



UL 10B

Underwriters Laboratories Inc.
Standard for Safety

Fire Tests of Door Assemblies



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UL Standard for Safety for Fire Tests of Door Assemblies, UL 10B

Tenth Edition, Dated February 7, 2008

Revisions: This Standard contains revisions through and including April 13, 2009.

Summary Of Topics

Revision pages have been issued for the Standard for Fire Tests of Door Assemblies, UL 10B, to reflect the latest ANSI approval date and to incorporate the proposals dated February 13, 2009. These proposals include the following:

- **Expansion of the Description of a Thermocouple Assembly Used to Measure Furnace Temperatures**

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Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The revised requirements are substantially in accordance with UL's Proposal(s) on this subject dated February 13, 2009.

The revisions dated April 13, 2009 include a reprinted title page (page1) for this Standard.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

As indicated on the title page (page1), this UL Standard for Safety has been adopted by the Department of Defense.

The UL Foreword is no longer located within the UL Standard. For information concerning the use and application of the requirements contained in this Standard, the current version of the UL Foreword is located on ULStandardsInfoNet at: <http://ulstandardsinfo.net/ulforeword.html>.

The master for this Standard at UL's Northbrook Office is the official document insofar as it relates to a UL service and the compliance of a product with respect to the requirements for that product and service, or if there are questions regarding the accuracy of this Standard.

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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This Standard consists of pages dated as shown in the following checklist:

| Page | Date |
|------------|------------------|
| 1-2..... | April 13, 2009 |
| 3-6..... | February 7, 2008 |
| 7..... | April 13, 2009 |
| 8-16..... | February 7, 2008 |
| A1-A2..... | February 7, 2008 |
| B1-B2..... | February 7, 2008 |
| C1-C2..... | February 7, 2008 |

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FEBRUARY 7, 2008
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HISTORICAL NOTE

ANSI/UL 10B-2009

Doors for protection of openings in walls and partitions have been subjected to fire-exposure tests by Underwriters Laboratories Inc. for a period of more than 100 years. Standard construction of wood-core, tin-clad fire doors was first formally recognized by the National Fire Protection Association in 1899. Hollow-metal doors were first submitted to Underwriters Laboratories for investigation and fire-exposure test in 1904. Fire-testing of other types of doors and shutters by UL has been conducted over a correspondingly long period. Study by a long-continued NFPA committee, of results of numerous fire tests of doors conducted under the auspices of this committee at Underwriters Laboratories in 1900 – 1901, formed the basis for many details of construction covered by Standards for protection of openings adopted by the National Fire Protection Association and by the National Board of Fire Underwriters in 1915, and published by both.

1

UL 10B

Standard for Fire Tests of Door Assemblies

- First Edition – November, 1942
- Second Edition – July, 1950
- Third Edition – November, 1957
- Fourth Edition – January, 1970
- Fifth Edition – February, 1974
- Sixth Edition – August, 1979
- Seventh Edition – May, 1986
- Eighth Edition – July, 1993
- Ninth Edition – April, 1997

Tenth Edition

February 7, 2008

This ANSI/UL Standard for Safety consists of the Tenth Edition including revisions through April 13, 2009.

The most recent designation of ANSI/UL 10B as an American National Standard (ANSI) occurred on April 13, 2009. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or effective date information.

The Department of Defense (DoD) has adopted UL 10B on September 6, 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 UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <http://csds.ul.com>.

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INTRODUCTION

1 Scope

1.1 These methods of fire tests are applicable to door assemblies of various materials and types of construction for use in wall openings to retard the passage of fire.

1.2 Tests made in conformity with these test methods register performance during the test exposure; and such tests shall not be construed as determining compliance for use after exposure to fire.

1.3 It is the intent that tests made in conformity with these test methods develop data to enable regulatory bodies to determine the compliance of door assemblies for use in locations where fire resistance of a specified duration is required.

1.4 These methods are intended to evaluate the ability of a door 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, is not representative of all fire conditions, which vary with changes in the amount, nature, and distribution of fire loading, ventilation, compartment size and configuration, and heat sink characteristics of the compartment. It does, however, provide a relative measure of fire performance of door assemblies under these specified fire exposure conditions.

1.6 Any variation from the construction or conditions that are tested is capable of substantially changing the performance characteristics of the assembly.

1.7 The methods do not provide the following:

- a) Full information as to performance of all door assemblies in walls constructed of materials other than those tested.
- b) Evaluation of the degree by which the door assembly contributes to the risk of fire by generation of smoke, toxic gases, or other products of combustion.
- c) A temperature limit on the unexposed side of the door assembly.
- d) A limit on the number of openings intended in glazed areas or of the number and size of lateral openings between the door and frame.
- e) Measurement of the degree of control or limitation of the passage of smoke or products of combustion through the door assembly.

2 General

2.1 Units of measurement

2.1.1 When a value for measurement is followed by a value in other units in parentheses, the first stated value is the requirement.

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.

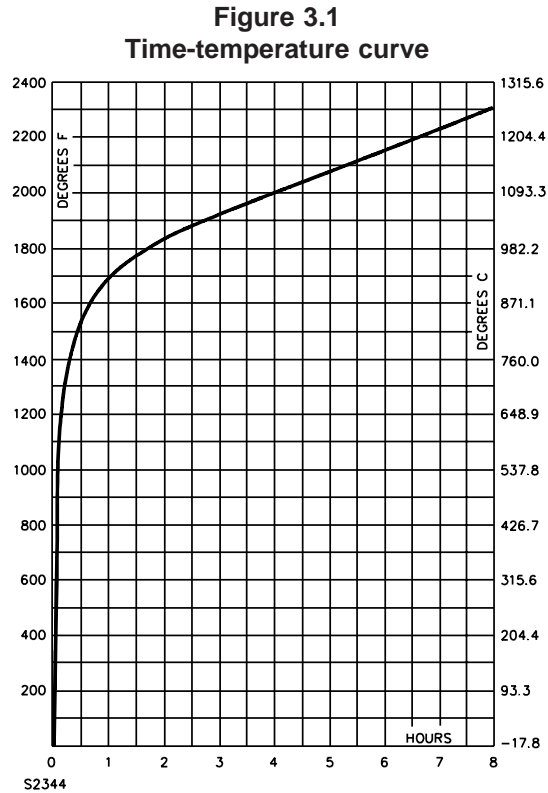
CONTROL OF FIRE TESTS

3 Time-Temperature Curve

3.1 The fire exposure of door 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:

- a) 1000°F (538°C) at 5 minutes,
- b) 1300°F (704°C) at 10 minutes,
- c) 1462°F (795°C) at 20 minutes,
- d) 1550°F (843°C) at 30 minutes,
- e) 1638°F (892°C) at 45 minutes,
- f) 1700°F (927°C) at 1 hour,
- g) 1792°F (978°C) at 1-1/2 hours,
- h) 1850°F (1010°C) at 2 hours,
- i) 1925°F (1052°C) at 3 hours, and
- j) 2000°F (1093°C) at 4 hours.

3.2 For a more detailed definition of the time-temperature curve, see Appendix A.



4 Furnace Temperatures

4.1 The temperatures of the test exposure shall be deemed to be the average temperature obtained from the readings of not less than nine thermocouples symmetrically disposed and distributed to show the temperature near all parts of the test assembly, see Figure 4.1. The thermocouple assembly is to consist of a thermocouple protected by a sealed porcelain tube having a 3/4 inch (19.1 mm) outside diameter and 1/8 inch (3.2 mm) wall thickness or, a base-metal thermocouple, protected by: (1) a 1/2-inch (12.7-mm) wrought-steel or wrought-iron pipe 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). The end of the thermocouple assembly is to be initially located 6 inches (152 mm) from the exposed face of the door assembly or from the wall assembly in which the door assembly is installed. During the fire exposure, if the movement of the test sample causes the sample's distance to the end of the thermocouple assembly to vary, the end of the thermocouple assembly is to be reset to 6 inches (152 mm) at intervals not exceeding 10 minutes during the first 30 minutes of the test. Thereafter, the intervals are to be increased to not more than 30 minutes.

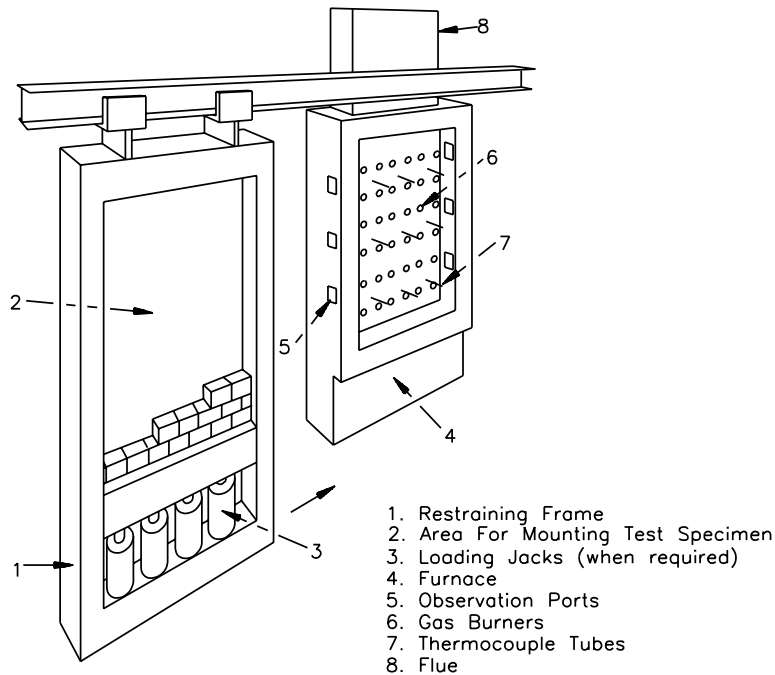
4.1 revised April 13, 2009

4.2 The temperatures are to be recorded at intervals not exceeding 1 minute.

4.3 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 tests of 1 hour or less duration or during the first hour of multi-hour tests, 7.5 percent in the first 2 hours of multi-hour tests, and within 5 percent for tests exceeding 2 hours in duration.

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Figure 4.1
Test furnace



S2320

1. Restraining Frame
2. Area For Mounting Test Specimen
3. Loading Jacks (when required)
4. Furnace
5. Observation Ports
6. Gas Burners
7. Thermocouple Tubes
8. Flue

5 Unexposed Surface Temperatures

5.1 Unexposed surface temperatures are to be recorded, and are to be determined in the following manner.

Exception: Single-layer metal doors are not required to comply with this section.

5.2 Unexposed surface temperatures are to be taken at not less than three points, with at least one thermocouple in each 16-square foot (1.5-m²) area of the door. Thermocouples are not to be located over reinforcements extending through the door, over glass panels, or nearer than 12 inches (305 mm) from the edge of the door.

5.3 Unexposed surface temperatures are to be measured with thermocouples placed under flexible, oven-dry, felted pads. The properties of these pads are to comply with the requirements specified in Appendix B.

5.4 Unexposed surface temperatures are to be recorded at intervals not exceeding 1 minute for the first 30 minutes of the test. After 30 minutes the thermocouples and the felted pads are to be removed unless the sponsor requests additional surface temperatures be recorded.

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TEST ASSEMBLIES

6 Construction and Size

6.1 The construction and size of the test door assembly, consisting of single doors, doors in pairs, special-use doors (such as Dutch doors or double-egress doors), or multisection doors, shall be representative of that for which classification or rating is specified.

6.2 A floor structure shall be provided as part of the opening to be protected, other than where such floor interferes with the operation of the door. The floor segment shall be of noncombustible material and shall project into the furnace for twice the thickness of the test door, the anticipated deflection of the bottom bar of a rolling door, or to the limit of the frame, whichever is greater.

7 Mounting for Test Purposes

7.1 Swinging doors shall be mounted so as to open into the furnace chamber.

7.2 Sliding and rolling doors, other than horizontal slide-type elevator doors, shall be mounted on the exposed side of the opening in the wall closing the furnace chamber.

7.3 Horizontal slide-type elevator doors shall be mounted on the unexposed side of the opening in the wall closing the furnace chamber.

7.4 Access-type doors and chute-type doors and frame assemblies shall be mounted so as to have one assembly open into the furnace chamber and another assembly open away from the furnace chamber.

7.5 Dumbwaiter and service-counter doors and frame assemblies shall be mounted on the exposed side of the opening in the wall.

7.6 The mounting of all doors shall be such that they fit within the frame, against the wall surfaces, or in guides, and such mounting shall not prevent free and easy operation of the test door.

7.7 Clearances for swinging doors shall be as follows: with a minus 1/16 inch (1.6 mm) tolerance – 1/8 inch (3.2 mm) along the top, 1/8 inch (3.2 mm) along the hinge and latch jambs, 1/8 inch (3.2 mm) along the meeting edge of doors in pairs, and 3/8 inch (9.5 mm) at the bottom edge of a single swing door, and 1/4 inch (6.4 mm) at the bottom of a pair of doors.

7.8 Clearances for horizontal sliding doors not mounted within guides are to be as follows: with a minus 1/8 inch (3.2 mm) tolerance – 1/2 inch (12.7 mm) between door and wall surfaces, 3/8 inch (9.5 mm) between door and floor structure, and 1/4 inch (6.4 mm) between the meeting edges of center-parting doors.

7.9 Clearances for vertical sliding doors moving within guides shall be as follows: with a minus 1/8 inch (3.2 mm) tolerance – 1/2 inch (12.7 mm) between door and wall surfaces along top and/or bottom door edges with guides mounted directly to the wall surface and 3/16 inch (4.8 mm) between meeting edges of bi-parting doors or 3/16 inch (4.8 mm) between door and floor structure or sill.

7.10 Clearances for horizontal slide-type elevator doors shall be as follows: with a minus 1/8 inch (3.2 mm) tolerance – 3/8 inch (9.5 mm) between the door and wall surfaces, 3/8 inch (9.5 mm) between multisection door panels, and 3/8 inch (9.5 mm) from the bottom of a panel to the sill. Multisection door panels shall overlap 3/4 inch (19.1 mm). Door panels shall overlap the wall opening 3/4 inch (19.1 mm) at sides and top.

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

7.12 Surface-mounted hardware (fire-exit devices) for use on fire doors shall be evaluated by being installed on one door assembly swinging into the furnace chamber and another door assembly swinging away from the furnace chamber.

7.13 Door frame wall anchors, when used, shall be intended for the wall or partition construction.

CONDUCT OF TESTS

8 Time of Testing

8.1 Masonry shall possess the strength to retain the assembly securely in position throughout the fire and hose stream test.

9 Fire Endurance Test

9.1 The pressure in the furnace chamber is to be 0 ± 0.01 inches of water at the top of the door.

9.2 The test is to be continued until the exposure period of the specified classification or rating is reached unless the conditions of acceptance set forth in Sections 12 and 13 are exceeded in a shorter period.

10 Hose Stream Test

10.1 Immediately after to within 3 minutes from the termination of the fire endurance test, the test assembly is to start to be subjected to the impact, erosion, and cooling effects of a hose stream directed first at the bottom center of the assembly and then at all parts of the exposed surface. The hose stream is to be applied, with a smooth steady movement of the hose at a rate to ensure that all parts of the test assembly are impacted by the hose stream. When all parts of the test assembly have been impacted by the hose stream, the application pattern is to be reversed. See Appendix C for a description of the pattern.

10.2 Deliver the hose stream through a 2-1/2-inch (64.5-mm) hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8-inch (28.6-mm) discharge tip of the standard-taper, smooth-bore pattern without shoulder at the orifice. The minimum water pressure at the base of the nozzle and the minimum duration of application in seconds per square foot (s/m^2) of exposed area is to be as prescribed in Table 10.1.

10.3 The tip of the nozzle is to be located a maximum of 20 feet (6 m) from and on a line normal to the center of the test door. When it is not possible to be so located, the nozzle is to be on a line deviating not more than 30 degrees from the line normal to the center of the test door. When so located, the distance from the center is to be less than 20 feet (6 m) by an amount equal to 1 foot (0.3 m) for each 10 degrees of deviation from the normal.

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Table 10.1
Water pressure at base of nozzle and duration of application

| Specified rating | Water pressure at base of nozzle, | | Duration of application of exposed area, | |
|---|-----------------------------------|-------|--|---------------------|
| | psi | (KPa) | seconds per square foot | (s/m ²) |
| 3-hour or 4-hour | 45 | 310 | 3.0 | 32 |
| 1-1/2-hour and over when less than 3-hour | 30 | 207 | 1.5 | 16 |
| 1-hour and over when less than 1-1/2-hour | 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 specimen, including a frame, hangers, tracks, or other parts of the assembly when provided, and 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 identified as the exposed area since the hose stream must traverse this area during its application.

REPORT

11 General

11.1 Results shall be reported in accordance with the performance in the tests prescribed in these test methods. The report shall show the performance under the specified exposure period chosen from the following: 20-minute, 30-minute, 3/4-hour, 1-hour, 1-1/2-hour, 3-hour or 4-hour. The report shall include the temperature measurements of the furnace and, when determined, of the unexposed side of the test assembly. See 5.1. It shall also contain a record of all observations having a bearing on the performance of the test assembly.

11.2 Any flaming on the unexposed surface of the door leaf shall be recorded.

11.3 The amount of movement of any portion of the edges of the door adjacent to the door frame from the original position shall be recorded. See Sections 12 and 13.

11.4 The materials and construction of the door, frame, and wall or partition, and the details of the installation, hardware, door frame and wall anchors, hangers, guides, trim, finish, and clearance or lap shall be recorded or referenced to provide positive identification or duplication in all respects.

11.5 Pressure measurements made in the furnace and location of such measurements relative to the elevation of the top of the door shall be recorded.

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CONDITIONS OF ACCEPTANCE

12 General

12.1 A door assembly shall be considered as meeting the requirements for intended performance when it remains in the opening during the fire endurance test and hose-stream test within the following limitations.

12.2 The lap edges of horizontal, slide-type passenger elevator doors, as defined in the Safety Code for Elevators and Escalators, ANSI/ASME A17.1/CSA B44, including the lap edges of multisection doors, shall not move from the wall or adjacent panel surfaces resulting in a separation of more than 2-7/8 inches (73.0 mm) during the entire classification period, or immediately following the hose stream test. The meeting edges of center-parting elevator door assemblies, for a fire and hose stream exposure of 1-1/2 hours or less, shall not move apart more than 1-1/4 inches (31.8 mm) as measured in any horizontal plane during the entire classification period or immediately following the hose stream test.

12.3 Doors mounted in guides shall not release from guides and guides shall not loosen such that passage of flames occurs.

12.4 The test assembly shall withstand the Fire Endurance Test, Section 9, and Hose-Stream Test, Section 10, without developing openings anywhere through the assembly.

Exception No. 1: Dislodging of small portions of glass during the hose stream, as specified in 14.6, is permitted.

Exception No. 2: Separation between meeting edges of pairs of doors within the limits specified in 12.2, 13.2.3, 13.2.4, 13.3.5, and 13.3.6 is permitted.

Exception No. 3: An opening between the bottom edge of a door and sill within the limits specified in 7.7 – 7.10, 13.3.3, and 13.3.7 is permitted.

12.5 For the purpose of the requirement of 12.4, an opening is defined as a through-hole in the assembly that is seen from the unexposed side when viewed from the direction perpendicular to the plane of the assembly at the location of the suspected opening.

13 Specific

13.1 All doors

13.1.1 No flaming shall occur on the unexposed surface of a door assembly during the first 30 minutes of the classification period.

13.1.2 After 30 minutes, intermittent light flaming [6 inches (152 mm) long], for periods not exceeding 5-minute intervals, is capable of occurring along the edges of doors.

13.1.3 Light flaming is capable of occurring during the last 15 minutes of the classification period on the unexposed surface area of the door, when it is contained within a distance of 1-1/2 inches (38.1 mm) from a vertical door edge and within 3 inches (76.2 mm) from the top edge of the door and within 3 inches (76.2 mm) from the top edge of the frame of a vision panel.

13.1.4 When hardware is to be evaluated for use on fire doors, it shall hold the door closed in accordance with the conditions of acceptance for the intended door assembly classification period and, in addition, the latch bolt shall remain projected and shall be intact after the test. The hardware is not required to be operable after test.

13.2 Swinging doors

13.2.1 The movement of swinging doors shall not result in any portion of the edges adjacent to the door frame moving from the original position in a direction perpendicular to the plane of the door more than the thickness of the door during the first half of the classification period, nor more than 1-1/2 times the door thickness during the entire classification period or as a result of the hose stream test.

13.2.2 The movement of swinging doors mounted in pairs shall not result in any portion of the meeting edges moving more than 1-1/2 times the thickness of the door away from the adjacent door edge in a direction perpendicular to the plane of the doors during the entire classification period or as a result of the Hose Stream Test, Section 10.

13.2.3 An assembly consisting of a pair of swinging doors incorporating an astragal shall not separate in a direction parallel to the plane of the doors more than 3/4 inch (19.1 mm) nor a distance equal to the throw of a latch bolt at the latch location.

13.2.4 An assembly consisting of a pair of swinging doors, without an overlapping astragal, for a fire and hose stream exposure of 1-1/2 hours or less, shall not separate along the meeting edges more than 3/8 inch (9.5 mm), including the initial clearance between doors.

13.2.5 An assembly consisting of a single swinging door shall not separate more than 1/2 inch (12.7 mm) at the latch location.

13.2.6 Door frames to be evaluated with doors shall remain securely fastened to the wall on all sides and shall not reveal through-openings between frame and doors or between frame and adjacent wall.

13.3 Sliding and rolling doors

13.3.1 Doors mounted on the face of the wall shall not move from the wall to develop a separation of more than 2-7/8 inches (47.8 mm) during the entire classification period or as a result of the hose stream test.

13.3.2 Doors mounted in guides shall not release from the guides, and the guides shall not loosen such that the passage of flames occurs.

13.3.3 The bottom bar of rolling steel doors shall not separate from the floor structure more than 3/4 inch (19.1 mm) during the entire classification period or as a result of the hose stream test.

13.3.4 The meeting edge of center-parting horizontal sliding doors and bi-parting vertical sliding doors shall not separate more than the door thickness in a direction perpendicular to the plane of the doors during the entire classification period or more than 1-1/2 times the door thickness as a result of the Hose Stream Test, Section 10.

13.3.5 The meeting edges of center-parting horizontal sliding doors and bi-parting vertical sliding doors without an overlapping astragal, for a fire and hose stream exposure of 1-1/2 hours or less, shall not separate in a direction parallel to the plane of the doors more than 3/8 inch (9.5 mm) along the meeting edges, including the initial clearance between doors.

13.3.6 The meeting edges of center-parting horizontal sliding doors incorporating an astragal shall not separate in a direction parallel to the plane of the doors more than 3/4 inch (19.1 mm) nor a distance equal to the throw of the latch bolt along the meeting edges.

13.3.7 The bottom edge of service-counter doors or single-slide dumbwaiter doors shall not separate from the sill more than 3/8 inch (9.5 mm).

13.3.8 A resilient astragal, when provided, shall not deteriorate and reveal through-openings during the fire endurance test; however, small portions are not prohibited from being dislodged during the hose stream test.

14 Glazing Assemblies

14.1 A glazing assembly shall be considered as meeting the requirements for intended performance when it remains in the opening during the fire endurance test and hose stream test within the following limitations.

14.2 The glazing assembly shall not be loosened from its fastenings.

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

14.4 During the fire exposure test, the glass edges shall not separate from the frame and create an opening.

14.5 Separation of the glass edges during the hose stream test 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.

14.6 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.

14.7 Openings for the purpose of 14.5 and 14.6 are defined as through-holes in the assembly that are seen from the unexposed side when looking perpendicular through the plane of the assembly at the location of the suspected opening.

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APPENDIX A

A1 Standard Time-Temperature Curve for Control of Fire Tests

| Time, Hr:Min | Temperature, °F | Area above 68°F base | | Temperature, °C | Area above 20°C base | |
|-----------------|--------------------|----------------------|---------|-----------------|----------------------|---------|
| | | °F – Min | °F – Hr | | °C – Min | °C – Hr |
| 0:00 | 68 | 00 | 0 | 20 | 00 | 0 |
| 0:05 | 1,000 | 2,330 | 39 | 538 | 1,290 | 22 |
| 0:10 | 1,300 | 7,740 | 129 | 704 | 4,300 | 72 |
| 0:15 | 1,399 | 14,150 | 236 | 760 | 7,860 | 131 |
| 0:20 | 1,462 | 20,970 | 350 | 795 | 11,650 | 194 |
| 0:25 | 1,510 | 28,050 | 468 | 821 | 15,590 | 260 |
| 0:30 | 1,550 | 35,360 | 589 | 843 | 19,650 | 328 |
| 0:35 | 1,584 | 42,860 | 714 | 862 | 23,810 | 397 |
| 0:40 | 1,613 | 50,510 | 842 | 878 | 28,060 | 468 |
| 0:45 | 1,638 | 58,300 | 971 | 892 | 32,390 | 540 |
| 0:50 | 1,661 | 66,200 | 1,103 | 905 | 36,780 | 613 |
| 0:55 | 1,681 | 74,220 | 1,237 | 916 | 41,230 | 687 |
| 1:00 | 1,700 | 82,330 | 1,372 | 927 | 45,740 | 762 |
| 1:05 | 1,718 | 90,540 | 1,509 | 937 | 50,300 | 838 |
| 1:10 | 1,735 | 98,830 | 1,647 | 946 | 54,910 | 915 |
| 1:15 | 1,750 | 107,200 | 1,787 | 955 | 59,560 | 993 |
| 1:20 | 1,765 | 115,650 | 1,928 | 963 | 64,250 | 1,071 |
| 1:25 | 1,779 | 124,180 | 2,070 | 971 | 68,990 | 1,150 |
| 1:30 | 1,792 | 132,760 | 2,213 | 978 | 73,760 | 1,229 |
| 1:35 | 1,804 | 141,420 | 2,357 | 985 | 78,560 | 1,309 |
| 1:40 | 1,815 | 150,120 | 2,502 | 991 | 83,400 | 1,390 |
| 1:45 | 1,826 | 158,890 | 2,648 | 996 | 88,280 | 1,471 |
| 1:50 | 1,835 | 167,700 | 2,795 | 1,001 | 93,170 | 1,553 |
| 1:55 | 1,843 | 176,550 | 2,942 | 1,006 | 98,080 | 1,635 |
| 2:00 | 1,850 | 185,440 | 3,091 | 1,010 | 103,020 | 1,717 |
| 2:10 | 1,862 | 203,330 | 3,389 | 1,017 | 112,960 | 1,882 |
| 2:20 | 1,875 | 221,330 | 3,689 | 1,024 | 122,960 | 2,049 |
| 2:30 | 1,888 | 239,470 | 3,991 | 1,031 | 133,040 | 2,217 |
| 2:40 | 1,900 | 257,720 | 4,295 | 1,038 | 143,180 | 2,386 |
| 2:50 | 1,912 | 276,110 | 4,602 | 1,045 | 153,390 | 2,556 |
| 3:00 | 1,925 | 294,610 | 4,910 | 1,052 | 163,670 | 2,728 |
| 3:10 | 1,938 | 313,250 | 5,221 | 1,059 | 174,030 | 2,900 |
| 3:20 | 1,950 | 332,000 | 5,533 | 1,066 | 184,450 | 3,074 |
| 3:30 | 1,962 | 350,890 | 5,848 | 1,072 | 194,940 | 3,249 |
| 3:40 | 1,975 | 369,890 | 6,165 | 1,079 | 205,500 | 3,425 |
| 3:50 | 1,988 | 389,030 | 6,484 | 1,086 | 216,130 | 3,602 |
| 4:00 | 2,000 | 408,280 | 6,805 | 1,093 | 226,820 | 3,780 |
| 4:10 | 2,012 | 427,670 | 7,128 | 1,100 | 237,590 | 3,960 |
| 4:20 | 2,025 | 447,180 | 7,153 | 1,107 | 248,430 | 4,140 |
| 4:30 | 2,038 | 466,810 | 7,780 | 1,114 | 259,340 | 4,322 |
| 4:40 | 2,050 | 486,560 | 8,110 | 1,121 | 270,310 | 4,505 |
| 4:50 | 2,062 | 506,450 | 8,441 | 1,128 | 281,360 | 4,689 |
| 5:00 | 2,075 | 526,450 | 8,774 | 1,135 | 292,470 | 4,874 |
| 5:10 | 2,088 | 546,580 | 9,110 | 1,142 | 303,660 | 5,061 |

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Table Continued on Next Page

Table Continued

| Time, Hr:Min | Temperature, °F | Area above 68°F base | | Temperature, °C | Area above 20°C base | |
|-----------------|--------------------|----------------------|---------|-----------------|----------------------|---------|
| | | °F – Min | °F – Hr | | °C – Min | °C – Hr |
| 5:20 | 2,100 | 566,840 | 9,447 | 1,149 | 314,910 | 5,248 |
| 5:30 | 2,112 | 587,220 | 9,787 | 1,156 | 326,240 | 5,437 |
| 5:40 | 2,125 | 607,730 | 10,129 | 1,163 | 337,630 | 5,627 |
| 5:50 | 2,138 | 628,630 | 10,473 | 1,170 | 349,090 | 5,818 |
| 6:00 | 2,150 | 649,120 | 10,819 | 1,177 | 360,620 | 6,010 |
| 6:10 | 2,162 | 670,000 | 11,167 | 1,184 | 372,230 | 6,204 |
| 6:20 | 2,175 | 691,010 | 11,517 | 1,191 | 383,900 | 6,398 |
| 6:30 | 2,188 | 712,140 | 11,869 | 1,198 | 395,640 | 6,594 |
| 5:40 | 2,200 | 733,400 | 12,223 | 1,204 | 407,450 | 6,791 |
| 6:50 | 2,212 | 754,780 | 12,580 | 1,211 | 419,330 | 6,989 |
| 7:00 | 2,225 | 776,290 | 12,938 | 1,218 | 431,270 | 7,188 |
| 7:10 | 2,238 | 797,920 | 13,299 | 1,225 | 443,290 | 7,388 |
| 7:20 | 2,250 | 819,680 | 13,661 | 1,232 | 455,380 | 7,590 |
| 7:30 | 2,262 | 841,560 | 14,026 | 1,239 | 467,540 | 7,792 |
| 7:40 | 2,275 | 863,570 | 14,393 | 1,246 | 479,760 | 7,996 |
| 7:50 | 2,288 | 885,700 | 14,762 | 1,253 | 492,060 | 8,201 |
| 8:00 | 2,300 | 907,960 | 15,133 | 1,260 | 504,420 | 8,407 |

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APPENDIX B

B1 Requirements for Thermocouple Pads

B1.1 The pads are not to break when shaped to contact the surface against which they are placed.

B1.2 Refractory fiber material^c is to have the following characteristics:

- a) Length and width – 6 ±1/8 inches (152 ±3 mm).
- b) Thickness^a – 0.375 ±0.063 inch (9.5 ±1.6 mm).
- c) Dry weight – 0.147 ±0.053 pounds (67 ±24 g).
- d) Thermal conductivity at 150°F (66°C) – 0.37 ±0.03 Btu-inch per hour per square foot per degree F (0.053 ±0.004 W/m-K).
- e) Hardness^b (on soft face) – 2.25 to 4.5 (modified Brinnell).

^aThe thickness measurement is to be made under the light load of a 1/2-inch (12.7-mm) diameter pad of a dial micrometer gage.

^bThe hardness measurement is to be made by pressing a 1 inch (25.4 mm) diameter steel ball against the specimen and measuring the indentation obtained between a minor load of 2 pounds-mass (0.91 kg) and an additional major load of 10 pounds-mass (4.5 kg), [12 pound-mass (5.4 kg) total load]. The hardness is obtained by the relationship:

$$\text{Hardness} = \frac{2.24}{y}$$

in which:

y is the difference in indentation in inches.

^cThermal Ceramics Americas Ceraform 126®, or the equivalent, is capable of being used as refractory fiber material.

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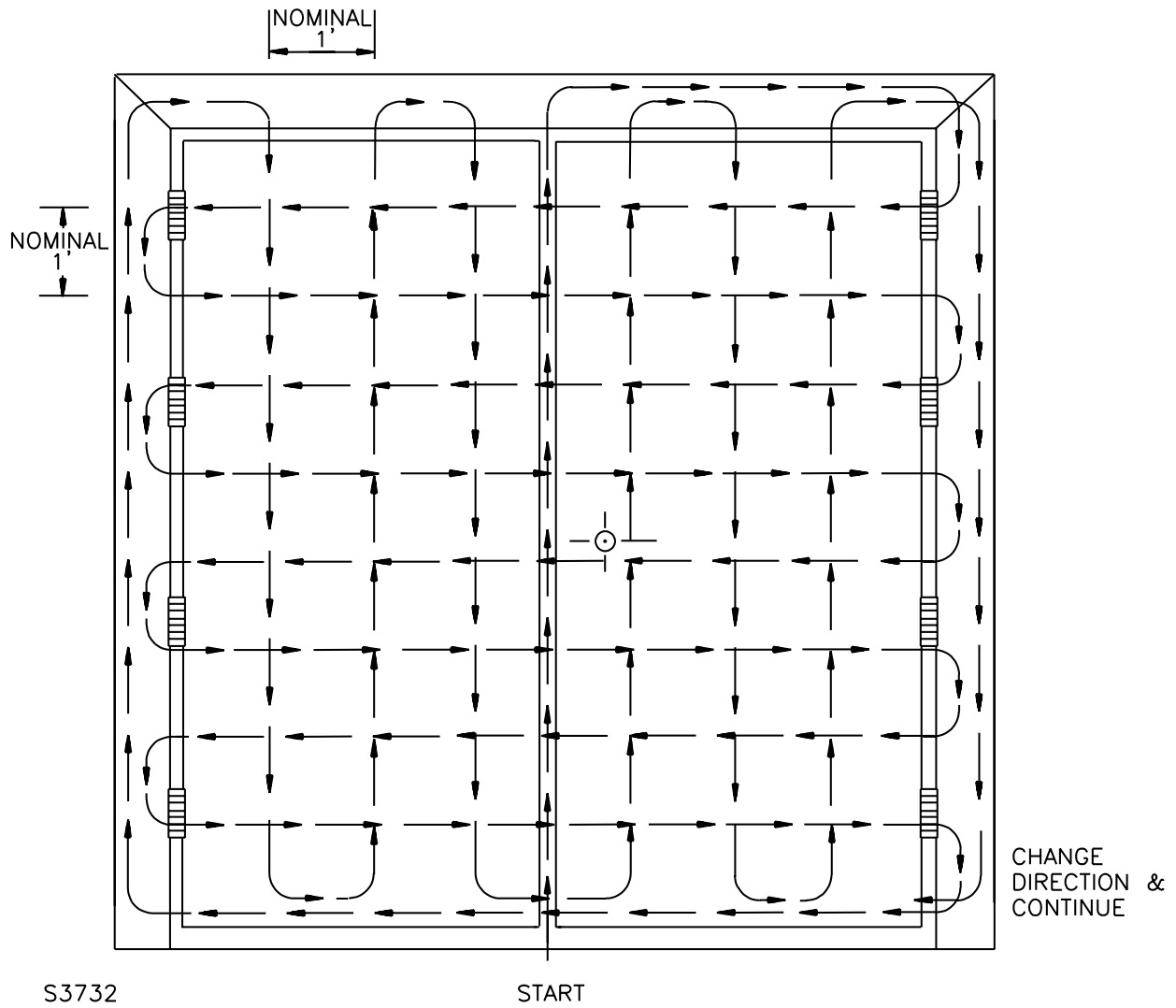
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Appendix C

C1 Hose Stream Pattern

C1.1 The hose stream is to be played over the test sample starting at the bottom center and then at all parts changing directions slowly. Figure C1.1 shows the typical pattern for one type of assembly, pairs of swinging doors. The pattern is capable of being mirrored, reversed, or otherwise modified to accommodate samples of various sizes and shapes.

Figure C1.1
Hose stream pattern



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