with testing and with interpretation of test results.

B.2 Application.

B.2.1 Compartmentation of buildings by fire-resistive walls has been recognized for many years as an effective method of restricting fires to their area of origin [1–7] or limiting their spread. The functional use of buildings, however, demands a reasonable amount of communication between compartments, necessitating openings in these fire-resistive walls. Fire door assemblies are utilized to protect these openings and maintain the integrity of the fire barrier [8]. Openings in walls have been traditionally classified by fire protection standards [6, 9, 10] and building codes in accordance with the location and purpose of the wall in which the opening exists. However, such classifications were deleted from these standards and codes in the early 1990s. Instead, these standards and codes specify the fire protection rating of the door assembly required to protect the openings.

B.2.2 Fire protection standards and building codes permit labeled vision panels and other openings such as labeled ventilation louvers in some fire door assemblies. The model building codes, NFPA 80, Standard for Fire Doors and Fire Windows [6], and the specific fire door manufacturer's listing should be referenced for information on the types and sizes of these openings.

B.2.3 Fire door assemblies should be properly installed to maintain their fire protection rating. NFPA 80, Standard for Fire Doors and Fire Windows [6], and the specific fire door manufacturer's listing should be consulted for details on the installation of fire door assemblies and for limitations on the application of specific labeled fire doors.

B.3 Historical Aspects. The first effort to test fire doors was reported in a series of tests conducted in Germany in 1893 [11–13]. The British Fire Prevention Committee began testing in 1899 and produced a Standard Table of Fire Resisting Elements, including Fire Resisting Doors [1]. Underwriters Laboratories Inc. was involved in testing and listing fire doors shortly after 1900, using its own standards. In 1941, ASTM adopted ASTM E 152, Standard Methods of Fire Tests of Door Assemblies, on fire door assembly tests. NFPA 252 was first issued by the NFPA in 1942.

Table A.4.1.1 Standard Temperature-Time Curve for Control of Fire Tests

Time (hr:min)	Temperature °F	Area Above 68°F Base		Temperature °C	Area Above 20°C Base	
		°F-min	°F-hr		°C-min	°C-hr
0:00	68	0	0	20	0	0
0:05	1000	2,330	39	538	1,290	22
0:10	1300	7,740	129	704	4,300	72
0:15	1399	14,150	236	760	7,860	131
0:20	1462	20,970	350	795	11,650	194
0:25	1510	28,050	468	821	15,590	260
0:30	1550	35,360	589	843	19,650	328
0:35	1584	42,860	714	862	23,810	397
0:40	1613	50,510	842	878	28,060	468
0:45	1638	58,300	971	892	32,390	540
0:50	1661	66,200	1,103	905	36,780	613
0:55	1681	74,220	1,237	916	41,230	687
1:00	1700	82,330	1,372	927	45,740	762
1:05	1718	90,540	1,509	937	50,300	838
1:10	1735	98,830	1,647	946	54,910	915
1:15	1750	107,200	1,787	955	59,560	993
1:20	1765	115,650	1,928	963	64,250	1,071
1:25	1779	124,180	2,070	971	68,990	1,150
1:30	1792	132,760	2,213	978	73,760	1,229
1:35	1804	141,420	2,357	985	78,560	1,309
1:40	1815	150,120	2,502	991	83,400	1,390
1:45	1826	158,890	2,648	996	88,280	1,471
1:50	1835	167,700	2,795	1,001	93,170	1,553
1:55	1843	176,550	2,942	1,006	98,080	1,635
2:00	1850	185,440	3,091	1,010	103,020	1,717
2:10	1862	203,330	3,389	1,017	112,960	1,882
2:20	1875	221,330	3,689	1,024	122,960	2,049
2:30	1888	239,470	3,991	1,031	133,040	2,217
2:40	1900	257,720	4,295	1,038	143,180	2,386
2:50	1912	276,110	4,602	1,045	153,390	2,556
3:00	1925	294,610	4,910	1,052	163,670	2,728
3:10	1938	313,250	5,221	1,059	174,030	2,900
3:20	1950	332,000	5,533	1,066	184,450	3,074
3:30	1962	350,890	5,848	1,072	194,940	3,249
3:40	1975	369,890	6,165	1,079	205,500	3,425
3:50	1988	389,030	6,484	1,086	216,130	3,602
4:00	2000	408,280	6,805	1,093	226,820	3,780
4:10	2012	427,670	7,128	1,100	237,590	3,960
4:20	2025	447,180	7,453	1,107	248,430	4,140
4:30	2038	466,810	7,780	1,114	259,340	4,322
4:40	2050	486,560	8,110	1,121	270,310	4,505
4:50	2062	506,450	8,441	1,128	281,360	4,689
5:00	2075	526,450	8,774	1,135	292,470	4,874
5:10	2088	546,580	9,110	1,142	303,660	5,061

5:20	2100	566,840	9,447	1,149	314,910	5,248

Table A.4.1.1 Standard Temperature-Time Curve for Control of Fire Tests (continued)

Time (hr:min)	Temperature °F	Area Above 68°F Base		Temperature °C	Area Above 20°C Base	
		°F-min	°F-hr		°C-min	°C-hr
5:50	2138	628,360	10,473	1,170	349,090	5,818
6:00	2150	649,120	10,819	1,177	360,620	6,010
6:10	2162	670,000	11,167	1,184	372,230	6,204
6:20	2175	691,010	11,517	1,191	383,900	6,398
6:30	2188	712,140	11,869	1,198	395,640	6,594
6:40	2200	733,400	12,223	1,204	407,450	6,791
6:50	2212	754,780	12,580	1,211	419,330	6,989
7:00	2225	776,290	12,938	1,218	431,270	7,188
7:10	2238	797,920	13,299	1,225	443,290	7,388
7:20	2250	819,680	13,661	1,232	455,380	7,590
7:30	2262	841,560	14,026	1,239	467,540	7,792
7:40	2275	863,570	14,393	1,246	479,760	7,996
7:50	2288	885,700	14,762	1,253	492,060	8,201
8:00	2300	907,960	15,133	1,260	504,420	8,407

B.4 Scope and Significance.

B.4.1 NFPA 252 provides methods for measuring the relative performance of fire door assemblies where exposed to predetermined standard fire conditions. The standard provides for testing of several types and methods of door operation including swinging, sliding, rolling, and sectional doors [6]. Since the effectiveness of the opening protection is dependent upon the entire assembly, proper attention should be paid to the installation as a unit. Accordingly, fire door assemblies are required to be tested as an assembly of all necessary elements and equipment, including the door frame, hardware, and any glazing or other openings in the assembly.

B.4.2 Fire protection ratings are assigned to indicate that the fire door assembly has continued to perform as required for periods of 1/3 hour, 1/2 hour, 3/4 hour, 1 hour, 1 1/2 hours, or 3 or more hours. Labels on assemblies formerly carried the letter designations of A, B, C, D, or E. These letter designations were not a part of the NFPA 252 standard classification system but were used to designate the class of opening for which the door was intended to protect as determined by codes and other standards [6, 9].

B.4.3 The 1/3-hour, or 20-minute, fire protection–rated door is relatively new. Concern about the uniform adequacy of the 44.7-mm (1 3/4-in.) solid bonded wood core door construction and the difficulty of determining the equivalency of other types of doors led to a voluntary consensus to test such doors for 20 minutes in the test furnace described in this standard using the same acceptance criteria specified for door assemblies traditionally tested for a longer periods of time, with the exception that the hose stream test required by this test method might not be required by regulatory codes.

B.4.4 It is common for a fire door to have a fire protection rating lower than the wall in which it is installed. For example, a 1 1/2-hour fire protection–rated door can be required in a wall having a fire resistance rating of 2 hours. This is justified in part by the fact that, under normal conditions of use, the potential fire exposure in the vicinity of a door opening is decreased since there will usually be a clear space on both sides of the opening for traffic purposes. Since wall assemblies are put together at the site, their uniformity is not as certain as a fire door assembly that is factory assembled (e.g., undesigned penetrations tend to show up in wall assemblies). For this reason, any factor of safety that is tacitly called for in a wall assembly requirement should exceed that of a door assembly. If the opening is not used, combustibles could be piled against the door, and the assumed enclosure protection might not be maintained. In these instances, ratings for the openings should be equivalent to the rating of the wall, or precautions should be taken to prevent storage of combustibles against the doors [2, 6].

B.5 Limitations.

B.5.1 The NFPA 252 test methods intend that the door be tested until the performance criteria are met for the desired exposure period or for a shorter period. The test methods do not intend that a fire door subjected to a building fire is satisfactory for use following the fire.

B.5.2 The variations in material performance preclude any prediction of an assembly's performance in walls other than those types used in the test. The standard also makes no provisions for measuring the generation of smoke and gases or other products of combustion from the unexposed side of the door. Temperature measurements on the unexposed surface of the door are stopped after 30 minutes.

B.6 Furnace.

B.6.1 The test methods provide details on the operation characteristics and temperature-measurement requirements of the test furnace. The walls of the furnace typically should be of furnace refractory materials and should be sufficiently rugged to maintain the overall integrity of the furnace during the fire exposure period.

B.6.2 The thermocouples in the furnace are located 152 mm (6 in.) from the face of the door or the wall in which the door is installed. Otherwise, no furnace depth is specified. A depth of 203 mm to 457 mm (8 in. to 18 in.) is considered desirable by most laboratories. Reference documents should be consulted for a more comprehensive review of furnace design and performance [14, 15].

B.7 Temperature-Time Curve.

B.7.1 A specific temperature-time relationship for the test fire is defined in the standard. The actual recorded temperature-time condition obtained in the furnace is required to be within specified percentages of those of the standard curve. The number and type of temperature-measuring devices are outlined in the standard. Specific standard practices for location and use of these temperature-measuring devices are also outlined in the standard.

B.7.2 The standard temperature-time (T-t) curve used in NFPA 252 represents a severe building fire [3]. The curve was adopted in 1918 as a result of several conferences by 11 technical organizations, including testing laboratories, insurance underwriters, fire protection associations, and technical societies [7, 10, 16]. It should be recognized that the T-t relationship of these test methods represents only one real fire situation [7, 16–27].

B.8 Furnace Control. The standard contains specific instruction for measuring temperatures in the furnace and for selection of the required thermocouples. Thermocouples of the design specified are sufficiently rugged to retain accuracy throughout anticipated test periods. However, their massive construction causes a significant delay in their response to

temperature change and results in temperatures exceeding the indicated temperatures during the early stages of the test period when the temperature rises rapidly. The iron or porcelain tubes surrounding the junction and leads of the thermocouple provide a shield against degradation of the junction and increase the thermal inertia. It is customary for laboratories to replace furnace thermocouples after three or four accumulated hours of use.

B.9 Unexposed Surface Temperature.

B.9.1 Conditions of acceptance for fire-resistive walls specify that the temperature increase on the unexposed surface of the wall not exceed an average of 140°C (250°F) above ambient and that there be no passage of flames or gases hot enough to ignite combustibles. It is obvious that the necessity of maintaining some clearances for efficient operation of the door and the possibility of warping preclude any attempt to restrict escape of gases and minor flames on the periphery of doors.

B.9.2 The standard describes a standard procedure for measuring the unexposed surface temperatures. However, unexposed surface temperatures are not a mandatory performance criterion for NFPA 252. Building regulations do restrict temperature transmission for some wall-opening protectives [6, 9]. For instance, it is usual for codes to limit the temperature rise on the unexposed side of fire doors protecting exit stairways to 250°C (450°F) during the first 30 minutes of test. This criterion assumes that a higher temperature would provide enough radiant heat to discourage, if not prevent, occupants from passing by the door during an emergency. It is current practice for testing laboratories to provide labels on fire doors indicating that the maximum transmitted temperature on the unexposed side is 140°C, 250°C, or 361°C (250°F, 450°F, or 650°F) above ambient. If not indicated on the label, the temperature rise during the first 30 minutes might or might not be in excess of 361°C (650°F). Temperature rise on the unexposed side of glass panels and louvers is not measured.

B.10 Test Assemblies.

B.10.1 NFPA 252 provides a relative measure of performance for door assemblies. In order to establish confidence that the tested doors will perform in a building as expected, the tested assembly and its installation in the test frame need to be representative of actual use conditions. Therefore, NFPA 80, Standard for Fire Doors and Fire Windows [6], or other such standards or specifications should be consulted before testing an assembly.

B.10.2 The standard provides additional minimum requirements including direction of door swing, location in relation to the exposed side of the wall, and specific clearance between the door and its frame or wall, or both. Regardless of other specifications, these instructions should be followed in order to make a comparative judgment on test results.

B.11 Conduct of Tests. The test frame or wall in which a door assembly is installed should be rugged enough to endure exposure to the fire during the specified period without affecting the door assembly. Traditionally, this wall has been of masonry construction. Fire doors are currently installed in other than masonry walls and have been tested in walls framed with metal and wood studs covered with a number of materials.

B.12 Furnace Pressures.

B.12.1 A fire in a building compartment creates both negative and positive pressures on door assemblies depending on atmospheric conditions, height above ground, wind conditions, and ventilation of the compartment at the start of and during the fire.

B.12.2 In the past, NFPA 252 specified that the pressure in the furnace be maintained as nearly equal to atmospheric pressure as possible. This method of test generally resulted in the test assembly being subjected to a negative pressure during the test, since most laboratories set the neutral pressure plane in the furnace at or above the top of the assembly. As revised, the standard permits tests to be conducted under either positive or negative pressure, depending on the needs and requirements of the manufacturer, test laboratory, or the authority having jurisdiction. For positive pressure, the neutral pressure plane is set at a 1016-mm (40-in.) height, whereas for negative (nearly neutral) pressure it is set at the top of the door. The pressure in the furnace is required to be controlled, measured, and reported.

B.13 Hose Stream Test. Immediately following a fire test, the test frame is removed from the furnace, and the door assembly is subjected to the impact, erosion, and cooling effects of a stream of water from a 63.7-mm (2 1/2-in.) hose discharging through a standard play pipe equipped with a 28.7-mm (1 1/8-in.) tip under specified pressures. Just as the standard fire exposure is not intended to be representative of any or all actual fire conditions, the standard hose stream exposure is not intended to be representative of any actual fire-fighting or fire suppression activity. The fire exposure test and the hose stream test provide a relative measure of the performance of constructions and assemblies under specified, standard exposure conditions. The hose stream test provides a method for evaluating the integrity of constructions and assemblies and eliminating inadequate materials or constructions. The cooling, impact, and erosion effects of the hose stream provide important tests of the integrity of the specimen being evaluated. The rapid cooling and thermal shock imposed by the hose stream test following the fire exposure test eliminates materials that are subject to failure under such conditions. The orthogonal load imposed by the hose stream subjects vertical specimens to a load in a direction perpendicular to the normal dead load of the specimen. This effect eliminates construction or assemblies with marginal factors of safety for structural loading. The erosion effects of the hose stream might remove char formed during the standard fire exposure that provides minimal contribution to the structural strength of the assembly.

The hose stream test provides a real and measurable load on the specimen. Testing by Ingberg at the National Bureau of Standards reported that the standard hose stream test produced a 26.4-kg (57.2-lb) force on the specimen.

The combined effects of the hose stream test provide a method for screening the integrity of a specimen that cannot be achieved by any other means.

B.14 Performance Criteria. The standard provides a specific set of conditions by which the performance of the door is measured, the most important condition being that the door remain in place during both the fire test and the hose stream test. The standard also restricts flaming on the unexposed surface and prohibits through-openings during both the fire test and the hose stream test. Specific limitations on the movement of the door during the tests are given for different types of doors such as side-hinged swinging and sliding doors.

B.15 References.

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Annex C Informational References

C.1 Referenced Publications. The following documents or portions thereof are referenced within this document for informational purposes only and are thus not part of the requirements of this document unless also listed in Chapter 2.

C.1.1 NFPA Publication. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 80, *Standard for Fire Doors and Fire Windows*, 1999 edition.

C.1.2 Other Publication.

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ASTM E 152, Standard Methods of Fire Tests of Door Assemblies, 1981.

C.2 Informational References. (Reserved)

C-3 References for Extracts. (Reserved)