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NFPA 257 Standard on Fire Test for Window and Glass Block Assemblies 1996 Edition

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An International Standards-Making Organization

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The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

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NFPA 257

Standard on Fire Test for

Window and Glass Block Assemblies

1996 Edition

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 Fall Meeting held November 13-15, 1995, in Chicago, IL. It was issued by the Standards Council on January 12, 1996, with an effective date of February 2, 1996, and supersedes all previous editions.

This edition of NFPA 257 was approved as an American National Standard on February 2, 1996.

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.

This 1996 edition of NFPA 257 is a complete rewrite that includes 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 include modifications to the furnace pressure. The neutral pressure has been eliminated so that the test assembly can 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 has been extended beyond the 45 minutes required in previous editions to allow for the testing of new glazing materials.

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Committee Scope: This Committee shall have primary responsibility for documents on fire testing procedures when such standards are not available; 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.

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Standard on Fire Test for

Window and Glass Block Assemblies

1996 Edition

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates explanatory material on that paragraph 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 to be used 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 in order 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 assembly 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 these standard test methods 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, however, is not necessarily representative of all fire conditions, due to the varying changes in the amount, nature, and distribution of fire loading, ventilation, compartment size and configuration, and the 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 the application of an actual hose stream used by a fire department during fire suppression efforts.

1-3.4 Any variation from the construction or conditions that are tested can change the performance characteristics of the assembly substantially.

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

1-3.6 This standard does not provide the following:

(a) Full information regarding the performance of a specific fire window assembly where installed in walls constructed of materials other than those tested;

(b) Evaluation of the degree by which the fire window assembly contributes to the fire hazard by generation of smoke, toxic gases, or other products of combustion;

(c) Measurement of the ability of the fire window assembly to control or limit smoke or similar products of combustion that pass through the assembly.

1-3.7 Through-openings created by cracking, separation, or loss of glazing material shall be permitted by these test methods, provided such openings do not exceed specified limits.

1-4 Definitions.

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.

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

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.

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

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.

Shall. Indicates a mandatory requirement.

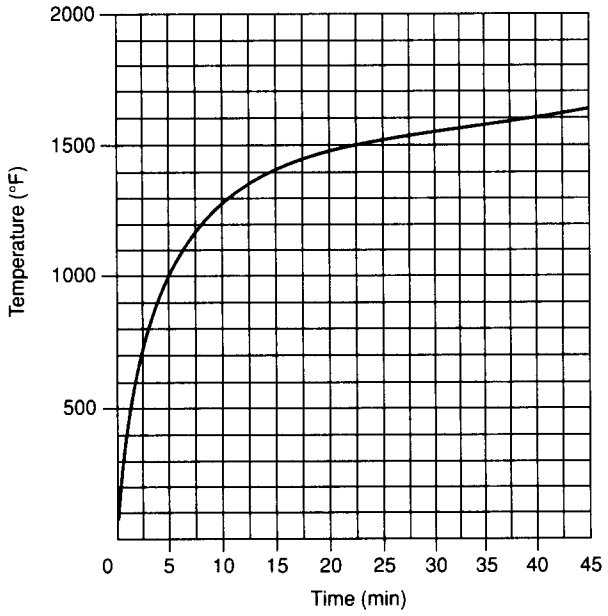
Should. Indicates a recommendation or that which is advised but not required.

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

Chapter 2 Control of Fire Test

2-1 Temperature-Time Curve. See Figure 2-1.1.

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. The points that determine the curve are specified immediately below Figure 2-1.1.



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

Figure 2-1.1 Temperature-time curve.

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

2-2 Furnace Temperatures.

2-2.1 The temperature of the fire test furnace shall be determined by the average temperature obtained from the readings of not less than nine thermocouples symmetrically disposed and distributed to measure the temperature near all parts of the fire window assembly. The thermocouples shall be protected by sealed porcelain tubes having a ¾-in. (19-mm) outside diameter and a ⅛-in. (3-mm) wall thickness, or, as an alternative in the case of base-metal thermocouples, they shall be protected by sealed ½-in. (13-mm) nominal diameter wrought-steel or wrought-iron pipe of standard weight, or they shall be enclosed 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. The exposed length of the thermocouple protection tube in the furnace chamber shall be not less than 12 in. (304.8 mm). The junction of the thermocouples shall be 6 in. (152.4 mm) from the exposed face of the test assembly, or from the wall in which the assembly is installed, during the entire test exposure.

2-2.2 The furnace temperature shall be measured and recorded 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 is 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, within 7.5 percent for those tests longer than 1 hour but not longer than 2 hours, and within 5 percent for those tests longer than 2 hours.

2-3 Furnace Pressure.

2-3.1 The vertical pressure distribution within the fire test furnace shall be measured in accordance with 2-3.1.1 through 2-3.1.4.

2-3.1.1 The pressure 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).

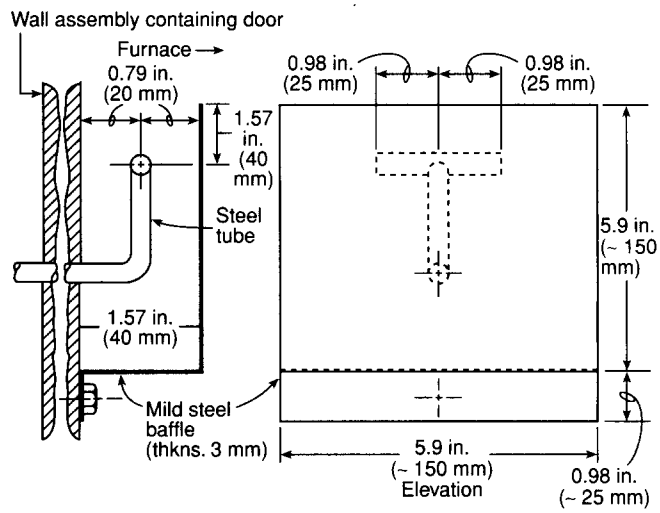


Figure 2-3.1.2(a) Static pressure-measuring device dimensions.

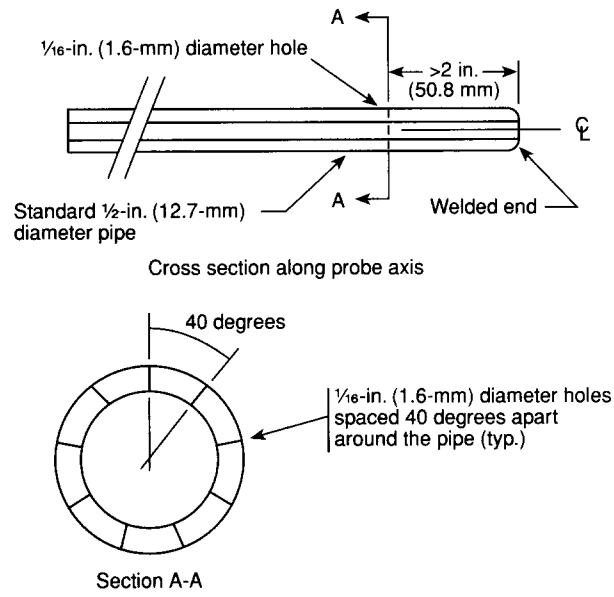


Figure 2-3.1.2(b) Pressure probe.

2-3.1.3 The pressure-sensing probes shall be located as near as practicable to 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 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 Control of the furnace pressure shall be established beginning no later than 10 minutes after the start of the test and shall be maintained throughout the remainder of the test.

2-3.3 Pressure. The differential pressures measured between the exposed and unexposed surfaces of the test assembly shall be controlled to within ± 20 percent of the intended pressures for the duration of the test (excluding the first 10 minutes).

2-3.4 The pressure shall be measured and recorded at least every 1 minute.

Chapter 3 Fire Window Assembly

3-1 Construction and Size.

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

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). If the conditions of use limit the construction to smaller dimensions, a proportionate reduction shall be permitted to be made in the dimensions of the fire window assembly for those tests used to qualify them 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 and easy operation of all operable components such as ventilators and sashes.

3-3 Strength. The wall or partition in which the fire window assembly is tested shall have the strength and fire resistance to retain the assembly securely in position 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 continued until the desired rating period is reached or until failure to meet the performance criteria of Chapter 6 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 the 2 minutes immediately following the fire endurance 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 2½-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 1⅛-in. (28.5-mm) discharge tip of the standard-taper, smoothbore pattern without shoulder at the orifice. The play pipe shall be fitted with a 2½-in. (64-mm) inside diameter by 6-in. (153-mm) long nipple mounted between the hose and the base of the play pipe. The pressure tap for measuring the water pressure at the base of the nozzle shall be normal to the surface of the nipple, centered on its length, and shall not protrude into the water stream. The water pressure shall be measured with a suitable pressure gauge [minimum 0 psi to 50 psi (0 kPa to 345 kPa)] graduated in no more than 2-psi (13.8-kPa) increments.

4-2.3 The tip of the nozzle shall be located 20 ft (6.1 m) from the center of the fire window assembly. The lengthwise centerline of the nozzle shall be aligned parallel to the plane of the fire window assembly. The lengthwise centerline of the nozzle shall be aligned so that it deviates not more than 30 degrees from the line parallel to the center of the fire window assembly. Where the nozzle is so positioned with respect to this parallel line, the required distance from the tip of the nozzle to the center of the fire window assembly shall be reduced by 1 ft (0.31 m) for each 10 degrees of deviation from the parallel 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 around the periphery of the fire window assembly and is approximately 1 ft (0.31 m) from reaching the starting point, the hose stream shall be applied in vertical paths approximately 1 ft (0.31 m) apart until the entire width has been covered, and then in horizontal paths approximately 1 ft (0.31 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 (0.31 m) outside of the perimeter edge of the fire window assembly.

4-2.5 The minimum water pressure at the base of the nozzle shall be as specified in Table 4-2.6.

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 4-2.6. The exposed area shall be calculated using the outside dimensions of the fire window assembly, including the frames.

Table 4-2.6 Water Pressure at Base of Nozzle and Duration of Application for Hose Stream

Desired Rating	Water Pressure at Base of Nozzle (psi)	(kPa)	Duration of Application of Exposed Area (sec/ft^2)	(sec/m^2)
3 hours and over	45	310	3.0	32
1½ hours and over and less than 3 hours	30	207	1.5	16
1 hour and over and less than 1½ hours	30	207	0.9	10
Less than 1 hour	30	207	0.6	6

NOTE: The exposed area shall be calculated using the outside dimensions of the test 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 create an opening.

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 the individual glass blocks or between the 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 Separation of the glazing material edges from the glazing frame due to movement away from the frame to create an opening 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 fire test.

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

Chapter 6 Report

6-1 Report Results. Results 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(a) through (l) as follows:

(a) A description of the construction details and materials used to construct the wall or partition in which the assembly is mounted for testing;

(b) The temperature measurements of the furnace plotted on a comparative graph showing the standard temperature-time curve;

(c) 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;

(d) A description of the fire window assembly, including fasteners and attachments, as they appear after both the fire and hose stream tests;

(e) The amount and nature of the movement of any operable components from the initial closed position;

(f) For fire 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;

(g) For glass block assemblies, any loosening of the blocks in the frame and any through-openings, including their location;

(h) The materials and construction of the fire window assembly, details of installation, including frames, latches, hinges, and fasteners used for mounting, and the size of the glazed area in order to ensure positive identification or duplication of the fire window assembly in all respects;

(i) Pressure differential measurements made between the furnace and the unexposed side of the fire window assembly [in. wg (Pa)] and the calculation that determines the position of the neutral plane with respect to the top of the fire window assembly during the fire test [ft (m)];

(j) The actual duration of the fire test as described in Section 4-1. The fire protection rating of the fire window assembly as determined in accordance with this standard also shall be reported. One of the following fire protection ratings shall be assigned:

1. 20 minutes;
2. 30 minutes;
3. 3/4 hour;
4. 1 hour;
5. 1 1/2 hours;
6. 2 hours;
7. 3 hours; or
8. Hourly increments for ratings over 3 hours.

(k) 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 those cases where it affects the fire protection rating. This 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 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 exposure 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.

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 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 [54°F/hr (30°C/hr)] [3240°F/min (1800°C/min)].

(l) The results of the hose stream test.

Chapter 7 Referenced Publications

7-1 The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

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*, 1988.

Appendix A Explanatory Material

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

A-1-4 Fire Window Assembly. For further information, see NFPA 80, *Standard for Fire Doors and Fire Windows.*

A-1-4 Glazing Material. For further information, see NFPA 80, *Standard for Fire Doors and Fire Windows.*

A-1-4 Window Assembly. For further information, see NFPA 80, *Standard for Fire Doors and Fire Windows.*

Appendix B Commentary — 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 commentary 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 commentary. The serious student of fire testing should review the referenced documents 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 incorporates significant revisions to the earlier editions in an effort to update the standard and to provide additional performance information useful for fire protection engineering purposes and building code requirements for 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 used by building codes to determine 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 where using fire window assemblies.

The requirements for the duration of the fire test have been left open, whereas, in previous editions, it was limited to 45 minutes. With the advent of new glazing materials that can provide various levels of fire protection, this edition of the standard responds to the needs of the industry and the fire protection community to establish various fire protection ratings that are both longer and shorter than the 45-minute specification in past editions. The 45-minute limit was based on the ability of standard wired glass to perform satisfactorily in accordance with earlier editions of this fire test standard.

To parallel the criteria in NFPA 252, *Standard Methods of Fire Tests of Door Assemblies*, the hose stream test duration and application pressure have been modified to reflect the increased duration of the fire test.

This standard also has been clarified with regard to the amount of glass or glass block that may be 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 Appendix B. Its purpose is to provide a standardized protocol for making such measurements so that the information developed can be used for fire protection engineering purposes and fire modeling where 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, these regulations permit window openings protected with fire windows. This 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 in corridors where wall openings are used to provide natural lighting of the corridor from adjacent rooms.

B-4 Scope and Significance. NFPA 257 provides a method for evaluating the effectiveness of light-transmitting opening protectives.

The fire window assembly is exposed to predetermined fire conditions for a desired fire protection rating period and then, at the option of the test sponsor, is subjected 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 method 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 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 12-in. (304-mm) minimum exposed length of the thermocouple protection tube. Reference documents 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 the 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 the standard. Specific standard practices for location and use of these temperature-measuring devices also are outlined in the standard.

The standard temperature-time curve represents a relatively severe building fire. 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. 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 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 in this manner 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. However, the internal heat flux developed in various test furnaces can vary.

B-7 Furnace Control. The 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 the thermal inertia. Depending on the type of thermocouple used and its method of protection, some laboratories replace furnace thermocouples after accumulating 3 or 4 hours of use.

B-8 Test Assemblies. Fire window assemblies are tested in relatively large sizes compared with most side-hinged swinging fire doors [e.g., 100 ft^2 (9.3 m^2) for windows versus 20 ft^2 to 40 ft^2 (6.1 m^2 to 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. Where assemblies are less than 100 ft^2 (9.3 m^2), this fact 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. Today, 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 atmospheric conditions, height above the ground, wind conditions, and ventilation of the compartment at the beginning of the fire and during the fire.

A furnace pressure that is slightly higher than the ambient pressure outside of the furnace could have 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 that 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 being subjected to a negative pressure during the test, since 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/requirements of the manufacturer, test laboratory, or the authority having jurisdiction. The pressure in the furnace is required to be measured and reported.

The differential pressure employed is intended to be that 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:

(a) Code requirements;

(b) The design pressure that can occur in the type of installation for which the test is proposed;

(c) The test sponsor; or

(d) 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 from a $2^1/_2$-in. (63.5-mm) hose discharging 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 ability of the assembly 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 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 for 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 eliminate 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 on the specimen. This effect eliminates constructions or assemblies with marginal factors of safety for withstanding lateral forces.

The hose stream test provides a real and measurable lateral impact load on the specimen. Testing by Ingberg at the National Bureau of Standards established that the standard hose stream test produced a 57.7-lb (256.6-N) force on the specimen.

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

B-12 Performance Criteria. During the fire and hose stream tests, the fire window assembly should remain in place and not become loosened from the test frame. During the hose stream test, fire window assemblies are permitted to have glazing material dislodged from the central portion, provided the amount dislodged does not exceed 5 percent of the area of each individual glazed light. During the hose stream test, separation of the glazing material edges from the frame by movement away from the frame to create an opening (*see definition in Section 1-4*) is limited to 30 percent of the perimeter of each individual glazed light. At least 70 percent of the glass blocks should not develop openings.

Appendix C Radiant and Total Heat Flux

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

C-1 Fire Test. Where it is desirable to obtain information and data on the transmission and reradiation of radiant heat through and by a fire window or glass block assembly, the following procedures should be followed. These procedures are intended to standardize the test methodology in order to develop comparative test results that can be used to establish a basis for incorporating mandatory procedures into this standard.

C-2 Furnace Heat Flux. Prior to performing measurements of thermal radiant heat transfer through window assemblies, a furnace calibration should be performed to determine baseline incident heat fluxes on the fire window assembly and to assess furnace heat flux uniformity. This should be performed in accordance with C-2.1 through C-2.5.

C-2.1 The calibration procedure should be performed for a minimum duration of 3 hours with the furnace operating at temperatures corresponding to the standard temperature-time curve specified in Section 2-1.

C-2.2 The furnace should initially be calibrated prior to measuring the unexposed surface radiation of any fire window assemblies. After the initial furnace calibration, it is

not necessary to recalibrate the furnace unless there is a significant modification made to the furnace or the furnace fuel that could have more than a nominal effect on the heat flux characteristics of the furnace.

C-2.3 The total (convective and radiative) heat flux produced in the furnace should be measured by three total heat flux transducers having a 180-degree view angle. The transducers should be installed on the exposed face of a calibration wall and located at the upper 1/4, middle, and lower 1/4 of the calibration wall along its vertical centerline. The calibration wall should have the same dimensions as the furnace opening that receives the test assembly. The calibration wall should be constructed of noncombustible materials and should have a solid backing. The face of the calibration wall to be installed in the furnace opening facing the burners should be covered with a single layer of low density ceramic fiber batts or blankets having a minimum thickness of 1 in. (25.4 mm). The calibration wall should be installed in the furnace opening prior to the start of the calibration procedure.

C-2.4 The radiant heat flux produced by the furnace should be measured by three radiant heat transducers having a 150-degree view angle that are located adjacent to each of the total heat flux transducers. The view angles are specified to provide for a view of the entire furnace back wall opposite the calibration wall. The heat flux transducers should be equipped with a window to limit the transducer measurement to radiant heat flux only over the appropriate radiation spectrum. Sapphire or calcium fluoride windows have been found satisfactory for the anticipated wavelength range.

C-2.5 The total heat flux transducers and the radiant heat flux transducers should be calibrated to indicate incident heat flux with a range of 0 kW/m^2 to 230 kW/m^2. Water-cooled Gardon-type transducers with an accuracy of ± 3 percent and a maximum nonlinearity of ± 2 percent of full range have been found to be suitable. The transducers initially should be calibrated traceable to NIST and not less than annually thereafter. The calibration schedule shall be verified and documented before the heat flux transducers are used.

C-3 Unexposed Surface Radiation. Thermal radiation from the unexposed surface of the fire window assembly should be measured in accordance with C-3.1 and C-3.3.

C-3.1 A minimum of two total heat flux transducers should be used.

C-3.2 The heat flux transducers should be located 6 ft ± 1 in. (1.83 m ± 0.3 mm) from the unexposed surface of the fire window assembly where measured along an axis perpendicular to the face of the test assembly. One transducer should be centered on the upper half of the fire window assembly, and one should be centered on the lower half. The transducers should be aligned to allow viewing of the corresponding area of the fire window assembly with the aid of a laser pointer. The field of view of the transducers should include only the unexposed surface of the fire window assembly to prevent the fluxmeter from sensing radiation from surfaces other than the fire window assembly. This can be accomplished by using a radiant heat shield with an unglazed opening of the appropriate size placed between the fire window assembly and the heat flux transducers. Radiation from the unexposed face of the fire window assembly should not pass through any glazing or light-transmitting material and should not otherwise be obstructed before reaching the target of the transducers. If it is not practicable to locate the transducers at the prescribed distance of 6 ft (1.83 m), they should be permitted to be located at a greater distance, but not more than 12 ft (3.66 m), along the axis perpendicular to the face of the fire window assembly. The radiant heat flux corresponding to a distance of 6 ft (1.83 m) should be calculated based on the ratio of the corresponding radiation configuration factors of the 6-ft (1.83-m) distance and the greater distance used.

C-3.3 The heat flux transducers should be calibrated to indicate incident heat flux and to have a range of 0 kW/m^2 to 50 kW/m^2. Water-cooled Gardon-type or Schmidt-Boelter-type transducers with an accuracy of ± 3 percent and a maximum nonlinearity of ± 2 percent of full range have been found to be suitable. The transducers initially should be calibrated traceable to NIST and not less than annually thereafter. The calibration schedule should be verified and documented before the heat flux transducers are used.

C-4 Report. The results of the heat flux measurements performed in accordance with this test procedure should be reported. The report should include, but should not be limited to, the following information:

(a) The total heat flux and the radiant heat flux measured inside the furnace (kW/m^2);

(b) The radiant heat flux (kW/m^2) measured on the unexposed face side of the fire window assembly, the position of the transducers (in ft), and the calculated radiant heat flux (kW/m^2) corresponding to a distance 6 ft (1.83 m) from the fire window assembly where the transducers are located more than 6 ft (1.83 m) from the test assembly.

Appendix D Referenced Publications

D-1 The following documents or portions thereof are referenced within this standard for informational purposes only and thus are not considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

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

NFPA 80, *Standard for Fire Doors and Fire Windows*, 1995 edition.

NFPA 80A, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures*, 1993 edition.

NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials*, 1995 edition.

NFPA 252, *Standard Methods of Tests of Door Assemblies*, 1995 edition.

D-1.2 Other Publications.

D-1.2.1 ASTM Publication. American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM E 814, *Standard Test Method for Fire Tests of Through-Penetration Fire Stops*, 1994.

D-1.2.2 "Thermal Radiation from Marine Fire Boundaries: Evaluation and Analysis of A-60, A-30, A-15, and A-0 Bulkhead Assemblies," Report No. CG-D-01-94, LeMoyne Boyer, SwRI, San Antonio, TX, July 1993.

Index

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Since 1896, one of the primary purposes of the NFPA has been to develop and update the standards covering all areas of fire safety.

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The code adoption process takes place twice each year and begins with a call for proposals from the public to amend existing codes and standards or to develop the content of new fire safety documents.

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Upon receipt of public proposals, the technical committee members meet to review, consider, and act on the proposals. The public proposals – together with the committee action on each proposal and committee-generated proposals – are published in the NFPA's Report on Proposals (ROP). The ROP is then subject to public review and comment.

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The Association meeting may, subject to review and issuance by the NFPA Standards Council, (a) adopt a report as published, (b) adopt a report as amended, contingent upon subsequent approval by the committee, (c) return a report to committee for further study, and (d) return a portion of a report to committee.

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Call for proposals to amend existing document or for recommendations on new document.

▼

Committee meets to act on proposals, to develop its own proposals, and to prepare its report.

▼

Committee votes on proposals by letter ballot. If two-thirds approve, report goes forward. Lacking two-thirds approval, report returns to committee.

▼

Report is published for public review and comment. (Report on Proposals - ROP)

▼

Committee meets to act on each public comment received.

▼

Committee votes on comments by letter ballot. If two-thirds approve, supplementary report goes forward. Lacking two-thirds approval, supplementary report returns to committee.

▼

Supplementary report is published for public review. (Report on Comments - ROC).

▼

NFPA membership meets (Annual or Fall Meeting) and acts on committee report (ROP and ROC).

▼

Committee votes on any amendments to report approved at NFPA Annual or Fall Meeting.

▼

Complaints to Standards Council on Association action must be filed within 20 days of the NFPA Annual or Fall Meeting.

▼

Standards Council decides, based on all evidence, whether or not to issue standard or to take other action, including hearing any complaints.

▼

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FORM FOR PROPOSALS ON NFPA TECHNICAL COMMITTEE DOCUMENTS

Mail to: Secretary, Standards Council
National Fire Protection Association, 1 Batterymarch Park, Quincy, Massachusetts 02269-9101
Fax No. 617-770-3500

Note: All proposals must be received by 5:00 p.m. EST/EDST on the published proposal-closing date.

If you need further information on the standards-making process, please contact the Standards Administration Department at 617-984-7249.

Date 9/18/93 **Name** John B. Smith **Tel. No.** 617-555-1212

Company _____

Street Address 9 Seattle St., Seattle, WA 02255

Please Indicate Organization Represented (if any) Fire Marshals Assn. of North America

1. a) NFPA Document Title National Fire Alarm Code **NFPA No. & Year** NFPA 72, 1993 ed.

b) Section/Paragraph 1-5.8.1 (Exception No.1)

2. Proposal recommends: (Check one)
- ☐ **new text**
- ☐ **revised text**
- ☒ **deleted text**

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3. Proposal (include proposed new or revised wording, or identification of wording to be deleted): (Note: Proposed text should be in legislative format: i.e., use underscore to denote wording to be inserted (inserted wording) and strike-through to denote wording to be deleted (~~deleted wording~~).

Delete exception.

4. Statement of Problem and Substantiation for Proposal: (Note: State the problem that will be resolved by your recommendation; give the specific reason for your proposal including copies of tests, research papers, fire experience, etc. If more than 200 words, it may be abstracted for publication.)

A properly installed and maintained system should be free of ground faults. The occurrence of one or more ground faults should be required to cause a "trouble" signal because it indicates a condition that could contribute to future malfunction of the system. Ground fault protection has been widely available on these systems for years and its cost is negligible. Requiring it on all systems will promote better installations, maintenance and reliability.

5. ☒ This Proposal is original material. (Note: Original material is considered to be the submitter's own idea based on or as a result of his/her own experience, thought, or research and, to the best of his/her knowledge, is not copied from another source.)

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4. Statement of Problem and Substantiation for Proposal: (Note: State the problem that will be resolved by your recommendation; give the specific reason for your proposal including copies of tests, research papers, fire experience, etc. If more than 200 words, it may be abstracted for publication.)

5. ❑ **This Proposal is original material.** (Note: Original material is considered to be the submitter's own idea based on or as a result of his/her own experience, thought, or research and, to the best of his/her knowledge, is not copied from another source.)

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