UL 9

STANDARD FOR SAFETY

Fire Tests of Window Assemblies

UL Standard for Safety for Fire Tests of Window Assemblies, UL 9

Eighth Edition, Dated July 2, 2009

Summary of Topics

This reaffirmation of UL 9 dated October 31, 2024 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

Text that has been changed in any manner or impacted by ULSE's electronic publishing system is marked with a vertical line in the margin.

The requirements are substantially in accordance with Proposal(s) on this subject dated August 30, 2024.

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UL 9

Standard for Fire Tests of Window Assemblies

Previous numbered and unnumbered editions of standards covering this material have been published since 1903.

First Edition – June, 1962
Second Edition – November, 1970
Third Edition – October, 1974
Fourth Edition – August, 1979
Fifth Edition – June, 1989
Sixth Edition – October, 1994
Seventh Edition – April, 2000

Eighth Edition

July 2, 2009

This ANSI/UL Standard for Safety consists of the Eighth Edition including revisions through October 31, 2024.

The most recent designation of ANSI/UL 9 as a Reaffirmed American National Standard (ANS) occurred on October 31, 2024. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

The Department of Defense (DoD) has adopted UL 9 on June 27, 1989. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

Comments or proposals for revisions on any part of the Standard may be submitted to ULSE at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These methods of fire tests are applicable to window assemblies, including glass block and other light transmitting assemblies, for use in the protection of openings in vertical fire resistive assemblies.

1.2 Assemblies classified in accordance with this standard provide only limited protection from the transmission of heat. This standard provides guidance to measure the heat flux emitted through the test specimen during the fire exposure and temperatures on the unexposed surface.

1.3 Tests made in conformity with these test methods shall not be construed as determining suitability of window assemblies for continued use after fire exposure.

1.4 These methods are intended to evaluate the ability of a window or other light transmitting assembly to remain in an opening during a predetermined test exposure.

1.5 The tests expose a specimen to a standard fire exposure controlled to achieve specified temperatures throughout a specified time period, followed by the application of a specified standard fire hose stream. The exposure, however, may not be representative of all fire exposure conditions, which may vary with changes in the amount, nature, and distribution of fire loading; ventilation; compartment size and configuration; and heat sink characteristics of the compartment. It does, however, provide a relative measure of fire performance of window assemblies under these specified exposure conditions.

1.6 This standard defines two pressure conditions for the control of the furnace during the fire exposure. One pressure condition is identified as a positive pressure condition and one is identified as a neutral pressure condition.

1.7 Any variation from the construction or conditions that are tested may substantially change the performance characteristics of the assembly.

1.8 These methods do not provide the following:

a) Full information as to performance of all window assemblies in walls constructed of materials other than tested.

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

c) Measurement of the degree of control or limitation of smoke or products of combustion passage through the window assembly.

These methods permit loss of glass lights and through openings, provided such loss and openings do not exceed specified limits.

2 General

2.1 Units of measurement

2.1.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

2.2 Undated references

2.2.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

PERFORMANCE

3 Control of Fire Tests

3.1 Time-temperature curve

3.1.1 The fire exposure of window assemblies shall be controlled to conform to the applicable portion of the standard time-temperature curve shown in Figure 3.1. The points on the curve that determine its character are:

1000°F (538°C) at 5 minutes

1300°F (704°C) at 10 minutes

1462°F (795°C) at 20 minutes

1550°F (843°C) at 30 minutes

1638°F (892°C) at 45 minutes

1700°F (927°C) at 1 hour

1792°F (978°C) at 1-1/2 hours

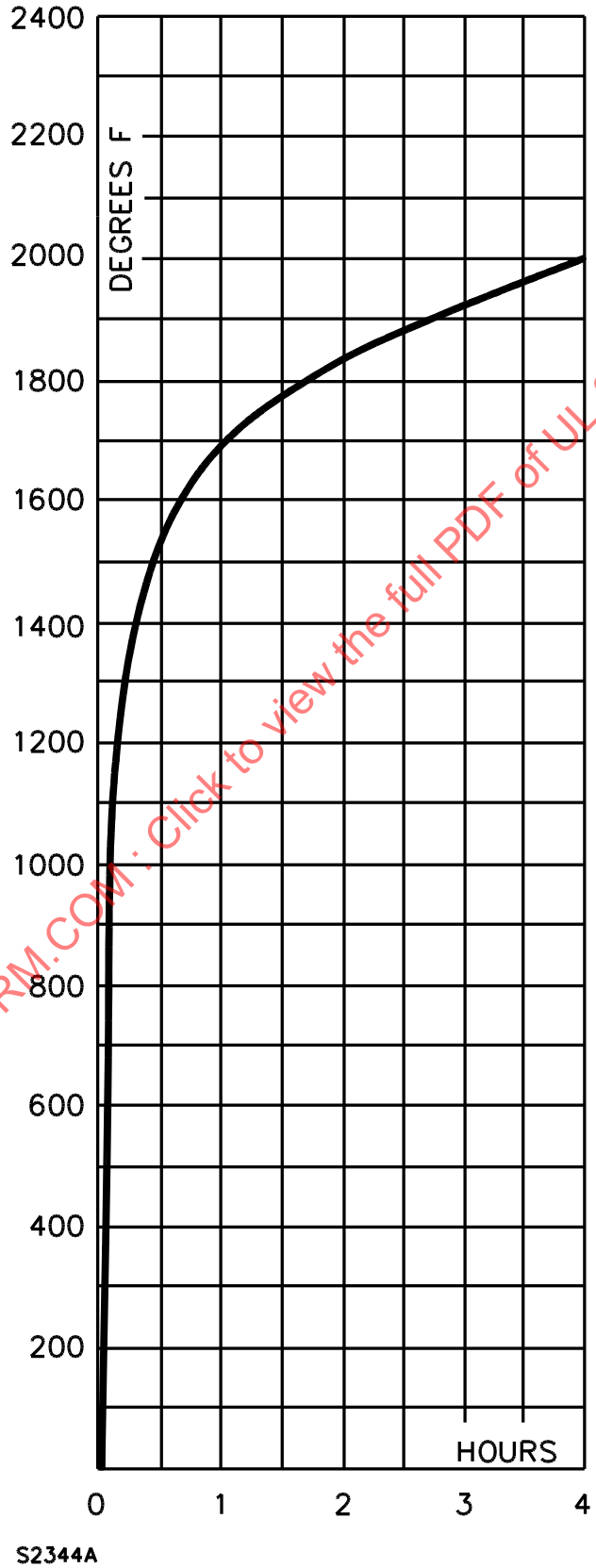
1850°F (1010°C) at 2 hours

1925°F (1052°C) at 3 hours

For a closer definition of the time-temperature curve, see Appendix A.

Figure 3.1

Time-temperature curve

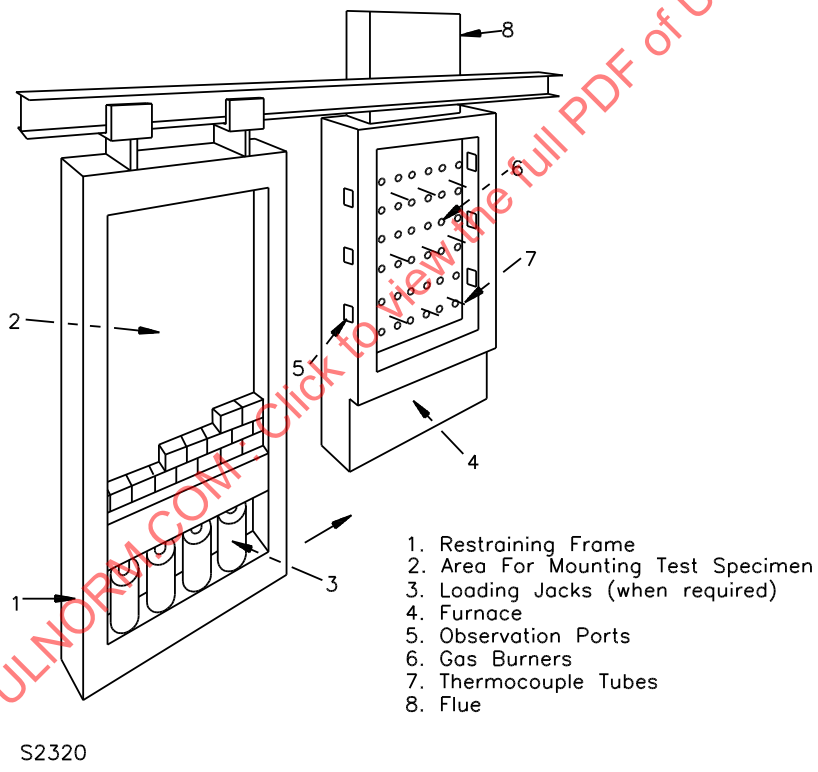


3.2 Furnace temperatures

3.2.1 The temperatures of the test exposure shall be the average temperature obtained by a minimum of three thermocouples and no fewer than one thermocouple per 15 square feet of test assembly exposed to the furnace symmetrically disposed and distributed to show the temperature near all parts of the test assembly. The thermocouples are to be protected by sealed porcelain tubes having 3/4 in (19.1 mm) outside diameter and 1/8 in (3.2 mm) wall thickness or, as an alternate in the case of base-metal thermocouples, protected by: (1) sealed 1/2-in (12.7-mm) wrought-steel or wrought-iron pipe, in accordance with Welded and Seamless Wrought Steel Pipe, ANSI/ASME B36.10M, of standard weight, or (2) Inconel 600 series schedule 40 pipe (0.8 inch OD / 0.6 inch ID, 20 mm OD / 15 mm ID). See Figure 3.2. The exposed length of the thermocouple protection tube in the furnace chamber is not to be less than 12 in (305 mm). The junction of the thermocouples is to be 6 in (152 mm) from the exposed face of the test assembly, or from the construction in which the assembly is installed during the entire test exposure.

Figure 3.2

Test furnace



3.2.2 The temperatures are to be read at intervals not exceeding 1 minute.

3.2.3 The accuracy of the furnace control is to be such that the area under the time-temperature curve, obtained by averaging the results from the thermocouple readings, is within 10 percent of the corresponding area under the standard time-temperature curve for fire test of 1 hour or less duration, within 7.5 percent for those over 1 hour and not more than 2 hours, and within 5 percent for tests exceeding 2 hours in duration.

3.3 Furnace Pressure

3.3.1 Furnace pressures are to be read at intervals not exceeding 1 minute.

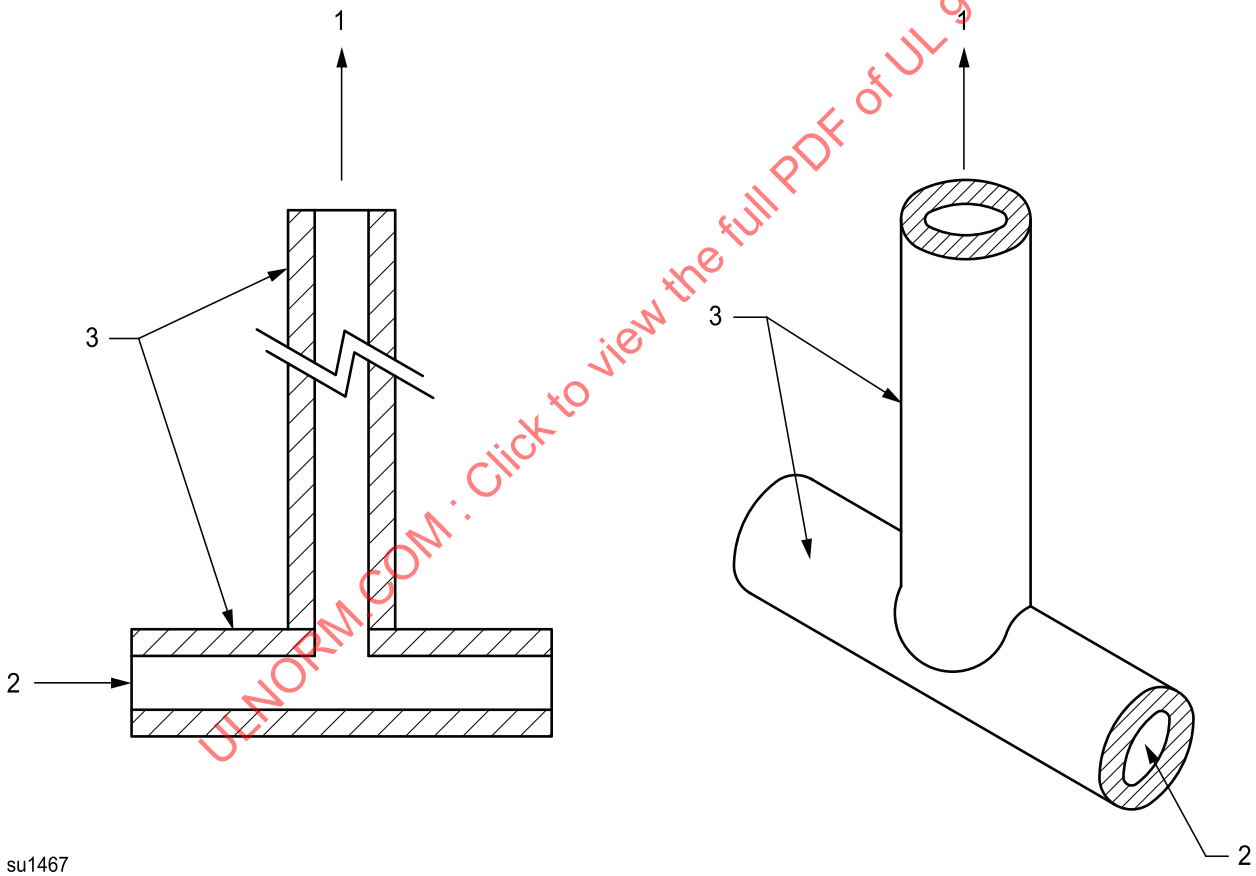
3.3.2 The neutral plane within the test furnace shall be established prior to the initiation of the fire test. Such pressure shall remain constant or increase to maintain the neutral plane upon initiation of the fire test. Control of the furnace pressure is to be established beginning no later than 5 minutes after the start of the test and is to be maintained throughout the remainder of the fire test.

3.3.3 The vertical pressure distribution within the furnace is to be measured by at least two pressure-sensing probes separated by a minimum vertical distance of 6 ft (1.8 m) inside the furnace for furnaces with a minimum vertical dimension of 10 ft (3.05 m). Minimum vertical separation between pressure probes is to be reduced proportionally for furnaces with an internal dimension less than 10 ft (3.05 m).

3.3.4 The pressure-sensing probes are to be as shown in either Figure 3.3 or Figure 3.4.

Figure 3.3

"T" shaped pressure-sensing probe



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Key

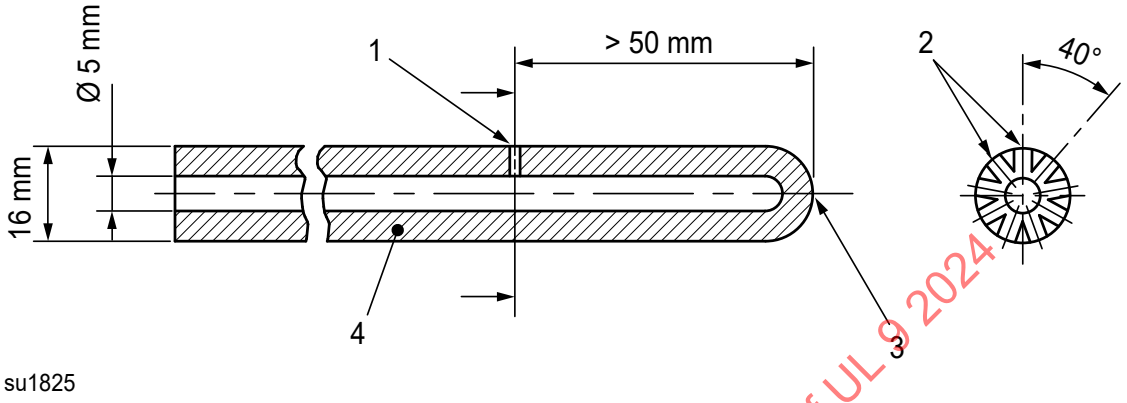
1) Open to transducer

2) Open

3) "T" shaped pressure-sensing probe. Inside diameter 0.2 in to 0.4 in (5 mm to 10 mm)

Figure 3.4

Tube shaped pressure-sensing probe



Key

1) Holes, 3.0 mm diameter

2) Holes, 3.0 mm diameter, spaced 40° apart around the pipe

3) Welded end

4) Tube shaped pressure-sensing probe

3.3.5 The pressure-sensing probes are to be located within 6 in (152 mm) of the vertical centerline of the furnace chamber.

3.3.6 The pressure at each location is to be measured using a differential pressure instrument capable of reading in increments no greater than 0.01 inch water gauge (2.5 Pa) with an accuracy of ±0.005 inch water gauge (±1.2 Pa) or better. The differential pressure measurement instrument is to 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.

3.3.7 Based on the vertical separation and pressure differences between the two pressure-sensing probes, a calculation of the zero pressure plane is to be made. The furnace pressure is to be positive above the zero pressure plane.

3.3.8 For fire tests conducted under positive pressure conditions, the zero pressure plane is to be established such that at least two-thirds of the height of the window assembly is located above the zero pressure plane.

3.3.9 For fire tests conducted under neutral pressure conditions, the zero pressure plane is to be established such that it is located within ±1 in (±6 mm) of the top of the window assembly.

4 Test Assemblies

4.1 Construction and size

4.1.1 The design, construction, material, workmanship, and hardware of the test assembly is to be representative of the construction under evaluation. A record of materials and construction details adequate for identification is to be made.

4.1.2 The area of the test assembly is not to be less than 100 ft^2 (9.29 m^2) with neither dimension less than 9 ft (2.7 m).

4.1.3 If the conditions of use limit the construction to smaller dimensions, a proportionate reduction may be made in the dimensions of the test assembly for tests qualifying them for such restricted use.

4.2 Mounting

4.2.1 The test assembly is to be installed in the wall or partition construction in the manner in which it is to be used. It is to be mounted so that the latches and fasteners other than hinges will be on the unexposed side, and the mounting is not to prevent the free and easy operation of all operable components such as ventilators and sash.

4.2.2 The wall or partition is to be constructed of masonry or other materials representative of the wall or partition construction. Window frame wall anchors, when used, are to be suitable for the wall or partition constructed.

5 Conduct of Tests

5.1 General

5.1.1 The wall or partition is to have sufficient strength at the time of the test to retain the assembly securely in position throughout the fire and hose stream test.

5.2 Heat flux

5.2.1 The radiative heat flux transmitted through the test assembly is to be measured when requested by the test sponsor. The flux measurements are to be recorded at least once every minute.

5.2.2 The radiative heat flux is to be measured by an instrument capable of measuring radiant heat flow having a range of 0 to 50 kW/m^2 with an accuracy of ±5% of the maximum range. The response time of the instrument is to be such that the instrument is capable of recording 64% of the maximum range within 10 seconds. The view angle of the instrument is to be 180 ±5°.

5.2.3 The radiative heat flux is to be measured in a plane parallel, and at a distance of 39 ±3/8 in (1.0 ±0.01 m) from the unexposed surface of the test assembly.

5.3 Unexposed surface temperatures

5.3.1 The temperatures on the unexposed surface of the glazing materials are to be measured when requested by the test sponsor. The temperature measurements are to be recorded at least once every minute.

5.3.2 When measured, the temperatures are to be measured with thermocouples with a wire diameter of not more than 0.03 in (0.7 mm). Each thermocouple is to be brazed to the center of the face of a copper

disk 1/2 in (12 mm) in diameter and 0.01 in (0.2 mm) thick, which is secured to the surface of the specimen at the required position. The thermocouples are to be placed under flexible, oven-dry, felted pads. The properties of these pads are to comply with the requirements specified in Appendix B, Requirements for Thermocouple Pads.

5.3.3 When measured, the unexposed surface temperatures are to be taken at not less than two points, with a minimum of one thermocouple in each 16-ft^2 (1.5 m^2) area of the glazing material. Thermocouples are not to be located more than 12 in (305 mm) from the edge of the framing.

5.3.4 The disk and the pad are to be fixed to the surface of the specimen by a sodium silicate (water glass) adhesive or an adhesive that is rated for use at temperatures equal to or greater than 700°F (370°C).

5.3.5 The thermocouples and pads are to be removed after 30 minutes of fire exposure.

Exception: The thermocouples and pads are to remain on the assembly when unexposed surface temperature data beyond the first 30 minutes of fire exposure is being evaluated.

5.4 Fire endurance test

5.4.1 The pressure in the furnace chamber is to be maintained as described in 3.3.8 for window assemblies tested under positive pressure conditions, and as in 3.3.9 for window assemblies tested under neutral pressure conditions.

5.4.2 The test is to be continued for the predetermined test exposure unless the conditions of acceptance set forth in Section 6 are exceeded in a shorter period.

5.4.3 The distance between the junction of the thermocouples used to measure furnace temperature is to be adjusted during the test so that the distance remains at 6 ±1 in (152 ±25 mm) during the test.

5.5 Hose stream test

5.5.1 Immediately following the fire endurance test and within 1-1/2 minutes, the fire exposed side of the test assembly is to be subjected to the impact, erosion, and cooling effects of the hose stream.

5.5.2 The hose stream is to be delivered through a 2-1/2-in (63.5-mm) hose discharging through a National Standard playpipe of corresponding size equipped with a 1-1/8 in (28.6 mm) discharge tip of the standard-taper smooth-bore pattern without shoulder at the orifice.

5.5.3 The tip of the nozzle is to be located 20 ft (6.1 m) from, and on a line normal to, the center of the test assembly. If such a location is not possible, the nozzle may be on a line deviating not more than 30 degrees from the line normal to the center of the test assembly. When so located, the distance from the plane of the surface of the test assembly is to be less than 20 ft (6.1 m) by an amount equal to 1 ft (305 mm) for each 10 degrees of deviation from the normal.

5.5.4 The hose stream is to be directed around the periphery of the test assembly starting upward from a lower corner. When the circuit is approximately 1 ft (305 mm) from the starting point, the hose stream is to be applied in paths approximately 1 foot apart up and down the assembly across the entire width and then back and forth horizontally across the entire height. The traverse rate of the hose stream across the assembly is to be 3 to 6 feet per second (0.9 to 1.8 meters per second).

5.5.5 The water pressure at the base of the nozzle and duration of application in seconds per square foot (s/m^2) of exposed area shall be as prescribed in Table 5.1.

Table 5.1
Water pressure at base of nozzle and duration of application

Desired rating	Water pressure at base of nozzle, psi	Water pressure at base of nozzle, (kPa)	Duration of application of exposed area, s/ft^2	Duration of application of exposed area, (s/m^2)
3 hour	45	310	3.0	32
1-1/2 hour and over if less than 3 hour	30	207	1.5	16
1 hour and over if less than 1-1/2 hour	30	207	0.9	10
Less than 1 hour	30	207	0.6	6

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

CONDITIONS OF ACCEPTANCE

6 General

6.1 Window assemblies

6.1.1 A window assembly shall be considered as complying with the requirements for performance if it remains in the opening during the fire endurance test and hose stream test within the following limitations.

6.1.2 The window assembly shall not be loosened from its fastenings.

6.1.3 Movement at the perimeter of openable components from the initial closed position shall not exceed the thickness of the frame member at any point.

6.1.4 During the fire exposure test, glass edges shall not be separated from the frame so as to create an opening.

6.1.5 During the hose stream test, separation of the glass edges from the glazing frame by movements away from the frame so as to create an opening shall not exceed 30 percent of each individual glass light perimeter.

6.1.6 During the hose stream test, openings created by glass breakage in the central area of each glass light shall not exceed 5 percent of the area of each individual glass light.

6.1.7 Openings for the purpose of 6.1.5 and 6.1.6 are defined as through holes in the assembly that are visible from the unexposed side when looking perpendicular through the plane of the assembly at the location of the suspected opening.

6.1.8 No flaming shall occur on the unexposed surface of the assembly.

6.2 Glass block assemblies

6.2.1 A glass block assembly shall be considered as complying with the requirements for performance if it remains in the opening during the fire endurance test and hose stream test within the following limitations.

6.2.2 The glass block assembly shall not be loosened from the frame.