NFPA 257
Standard on Fire Test for Window and Glass Block Assemblies

2000 Edition

National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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This edition of NFPA 257, *Standard on Fire Test for Window and Glass Block Assemblies*, was prepared by the Technical Committee on Fire Tests and acted on by the National Fire Protection Association, Inc., at its November Meeting held November 14–17, 1999, in New Orleans, LA. It was issued by the Standards Council on January 14, 2000, with an effective date of February 11, 2000, and supersedes all previous editions.

This edition of NFPA 257 was approved as an American National Standard on February 11, 2000.

Origin and Development of NFPA 257

This standard was tentatively adopted by the NFPA in 1969 and officially adopted in 1970. Subsequent revisions were released in 1975, 1980, 1985, and 1990.

The 1996 edition of NFPA 257 was a complete rewrite that included editorial and technical revisions. Many of the editorial and technical revisions were made to parallel those of NFPA 252, *Standard Methods of Fire Tests of Door Assemblies*. The technical revisions included modifications to the furnace pressure. The neutral pressure was eliminated so that the test assembly could be tested to the pressure required by other code requirements (i.e., NFPA *101®*, *Life Safety Code®*, and the model building codes). In addition, the duration of the test method was extended beyond the 45 minutes required in previous editions to allow for the testing of new glazing materials.

The 2000 edition was completely revised for the purpose of consistency and editorial reformatting. This document was modified so that the test protocols and equipment used will be more consistent with the provisions found in NFPA 251, *Standard Method of Tests of Fire Endurance of Building Construction and Materials*, and NFPA 252, *Standard Method of Fire Tests of Door Assemblies*. This revision recognizes the positive pressure testing required by some of the model building codes. It also provides greater clarification on how to conduct the hose stream test to achieve greater repeatability and reproducibility.

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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.

Contents

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Standard on

Fire Test for Window and Glass Block Assemblies

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

Information on referenced publications can be found in Chapter 7 and Appendix D.

Chapter 1 General

1-1 Scope. This standard prescribes standardized fire and hose stream test procedures that apply to fire window assemblies, including window, glass block, and other light-transmitting assemblies intended for use in window openings to retard the spread of fire through such openings in fire-resistive walls.

1-2 Purpose. The purpose of this standard is to prescribe specific fire and hose stream test procedures for fire window 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 window openings in fire-resistive walls. The degree of fire protection measured in units of time is not an absolute value, since all possible actual fire scenarios are not represented by the standard fire exposure described herein. This standard allows different fire window assemblies to be compared with each other to evaluate their relative performance as measured against a standard fire exposure.

1-3 Significance.

1-3.1 This standard is intended to evaluate the ability of a window, glass block, or other light-transmitting assemblies to remain in a wall opening during a prescribed fire test exposure, which then is followed by the application of a prescribed hose stream.

1-3.2 Tests made in conformity with the test methods in this standard register performance during the test exposure and develop data that enable regulatory bodies to determine the suitability of fire window assemblies for use in wall openings where fire protection is required.

1-3.3 The tests described herein expose a specimen to a standard fire exposure that is controlled to achieve specified temperatures throughout a specified time period, which then is followed by the application of a specified standard hose stream. The fire exposure is not necessarily representative of all fire conditions, due to varying 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 fire performance of fire window assemblies under these specified fire exposure conditions. Similarly, the hose stream exposure is not necessarily 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 in the construction or conditions of the window assembly as tested has the potential to change the performance characteristics of the fire window assembly.

1-3.5 These tests shall not be construed as determining the suitability of fire window assemblies for continued use after exposure to actual fires.

1-3.6 This standard does not provide the following:

(1) Full information regarding the performance of a specific fire window assembly where installed in walls constructed of materials other than those tested
(2) Evaluation of the degree to which the fire window assembly contributes to the fire hazard by generation of smoke, toxic gases, or other products of combustion
(3) Measurement of the fire window assembly's ability to control or limit the passage of smoke or similar products of combustion through the assembly

1-3.7 The test methods permit through-openings created by cracking, separation, or loss of glazing material, provided such openings do not exceed specified limits.

1-4 Definitions.

1-4.1* Fire Window Assembly. A window or glass block assembly for which a fire protection rating is determined in accordance with this standard and that is intended for installation in walls or partitions.

1-4.2 Glass Block Assembly. A light-transmitting assembly constructed of glass block held together with mortar or other suitable materials.

1-4.3 Glazed Light. A pane of glazing material that is separated by muntins and mullions from adjacent panes of glazing material in a fire window assembly.

1-4.4* Glazing Material. A transparent or translucent material used in fire window assemblies.

1-4.5 Opening. For the purpose of Chapter 5, a through-hole in the fire window assembly that can be seen from the unexposed side while looking through the plane of the assembly from a perpendicular position.

1-4.6 Shall. Indicates a mandatory requirement.

1-4.7 Should. Indicates a recommendation or that which is advised but not required.

1-4.8 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 appendix, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

1-4.9* Window Assembly. An integral, fabricated unit that contains a glazed light(s) placed in an opening in a wall and that is intended primarily for the transmission of light or of light and air and not primarily for human entrance or exit.

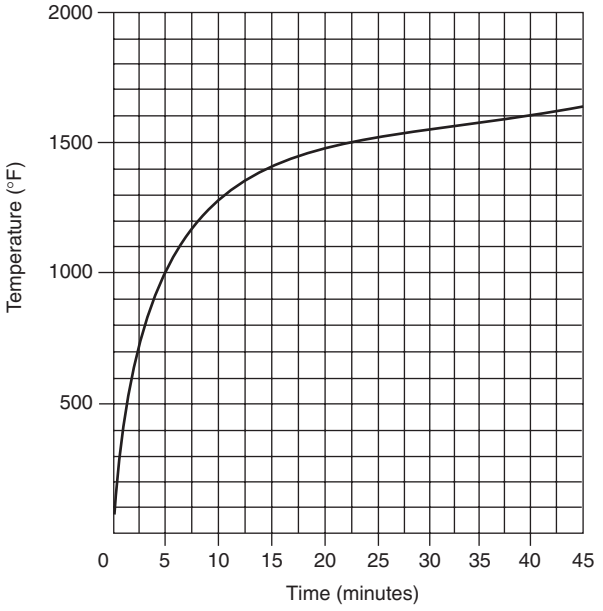
Chapter 2 Control of Fire Test

2-1 Temperature–Time Curve.

2-1.1 The temperature inside the furnace to which the test assemblies are exposed during the fire test shall be controlled to conform to the standard temperature–time curve shown in

Figure 2-1.1 for the duration of the fire test, with the points that determine the curve specified beneath the graph in Figure 2-1.1.

FIGURE 2-1.1 Temperature–time curve.



1000°F (583°C) ..... at 5 minutes
1300°F (704°C) ..... at 10 minutes
1399°F (760°C) ..... at 15 minutes
1462°F (795°C) ..... at 20 minutes
1510°F (821°C) ..... at 25 minutes
1550°F (843°C) ..... at 30 minutes
1584°F (868°C) ..... at 35 minutes
1613°F (878°C) ..... at 40 minutes
1638°F (892°C) ..... at 45 minutes
1700°F (927°C) ..... at 1 hour
1792°F (978°C) ..... 1½ hours
1925°F (1052°C) ..... at 3 hours

2-1.2 At the start of the fire test, the temperature inside the furnace shall be ambient.

2-2 Furnace Temperatures.

2-2.1 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 window assembly. The thermocouples shall be protected by sealed porcelain tubes with a $^{3}/_{4}$-in. (19-mm) outside diameter and a $^{1}/_{8}$-in. (3-mm) wall thickness. Base-metal thermocouples shall be protected by sealed $^{1}/_{2}$-in. (13-mm) nominal diameter wrought-steel or wrought-iron pipe of standard weight, or they shall be enclosed in protective tubes of materials and dimensions such that the time constant of the protected thermocouple assembly is 5.0 minutes to 7.2 minutes.

The exposed length of the thermocouple protection tube in the furnace chamber shall be not less than 12 in. (305 mm). The junction of the thermocouples shall be 6 in. (152 mm) from the exposed face of the fire window assembly or from the test wall in which the assembly is installed.

2-2.2 The furnace temperature shall be measured and recorded during the fire test at intervals not exceeding 1 minute.

2-2.3 The furnace temperature shall be controlled so that the area under the temperature–time curve, obtained by averaging the results from the temperature readings specified in 2-2.1, is as follows:

(1) Within 10 percent of the corresponding area under the standard temperature–time curve shown in Figure 2-1.1 for fire tests of 1 hour or less
(2) Within 7.5 percent of the corresponding area under the standard temperature–time curve for tests longer than 1 hour but not longer than 2 hours
(3) Within 5 percent of the corresponding area under the standard temperature–time curve for tests longer than 2 hours

2-3 Furnace Pressure.

2-3.1 Vertical Pressure. The vertical pressure distribution within the furnace shall be measured and controlled in accordance with 2-3.1.1 through 2-3.1.5.

2-3.1.1 The vertical pressure distribution within the furnace shall be measured by at least two pressure-sensing probes separated by a minimum vertical distance of 6 ft (1.8 m) inside the furnace.

2-3.1.2 The pressure-sensing probes shall be as shown in either Figure 2-3.1.2(a) or Figure 2-3.1.2(b).

FIGURE 2-3.1.2(a) Static pressure-measuring device dimensions.

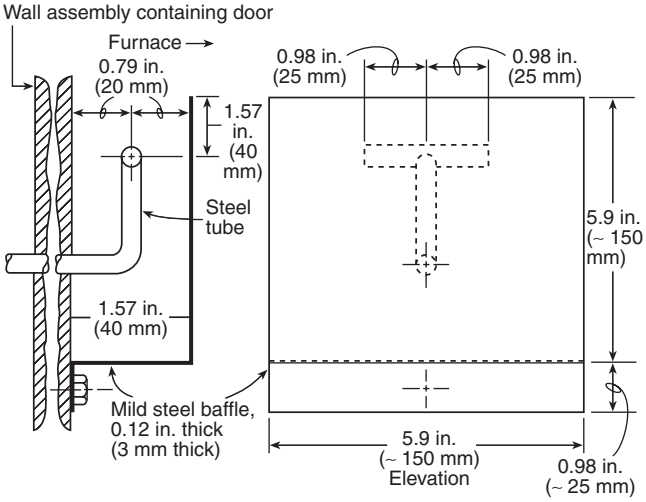
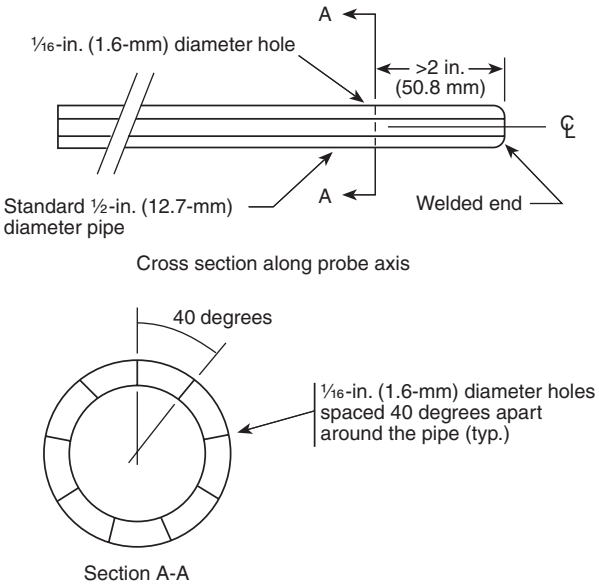


FIGURE 2-3.1.2(b) Pressure probe.



2-3.1.3 The pressure-sensing probes shall be located within 6 in. (152 mm) of the vertical centerline of the furnace opening.

2-3.1.4 The pressure at each location shall be measured using a differential pressure instrument capable of reading in increments no larger than 0.01 in. wg (2.5 Pa) with a precision of not more than ±0.005 in. wg (±1.25 Pa). The differential pressure measurement instrument shall be located so as to minimize stack effects caused by vertical runs of pressure tubing between the pressure-sensing probes and the differential pressure measurement instrument locations.

2-3.1.5 Based on the vertical separation and pressure differences between the two pressure-sensing probes, a calculation of the neutral plane [0 (zero) differential pressure] location shall be made.

2-3.2 Maintenance of Pressure. 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.

2-3.3 Positive Pressure. Where the fire test is to be conducted under positive pressure, the neutral pressure plane in the furnace shall be established such that at least two-thirds of the height of the fire window assembly is located above the neutral pressure plane.

2-3.4 Neutral Pressure. Where the fire test is to be conducted such that the furnace pressure is as close to neutral as possible, the neutral pressure plane shall be established at the top of the fire window assembly ±1 in. (±25 mm).

2-3.5 Measurement of Pressure. The furnace pressure shall be measured and recorded throughout the fire test period at intervals not exceeding 1 minute.

Chapter 3 Fire Window Assembly

3-1 Construction and Size.

3-1.1 The design, construction, material, workmanship, hardware, and size of the fire window assembly shall represent those for which a fire protection rating is desired. A record of materials and construction details shall be kept for the purpose of identification.

3-1.2 The area of the fire window assembly shall be not less than 100 ft^2 (9.29 m^2), with no dimension less than 9 ft (2.75 m). When the conditions of use limit the construction to smaller dimensions, a proportionate reduction shall be permitted to be made in the dimensions of the tests used to qualify the fire window assemblies for such restricted use.

3-2 Mounting. The fire window assembly shall be installed in the wall or partition construction in the manner in which it is to be used. It shall be mounted so that the latches and fasteners, other than hinges, are on the unexposed side, and the mounting shall not prevent the free, unrestricted operation of all operable components such as ventilators and sashes.

3-3 Test Wall. The test wall or partition in which the fire window assembly is mounted and tested shall have the strength and fire resistance to retain the assembly throughout the fire and hose stream tests. The wall or partition shall be constructed of materials representative of the wall or partition construction in which the fire window assembly is intended to be installed. Where used, wall anchors shall be suitable for the wall or partition in which the fire window assembly is installed.

Chapter 4 Conduct of Tests

4-1 Fire Test.

4-1.1 Duration. The 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 5 occurs.

4-1.2 Furnace Heat Flux. Procedures for measuring the total heat flux (convective and radiative) and the radiative heat flux within the furnace are provided in Appendix C.

4-1.3 Unexposed Surface Radiation. Procedures for measuring the radiant heat flux from the unexposed face of the fire window assembly are provided in Appendix C.

4-2 Hose Stream Test.

4-2.1 Within 2 minutes immediately following the fire test, the fire-exposed side of the fire window assembly shall be subjected to the impact, erosion, and cooling effects of a standard hose stream.

4-2.2 The standard hose stream shall be delivered through a $2^1/_2$-in. (64-mm) 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.*

The play pipe shall have an overall length of 30 in. (762 mm) and shall be equipped with a $1^1/_8$-in. (28.5-mm) discharge tip of the standard-taper, smooth-bore pattern without shoulder at the orifice. The play pipe shall be fitted with a nipple that has a $2^1/_2$-in. (64-mm) inside diameter and 6-in. (153-mm) length and is mounted between the hose and the base of the play pipe.

The pressure tap for measuring the water pressure at the base of the play pipe shall be normal to the surface of the nip-

ple, centered on its length, and shall not protrude into the water stream. The water pressure shall be measured with a pressure gauge that has a minimum range of 0 to 50 psi (0 to 345 kPa) graduated in increments not greater than 2 psi (13.8 kPa).

4-2.3 The tip of the play pipe shall be located 20 ft (6.1 m) from the fire window assembly. The lengthwise centerline of the play pipe shall be aligned perpendicularly to the plane of the fire window assembly and shall not deviate more than 30 degrees from the line perpendicular to the center of the fire window assembly.

Exception: Where the play pipe so deviates from the perpendicular pipe line, the required distance from the tip of the play pipe to the center of the fire window assembly shall be permitted to be reduced by 1 ft (0.3 m) for each 10 degrees of deviation from the perpendicular line.

4-2.4 The hose stream shall be directed around the periphery of the fire window assembly, starting upward from either bottom corner. When the hose stream has traversed the periphery of the fire window assembly and is approximately 1 ft (0.3 m) from reaching the starting point, the hose stream shall be applied in vertical paths approximately 1 ft (0.3 m) apart until the entire width of the assembly has been covered. The hose stream then shall be applied in horizontal paths approximately 1 ft (0.3 m) apart until the entire height has been covered.

If the required duration of the hose stream test has not been reached after this procedure has been performed, the procedure then shall be reversed and followed until the required duration has been met. Reversals in the direction of the hose stream shall be made within 1 ft (0.3 m) outside of the perimeter edge of the fire window assembly.

4-2.5 The minimum water pressure at the base of the play pipe during the hose stream test shall be as specified in Table 4-2.5.

Table 4-2.5 Water Pressure at Base of Play Pipe and Duration of Application for Hose Stream

	Water Pressure at Base of Play Pipe		Duration of Application for Exposed Area	
Desired Rating	**psi**	**kPa**	**sec/ft²**	**sec/m²**
≥3 hours	45	310	3.0	32
≥1 1/2 hours and <3 hours	30	207	1.5	16
≥1 hour and <1 1/2 hours	30	207	0.9	10
<1 hour	30	207	0.6	6

4-2.6* The hose stream shall be applied over the exposed area of the fire window assembly in accordance with the criteria specified in Table 4-2.5. The exposed area shall be calculated using the outside dimensions of the fire window assembly, including the frames.

Chapter 5 Performance Criteria

5-1 Fire Test.

5-1.1 Window Assemblies. During the fire test, a window assembly shall meet the performance criteria specified in 5-1.1.1 through 5-1.1.6.

5-1.1.1 The window assembly shall remain in the wall in which it is installed for the duration of the fire test.

5-1.1.2 No flaming shall occur on the unexposed surface of the assembly.

5-1.1.3 There shall be no separation of the glazing material edges from the glazing frame that creates openings.

5-1.1.4 At the perimeter of operable components, movement from the initial closed position shall not exceed the thickness of the frame member at any point.

5-1.1.5 The window assembly shall not move away from the wall to the extent that an opening is created.

5-1.1.6 There shall be no openings in the window assembly.

5-1.2 Glass Block Assemblies. During the fire test, a glass block assembly shall meet the performance criteria specified in 5-1.2.1 through 5-1.2.4.

5-1.2.1 The glass block assembly shall remain in the frame in which it is installed for the duration of the fire test.

5-1.2.2 No flaming shall occur on the unexposed surface of the assembly.

5-1.2.3 There shall be no openings in any of the individual glass blocks.

5-1.2.4 No openings shall be produced during the test in the joints between individual glass blocks or between glass blocks and the frame in which the glass block assembly is installed.

5-2 Hose Stream Test.

5-2.1 Window Assemblies. During the hose stream test, a window assembly shall meet the performance criteria specified in 5-2.1.1 through 5-2.1.4.

5-2.1.1 The window assembly shall remain in the wall in which it is installed for the duration of the hose stream test.

5-2.1.2 At the perimeter of operable components, movement from the initial closed position shall not exceed the thickness of the frame member at any point.

5-2.1.3 Openings created by separation of the glazing material edges from the glazing frame due to movement away from the frame shall not exceed 30 percent of each individual glazed light perimeter.

5-2.1.4 Openings created by glazing material breakage in the central area of each individual glazed light shall not exceed 5 percent of the area of the glazed light.

5-2.2 Glass Block Assemblies. During the hose stream test, a glass block assembly shall meet the performance criteria specified in 5-2.2.1 and 5-2.2.2.

5-2.2.1 The glass block assembly shall remain in the frame in which it is installed for the duration of the fire test.

5-2.2.2 At least 70 percent of the glass blocks shall not develop openings.

Chapter 6 Report

6-1 Results. Results of fire exposure tests shall be reported in accordance with the performance of the fire window assembly subjected to the tests as prescribed in these test methods. The report shall include, but shall not be limited to, the information specified in 6-1.1 through 6-1.13.

6-1.1 The construction details and materials used to construct the test wall or partition in which the fire window assembly is mounted for testing shall be described.

6-1.2 The temperature measurements of the furnace shall be plotted on a comparative graph showing the standard temperature–time curve.

6-1.3 All observations of the reactions of the fire window assembly that have an influence on its performance during both the fire and hose stream tests shall be reported.

6-1.4 The fire window assembly, including fasteners and attachments, as they appear after both the fire and hose stream tests shall be described.

6-1.5 The amount and nature of the movement of any operable components from the initial closed position shall be given.

6-1.6 For window assemblies, the condition of the individual glazed lights, including movement of the edges, and the percentage and location of glazing material fragments dislodged during the tests shall be reported.

6-1.7 For glass block assemblies, any loosening of the blocks in the frame and any through-openings, including their location, shall be described.

6-1.8 The materials and construction of the fire window assembly, the details of installation, including frames, latches, hinges, and fasteners used for mounting, and the size of the glazed area shall be described. This information shall ensure positive identification and duplication of the fire window assembly in all respects.

6-1.9 Pressure differential measurements made between the furnace and the unexposed side of the fire window assembly, and the calculation that determines the position of the neutral plane with respect to the bottom of the fire window assembly during the fire test, shall be reported.

6-1.10 The actual duration of the fire test shall be given. The fire protection rating of the fire window assembly that successfully meets the performance criteria specified in Chapter 5 also shall be reported. The fire protection rating shall be based on, but shall not be more 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) 2 hours
(7) 3 hours
(8) Hourly increments for ratings over 3 hours

6-1.11 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 2-2.3 in cases when exposure time affects the fire protection rating. To apply the correction, the test duration shall be multiplied by two-thirds of the difference in area between the curve of the average furnace temperature and the standard temperature–time curve for the first three-quarters of the test duration. The product then shall be divided by the difference in area between the standard temperature–time curve and a baseline of 68°F (20°C) for the same portion of the test, increasing the latter area by 54°F/hr (30°C/hr) [3240°F/min (1800°C/min)], to compensate for the thermal lag of the furnace thermocouples during the first part of the test.

For fire test exposures 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. 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 units as I
I = indicated fire protection rating
A = area under the curve of the indicated average furnace temperature for the first three-quarters 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 [54°F/hr (30°C/hr)] [3240°F/min (1800°C/min)]

6-1.12 The results of the hose stream test shall be reported.

6-1.13 The fire window assembly, including fasteners, attachments, and other hardware, as they appear after the fire test and the hose stream test shall be described.

Chapter 7 Referenced Publications

7-1 The following documents or portions thereof are referenced within this standard as mandatory requirements and shall be considered part of the requirements of this standard. The edition indicated for each referenced mandatory document is the current edition as of the date of the NFPA issuance of this standard. Some of these mandatory documents might also be referenced in this standard for specific informational purposes and, therefore, are also listed in Appendix D.

7-1.1 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*, 1993.

Appendix A Explanatory Material

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

A-1-4.1 Fire Window Assembly. For further information, see NFPA 80, *Standard for Fire Doors and Fire Windows*.

A-1-4.4 Glazing Material. For further information, see NFPA 80, *Standard for Fire Doors and Fire Windows*.

A-1-4.9 Window Assembly. For further information, see NFPA 80, *Standard for Fire Doors and Fire Windows*.

A-4-2.6 The exposed area of the fire window assembly is required to be calculated using the outside dimensions of the test specimen, including the frame, but normally not including the wall or partition into which the specimen is mounted. Where multiple test specimens are mounted in the same wall or partition, the rectangular or square wall area encompassing all of the specimens is considered to be the exposed area because the hose stream has to traverse the exposed area during its application.

Appendix B Background and Development

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

B-1 Introduction. This appendix provides the user of NFPA 257 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 the available information on fire testing in this appendix.

The serious student of fire testing should review the documents referenced in Appendix D for a better appreciation of the intricate problems associated with testing and with the interpretation of test results.

B-2 Major Revisions. The 1996 edition of this standard incorporated significant revisions to update the standard and to provide additional performance information. That information is useful for fire protection engineering purposes and building code requirements pertaining to the use and application of fire window assemblies.

Based on international standards, it has been determined that additional useful information can be obtained readily during the fire test of fire window assemblies. This information can be incorporated in building codes for use in determining acceptable levels of performance and can be applied by fire protection engineers and other design professionals to achieve a more cost-effective level of fire and life safety in the use of fire window assemblies.

The current requirements for fire test duration are open, whereas previous editions limited the duration to 45 minutes. With the advent of new glazing materials that provide various levels of fire protection, the current requirements have responded to the needs of the industry and the fire protection community by establishing various fire protection ratings that are both longer and shorter than the previous 45-minute specification. The 45-minute limit was based on the ability of standard wired glass to perform satisfactorily in accordance with earlier editions of NFPA 257.

To parallel the criteria in NFPA 252, *Standard Methods of Fire Tests of Door Assemblies*, the hose stream test duration and application pressure in this standard reflect the increased duration of the fire test. This standard also has been clarified with regard to the amount of glass or glass block permitted to be broken or otherwise dislodged during the fire test and the hose stream test.

Criteria also have been established for limiting flaming on the unexposed face of the fire window assembly. A test procedure for measuring the radiant heat flux from the unexposed face of the window assembly has been added to this appendix. Its purpose is to provide a standardized protocol for making such measurements. The information obtained is then appropriate for fire protection engineering usage and for fire modeling in which it is desirable to control the radiant heat transfer through a fire window or glass block assembly.

B-3 Application. Openings in the exterior walls of buildings have contributed to the spread of fire. Fire protection standards and building codes recognize the hazard associated with exterior wall openings that are created by inadequate spatial separation between buildings. Where the spatial separation is inadequate and the expected fire exposure is moderate or light, such codes and standards permit window openings protected by fire windows. Such protection can be provided by properly designed windows and glass block assemblies. Where sustained severe exposures are possible, the openings should be protected with fire door assemblies.

To protect paths of egress from interior fires, fire window assemblies can be specified for openings abutting exterior stairs and fire escapes and for openings in corridors whose wall openings are used to provide natural lighting of the corridor from adjacent rooms.

B-4 Scope and Significance. NFPA 257 provides a test method for evaluating the effectiveness of protection for light-transmitting openings.

The test exposes the fire window assembly to predetermined fire conditions for a desired fire protection rating period, then, at the option of the test sponsor, subjects the assembly to a standard hose stream impact test.

NFPA 257 also measures heat transmission and radiation through the assembly *(see Appendix C)*. NFPA 80A, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures*, should be consulted for information on exterior fire exposure problems, and NFPA 80, *Standard for Fire Doors and Fire Windows*, should be referenced for information on radiant heat transfer.

Openings in walls, even where protected, provide a lower fire protection rating than that of the wall, and the designed protection cannot be expected if combustibles are located directly in front of or behind the protectives. Therefore, clear spaces should be provided on both sides of openings in fire-rated walls and partitions.

B-5 Furnace. The test method referred to in Section B-4 provides details on the operating 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.

The thermocouples in the furnace are required to be located 6 in. (152 mm) from the face of the wall in which the fire window assembly is installed. Otherwise, no furnace depth

is specified. A minimum depth of 18 in. (457 mm) is necessary to meet the requirement that the exposed length of the thermocouple protection tube be at least 12 in. (304 mm). The documents referenced in Appendix D should be consulted for a more comprehensive review of furnace design and performance.

B-6 Temperature–Time Curve. A specified temperature–time relationship for the test fire is defined in this standard. The actual recorded temperature–time condition achieved in the furnace during the test as measured by the area under the temperature–time curve is required to be within the specified percentages of those of the standard curve. The number and type of temperature-measuring devices are outlined in this standard, as are specific standard practices for location and use of temperature-measuring devices.

The standard temperature–time curve represents a relatively severe building fire. The curve was adopted in 1918 as a result of several conferences held by eleven technical organizations, including testing laboratories, insurance underwriters, fire protection associations, and technical societies. It should be recognized that the temperature–time relationship of this test method represents only one actual fire situation. However, it is used in other fire test methods such as those specified in NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials;* NFPA 252, *Standard Methods of Fire Tests of Door Assemblies;* and ASTM E 814, *Standard Test Method for Fire Tests of Through-Penetration Fire Stops.*

Although the temperature–time curve is specified for standard thermocouples located within the furnace, measurement of the temperature–time curve using standard thermocouples does not establish a standard incident heat flux on the tested specimen. Incident heat flux that occurs in an actual fire can vary significantly from that developed by tests conducted by this standard test method. Similarly, this standard provides for a standard temperature–time relationship to be followed by all furnaces using this standard method, although the internal heat flux developed in various test furnaces can vary.

B-7 Furnace Control. This standard contains specific instructions for measuring temperatures in the furnace and for the selection of required thermocouples. Thermocouples of the design specified are sufficiently rugged to retain accuracy throughout anticipated test periods. However, their massive construction results in a significant time delay in response to temperature change, causing actual temperatures that exceed 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 thermal inertia. Depending on the type of thermocouple used and its method of protection, some laboratories replace furnace thermocouples after accruing 3 or 4 hours of use.

B-8 Test Assemblies. Fire window assemblies are tested in relatively large sizes compared to most side-hinged swinging fire doors [for example, 100 ft^2 (9.3 m^2) for windows versus 20–40 ft^2 (6.1–12.2 m^2) for doors]. The size of individual panes of glazing material is determined by the designer. Fire window assemblies as large as 150 ft^2 (13.9 m^2) have been tested. When the size of any assembly is less than 100 ft^2 (9.3 m^2), it should be reported.

B-9 Conduct of the Tests. The test frame or wall in which a fire window assembly is installed should be rugged enough to endure the fire exposure during the test period without affecting the window assembly. Traditionally, this wall has been of masonry construction. Currently, fire windows are installed in walls of other than masonry construction and have been tested in such walls as well.

B-10 Furnace Pressures. A fire in a building compartment creates both negative and positive pressures on window assemblies, depending on the following:

(1) Atmospheric conditions
(2) Height above ground
(3) Wind conditions
(4) Ventilation of the compartment at the beginning of the fire
(5) Ventilation during the fire

A furnace pressure that is slightly higher than the ambient pressure outside of the furnace could have a significant impact on the performance of fire barrier assemblies. Operating a test furnace at a negative pressure differential has the effect of drawing any hot gases or flames back into the furnace chamber, so the ability to observe flaming around any openings on the unexposed surface is minimized. Furthermore, the draft induced by the negative pressure differential reduces any heating that might occur along the edges of any openings and, in fact, provides some degree of cooling of surfaces. Positive compartment pressures in actual fires have the opposite effect.

In previous editions, NFPA 257 specified that the pressure in the furnace should be maintained as nearly equal to atmospheric as possible. This method of test generally resulted in the test assembly's subjection to a negative pressure during the test because most laboratories set the neutral plane in the furnace at or above the top of the assembly. As revised, the standard now permits tests to be conducted under any pressure situation, depending on the needs or requirements of the manufacturer, the test laboratory, or the authority having jurisdiction. The pressure in the furnace is required to be measured and reported.

The differential pressure employed is the pressure that is necessary to evaluate the fire window assembly with respect to its field installation. The differential pressure should be determined by one of the following:

(1) Code requirements
(2) The design pressure that can occur in the type of installation for which the test is proposed
(3) The test sponsor
(4) Other circumstances

B-11 Hose Stream Test. Immediately following the fire test, the test assembly is removed from the furnace, and the fire window assembly is subjected to the impact, erosion, and cooling effects of a stream of water. The water discharges from a $2^1/_2$-in. (63.5-mm) hose through a standard play pipe, equipped with a $1^1/_8$-in. (28.5-mm) tip, under a specified pressure for a specified duration based on the length of the fire test and the area of the fire window assembly.

The application of water produces stresses in the assembly and provides a measure of its structural capabilities. Weights have been used in Europe to provide a measure of the assembly's ability to withstand impact. The hose stream is considered to be an improvement over the weights in both uniformity and accuracy.

Just as the standard fire exposure is not intended to be representative of any or all actual fire conditions, the standard