UL 263

Fire Tests of Building
Construction and Materials
Underwriters Laboratories Inc. (UL)
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Northbrook, IL 60062-2096


Summary of Topics

Revision pages for UL 263 are being issued to reflect the recent reaffirmation of UL 263 as an American National Standard.

Text that has been changed in any manner is marked with a vertical line in the margin.

The revisions dated October 24, 2007 include a reprinted title page (page 1) 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.

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://ulstandardsinfonet.ul.com/ulforeword.html

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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that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.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 Classification and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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<table>
<thead>
<tr>
<th>Page</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>October 24, 2007</td>
</tr>
<tr>
<td>4-5</td>
<td>April 4, 2003</td>
</tr>
<tr>
<td>6</td>
<td>October 24, 2007</td>
</tr>
<tr>
<td>7-30</td>
<td>April 4, 2003</td>
</tr>
<tr>
<td>A1-A2</td>
<td>April 4, 2003</td>
</tr>
<tr>
<td>B1-B2</td>
<td>April 4, 2003</td>
</tr>
<tr>
<td>C1-C2</td>
<td>April 4, 2003</td>
</tr>
</tbody>
</table>
HISTORICAL NOTE

These requirements are an outgrowth of proposals of the British Fire Prevention Committee and were adopted in 1903 at an International Fire Congress in London. They were modified for American practice as the result of experience of Underwriters Laboratories Inc. (UL), dating from about the same time, and of study by the Committee on Fire Resistive Construction of the National Fire Prevention Association (NFPA) and the Committee on Fire Proofing of the American Society for Testing Materials (ASTM).

Conferences called jointly by the two committees in 1916-17, which were attended by representatives of the National Board of Fire Underwriters (NFBU), currently the American Insurance Association (AIA), UL, Associated Factory Mutual Fire Insurance Companies, currently the Factory Mutual Research Corporation (FMRC), National Bureau of Standards (NBS), currently the National Institute of Standards and Technology, and other interested national societies, resulted in drafting fire-test requirements which were adopted in 1918 by NFPA and ASTM. They were approved as a tentative American Standard by the American Engineering Standards Committee in 1919.

The Standard Time-Temperature Curve is a composite of a considerable number of performance and calculated curves studied by the above conference. Its principal difference from other curves lies in the rapid rate of rise during the first 10 minutes of the test, a feature embodying the experience and practice of UL.

Fire-test requirements were promulgated by UL as appendices to its reports to clients for many years prior to the adoption of the above requirements. The first UL publication of the fire test requirements, as a separate Standard, appeared in 1926 and was followed by the First Edition of the present Standard in May, 1929.

The Standard has been revised and approved on several occasions as an American National Standard, ANSI A2.1, by the American National Standards Institute (ANSI) under joint sponsorship of ASTM (Serial designation E119), NBS, and ANSI Fire Protection Group, consisting of NFPA, AIA, FMRC, and UL.

UL 263
Standard for Fire Tests of Building Construction and Materials

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The most recent designation of ANSI/UL 263-2003 (R2007) as a Reaffirmed American National Standard (ANS) occurred on October 24, 2007. The ANSI approval for this Standard does not include the Cover page, Transmittal pages, or Title page.

This ANSI/UL Standard for Safety, which consists of the Thirteenth edition, is under continuous maintenance, whereby each revision is ANSI approved upon publication.

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc. and is not part of the ANSI approved Standard.

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements. 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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CONTENTS

INTRODUCTION

1 Scope ...............................................................................7
2 General .............................................................................8
  2.1 Units of measurement ...................................................8
  2.2 Undated references .........................................................8
3 Control of Fire Tests ..........................................................8
  3.1 Time-temperature curve ...............................................8
  3.2 Furnace temperatures ....................................................8
  3.3 Temperatures of unexposed surfaces of floors, roofs, walls, and partitions .....10
4 Classification as Determined by Test .....................................11

PERFORMANCE

5 General .............................................................................12
  5.1 Test specimen ..............................................................12
  5.2 Protection and conditioning of test specimen .......................13
  5.3 Conduct of fire endurance tests .......................................14
  5.4 Conduct of hose stream test ..........................................14
6 Bearing Walls and Partitions Test .........................................15
  6.1 Application .................................................................15
  6.2 Size and character of specimen ......................................15
  6.3 Loading .........................................................................15
  6.4 Conditions of acceptance .............................................16
7 Nonbearing Walls and Partitions Test .....................................16
  7.1 Application .................................................................16
  7.2 Size and character of specimen ......................................16
  7.3 Conditions of acceptance .............................................16
8 Columns Test ......................................................................17
  8.1 Application .................................................................17
  8.2 Size and character of specimen ......................................17
  8.3 Loading .........................................................................17
  8.4 Exposure to fire ...........................................................17
  8.5 Conditions of acceptance .............................................17
9 Alternate Test – Protection for Structural Steel Columns ..........17
  9.1 Application .................................................................17
  9.2 Size and character of specimen ......................................18
  9.3 Temperature measurement ..........................................18
  9.4 Exposure to fire ...........................................................18
  9.5 Conditions of acceptance .............................................18
  9.6 Report of results ..........................................................18
10 Floor and Roof Assemblies Test ..........................................19
  10.1 Application ...............................................................19
  10.2 Size and character of specimen .....................................19
  10.3 Loading .......................................................................20
  10.4 Temperature measurement ..........................................20
  10.5 Conditions of acceptance – restrained assembly ..............23
  10.6 Conditions of acceptance – unrestrained assembly ..........23
11 Loaded Restrained Beams Test ..................................................... 24
11.1 Application ........................................................................... 24
11.2 Size and character of specimen .................................................. 24
11.3 Loading .................................................................................. 24
11.4 Temperature measurement ....................................................... 25
11.5 Conditions of acceptance .......................................................... 25
12 Alternate Test – Protection for Loaded Beams ......................... 26
12.1 Application ........................................................................... 26
12.2 Conditions of acceptance .......................................................... 26
13 Alternate Test – Protection for Solid Structural Steel Beams and Girders .......................................................... 26
13.1 Application ........................................................................... 26
13.2 Size and character of specimen .................................................. 27
13.3 Temperature measurement ....................................................... 27
13.4 Conditions of acceptance .......................................................... 27
13.5 Report of results ................................................................. 27
14 Tests of Protective Membranes in Wall, Partition, Floor, or Roof Assemblies .................. 28
14.1 Application ........................................................................... 28
14.2 Size and character of specimen .................................................. 28
14.3 Temperature performance of protective membranes .................. 28
14.4 Conditions of acceptance .......................................................... 29
14.5 Report of results ................................................................. 29

APPENDIX A

Standard Time-Temperature Curve for Control of Fire Tests ............................... A1

APPENDIX B

Requirements for Thermocouple Pads .......................................................... B1

APPENDIX C

Nonmandatory Guide for Determining Conditions of Restraint for Floor and Roof Assemblies and for Individual Beams .......................................................... C1
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INTRODUCTION

1. Scope

1.1 These fire tests are applicable to assemblies of masonry units and to composite assemblies of structural materials for buildings, including bearing and other walls and partitions, columns, girders, beams, slabs, and composite slab and beam assemblies for floors and roofs. They are also applicable to other assemblies and structural units that constitute permanent integral parts of a finished building.

1.2 The classifications for building construction and materials are intended to register performance during the period of fire exposure and are not intended to be interpreted as having determined their acceptability for use after fire exposure.

1.3 These requirements are intended to evaluate the length of time that the types of assemblies specified in 1.1 will contain a fire or retain their structural integrity, or both, dependent upon the type of assembly involved, during a predetermined test exposure. The test evaluates the assembly's resistance to heat, and in some instances to a hose stream, while carrying an applied load, if the assembly is load bearing.

1.4 Under these requirements a specimen is subjected to a standard fire exposure controlled to achieve specified temperatures throughout a specified time period. In some instances, the fire exposure may be followed by the application of a specified standard fire hose stream. This exposure by itself may not be representative of all fire conditions; conditions 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. These requirements provide a relative measure of fire performance of comparable assemblies under these specified fire exposure conditions. Any variation from the construction or conditions that are tested such as size, method of assembly, and materials, may substantially change the performance characteristics of the assembly.

1.5 These requirements cover the following measurements and determinations during the test exposure:

a) Measurement of the transmission through the assembly of heat, and of gases sufficiently hot to ignite cotton waste in walls, partitions, floors, and roofs.

b) Measurement of the load carrying ability of load bearing elements in wall, partition, floor, and roof assemblies.

c) Measurement of the load carrying ability of individual load bearing assemblies, such as beams and columns, with consideration for the end support conditions, either restrained or not restrained.

1.6 These requirements do not cover:

a) Accumulation of data as to performance of assemblies constructed with components or lengths other than those tested.

b) Evaluation of the contribution of the assembly to generation of smoke, toxic gases, or other products of combustion.

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

d) Simulation of the fire behavior of joints between building elements, such as floor-wall or wall-wall, and like connections.
e) Measurement of flame spread over the surface of the tested element.

f) The effect on fire endurance of conventional openings in the assembly, such as openings for electrical receptacle outlets, plumbing pipe, or the like, unless specifically provided for in the construction tested.

1.7 Tests for burning characteristics of building materials, based on the rate of flame spread, can be found in the Standard for Test for Surface Burning Characteristics of Building Materials, UL 723.

1.8 The tests described herein may be cited as the “Standard Fire Tests,” and the performance of exposure expressed as “2-hour,” “6-hour,” “1/2-hour,” or the like.

1.9 The results of these tests represent one factor in assessing fire performance of building construction and assemblies. These requirements prescribe a standard fire exposure for comparing the performance of building construction assemblies. Application of these test results to predict the performance of actual building construction requires careful evaluation of test conditions.

1.10 If a factor of safety exceeding that inherent in the test conditions is desired, a proportional increase should be made in the specified time classification period.

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.

3 Control of Fire Tests

3.1 Time-temperature curve

3.1.1 The conduct of fire tests of materials and construction is to be controlled by 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
1550°F (843°C) at 30 minutes
1700°F (927°C) at 1 hour
1850°F (1010°C) at 2 hours
2000°F (1093°C) at 4 hours
2300°F (1260°C) at 8 hours or over

For a more precise definition of the time-temperature curve, see Standard Time-Temperature Curve for Control of Fire Tests, Appendix A.

3.2 Furnace temperatures

3.2.1 The measured temperature to be compared with the standard time-temperature curve is to be the average temperature obtained from the readings of not fewer than nine thermocouples for a floor, roof, wall or partition and not fewer than eight thermocouples for a structural beam or column, symmetrically disposed and distributed to indicate the temperature near all parts of the specimen.

Figure 3.1

Time-temperature curve

3.2.2 The thermocouples are to be enclosed in sealed porcelain tubes, 3/4 inch (19.1 mm) in outside diameter and 1/8 inch (3.2 mm) in wall thickness or, as an alternative in the case of base metal thermocouples, enclosed in sealed, standard-weight 1/2 inch (0.84 inch (21.3 mm) outside diameter) black wrought steel or black wrought iron pipe. See the Standard for Welded and Seamless Wrought Steel Pipe, ASME B36.10M. The exposed length of the pyrometer tube and thermocouple in the furnace chamber is to be not less than 12 inches (305 mm). Other types of protecting tubes or pyrometers may be used that, under test conditions, give the same indications as those specified within the limit of accuracy that applies for furnace temperature measurements.
3.2.3 For floors, roofs, beams and columns, the junction of each thermocouple is to be placed 12 inches (305 mm) away from the exposed face of the specimen at the beginning of the test and is not to touch the specimen during the test, as a result of specimen deflection.

3.2.4 For walls and partitions, the thermocouples are to be placed 6 inches (152 mm) away from the exposed face of the specimen at the beginning of the test and are not to touch the specimen during the test as a result of specimen deflection.

3.2.5 The temperatures are to be read at intervals not exceeding 5 minutes during the first 2 hours; the intervals thereafter may be increased to not more than 10 minutes.

3.2.6 The temperature of the furnace is to be controlled so that the area under the measured time-temperature curve, obtained by averaging the results from the pyrometer readings, is within:

   a) 10 percent of the corresponding area under the standard time-temperature curve shown in Figure 3.1 for fire tests of 1 hour or less duration,

   b) 7.5 percent for tests longer than 1 hour but not longer than 2 hours, and

   c) 5 percent for tests exceeding 2 hours in duration.

3.3 Temperatures of unexposed surfaces of floors, roofs, walls, and partitions

3.3.1 Temperatures at unexposed surfaces are to be measured with thermocouples or thermometers (under certain condition it may be impracticable to use thermometers), placed under flexible, dry, felted pads. The properties of these pads shall comply with the requirements specified in Requirements for Thermocouple Pads, Appendix B.

3.3.2 The wire leads of the thermocouple or the stem of the thermometer are to have an immersion under the pad and be in contact with the unexposed surface for not less than 3-1/2 inches (88.9 mm). The hot junction of the thermocouple or the bulb of the thermometer is to be placed approximately under the center of the pad. The outside diameter of protecting or insulating tubes and of thermometer stems is to be not more than 5/16 inch (7.9 mm). The pad is to be held firmly against the surface and is to fit closely about the thermocouples or the thermometer stems. Thermometers are to be of the partial immersion type with a 3-inch (76.2-mm) length of stem measured between the end of the bulb and the immersion mark. The wires for the thermocouple in the length covered by the pad are not to be heavier than No. 18 B&S gage [0.04 inches (1.02 mm)] and are to be electrically insulated with heat- and moisture-resistant coatings.

3.3.3 For the purpose of testing roof assemblies, the "unexposed surface" is defined as the surface exposed to ambient air.

3.3.4 Temperature readings are to be taken at not less than nine points on the surface. Five of these are to be symmetrically disposed, one at approximately the center of the specimen and four at approximately the center of its quarter sections. The other four are to be located at the discretion of the testing body to obtain representative information on the performance of the construction under test. No thermocouple is to be located nearer to the edges of the test specimen than one and one-half times the thickness of the construction, or 12 inches (305 mm), unless necessary to include an element of the construction not otherwise represented in the remainder of the test specimen.
3.3.5 Thermocouples located opposite or on top of fasteners, such as screws, nails, or staples that will be obviously higher or lower in temperature than at more representative locations, are not to be used in determining the classification period if:

a) The aggregate area of any part of such fasteners projected to the unexposed surface is less than 0.8 percent of the area within any 5-inch (127-mm) square area, and

b) The fasteners do not extend through the assembly.

3.3.6 Thermocouples are not to be located opposite or on top of beams, girders, pilasters, or other structural members if temperatures at such points will be obviously lower than at more representative locations.

3.3.7 Temperature readings are to be taken at intervals not exceeding 15 minutes until a reading exceeding 212°F (100°C) has been obtained at any one point. Thereafter, the readings may be taken more frequently at the discretion of the testing body, but the intervals need not be less than 5 minutes.

3.3.8 If the conditions of acceptance place a limitation on the rise of temperature of the unexposed surface, the temperature end point of the fire endurance period is to be determined by the average of the measurements taken at individual points, except that if a temperature rise of 30 percent in excess of the specified limit occurs at any one of these points, the remainder is to be ignored and the fire endurance period considered as ended.

4 Classification as Determined by Test

4.1 Results are to be reported in accordance with the performance in the tests described in these requirements and are to be expressed in time periods of resistance to the nearest integral minute. Reports are to include observations of significant details of the behavior of the material or construction during the test and after the furnace fire is extinguished, including information on deformation, spalling, cracking, burning of the specimen or its component parts, continuance of flaming, and production of smoke.

4.2 Reports of tests involving wall, floor, beam, or ceiling constructions in which restraint is provided against expansion, contraction, or rotation of the construction are to include a description of the method used to provide the restraint.

4.3 A report of a test in which other than maximum load conditions were imposed is to fully define the conditions of loading used in the test, and the title of the report is to specify that a restricted load condition was used.

4.4 When the indicated resistance period is 1/2 hour or longer as determined by the average or maximum temperature rise on the unexposed surface or within the test specimen, or by failure under load, a correction is to be applied for variation of the furnace exposure from that specified, if it will affect the classification. The correction is to be applied by multiplying the indicated resistance period by two-thirds of the difference in area between the curve of average furnace temperature and the standard curve for the first three-fourths of the period. The product is to be divided by the area between the standard curve and a base line period, of 68°F (20°C) for the same part of the indicated period, the latter area increased by 54°F-hour or 30°C-hour (3240°F-minute or 1800°C-minute), 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 standard, the indicated resistance period is to be increased by the amount of the correction and is to be similarly decreased for fire exposure below standard. The correction can be expressed by the following formula:
\[ C = \frac{2I}{3} \left( \frac{A - A_s}{A_s + L} \right) \]

In which:

- \( C \) is the correction in the same unit as \( I \),
- \( I \) is the indicated fire-resistance period,
- \( A \) is the area under the curve of the measured average furnace temperature for the first three-fourths of the indicated period,
- \( A_s \) is the area under the standard furnace curve for the first three-fourths of the indicated period, and
- \( L \) is the lag correction in the same units as \( A \) and \( A_s \) \([54^\circ F\text{-hour or } 30^\circ C\text{-hour (3240^\circ F\text{-minute or } 1800^\circ C\text{-minute})}]\)

4.5 An unsymmetrical wall assembly may be tested with either side exposed to the fire, and the report is to indicate the side so exposed. Both sides may be tested, and the report is to indicate the fire endurance classification applicable to each side.

PERFORMANCE

5 General

5.1 Test specimen

5.1.1 The test specimen is to be representative of the construction for which classification is desired as to materials, workmanship, and details such as dimensions of parts, and is to be built under conditions representative of those practically applied in building construction and operation. The physical properties of the materials and ingredients used in the specimen are to be determined and recorded.

5.1.2 The size and dimensions of the test specimen as specified are intended to apply for rating constructions of dimensions within the usual general range employed in buildings. If the conditions of use limit the test specimens to smaller dimensions than specified, a proportionate reduction may be made in the dimensions of the specimens for a test qualifying them for such restricted use.

5.1.3 If it is desired to include a built-up roof covering, the test specimen is to have a roof covering of 3 ply, 15-pound type felt and not have in excess of 120 pounds per 100 square feet \((5.86 \text{ kg/m}^2)\) of hot mopping asphalt without gravel surfacing. Tests of assemblies with this covering do not preclude the field use of other built-up roof coverings.
5.2 Protection and conditioning of test specimen

5.2.1 The test specimen is to be protected during and after fabrication to provide normality of its quality and condition at the time of test. It is not to be tested until a large portion of its final strength has been attained, and, if it contains moisture, until the excess has been removed to achieve an air-dry condition in accordance with 5.2.2 – 5.2.6. The testing equipment and specimen undergoing the fire endurance test are to be protected from any condition of wind or weather that might lead to abnormal results. The ambient air temperature at the beginning of the test is to be within the range of 50 to 90°F (10 to 32°C). The velocity of air across the unexposed surface of the specimen, measured just before the test begins, is not to exceed 4.4 feet per second (1.3 m/s), as determined by an anemometer placed at right angles to the unexposed surface. If mechanical ventilation is employed during the test, an air stream is not to be directed across the surface of the specimen.

5.2.2 Prior to the fire endurance test, specimens are to be conditioned to provide, within a reasonable time, a moisture condition within the specimen approximately representative of that likely to exist in similar construction in buildings. This moisture condition is considered as that which would be established at equilibrium resulting from drying in an ambient atmosphere of 50 percent relative humidity of 73°F (23°C). However, with some specimens it may be difficult or impossible to achieve the equilibrium moisture condition within a reasonable period of time. Therefore, specimens may be tested when the dampest portion of the structure [the portion at 6 inch (152 mm) depth below the surface of massive constructions] has achieved a moisture content corresponding to drying to equilibrium with air in the range of 50 to 75 percent relative humidity at 73 ±5°F (23 ±3°C). If specimens dried in a heated building do not comply with these requirements after a 12-month conditioning period, or if the nature of the construction is such that drying of the specimen interior will be prevented by hermetic sealing, these requirements may be waived, except as to attainment of a large portion of final strength, and the specimen tested in the condition in which it then exists.

5.2.3 A method for determining the relative humidity within a hardened concrete specimen with electric sensing elements is described in Appendix I of a paper by Carl A. Menzel, "A Method for Determining the Moisture Condition of Hardened Concrete in Terms Relative Humidity," Proceedings, ASTM, Volume 55, page 1085 (1955). A similar procedure with electric sensing elements can be used to determine the relative humidity within fire test specimens made with other materials.

5.2.4 With wood construction, the moisture meter based on the electrical resistance method can be used, when appropriate, as an alternate to the relative humidity method to indicate when wood has attained the proper moisture content. Electrical methods are described on pages 3 – 22 of the 1974 edition of the "Wood Handbook of the Forest Products Laboratory," U.S. Department of Agriculture. The relationships between relative humidity and moisture content are given by Table 3 – 4 on page 3 – 8. The table indicates that wood has a moisture content of 13 percent at a relative humidity of 70 percent for a temperature of 70 to 80°F (21 to 27°C).

5.2.5 If, during the conditioning of the specimen, it appears desirable or is necessary to use accelerated drying techniques, it is the responsibility of the laboratory conducting the test to avoid procedures that will significantly alter the structural or fire endurance characteristics of the specimen, or both, from those produced as the result of drying in accordance with procedures specified in 5.2.2.
5.2.6 Within 72 hours prior to the fire test, information on the actual moisture content and distribution within the specimen is to be obtained. If the moisture condition of the fire test assembly is likely to change drastically from the 72 hour sampling condition prior to test, the sampling is to be made not later than 24 hours prior to the test. This information is to be included in the test report.

5.3 Conduct of fire endurance tests

5.3.1 The fire endurance test on the specimen with its applied load, if any, is to be continued until failure occurs or until the specimen has withstood the test conditions for a period equal to that specified in the conditions of acceptance for a given test.

5.3.2 The test may be continued beyond the time the fire endurance classification is determined for the purpose of obtaining additional performance data.

5.4 Conduct of hose stream test

5.4.1 If required by the conditions of acceptance, a duplicate specimen is to be subjected to a fire exposure test for a period equal to one-half of that indicated as the resistance period in the fire endurance test, but not for more than 1 hour, immediately after which the specimen is to be subjected to the impact, erosion, and cooling effects of a hose stream as specified in Table 5.1 directed first at the middle and then at all parts of the exposed face, with changes in direction being made slowly.

5.4.2 The hose stream test is not required in the case of constructions having a resistance period, indicated in the fire endurance test, of less than 1 hour.

5.4.3 The submitter may elect, with the advice and consent of the testing body, to have the hose stream test made on the specimen subjected to the fire endurance test and immediately following the expiration of the fire endurance test.

5.4.4 The stream is to be delivered through 2-1/2 inch (63.5 mm) hose and discharged through playpipe constructed in accordance with the Standard for Play Pipes for Water Supply Testing in Fire-Protection Service, UL 385. The playpipe is to be equipped with a 1-1/8 inch (28.6 mm) discharge tip of the standard-taper, smooth-bore pattern without a shoulder at the orifice. The water pressure and duration of application are to be as specified in Table 5.1.

5.4.5 The nozzle orifice is to be 20 feet (6.1 m) from the center of the exposed surface of the test specimen if the nozzle is so located that, when directed at the center, its axis is normal to the surface of the test specimen. If otherwise located, its distance from the center is to be less than 20 feet (6.1 m) by an amount equal to 1 foot (305 mm) for each 10 degrees of deviation from the normal.
Table 5.1
Pressure and duration of hose stream test

<table>
<thead>
<tr>
<th>Resistance period</th>
<th>Water pressure at base of nozzle, PSIG (kPa)</th>
<th>Duration of application, minutes per 100 square feet of exposed area (minutes per square meter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 hours and over</td>
<td>45 (310)</td>
<td>6 (0.65)</td>
</tr>
<tr>
<td>4 hours and over, if less than 8</td>
<td>45 (310)</td>
<td>5 (0.54)</td>
</tr>
<tr>
<td>2 hours and over, if less than 4</td>
<td>30 (207)</td>
<td>2-1/2 (0.27)</td>
</tr>
<tr>
<td>1-1/2 hours and over, if less than 2</td>
<td>30 (207)</td>
<td>1-1/2 (0.16)</td>
</tr>
<tr>
<td>1 hour and over, if less than 1-1/2</td>
<td>30 (207)</td>
<td>1 (0.11)</td>
</tr>
<tr>
<td>Less than 1 hour, if desired</td>
<td>30 (207)</td>
<td>1 (0.11)</td>
</tr>
</tbody>
</table>

6 Bearing Walls and Partitions Test

6.1 Application

6.1.1 This test procedure is applicable to bearing walls and partitions. For symmetrical walls, only one face of the wall is to be subjected to the fire exposure. Unsymmetrical wall assemblies are tested with either side exposed to the fire, and the report shall indicate the side so exposed. When both sides are tested, the report then shall so indicate the fire endurance classification applicable to each side. The classification for the bearing wall and partition is to be based upon the Conditions of Acceptance, see 6.4.

6.2 Size and character of specimen

6.2.1 The area exposed to fire is to be not less than 100 square feet (9.3 m²), with neither dimension less than 9 feet (2.7 m). The test specimen is not to be restrained on its vertical edges.

6.2.2 The specimen is to be installed in accordance with the fabrication procedures for the types and constructions and is to be representative of the design that the test is intended to examine.

6.3 Loading

6.3.1 During the fire endurance test and the fire and hose stream test, a superimposed load is to be applied to the specimen to simulate a maximum load condition. The maximum load condition is to be as nearly as practicable the maximum load allowed by the limiting condition of design under nationally recognized structural design criteria. The tests may also be conducted by applying to the specimen a load less than the maximum. Such tests are to be identified in the test report as having been conducted under restricted-load conditions. The applied load, and the applied load expressed as a percentage of the maximum allowable design load, are to be included in the report.

6.3.2 A double wall may be tested either with each side loaded separately or both sides loaded together, depending on the intended use and whether the load on the exposed side will be transferred, after failure, to the unexposed side. The method used is to be recorded.
6.4 Conditions of acceptance

6.4.1 During the tests, the construction shall have complied with the following conditions:

a) The wall or partition shall have sustained the applied load during the classification period without passage of flame or passage of gases hot enough to ignite cotton waste.

b) The wall or partition shall have sustained the applied load during the hose stream test without development of an opening that would permit a projection of water from the hose stream beyond the unexposed surface.

c) Transmission of heat through the wall or partition during the classification period shall not have raised the temperature on its unexposed surface to more than 250°F (139°C) above its initial temperature.

7 Nonbearing Walls and Partitions Test

7.1 Application

7.1.1 This test procedure is applicable to nonbearing walls and partitions. For symmetrical walls, only one face of the wall is to be subjected to the fire exposure. Usymmetrical wall assemblies are tested with either side exposed to the fire, and the report shall indicate the side so exposed. When both sides are tested, the report then shall so indicate the fire endurance classification applicable to each side. The classification of the nonbearing wall and partition is to be based upon the Conditions of Acceptance, see 7.3.

7.2 Size and character of specimen

7.2.1 The area exposed to fire is to be not less than 100 square feet (9.3 m²), with neither dimension less than 9 feet (2.7 m). The test specimen is to be restrained on all four edges.

7.2.2 The specimen is to be installed in accordance with the fabrication procedures for the type of construction and is to be representative of the design that the test is intended to examine.

7.3 Conditions of acceptance

7.3.1 During the tests, the construction shall have complied with the following conditions:

a) The wall or partition shall have sustained the fire endurance test without passage of flame or passage of gases hot enough to ignite cotton waste during the classification period.

b) The wall or partition shall have sustained the hose stream test without development of an opening that would permit a projection of water from the hose stream beyond the unexposed surface.

c) Transmission of heat through the wall or partition during the classification period shall not have raised the temperature on its unexposed surface to more than 250°F (139°C) above its initial temperature.
8 Columns Test

8.1 Application

8.1.1 This test procedure is applicable to loaded column specimens. The test procedure is to be used whenever the protective material is designed to carry any of the column load.

8.2 Size and character of specimen

8.2.1 If practicable, the length of the column exposed to fire is to approximate the maximum clear length contemplated by the design. For columns that have a design length in excess of 9 feet (2.7 m), the specimen length shall not be less than 9 feet (2.7 m). The details for column connections and their protection, if any, are to be applied in accordance with the methods of standard field practice.

8.3 Loading

8.3.1 During the fire endurance test, the column is to be loaded. This load is to be the maximum load condition allowed under nationally recognized structural design criteria unless limited design criteria are specified and a corresponding reduced load is applied. Provision is to be made for transmitting the load to the exposed portion of the column without increasing the effective column length.

8.3.2 If the submitter and the testing body agree, the column may be subjected to 1-3/4 times its designed working load before the fire endurance test. This stress-loading test is not to be construed as having had a deleterious effect on the fire endurance test performance.

8.4 Exposure to fire

8.4.1 During the fire endurance test, the specimen is to be exposed to fire on all sides for its full length.

8.5 Conditions of acceptance

8.5.1 The column shall have sustained the applied load during the fire endurance test for a period equal to that for which classification is desired.

9 Alternate Test – Protection for Structural Steel Columns

9.1 Application

9.1.1 This test does not require column loading at any time and may be used at the discretion of the testing laboratory to evaluate steel column protections that are not required by design to carry any of the column load.
9.2 Size and character of specimen

9.2.1 The size of the steel column used is to provide a test specimen that is representative of the design, materials, and workmanship for which classification is desired. The protection material is to be applied to the specimen in accordance with methods of acceptable field practice. The length of the protected column is to be at least 8 feet (2.4 m). The column is to be vertical during the application of the protection and during the fire exposure test.

9.2.2 The applied protection material is to be restrained against longitudinal temperature expansion greater than that of the steel column by attaching rigid steel plates or reinforced concrete to the ends of the steel column before the protection material is applied. The size of the plates or concrete is to provide direct bearing for the entire transverse area of the protection.

9.2.3 The ends of the specimen, including the means for restraint, are to be given sufficient thermal insulation to prevent appreciable direct heat transfer through the ends of the column.

9.3 Temperature measurement

9.3.1 The temperature of the steel in the column is to be measured by at least three thermocouples located at each of four levels. The upper and lower levels are to be 2 feet (610 mm) from the ends of the steel column, and the other two intermediate levels are to be equally spaced. The thermocouples at each level are to be placed to measure significant temperatures of the component elements of the steel section.

9.4 Exposure to fire

9.4.1 During the fire endurance test, the specimen is to be exposed to fire on all sides for its full length.

9.5 Conditions of acceptance

9.5.1 The transmission of heat through the protection during the period of fire exposure for which classification is desired shall not raise the average (arithmetical) temperature of the steel at any one of the four levels above 1000°F (538°C), or above 1200°F (649°C) at any one of the measured points.

9.6 Report of results

9.6.1 The test report shall state that the column was not loaded during the fire exposure.

9.6.2 The test report shall state that the protection provided to the column was not designed to function structurally in resisting applied loads.
10 Floor and Roof Assemblies Test

10.1 Application

10.1.1 This test is applicable to floor and roof assemblies with or without attached, furred, or suspended ceilings and requires application of fire exposure to the underside of the specimen under test.

10.1.2 Two fire endurance classifications are to be developed for assemblies restrained against thermal expansion:

   a) A restrained assembly classification based upon the conditions of acceptance specified in 10.5.1.

   b) An unrestrained assembly classification based upon the conditions of acceptance specified in 10.6.1.

Note: See Nonmandatory Guide for Determining Condition of Restraint for Floor and Assemblies and for Individual Beams, Appendix C, as a guide in determining the conditions of thermal restraint applicable to floor and roof constructions and individual beams in actual building construction.

10.1.3 One fire endurance classification is to be developed from tests of assemblies not restrained against thermal expansion based upon the conditions of acceptance specified in 10.6.1(a) and 10.6.1(b).

10.1.4 Individual unrestrained classifications may be developed for beams tested in accordance with this test using the conditions of acceptance specified in 12.2.1.

10.2 Size and character of specimen

10.2.1 The area exposed to fire is not to be less than 180 square feet (16.7 m²), with neither dimension less than 12 feet (3.7 m). Structural members, if a part of the construction under test, are to lie within the combustion chamber and have a side clearance of not less than 8 inches (203 mm) from its walls.

10.2.2 The specimen is to be installed in accordance with recommended fabrication procedures for the type of construction and shall be representative of the design that the test is intended to examine. Where a restrained classification is desired, specimens representing forms of construction in which restraint to thermal expansion occurs are to be reasonably restrained in the furnace.
10.3 Loading

10.3.1 Throughout the fire endurance test a superimposed load is to be applied to the specimen to simulate a maximum load condition. The maximum load condition is to be as nearly as practicable the maximum load allowed by the limiting condition of design under nationally recognized structural design criteria. A fire endurance test may be conducted by applying to the specimen a load less than the maximum. Such tests shall be identified in the test report as having been conducted under restricted-load conditions. The applied load, and the applied load expressed as a percentage of the maximum allowable design load, is to be included in the report.

10.4 Temperature measurement

10.4.1 For specimens employing structural members (beams, open-web steel joists, or the like) spaced at more than 4 feet (1.2 m) on centers, the steel temperature of these structural members is to be measured by thermocouples at three or more sections spaced along the length of the members, with one section preferably located at mid-span; except that, in cases where the cover thickness is not uniform along the specimen length, at least one of the sections at which temperatures are measured is to include the point of minimum cover.

10.4.2 For specimens employing structural steel members (beams, open-web steel joists, or the like) spaced at 4 feet (1.2 m) or less on centers, the temperature of the steel in the structural members is to be measured by four thermocouples placed on each member; except that not more than four members are to be so instrumented. The groups of four thermocouples are to be placed in significant locations, such as at mid-span, over joints in the ceiling, over light fixtures, and the like.

10.4.3 For steel structural members, there are to be four thermocouples at each section; except that, if only four thermocouples are required on a member, the thermocouples may be distributed along the member in accordance with the requirement in 10.4.2. The thermocouples are to be located as follows:

a) Two on the bottom of the bottom flange or chord, one at the edge and one at the center,

b) One on the web at the center, and

c) One on the bottom of the top flange or chord.

See Figure 10.1.
10.4.4 For reinforced or prestressed concrete structural members, thermocouples are to be located on each side of the tension reinforcing elements unless there are more than eight such elements, in which case thermocouples are to be placed on eight elements selected in such a manner as to obtain representative temperatures of all the elements.

10.4.5 For steel floor or roof units, four thermocouples are to be located on each section (a section is to comprise the width of one unit), one on the bottom plane of the unit at an edge joint, one on the bottom plane of the unit remote from the edge, one on a side wall of the unit, and one on the top plane of the unit. The thermocouples are to be applied, if practicable, to the surface of the units remote from fire and are to be spaced across the width of the unit. No more than four nor less than two sections are to be so instrumented in each representative span. The groups of four thermocouples are to be located in representative locations. Typical thermocouple locations for a unit section are illustrated in Figure 10.2.
Figure 10.2
Typical locations of thermocouples on steel floor or roof units

Fluted Unit

Cellular Unit

Cellular Unit

S2618
10.5 Conditions of acceptance – restrained assembly

10.5.1 To obtain a restrained assembly classification, the assembly shall have complied with the following conditions:

   a) The specimen shall have sustained the applied load during the classification period without developing unexposed surface conditions which will ignite cotton waste.

   b) Transmission of heat through the specimen during the classification period shall not have raised the average temperature on its unexposed surface to more than 250°F (139°C) above its initial temperature.

   c) For specimens employing steel structural members (beams, open-web steel joists, or the like) spaced more than 4 feet (1.2 m) on centers, the assembly shall achieve a fire endurance classification on the basis of the temperature criteria specified in 10.6.1(c), for assembly classifications up to and including 1 hour. For classifications greater than 1 hour, this temperature criteria applies for a period of one-half the classification of the assembly or for 1 hour, whichever is the greater.

   d) For specimens employing steel structural members (beams, open-web steel joists, or the like) spaced 4 feet (1.2 m) or less on centers, the assembly shall achieve a fire endurance classification on the basis of the temperature criteria specified in 10.6.1(d), for assembly classifications up to and including 1 hour. For classifications greater than 1 hour, this temperature criteria applies for a period of one-half the classification of the assembly or for 1 hour, whichever is the greater.

   e) For specimens employing conventionally designed concrete beams, spaced more than 4 feet (1.2m) on centers, the assembly shall achieve a fire endurance classification on the basis of the temperature criteria specified in 10.6.1(e), for assembly classifications up to and including 1 hour. For classifications greater than 1 hour, this temperature criteria applies for a period of one-half the classification of the assembly or for 1 hour, whichever is the greater.

10.6 Conditions of acceptance – unrestrained assembly

10.6.1 To obtain an unrestrained assembly classification, the assembly shall have complied with the following conditions:

   a) The specimen shall have sustained the applied load during the classification period without developing unexposed surface conditions which will ignite cotton waste.

   b) The transmission of heat through the specimen during the classification period shall not have raised the average temperature on its unexposed surface to more than 250°F (139°C) above its initial temperature.

   c) For specimens employing steel structural members (beams, open-web steel joists, or the like), spaced more than 4 feet (1.2 m) on centers, the temperature of the steel shall not have exceeded 1300°F (704°C) at any location during the classification period nor shall the average temperature recorded by four thermocouples at any section have exceeded 1100°F (593°C) during this period.

   d) For specimens employing steel structural members (beams, open-web steel joists, or the like), spaced 4 feet (1.2 m) or less on centers, the average temperature recorded by all joist or beam thermocouples shall not have exceeded 1100°F (593°C) during the classification period.
e) For specimens employing concrete structural members (excluding cast-in-place concrete roof or floor slabs having spans equal to or less than those tested), the average temperature of the tension steel at any section shall not have exceeded 800°F (427°C) for cold-drawn prestressing steel or 1100°F (593°C) for reinforcing steel during the classification period.

f) For specimens employing steel floor or roof units intended for use in spans greater than those tested, the average temperature recorded by all thermocouples located on any one span of the floor or roof units shall not have exceeded 1100°F (593°C) during the classification period.

11 Loaded Restrained Beams Test

11.1 Application

11.1.1 An individual classification of a restrained beam may be obtained by this test and based upon the conditions of acceptance specified in 11.5.1. The fire endurance classification is applicable to the beam when used with a floor or roof construction that has a comparable or greater capacity for heat dissipation from the beam than the floor or roof with which it was tested. The fire endurance classification developed by this method is not applicable to sizes of beams smaller than those tested.

11.2 Size and character of specimen

11.2.1 The test specimen is to be installed in accordance with recommended fabrication procedures for the type of construction and is to be representative of the design that the test is intended to examine. The length of beam exposed to the fire is to be not less than 12 feet (3.7 m), and the member is to be tested in its normal horizontal position. A section of a representative floor or roof construction, not more than 7 feet (2.1 m) wide, symmetrically located with reference to the beam, may be included with the test specimen and exposed to the fire from below. The beam, including that part of the floor or roof element forming the complete beam as constructed, such as composite steel or concrete construction, is to be restrained against longitudinal thermal expansion to simulate the restraint in the construction represented. The perimeter of the floor or roof element of the specimen, except that part forming part of a beam as constructed, is not to be supported or restrained.

11.3 Loading

11.3.1 Throughout the fire endurance test, a superimposed load is to be applied to the specimen. This load is to be the maximum load condition allowed under nationally recognized structural design criteria unless limited design criteria are specified and a corresponding reduced load is applied.
11.4 Temperature measurement

11.4.1 The temperature of the steel in structural members is to be measured by thermocouples at three or more sections spaced along the length of the members with one section located at mid-span; except that in cases where the cover thickness is not uniform along the specimen length, at least one of the sections at which temperatures are measured is to include the point of minimum cover.

11.4.2 For steel beams, there are to be four thermocouples at each section; two are to be located on the bottom of the bottom flange, one on the web at the center, and one on the bottom of the top flange.

11.4.3 For reinforced or prestressed concrete structural members, thermocouples are to be located on each of the tension reinforcing elements unless there are more than eight such elements, in which case thermocouples are to be placed on eight elements selected to obtain representative temperatures of all elements.

11.4.4 For steel structural members, there are to be four thermocouples at each section. The thermocouples are to be located as follows:

a) Two on the bottom flange or chord, one at the edge and one at the center,

b) One on the web at the center, and

c) One on the bottom of the top flange or chord.

11.5 Conditions of acceptance

11.5.1 To obtain a restrained beam classification, the specimen shall have complied with the following conditions:

a) The specimen shall have sustained the applied load during the classification period.

b) The specimen shall have achieved a fire endurance classification as follows for one-half the classification period or 1 hour, whichever is the greater:

1) For specimens employing steel structural members (beams, open-web steel joists, or the like), the temperature of the steel shall not have exceeded 1300°F (704°C) at any location during the classification period nor shall the average temperature recorded by four thermocouples at any section have exceeded 1100°F (593°C) during this period.

2) For specimens employing concrete structural members (excluding cast-in-place concrete roof or floor slabs having spans equal to or less than those tested), the average temperature of the tension steel at any section shall not have exceeded 800°F (427°C) for cold-drawn prestressing steel or 1100°F (593°C) for reinforcing steel during the classification period.

11.5.2 To obtain an unrestrained beam classification, the specimen shall have complied with the following conditions:

a) The specimen shall have sustained the applied load during the classification period.

b) The specimen shall have achieved a fire endurance classification as follows for the classification period:
1) For specimens employing steel structural members (beams, open-web steel joists, or the like), the temperature of the steel shall not have exceeded 1300°F (704°C) at any location during the classification period nor shall the average temperature recorded by four thermocouples at any section have exceeded 1100°F (593°C) during this period.

2) For specimens employing concrete structural members (excluding cast-in-place concrete roof or floor slabs having spans equal to or less than those tested), the average temperature of the tension steel at any section shall not have exceeded 800°F (421°C) for cold-drawn prestressing steel or 1100°F (593°C) for reinforcing steel during the classification period.

12 Alternate Test – Protection for Loaded Beams

12.1 Application

12.1.1 Individual unrestrained beam classifications may be developed for beams tested as part of a floor or roof assembly as described in 10.1.1, 10.1.2, and 10.1.4 – 10.4.5. An individual restrained beam classification is not developed for beams tested as part of a floor or roof assembly.

12.2 Conditions of acceptance

12.2.1 To obtain an unrestrained beam classification for a beam tested as part of a floor or roof assembly, the specimen shall have complied with the following conditions:

   a) The specimen shall have sustained the applied load during the classification period.

   b) For steel beams, the temperature of the steel shall not have exceeded 1300°F (704°C) at any location during the classification period nor shall the average temperature recorded by four thermocouples at any section have exceeded 1100°F (593°C) during this period.

   c) For concrete beams, the average temperature of the tension steel at any section shall not have exceeded 800°F (421°C) for cold-drawn prestressing steel or 1100°F (593°C) for reinforcing steel during the classification period.

13 Alternate Test – Protection for Solid Structural Steel Beams and Girders

13.1 Application

13.1.1 If the loading required in 10.3.1 or 11.3.1 is not feasible, this alternate test may be used to evaluate the protection of steel beams and girders without application of design load, provided that the protection is not required by design to function structurally in resisting applied loads. The conditions of acceptance of this alternate test are not applicable to tests made under design load as provided under tests of floors and roofs in 10.1.1 – 10.2.2, 10.5.1, and 10.6.1 or provided under tests of loaded restrained beams in 11.1.1, 11.2.1, and 11.4.1.
13.2 Size and character of specimen

13.2.1 The size of the steel beam or girder is to provide a test specimen that is representative of the design that the test is intended to examine. The protection is to be applied according to the methods of acceptable field practice, and the projection below the ceiling, if any, is to be representative of the conditions of intended use. The length of beam or girder exposed to the fire is to be not less than 12 feet (3.7 m), and the member is to be tested in a horizontal position. A section of floor construction not less than 5 feet (1.5 m) wide, symmetrically located with reference to the beam or girder, and extending its full length, is to be included in the test assembly and exposed to fire from below. The rating of performance is not applicable to sizes smaller than those tested.

13.2.2 The applied protection material is to be restrained against longitudinal temperature expansion greater than that of the steel beam or girder by attaching rigid steel plates or reinforced concrete to the ends of the member before the protection material is applied.

13.2.3 The ends of the member, including the means for restraint, are to be given sufficient thermal insulation to prevent appreciable direct heat transfer to the unexposed ends of the member or from the ends of the member to the outside of the furnace.

13.3 Temperature measurement

13.3.1 The temperature of the steel in the beam or girder is to be measured with not less than four thermocouples at each of four sections equally spaced along the length of the beam, symmetrically disposed, and not nearer than 2 feet (610 mm) from the inside face of the furnace. The thermocouples of each section are to be symmetrically placed so as to measure significant temperatures of the component elements of the steel section.

13.4 Conditions of acceptance

13.4.1 The transmission of heat through the protection during the period of fire exposure for which classification is desired shall not raise the average (arithmetical) temperature of the steel at any one of the four sections above 1000°F (538°C) or above 1200°F (649°C) at any one of the measured points.

13.5 Report of results

13.5.1 The test report shall state that the beam or girder was not loaded during the fire exposure.

13.5.2 The test report shall state that the protection provided to the beam or girder was not designed to function structurally in resisting applied loads.
14 Tests of Protective Membranes in Wall, Partition, Floor, or Roof Assemblies

14.1 Application

14.1.1 This test is to be used for determining the thermal protection afforded by membrane elements in wall, partition, floor, or roof assemblies. The nonstructural performance of protective membranes is to be obtained by following the procedure described in 14.2.1 – 14.4.1. The performance of protective membranes is supplementary information only and is not a substitute for the fire endurance classification determined in Sections 6 – 13 of this standard.

14.2 Size and character of specimen

14.2.1 The area of a wall and partition protection specimen exposed to fire is to be not less than 100 square feet (9.3 m²), with neither dimension less than 9 feet (2.7 m); the exposed area of a floor protection specimen is to be not less than 180 square feet (16.7 m²), with neither dimension less than 12 feet (3.7 m).

14.2.2 The test specimen is to include all elements of the construction which will influence the transmission of heat through the assembly.

14.3 Temperature performance of protective membranes

14.3.1 The temperature performance of protective membranes is to be measured with thermocouples.

14.3.2 When the protective membrane is in contact with the element being protected, the temperature performance of the protective membrane is to be measured with the measuring junction of the thermocouples inserted between and in intimate contact with the membrane and the element being protected. When the protective membrane is not in contact with the element being protected, the thermocouple junction is to be attached and in intimate contact with the element being protected. The diameter of the wires used to form the thermojunction is not to be greater than the thickness of sheet metal framing or panel members to which they are attached and in no case greater than No. 18 B&S gage [0.040 inch (1.02 mm)]. The lead shall be electrically insulated with heat- and moisture-resistant coatings.

14.3.3 For each class of elements being protected, temperature readings are to be taken at not less than five representative points. None of the thermocouples are to be located nearer the edges of the test assembly than 12 inches (305 mm). An exception can be made in those cases where there is an element or feature of the construction that is not otherwise represented in the test assembly. None of the thermocouples are to be located opposite, on top of, or adjacent to fasteners such as screws, nails, or staples.

14.3.4 Thermocouples are to be located to obtain representative information on the temperatures of the element being protected at its surface nearest the fire.

14.3.5 Temperature readings are to be taken at intervals not exceeding 5 minutes.
14.4 Conditions of acceptance

14.4.1 Unless otherwise specified, the performance of protective membranes is to be determined as the time at which the following conditions occur:

   a) The average temperature rise of any set of thermocouples for each class of element being protected is more than 250°F (139°C) above the initial temperature, or

   b) The temperature rise of any one thermocouple of the set for each class of element being protected is more than 325°F (181°C) above the initial temperature.

14.5 Report of results

14.5.1 The protective membrane performance for each class of element being protected shall be reported to the nearest integral minute.

14.5.2 The test report shall identify each class of elements being protected and shall show the location of each thermocouple.

14.5.3 The test report shall show the time-temperature data recorded for each thermocouple and the average temperature for the set of thermocouples on each element being protected.

14.5.4 The test report shall record any visual observations that are pertinent to the performance of the protective membrane.
No Text on This Page
APPENDIX A

Standard Time-Temperature Curve for Control of Fire Tests

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<thead>
<tr>
<th>Time, hr: min.</th>
<th>Temperature, degrees F</th>
<th>Area above 68°F base</th>
<th>Temperature, degrees C</th>
<th>Area above 20°C base</th>
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<td>degrees C hr.</td>
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<td>907 960</td>
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<td>502 420</td>
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APPENDIX B

Requirements for Thermocouple Pads

B1.1 Refractory fiber material\(^a\) is to be used as a thermocouple pad when distortion of the unexposed face of the test specimen will be insignificant. Such material is not to be used on surfaces subject to sharp distortions or discontinuities during the test. A pad formed from this material is to have the following characteristics:

a) Length and width - 6 ±1/8 (152 ±3 mm).

b) Thickness\(^b\) - 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\(^c\) (on soft face) - 2.25 to 4.5 (modified Brinnell).

\(^a\)Johns-Manville Ceraform 126, or the equivalent, complies with these specifications.

\(^b\)The 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.

\(^c\)The 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 pounds-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,
APPENDIX C

Nonmandatory Guide for Determining Conditions of Restraint for Floor and Roof Assemblies and for Individual Beams

C1.1 Revisions adopted in 1970 introduced the concept of fire endurance classifications based on two conditions of support: restrained and unrestrained. As a result, specimens are fire tested to derive these two classifications.

C1.2 In fire tests, a restrained condition, as used in this standard, is one in which expansion at the supports of a load-carrying element resulting from the effects of the fire is resisted by forces external to the element. An unrestrained condition is one in which the load-carrying element is free to expand and rotate at its supports.

C1.3 This guide is based on knowledge currently available and classifies all constructions as either restrained or unrestrained. This classification will enable the architect, engineer, or building official to correlate the fire endurance classification, based on conditions of restraint, with the construction type under consideration. While it has been shown that certain conditions of restraint will improve fire endurance, methodologies for establishing the presence of sufficient restraint in actual constructions have not been standardized.

C1.4 For the purpose of this Guide, restraint in buildings is defined as follows:

Floor and roof assemblies and individual beams in buildings shall be considered restrained when the surrounding or supporting structure is capable of resisting substantial thermal expansion throughout the range of anticipated elevated temperatures. Constructions not complying with this definition are assumed to be free to rotate and expand and shall therefore be considered as unrestrained.

C1.5 The definition in C1.4 requires the exercise of engineering judgment to determine what constitutes restraint to “substantial thermal expansion.” Restraint may be provided by the lateral stiffness of supports for floor and roof assemblies and intermediate beams forming part of the assembly. In order to develop restraint, connections must adequately transfer thermal thrusts to such supports. The rigidity of adjoining panels or structures should be considered in assessing the capability of a structure to resist thermal expansion. Continuity, such as that occurring in beams acting continuously over more than two supports, will induce rotational restraint which will usually add to the fire resistance of structural members. In Table C1.1 only the common types of constructions are listed. Having these examples in mind, as well as the philosophy expressed in the preamble, the user should be able to rationalize the less common types of construction.

C1.6 The foregoing methods of determining the presence or absence of restraint, according to the type and detail of construction, represent only one procedure for establishing dual fire endurance classifications. This procedure alone does not represent all restrained and unrestrained construction conditions.
Table C1.1
Considerations of restraint for common construction

<table>
<thead>
<tr>
<th>I. Wall Bearing:</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>A. Single span and simply supported end spans of multiple bays. a</td>
<td></td>
</tr>
<tr>
<td>1. Open-web steel joists or steel beams supporting concrete slab, precast units, or metal decking.</td>
<td>Unrestrained</td>
</tr>
<tr>
<td>2. Concrete slabs, precast units, or metal decking.</td>
<td>Unrestrained</td>
</tr>
<tr>
<td>B. Interior spans of multiple bays.</td>
<td></td>
</tr>
<tr>
<td>1. Open-web steel joists, steel beams, or metal decking supporting continuous concrete slab.</td>
<td>Restrained</td>
</tr>
<tr>
<td>2. Open-web steel joists or steel beams, supporting precast units or metal decking.</td>
<td>Unrestrained</td>
</tr>
<tr>
<td>3. Cast-in-place concrete slab systems.</td>
<td>Restrained</td>
</tr>
<tr>
<td>4. Precast concrete where the potential thermal expansion is resisted by adjacent construction. b</td>
<td>Restrained</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>II. Steel Framing:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Steel beams welded, riveted, or bolted to the framing members.</td>
<td>Restrained</td>
</tr>
<tr>
<td>B. All types of cast-in-place floor and roof systems (such as beam-and-slabs, flat slabs, panel joists, and waffle slabs) where the floor or roof system is secured to the framing members.</td>
<td>Restrained</td>
</tr>
<tr>
<td>C. All types of prefabricated floor or roof systems where the structural members are secured to the framing members and the potential thermal expansion of the floor or roof system is resisted by the framing system or the adjoining floor or roof construction. b</td>
<td>Restrained</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>III. Concrete Framing:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Beams securely fastened to the framing members.</td>
<td>Restrained</td>
</tr>
<tr>
<td>B. All types of cast-in-place floor or roof systems, such as beam-and-slabs, flat slabs, panel joists, and waffle slabs, where the floor system is cast with the framing members.</td>
<td>Restrained</td>
</tr>
<tr>
<td>C. Interior and exterior spans of precast systems with cast-in-place joints resulting in restraint equivalent to that which would exist in Condition III, item A.</td>
<td>Restrained</td>
</tr>
<tr>
<td>D. All types of prefabricated floor or roof systems where the structural members are secured to such systems and the potential thermal expansion of the floor or roof system is resisted by the framing system or the adjoining floor or roof construction. b</td>
<td>Restrained</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>IV. Wood Construction:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. All types.</td>
<td>Unrestrained</td>
</tr>
</tbody>
</table>

a Floor and roof systems can be considered restrained if they are tied into walls with or without tie beams, and the walls are designed and detailed to resist thermal thrust from the floor or roof system.

b For example, resistance to potential thermal expansion is considered to be achieved if:

1. Continuous structural concrete topping is used.
2. The space between the ends of precast units or between the ends of units and the vertical face of supports is filled with concrete or mortar.
3. The space between the ends of precast units and the vertical faces of supports or between the ends of solid or hollow core slab units does not exceed 0.25 percent of the length for normal-weight concrete members or 0.1 percent of the length for structural lightweight concrete members.
resistance of the column shall be continuous from the top of the foundation or floor/ceiling assembly below through the ceiling space to the top of the column.

714.2.3 Truss protection. The required thickness and construction of fire-resistance-rated assemblies enclosing trusses shall be based on the results of full-scale tests or combinations of tests on truss components or on approved calculations based on such tests that satisfactorily demonstrate that the assembly has the required fire resistance.

714.2.4 Attachments to structural members. The edges of lugs, brackets, rivets and bolt heads attached to structural members shall be permitted to extend to within 1 inch (25 mm) of the surface of the fire protection.

714.2.5 Reinforcing. Thickness of protection for concrete or masonry reinforcement shall be measured to the outside of the reinforcement except that stirrups and spiral reinforcement ties are permitted to project not more than 0.5-inch (12.7 mm) into the protection.

714.3 Embedments and enclosures. Pipes, wires, conduits, ducts or other service facilities shall not be embedded in the required fire protective covering of a structural member that is required to be individually encased.

714.4 Impact protection. Where the fire protective covering of a structural member is subject to impact damage from moving vehicles, the handling of merchandise or other activity, the fire protective covering shall be protected by corner guards or by a substantial jacket of metal or other noncombustible material to a height adequate to provide full protection, but not less than 5 feet (1524 mm) from the finished floor.

714.5 Exterior structural members. Load-bearing structural members located within the exterior walls or on the outside of a building or structure shall be provided with the highest fire-resistance rating as determined in accordance with the following:

1. As required by Table 601 for the type of building element based on the type of construction of the building;
2. As required by Table 601 for exterior bearing walls based on the type of construction; and
3. As required by Table 602 for exterior walls based on the fire separation distance.

714.6 Bottom flange protection. Fire protection is not required at the bottom flange of lintels, shelf angles and plates, spanning not more than 6 feet (1829 mm) whether part of the structural frame or not, and from the bottom flange of lintels, shelf angles and plates not part of the structural frame, regardless of span.

714.7 Seismic isolation systems. Fire-resistance ratings for the isolation system shall meet the fire-resistance rating required for the columns, walls or other structural elements in which the isolation system is installed in accordance with Table 601.

Isolation systems required to have a fire-resistance rating shall be protected with approved materials or construction assemblies designed to provide the same degree of fire resistance as the structural element in which it is installed when tested in accordance with ASTM E 119 (see Section 703.2).

Such isolation system protection applied to isolator units shall be capable of retarding the transfer of heat to the isolator unit in such a manner that the required gravity load-carrying capacity of the isolator unit will not be impaired after exposure to the standard time-temperature curve fire test prescribed in ASTM E 119 for a duration not less than that required for the fire-resistance rating of the structure element in which it is installed.

Such isolation system protection applied to isolator units shall be suitably designed and securely installed so as not to dislodge, loosen, sustain damage or otherwise impair its ability to accommodate the seismic movements for which the isolator unit is designed and to maintain its integrity for the purpose of providing the required fire-resistance protection.

SECTION 715
OPENING PROTECTIVES

715.1 General. Opening protective required by other sections of this code shall comply with the provisions of this section.

715.2 Fire-resistance-rated glazing. Labeled fire-resistance-rated glazed tested as part of a fire-resistance-rated wall assembly in accordance with ASTM E 119 shall not be required to comply with this section.

715.3 Alternative methods for determining fire protection ratings. The application of any of the alternative methods listed in this section shall be based on the fire exposure and acceptance criteria specified in NFPA 252 or NFPA 257. The required fire resistance of an opening protective shall be permitted to be established by any of the following methods or procedures:

1. Designs documented in approved sources.
2. Calculations performed in an approved manner.
3. Engineering analysis based on a comparison of opening protective designs having fire-protection ratings as determined by the test procedures set forth in NFPA 252 or NFPA 257.
4. Alternative protection methods as allowed by Section 104.11.

715.4 Fire door and shutter assemblies. Approved fire door and fire shutter assemblies shall be constructed of any material or assembly of component materials that conforms to the test requirements of Section 715.4.1, 715.4.2 or 715.4.3 and the fire-protection rating indicated in Table 715.4. Fire door assemblies and shutters shall be installed in accordance with the provisions of this section and NFPA 80.

Exceptions:

1. Labeled protective assemblies that conform to the requirements of this section or UL 10A, UL 14B and UL 14C for tin-clad fire door assemblies.
2. Floor fire door assemblies in accordance with Section 711.8.

715.4.1 Side-hinged or pivoted swinging doors. Side-hinged and pivoted swinging doors shall be tested in accordance with NFPA 252 or UL 10C. After 5 minutes into
the NFPA 252 test, the neutral pressure level in the furnace shall be established at 40 inches (1016 mm) or less above the sill.

715.4.2 Other types of doors. Other types of doors, including swinging elevator doors, shall be tested in accordance with NFPA 252 or UL 10B. The pressure in the furnace shall be maintained as nearly equal to the atmospheric pressure as possible. Once established, the pressure shall be maintained during the entire test period.

715.4.3 Door assemblies in corridors and smoke barriers. Fire door assemblies required to have a minimum fire protection rating of 20 minutes where located in corridor walls or smoke-barrier walls having a fire-resistance rating in accordance with Table 715.4 shall be tested in accordance with NFPA 252 or UL 10C without the hose stream test.

Exceptions:
1. Viewports that require a hole not larger than 1 inch (25 mm) in diameter through the door, have at least a 0.25-inch-thick (6.4 mm) glass disc and the holder is of metal that will not melt out where subject to temperatures of 1,700°F (927°C).
2. Corridor door assemblies in occupancies of Group I-2 shall be in accordance with Section 407.3.1.
3. Unprotected openings shall be permitted for corridors in multiplexer complexes where each motion picture auditorium has at least one-half of its required exit or exit access doorways opening directly to the exterior or into an exit passageway.

715.4.3.1 Smoke and draft control. Fire door assemblies shall also meet the requirements for a smoke and draft control door assembly tested in accordance with UL 1784. Louvers shall be prohibited. Installation of smoke doors shall be in accordance with NFPA 105.

TABLE 715.4
FIRE DOOR AND FIRE SHUTTER FIRE PROTECTION RATINGS

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<th>TYPE OF ASSEMBLY</th>
<th>REQUIRED ASSEMBLY RATING</th>
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<td>Fire walls and fire barriers having a required fire-resistance rating greater than 1 hour</td>
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<td>1/2</td>
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<td>Fire barriers having a required fire-resistance rating of 1 hour:</td>
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<td>Shaft, exit enclosure and exit passageway walls</td>
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<td>Other fire barriers</td>
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<td>Fire partitions:</td>
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<td>Corridor walls</td>
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<tr>
<td>Smoke barriers</td>
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<th>FUTURE FIRE DOOR AND FIRE SHUTTER ASSEMBLY RATING (hours)</th>
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</tr>
<tr>
<td>1/4</td>
</tr>
</tbody>
</table>

a. Two doors, each with a fire protection rating of 1/2 hours, installed on opposite sides of the same opening in a fire wall, shall be deemed equivalent in fire protection rating to one 3-hour fire door.

b. For testing requirements, see Section 715.3.3.

2006 INTERNATIONAL BUILDING CODE®
715.4.5.1 Fire door labeling requirements. Fire doors shall be labeled showing the name of the manufacturer, the name of the third-party inspection agency, the fire protection rating and, where required for fire doors in exit enclosures and exit passageways by Section 715.4.4, the maximum transmitted temperature end point. Smoke and draft control doors complying with UL 1784 shall be labeled as such. Labels shall be approved and permanently affixed. The label shall be applied at the factory or location where fabrication and assembly are performed.

715.4.5.2 Oversized doors. Oversized fire doors shall bear an oversized fire door label by an approved agency or shall be provided with a certificate of inspection furnished by an approved testing agency. When a certificate of inspection is furnished by an approved testing agency, the certificate shall state that the door conforms to the requirements of design, materials, and construction, but has not been subjected to the fire test.

715.4.5.3 Smoke and draft control door labeling requirements. Smoke and draft control doors complying with UL 1784 shall be labeled in accordance with Section 715.4.5.1 and shall show the letter “S” on the fire rating label of the door. This marking shall indicate that the door and frame assembly are in compliance when listed or labeled gasketing is also installed.

715.4.5.4 Fire door frame labeling requirements. Fire door frames shall be labeled showing the names of the manufacturer and the third-party inspection agency.

715.4.6 Glazing material. Fire-protection-rated glazing conforming to the opening protection requirements in Section 715.4 shall be permitted in fire door assemblies.

715.4.6.1 Size limitations. Wired glass used in fire doors shall comply with Table 715.5.3. Other fire-protection-rated glazing shall comply with the size limitations of NFPA 80.

Exceptions:
1. Fire-protection-rated glazing in fire doors located in fire walls shall be prohibited except that where serving as a horizontal exit, a self-closing swinging door shall be permitted to have a vision panel of not more than 100 square inches (0.065 m²) without a dimension exceeding 10 inches (254 mm).
2. Fire-protection-rated glazing shall not be installed in fire doors having a 1 hr fire protection rating intended for installation in fire barriers, unless the glazing is not more than 100 square inches (0.065 m²) in area.

715.4.6.2 Exit and elevator protective. Approved fire-protection-rated glazing used in fire door assemblies in elevator and exit enclosures shall be so located as to furnish clear vision of the passageway or approach to the elevator, ramp, or stairway.

715.4.6.3 Labeling. Fire-protection-rated glazing shall bear a label or other identification showing the name of the manufacturer, the test standard and information required in Section 715.5.8.1 that shall be issued by an approved agency and shall be permanently affixed to the glazing.

715.4.6.3.1 Identification. For fire-protection-rated glazing, the label shall bear the following four-part identification: “D – H or NH – T or NT – XXX.” “D” indicates that the glazing shall be used in fire door assemblies and that the glazing meets the fire resistance requirements of the test standard. “H” shall indicate that the glazing meets the hose stream requirements of the test standard. “NH” shall indicate that the glazing does not meet the hose stream requirements of the test. “T” shall indicate that the glazing meets the temperature requirements of Section 715.4.4.1. “NT” shall indicate that the glazing does not meet the temperature requirements of Section 715.4.4.1. The placeholder “XXX” shall specify the fire-protection-rating period, in minutes.

715.4.6.4 Safety glazing. Fire-protection-rated glazing installed in fire doors or fire window assemblies in areas subject to human impact in hazardous locations shall comply with Chapter 24.

715.4.7 Door closing. Fire doors shall be self- or automatic closing in accordance with this section.

Exceptions:
1. Fire doors located in common walls separating sleeping units in Group R-1 shall be permitted without automatic- or self-closing devices.
2. The elevator car doors and the associated hoistway enclosure doors at the floor level designated for recall in accordance with Section 3003.2 shall be permitted to remain open during Phase I emergency recall operation.

715.4.7.1 Latch required. Unless otherwise specifically permitted, single fire doors and both leaves of pairs of side-hinged swinging fire doors shall be provided with an active latch bolt that will secure the door when it is closed.

715.4.7.2 Automatic-closing fire door assemblies. Automatic-closing fire door assemblies shall be self-closing in accordance with NFPA 80.

715.4.7.3 Smoke-activated doors. Automatic-closing doors installed in the following locations shall be automatic closing by the actuation of smoke detectors installed in accordance with Section 907.10 or by loss of power to the smoke detector or hold-open device. Doors that are automatic closing by smoke detection shall not have more than a 10-second delay before the door starts to close after the smoke detector is actuated:

1. Doors installed across a corridor.
2. Doors that protect openings in exits or corridors required to be of fire-resistance-rated construction.
3. Doors that protect openings in walls that are capable of resisting the passage of smoke in accordance with Section 508.2.2.1.
4. Doors installed in smoke barriers in accordance with Section 709.5.
5. Doors installed in fire partitions in accordance with Section 708.6.
6. Doors installed in a fire wall in accordance with Section 705.8.
7. Doors installed in shaft enclosures in accordance with Section 707.7.
8. Doors installed in refuse and laundry chutes and access and termination rooms in accordance with Section 707.13.
9. Doors installed in the walls for compartmentation of underground buildings in accordance with Section 405.4.2.
10. Doors installed in the elevator lobby walls of underground buildings in accordance with Section 405.4.3.
11. Doors installed in smoke partitions in accordance with Section 710.5.3.

715.4.7.4 Doors in pedestrian ways. Vertical sliding or vertical rolling steel doors in openings through which pedestrians travel shall be heat activated or activated by smoke detectors with alarm verification.

715.4.8 Swinging fire shutters. Where fire shutters of the swinging type are installed in exterior openings, not less than one row in every three vertical rows shall be arranged to be readily opened from the outside, and shall be identified by distinguishing marks or letters not less than 6 inches (152 mm) high.

715.4.9 Rolling fire shutters. Where fire shutters of the rolling type are installed, such shutters shall include approved automatic-closing devices.

715.5 Fire-protection-rated glazing. Glazing in fire window assemblies shall be fire-protection rated in accordance with this section and Table 715.5. Glazing in fire door assemblies shall comply with Section 715.4.6. Fire-protection-rated glazing shall be tested in accordance with and shall meet the acceptance criteria of NFPA 257. Fire-protection-rated glazing shall also comply with NFPA 80. Openings in non-fire-resistance-rated exterior wall assemblies that require protection in accordance with Section 704.3, 704.8, 704.9 or 704.10 shall have a fire-protection rating of not less than 3/4 hour.

Exceptions:

1. Wired glass in accordance with Section 715.5.3.
2. Fire-protection-rated glazing in 0.5-hour fire-resistance-rated partitions is permitted to have an 0.33-hour fire-protection rating.

715.5.1 Testing under positive pressure. NFPA 257 shall evaluate fire-protection-rated glazing under positive pressure. Within the first 10 minutes of a test, the pressure in the furnace shall be adjusted so that at least two-thirds of the test specimen is above the neutral pressure plane, and the neutral pressure plane shall be maintained at that height for the balance of the test.

### Table 715.5

<table>
<thead>
<tr>
<th>TYPE OF ASSEMBLY</th>
<th>REQUIRED ASSEMBLY RATING (hours)</th>
<th>MINIMUM FIRE WINDOW ASSEMBLY RATING (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior walls:</td>
<td>All</td>
<td>NP*</td>
</tr>
<tr>
<td>Fire walls</td>
<td>&gt; 1</td>
<td>3/4</td>
</tr>
<tr>
<td>Smoke barriers</td>
<td>1</td>
<td>3/4</td>
</tr>
<tr>
<td>and fire partitions</td>
<td>1</td>
<td>3/4</td>
</tr>
<tr>
<td>Exterior walls</td>
<td>&gt; 1</td>
<td>1 1/2</td>
</tr>
<tr>
<td>Party wall</td>
<td>All</td>
<td>NP*</td>
</tr>
</tbody>
</table>

NP* = Not Permitted.
a. Not permitted except as specified in Section 715.2.

715.5.2 Nonsymmetrical glazing systems. Nonsymmetrical fire-protection-rated glazing systems in fire partitions, fire barriers or in exterior walls with a fire separation distance of 5 feet (1524 mm) or less pursuant to Section 704 shall be tested with both faces exposed to the furnace, and the assigned fire protection rating shall be the shortest duration obtained from the two tests conducted in compliance with NFPA 257.

715.5.3 Wired glass. Steel window frame assemblies of 0.125-inch (3.2 mm) minimum solid section or of not less than nominal 0.048-inch-thick (1.2 mm) formed sheet steel members fabricated by pressing, mitering, riveting, interlocking or welding and having provision for glazing with 3/4-inch (6.4 mm) wired glass where securely installed in the building construction and glazed with 3/4-inch (6.4 mm) labeled wired glass shall be deemed to meet the requirements for a 1/2-hour fire window assembly. Wired glass panels shall conform to the size limitations set forth in Table 715.5.3.

### Table 715.5.3

<table>
<thead>
<tr>
<th>OPENING FIRE PROTECTION RATING</th>
<th>MAXIMUM AREA (square inches)</th>
<th>MAXIMUM HEIGHT (inches)</th>
<th>MAXIMUM WIDTH (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 hours</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1 1/2-hour doors in exterior walls</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1 and 1 1/2 hours</td>
<td>100</td>
<td>33</td>
<td>10</td>
</tr>
<tr>
<td>1/2 hour</td>
<td>1,296</td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>20 minutes</td>
<td>Not Limited</td>
<td>Not Limited</td>
<td>Not Limited</td>
</tr>
<tr>
<td>Fire window assemblies</td>
<td>1,296</td>
<td>54</td>
<td>54</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 square inch = 645.2 mm².

715.5.4 Nonwired glass. Glazing other than wired glass in fire window assemblies shall be fire-protection-rated glaz-
ing installed in accordance with and complying with the size limitations set forth in NFPA 80.

715.5.5 Installation. Fire-protection-rated glazing shall be in the fixed position or be automatic-closing and shall be installed in approved frames.

715.5.6 Window mullions. Metal mullions that exceed a nominal height of 12 feet (3658 mm) shall be protected with materials to afford the same fire-resistance rating as required for the wall construction in which the protective is located.

715.5.7 Interior fire window assemblies. Fire-protection-rated glazing used in fire window assemblies located in fire partitions and fire barriers shall be limited to use in assemblies with a maximum fire-resistance rating of 1 hour in accordance with this section.

715.5.7.1 Where permitted. Fire-protection-rated glazing shall be limited to fire partitions designed in accordance with Section 708 and fire barriers utilized in the applications set forth in Sections 706.3.6 and 706.3.8 where the fire-resistance rating does not exceed 1 hour.

715.5.7.2 Size limitations. The total area of windows shall not exceed 25 percent of the area of a common wall with any room.

715.5.8 Labeling requirements. Fire-protection-rated glazing shall bear a label or other identification showing the name of the manufacturer, the test standard and information required in Section 715.5.8.1 that shall be issued by an approved agency and shall be permanently affixed to the glazing.

715.5.8.1 Identification. For fire-protection-rated glazing, the label shall bear the following two-part identification: "OH – XXX." "OH" indicates that the glazing meets both the fire-resistance and the hose-stream requirements of NFPA 257 and is permitted to be used in openings. "XXX" represents the fire-protection rating period, in minutes, that was tested.

SECTION 716

DUCTS AND AIR TRANSFER OPENINGS

716.1 General. The provisions of this section shall govern the protection of duct penetrations and air transfer openings in assemblies required to be protected.

716.1.1 Ducts without dampers. Ducts that penetrate fire-resistance-rated assemblies and are not required by this section to have dampers shall comply with the requirements of Section 712.

716.2 Installation. Fire dampers, smoke dampers, combination fire/smoke dampers and ceiling radiation dampers located within air distribution and smoke control systems shall be installed in accordance with the requirements of this section, the manufacturer's installation instructions and the dampers' listing.

716.2.1 Smoke control system. Where the installation of a fire damper will interfere with the operation of a required smoke control system in accordance with Section 909, approved alternative protection shall be utilized.

716.2.2 Hazardous exhaust ducts. Fire dampers for hazardous exhaust duct systems shall comply with the International Mechanical Code.

716.3 Damper testing and ratings. Dampers shall be listed and bear the label of an approved testing agency indicating compliance with the standards in this section. Fire dampers shall comply with the requirements of UL 555. Only fire dampers labeled for use in dynamic systems shall be installed in heating, ventilation and air-conditioning systems designed to operate with fans on during a fire. Smoke dampers shall comply with the requirements of UL 555S. Combination fire/smoke dampers shall comply with the requirements of both UL 555 and UL 555S. Ceiling radiation dampers shall comply with the requirements of UL 555C.

716.3.1 Fire protection rating. Fire dampers shall have the minimum fire protection rating specified in Table 716.3.1 for the type of penetration.

<table>
<thead>
<tr>
<th>TYPE OF PENETRATION</th>
<th>MINIMUM DAMPER RATING (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 3-hour fire-resistance-rated assemblies</td>
<td>1.5</td>
</tr>
<tr>
<td>3-hour or greater fire-resistance-rated assemblies</td>
<td>3</td>
</tr>
</tbody>
</table>

716.3.1.1 Fire damper actuating device. The fire damper actuating device shall meet one of the following requirements:

1. The operating temperature shall be approximately 50°F (10°C) above the normal temperature within the duct system, but not less than 160°F (71°C).
2. The operating temperature shall be not more than 286°F (141°C) where located in a smoke control system complying with Section 909.
3. Where a combination fire/smoke damper is located in a smoke control system complying with Section 909, the operating temperature rating shall be approximately 50°F (10°C) above the maximum smoke control system designed operating temperature, or a maximum temperature of 350°F (177°C). The temperature shall not exceed the UL 555S degradation test temperature rating for a combination fire/smoke damper.

716.3.2 Smoke damper ratings. Smoke damper leakage ratings shall not be less than Class II. Elevated temperature ratings shall not be less than 250°F (121°C).

716.3.2.1 Smoke damper actuation methods. The smoke damper shall close upon actuation of a listed smoke detector or detectors installed in accordance with Section 907.10 and one of the following methods, as applicable:

1. Where a damper is installed within a duct, a smoke detector shall be installed in the duct within 5 feet (1524 mm) of the damper with no air outlets or
AGENCY AUTHORIZATION NOTIFICATION

Choose a method to return the completed Agreement:

Mail to: Customer Service - Fire Protection Division (3024XFPI)
333 Pfingsten Road, Northbrook, IL 60062, USA.
Fax to: 847-272-2020
E-mail to: leilani.m.lichtenstein@us.ul.com

Dear UL Client:

UL understands that you, the Applicant, wish to use an Agency with respect to matters relating to UL's investigation of components, products, devices or systems, Follow-Up Service, and/or various other matters involved in the relationship between UL and you.

For your information, the term "Applicant" refers to the company or individual that applies to UL for the investigation of a component, product or system; and the term "Manufacturer" refers to the company or individual that maintains and operates the factory facilities where a UL Listed, Classified or Recognized product is manufactured or assembled, and where the product is normally inspected and/or tested as a part of UL's Follow-Up Service.

Please provide UL with the following Agency Information:

The Agency is: PRODUCT CERTIFICATION
CONSULTANTS L L C 1676 TUPOLO DR SAN JOSE CA 95124

The contact person at the agency is:

Name: Mr. Garrett Tom
Telephone: 408-264-0131
Fax: 408-264-3772
E-Mail: garrett@productcc.com

By signing this Notification, we officially notify UL that the Agency identified above has been authorized to represent us as indicated in this Notification with respect to matters relating to UL's investigation of components, products or systems, Follow-Up Service, and/or other various matters involved in the relationship between UL and the Applicant. UL is fully authorized to deal with the Agency to the extent and within the limitations set forth in this Notification.

IN ADDITION, WE AGREE TO THE TERMS AND CONDITIONS SET FORTH ON EACH PAGE OF THIS NOTIFICATION AND WARRANT THAT NO ALTERATIONS OF ITS TEXT HAVE BEEN MADE WITHOUT UL'S PRIOR WRITTEN CONSENT. THE UNDERSIGNED REPRESENTS AND WARRANTS THAT SHE IS AUTHORIZED TO EXECUTE THIS NOTIFICATION ON BEHALF OF APPLICANT.

NOTICE: THIS NOTIFICATION IS NOT TO BE SIGNED BY THE AGENCY AND MUST BE COMPLETED FOR THE AGENCY ARRANGEMENT YOU CHOOSE.

SAFTI
325 NEW HALL ST SAN FRANCISCO CA 94124

By: WILLIAM F. O'KEEFFE, PRESIDENT

The contact person at your company regarding the information contained in this Notification is:

Name: Mr. William F. O'Keeffe
Telephone: 415-822-4222
Fax: 415-822-5222
E-Mail: wfo@okeeffes.com

Page 1 of 2
AGENCY ARRANGEMENTS:

1. The Agency has the authority to sign, on the Applicant's behalf, any UL Agreements (e.g. the L40 Services Agreement) or Applications:
   - [ ] Yes
   - [ ] No

2. Invoices should be sent as checked: (Check only one box for the recipient of each type of invoice.)
   - [ ] New Work
   - [ ] Follow-Up
   - [ ] Agency
   - [ ] Applicant
   - [ ] Manufacturer
   *UL reserves the right to send invoices directly to the Applicant, in addition to the Agency.
   ** Only one Agency/Agent can receive Follow-Up Invoices for an Applicant/File combination

3. UL Reports should be sent to:
   - [ ] Agency and Applicant
   - [ ] Only Applicant

4. Correspondence should be sent to:
   - [ ] Agency
   - [ ] Applicant
   *UL reserves the right to send documents directly to the Applicant, in addition to the Agency.

5. UL Procedures should be sent to:
   - [ ] Agency and Applicant
   - [ ] Only Applicant

CONDITIONS AND STIPULATIONS:

We, the Applicant, agree that unless and until we notify UL otherwise, UL is to take the above actions and operate on the following basis with respect to our authorization of Agency:

A. This Agency relationship which is the subject of this Notification shall continue in effect until further written notice from us is provided to UL. If we want to withdraw authorization for an Agency, we will advise UL in writing.

B. By authorizing the Agency as set forth in this Notification, we expressly authorize UL to communicate to the Agency any of our information which we might otherwise consider confidential or proprietary.

C. Applicant hereby authorizes UL to transmit unencrypted confidential information and other information through the Internet or a public network to e-mail addresses or other locations provided by Applicant or Agency. Applicant acknowledges that UL cannot guarantee the privacy and confidentiality of such transmissions. Applicant agrees that UL's transmission of confidential information via the Internet or other public network shall not be a breach of any confidentiality obligation under this Agreement and that UL shall not be liable for any damages resulting from such transmissions.

D. Applicant represents and warrants that during the term of this Agreement it shall not cause, or allow the Agency to cause, UL to violate any U.S. trade sanction laws administered by the U.S. Department of Treasury, Office of Foreign Asset Control (www.treasurer.gov/oeac), shall obtain all applicable export licenses, and shall ensure that any payments made to or by UL or its affiliates will not be paid from or deposited into a financial institution and account subject to any U.S. trade sanction laws. UL has the right to terminate the Agreement immediately if it is prohibited by U.S. law from doing business with Applicant or Agency.

E. Applicant represents and warrants that all information and data provided to UL by Applicant or on its behalf are complete and accurate and that UL may rely thereon when providing Services. Applicant agrees that UL may share Applicant's information with its affiliates, subcontractors, or others as necessary to perform the requested Services or when in the interests of public safety.

F. UL will only accept requests for withdrawal and/or transfer of Listings, Recognitions or Classifications and name and/or ownership changes from the Applicant.

G. We hold UL harmless from any and all actions UL takes in reliance upon the information set forth in this Notification and any changes we later make to that information. We understand that the selection of the Agency is our choice and, therefore, we agree to hold UL harmless and to defend and indemnify UL against any loss, expense, liability, or damage, including reasonable attorney's fees, arising out of any and all actions or omissions by the Agency.

H. We are and remain responsible and liable for all unpaid bills, including any unpaid bank fees incurred with wire transfers, from and subject to all collection actions instituted by UL for services rendered to or on our behalf, notwithstanding that we may have designated the Agency to receive billing and related materials from UL and/or to pay our UL bills.

I. We agree to the terms and conditions set forth on the front and back of this Notification.

J. We are executing this Notification by a fully authorized officer, proprietor or partner.
Choose a method to return the completed Agreement:

Mail to: Customer Service - Fire Protection Division (3024XFDP)
333 Pfingsten Road, Northbrook, IL 60062, USA.

Fax to: 847-272-2020

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The Agency is: PRODUCT CERTIFICATION
CONSULTANTS LLC 1676 TUPOLO DR SAN JOSE CA 95124

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Telephone: 408-264-0131
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E-Mail: garrett@productcc.com

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325 NEW HALL ST SAN FRANCISCO CA 94124

By: WILLIAM F. O'KEEFE, PRES.
Date: April 18th, 2005

The contact person at your company regarding the information contained in this Notification is:

Name: Mr. William F. O'Keefe
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E-Mail: wfo@okeeffes.com

Page 1 of 2
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☐ Yes   ☐ No

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<table>
<thead>
<tr>
<th>Type</th>
<th>Agency*</th>
<th>OR</th>
<th>Applicant</th>
<th>OR</th>
<th>Manufacturing</th>
</tr>
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<tr>
<td>New Work</td>
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<td></td>
<td>N/A</td>
</tr>
<tr>
<td>Follow-Up **</td>
<td>☐</td>
<td></td>
<td>☑</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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☐ Agency and Applicant  OR  ☑ Applicant only

4. Correspondence should be sent to:

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J. We are executing this Notification by a fully authorized officer, proprietor or partner.

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Chapter 15-12 FIRE-RESISTIVE MATERIALS AND CONSTRUCTION

15-12-010 Scope.
15-12-020 Performance standards.
15-12-030 Use of combustibles.
15-12-040 Definitions.
15-12-050 Accepted engineering practice.
15-12-060 Fire tests for building materials and construction.
15-12-070 Opening protective assemblies—Doors and shutters.
15-12-080 Opening protective assemblies—Defined.
15-12-090 Test procedure.
15-12-100 Test assemblies.
15-12-110 Classification of doors and shutters.
15-12-120 Maximum size of doors and shutters.
15-12-130 Approved protective assemblies.
15-12-140 Identification.
15-12-150 Installation.
15-12-160 Opening protective assemblies—Windows.
15-12-170 Definition.
15-12-180 Test procedure.
15-12-190 Test assemblies.
15-12-200 Conditions of acceptance.
15-12-210 Hollow metal windows.
15-12-220 Solid section windows.
15-12-230 Other windows.
15-12-240 Approved protective assemblies.
15-12-250 Identification.
15-12-010 Scope.

The provisions of this chapter shall govern the use and design of all materials and methods of construction with respect to required protection against fire exposure.

(Prior code § 65-1)

15-12-020 Performance standards.

The requirements of this section shall constitute the minimum functional performance standards for fire protection purposes. Such requirements shall not be deemed to decrease or waive any requirements of this Code with respect to safe load capacity, durability or other specified requirements.

(Prior code § 65-1.1)

15-12-030 Use of combustibles.

All materials and forms of construction that develop the fire resistance required by this Code shall be acceptable for fireproofing and construction purposes, except that all structural components shall be non-combustible in wall and roof assemblies of Type I, II and III buildings and in all floor and roof/ceiling assemblies of Type I and II buildings. The requirement regarding non-combustibility of two-hour rated assemblies shall not apply to interior walls and floors in construction Types III-A, III-B and IV-A.

(Prior code § 65-1.2; Amend Coun. J. 10-2-95, p. 8040; Amend Coun. J. 5-17-00, p. 32653, § 4)

15-12-040 Definitions.

(a) "Combustible material" means a material which will ignite when heated to a temperature at or below 1,200 degrees Fahrenheit.
(b) "Fire resistance," as applied to building materials and construction, means the ability to withstand fire or give protection from it for given periods under prescribed test conditions.

(c) "Fire-resistive rating" means the degree of fire resistance of a fabricated unit or assembly of units of construction, determined by the standard fire test expressed in hours or fractions of an hour.

(d) "Flame-spread rating" means the degree of flame resistance of materials used for interior finish and trim or for decorative purposes determined by the rate of flame spread in the standard tunnel test.

(e) "Noncombustible material" means a material which will not ignite when heated to a temperature of 1,200 degrees Fahrenheit.

(f) "Fire-retardant-treated wood" means lumber or plywood that has a Class 1 rating when tested in accordance with ASTM E-84, UL 723, or NFPA 255 for a period of 30 minutes and which, at no time during the period of the test, shows evidence of significant progressive combustion or experiences progress of the flame front more than 10 1/2 feet beyond the centerline line of burner. Each piece of fire-retardant-treated wood shall be identified at two-foot intervals by a label or a stamp of an approved agency acceptable to the executive director of the department of construction and permits and the fire prevention bureau having an inspection service, and further by the marking of a continuous double line between the labels or stamps. Where fire-retardant-treated wood is to be subject to sustained high humidity or exposed to the weather, it shall be further identified to indicate there is no increase in listed fire hazard classification when subjected to "The Standard Rain Test" (ASTM D-2898-81).

(Prior code § 65-2; Amend Coun. J. 6-14-95, p. 2832; Amend Coun. J. 3-5-03, p. 104990, § 43)

15-12-050 Accepted engineering practice.

Recognized Authoritative Agencies. The applicable test procedures of the following agencies are recognized as accepted engineering practice with respect to fire-resistive qualities of materials and assemblies:

American Standards Association (ASA);
American Society for Testing Materials (ASTM);
National Board of Fire Underwriters (NBFU);
National Bureau of Standards, Department of Commerce (NBS);
National Fire Protection Association (NFPA);
Underwriters' Laboratories, Inc. (UL).

(Prior code § 65-3)

15-12-060 Fire tests for building materials and construction.

(a) Test Procedure. Where fire-resistive ratings of building materials and construction are required in this Code, such fire-resistive ratings shall be determined by the test procedures and conditions of acceptance prescribed in the following documents:

Fire-retardant wood ASTM E-84 (30 minutes) and ASTM 1-2898 (exposure to weather).

(b) Approved Materials and Construction.

(1) Materials and construction listed in either of the following documents for specific fire-resistant ratings shall be acceptable as meeting the requirements of this Code:


Fire-resistance ratings as listed in the Fire Resistance Design Manual, Tenth Edition, as published by the Gypsum Association, are incorporated by reference and may be referred to as herein listed.

(2) Nothing in this section shall preclude the use of other materials and construction meeting the required test standards.

(Prior code § 65-4; Amend Coun. J. 8-7-85, p. 18993)

15-12-070 Opening protective assemblies—Doors and shutters.

Doors and shutters required as opening protective assemblies shall comply with the provisions of Sections 15-12-080 to 15-12-150, inclusive.

(Prior code § 65-5)

15-12-080 Opening protective assemblies—Defined.

Opening protective assemblies as applied to the requirements for doors or shutters shall include such doors or shutters together with their frames, hardware and other accessories essential to the fire-resistive rating of the assembly.

(Prior code § 65-5.1)

15-12-090 Test procedure.

Where fire-resistive door and shutter assemblies are required by this Code, the fire-resistive values of such assemblies and their classification shall be determined by the test procedure and the conditions of acceptance prescribed in the following document: Methods of Fire Tests of Door Assemblies—ASTM Designation: E152-56T.

(Prior code § 65-5.2)

15-12-100 Test assemblies.

Tests shall be made upon complete full-size samples of the assembly, including hanging and operating hardware, frames, bucks and other anchorage.

(Prior code § 65-5.3)

15-12-110 Classification of doors and shutters.

Doors and shutters shall be classified in accordance with their fire-resistive qualities in accordance with http://www.amlegal.com/nxt/gateway.dll/illinois/chicago_il/title15fireprevention/chapter15-12fire... 1/23/2008
requirements of this section.

(a) Class A Doors and Shutters.
   (1) Class A doors and shutters shall be used for protection of openings in firewalls and shall be installed on both sides of walls.
   (2) There shall be no glass panels in Class A doors and shutters.

(b) Class B Doors and Shutters.
   (1) Class B doors and shutters shall be used where required elsewhere in this Code for protection of openings in vertical shafts and other openings.
   (2) Class B doors may have an observation panel of standard wired glass having an exposed area not exceeding 100 square inches and a width or height not exceeding 12 inches.

(c) Class C Doors.
   (1) Class C doors shall be used where required elsewhere in this Code for protection of openings between rooms or between rooms and corridors.
   (2) Class C doors may have panels of standard wired glass. Exposed area of individual glass lights shall not exceed 1,296 square inches.

(d) Class D and E Doors and Shutters.
   (1) Class D and E doors and shutters shall be used where required elsewhere in this Code for protection of openings in exterior walls.
   (2) Glass lights for panels shall not be used in Class D doors. Panels of standard wired glass having an area not exceeding 720 square inches and a height not exceeding 54 inches may be used in Class E doors.

(Prior code § 65-5.4)

15-12-120 Maximum size of doors and shutters.

Openings required to be protected by fire doors or shutters shall not exceed the heights, widths and areas established in Table 15-12-120. (See Table 15-12-120.)

(Prior code § 65-5.5)

GRAPHIC LINK (not available): Table 15-12-120 (maximum sizes of fire doors and shutters)

15-12-130 Approved protective assemblies.

(a) Fire-resistive door and shutter assemblies for specific conditions of use in the "Fire Protection Equipment List," Underwriters' Laboratories, Inc., January, 1959, shall be acceptable as meeting the requirements of this section.

(b) Nothing in this section shall preclude the use of other opening protective assemblies meeting the required test standards.

(Prior code § 65-5.6)
15-12-140 Identification.

Approved protective assemblies shall be properly identified by label as conforming to the requirements of this section.

(Prior code § 65-5.7)

15-12-150 Installation.

Installation of fire-resistive door and shutter assemblies shall comply with the requirements of the following document: Protection of Openings in Walls and Partitions—NBFU-80–1939.

(Prior code § 65-5.8)

15-12-160 Opening protective assemblies—Windows.

Windows required as opening protective assemblies shall comply with the provisions of Sections 15-12-170 to 15-12-250, inclusive.

(Prior code § 65-6)

15-12-170 Definition.

Opening protective assemblies as applied to the requirements for windows shall include sash, frames, hardware and other accessories essential to the fire-resistive rating of the assembly.

(Prior code § 65-6.1)

15-12-180 Test procedure.

Where fire-resistive windows are required by this Code, the fire-resistive values of such windows shall be determined by test procedure. The required time-temperature curve and method of testing shall be similar to that required for fire doors and shutters in Section 15-12-070. The duration of test on fire windows shall be not less than 45 minutes and shall include a hose-stream test.

(Prior code § 65-6.2)

15-12-190 Test assemblies.

(a) Test assemblies shall be truly representative as to material, workmanship of the construction and details, including installation, glass size, method of closing, hardware, trim and finish.

(b) The fire-resistive rating derived from the test shall be assumed to apply to all like assemblies smaller in dimension and area than the test specimen and to larger sizes not exceeding the area of the test specimen by more than 25 percent.

(Prior code § 65-6.3)
15-12-200 Conditions of acceptance.

The fire-resistance test shall not be regarded as successful unless the following conditions are met:

(a) The test assembly shall have remained securely in the opening during the fire exposure period and during the hose-stream test, except that small fragments of glass dislodged from the exposed surface by the hose stream shall not be considered a weakness. The fastening of ventilators or movable sections shall have remained secure.

(b) The test assembly shall have withstood the fire-endurance test without passage of flame; and shall have withstood the fire-endurance and hose-stream tests without the dislodgement of an excessive proportion of the glass area. A loss of approximately ten percent shall not be considered excessive.

(Prior code § 65-6.4)

15-12-210 Hollow metal windows.

(a) Hollow metal windows shall consist of reinforced hollow metal sections and may be of double-hung, counter-balanced, pivoted, stationary, tilting, hinged or projected sash.

(b) Hollow metal windows shall not exceed the following sizes:

(1) Single sash, other than casement, five feet by five feet;

(2) Double sash, other than casement, five feet by ten feet;

(3) Casements, single, three and one-half feet by ten feet;

(4) Casements, pairs, five feet by ten feet.

(c) Individual glass lights in windows shall not exceed 720 square inches in exposed area, 54 inches in vertical dimension, and 48 inches in horizontal dimension.

(Prior code § 65-6.5)

15-12-220 Solid section windows.

(a) Solid section windows shall be constructed of rolled steel sections and may be equipped with ventilators of the same construction of the projected, tilting, pivoted or hinged type.

(b) Windows shall not exceed the following sizes:

(1) Standard fire windows of inside angle glazed type shall not exceed 84 square feet in area. Neither the height nor the width shall exceed 12 feet; provided, that when installed with unprotected vertical steel mullions, the width shall not exceed seven feet.

(2) Lightweight casement type shall not exceed six and one-half feet in either dimension and, when installed with unprotected vertical steel mullions, the width shall not exceed three and one-half feet.

(3) Intermediate-weight casement types shall not exceed 50 square feet in area with neither dimension exceeding ten feet. When installed with unprotected steel mullions, the width shall not exceed six and one-half feet.

(4) Detention-type windows shall not exceed 84 square feet in area, with neither dimension.
exceeding 12 feet. When installed with unprotected vertical steel mullions, the width shall not exceed seven feet.

(c) Individual glass lights shall be glazed with standard wired glass and shall not exceed 720 square inches in exposed area, 54 inches in vertical dimension and 48 inches in horizontal dimension.

(Prior code § 65-6.6)

15-12-230 Other windows.

Windows constructed of a combination of hollow metal and solid section members, or a combination of hollow metal and plate steel members, shall conform to the requirements of hollow metal windows, Section 15-12-210.

(Prior code § 65-6.7)

15-12-240 Approved protective assemblies.

(a) Fire windows and accessory parts thereof approved for specific conditions of use in the list of "Fire Protection Equipment List," Underwriters' Laboratories, Inc., January, 1959, shall be acceptable as meeting the requirements of this section.

(b) Nothing in this section shall preclude the use of other opening protective assemblies meeting the required test standards.

(Prior code § 65-6.8)

15-12-250 Identification.

Approved protective assemblies shall be properly identified by label as conforming to the requirements of this section.

(Prior code § 65-6.9)

15-12-260 Roof coverings.

Roof coverings shall comply with the provisions of Sections 15-12-270 to 15-12-310, inclusive.

(Prior code § 65-7)

15-12-270 Class A roof coverings.

Class A roof coverings shall be of material approved by the executive director of the department of construction and permits after satisfactory evidence that it is effective against severe fire exposures. Under such exposures, Class A roof coverings shall not be readily flammable; shall not carry or communicate fires; shall afford a fairly high degree of heat insulation to the roof deck; shall not slip from position; shall possess nonflying brand hazard; and shall not require frequent repairs in order to maintain their fire-resistive properties.

(Prior code § 65-7.1; Amend Coun. J. 3-5-03, p. 104990, § 43)

15-12-280 Class B roof coverings.

Class B roof coverings shall be of fire-resistive material, approved by the executive director of the department of construction and permits after satisfactory evidence that it is effective against moderate fire exposures. Under such exposures, Class B roof coverings shall not be readily flammable; shall not readily carry or communicate fire, shall afford a moderate degree of heat insulation to the roof deck; shall not slip from position; shall possess no flying brand hazard; and shall require only infrequent repairs to maintain their fire-resistant properties.

(Prior code § 65-7.2; Amend Coun. J. 3-5-03, p. 104990, § 43)

15-12-290 Class C roof coverings.

Class C roof coverings shall be of material approved by the executive director of the department of construction and permits after satisfactory evidence that it is effective against light fire exposures. Under such exposures, Class C roof coverings shall not be readily flammable; shall not readily carry or communicate fire; shall afford at least a slight degree of heat insulation to the roof deck; shall not slip from position; and shall possess no flying brand hazard; but may require occasional repairs or renewals in order to maintain their fire-resistant properties.

(Prior code § 55-7.3; Amend Coun. J. 3-5-03, p. 104990, § 43)

15-12-300 Approved roof coverings.

(a) Roof coverings which are classified as Class A, Class B or Class C in the "Fire Protection Equipment List," Underwriters' Laboratories, Inc., January, 1959, shall be acceptable as meeting the requirements of this section for each respective class of roof covering.

(b) Nothing in this section shall preclude the use of other roof coverings meeting the required test standards.

(Prior code § 65-7.4)

15-12-310 Identification.

Approved roof coverings shall be properly identified by label as conforming to the requirements of this section.

(Prior code § 65-7.5)

15-12-320 Interior wall and ceiling finish, floor covering, and trim.

Interior wall and ceiling finish, floor covering, and trim shall comply with the provisions of Sections 15-12-330 to 15-12-346, inclusive.

(Prior code § 65-8; Amend Coun. J. 6-27-90, p. 17610)

15-12-330 Test procedure.

All interior wall and ceiling finish and trim shall be classified in accordance with resistance to spread of flame. Rate of spread of flame shall be determined by the tunnel-type test methods established in the following documents:
(a) Bulletin of Research No. 32, Fire Hazard Classification of Building Materials. ULI, September, 1944;


(Prior code § 65-8.1)

15-12-340 Classification–Interior wall, ceiling finish and trim.

Interior wall and ceiling finish and trim shall be classified in accordance with flame spread ratings as follows:

TABLE INSET:

<table>
<thead>
<tr>
<th>Classification</th>
<th>Flame Spread Rating</th>
<th>Smoke Developed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 1</td>
<td>200</td>
<td>0 to 25</td>
</tr>
<tr>
<td>Class 2</td>
<td>450</td>
<td>26 to 75</td>
</tr>
<tr>
<td>Class 3</td>
<td>450</td>
<td>76 to 266</td>
</tr>
</tbody>
</table>

(Prior code § 65-8.2; Amend Coun. J. 6-27-90, p. 17610)

15-12-344 Classification–Interior floor coverings.

All interior floor coverings shall be classified in accordance with the critical radiant flux characteristic as established in the following document.


(Prior code § 65-8.3; Added Coun. J. 6-27-90, p. 17610)

15-12-346 Classification–Materials used as floor coverings.

Classification of materials used as floor coverings shall be in accordance with the critical radiant flux characteristics as follows:

TABLE INSET:

<table>
<thead>
<tr>
<th>Classification</th>
<th>Critical Radiant Flux</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.45 watts per square centimeter or higher.</td>
</tr>
<tr>
<td>B</td>
<td>0.22 to 0.44 watts per square centimeter.</td>
</tr>
</tbody>
</table>

(Prior code § 65-8.4; Added Coun. J. 6-27-90, p. 17610)

15-12-350 Foam plastic insulation.

Foam plastics, where approved, shall have a smoke developed rating of not more than 450 when tested in accordance with ASTME 84-98. The products of combustion shall be no more toxic than those of untreated wood burned under similar conditions.

The use of foam plastics in or on walls, ceilings or roof assemblies shall be permitted when there is [http://www.amlegal.com/nxt/gateway.dll/Illinois/chicago_il/title15fireprevention/chapter15-12fire... 1/23/2008]
compliance with requirements as follows:

(a) When the plastic foam is installed within an assembly, it shall be protected from the interior of the building by at least a 15-minute thermal barrier (such as 1/2 inch gypsum board) or a wythe of masonry and the foam shall have a flame spread not higher than 75.

(b) When the plastic foam is installed on the exterior of the building as part of an exterior insulation and finish system, it shall be protected by a synthetic stucco coating or an approved non-combustible finish and the foam shall have a flame spread not higher than 25.

(c) Foam plastic insulation having a flame spread rating of 75 or less when tested in a thickness of four inches may be used for temperature-control applications in thickness up to ten inches; if the total floor area does not exceed 500 square feet, and providing the insulation is covered with an approved thermal barrier of material having a finish rating of not less than 15 minutes. Thermal barriers shall be installed in a manner that will assure they remain in place for 15 minutes. Areas that exceed the 500 square feet limit shall, in addition, be protected with an approved automatic sprinkler system.

(d) Foam plastic insulation having a flame spread rating of 25 or less when tested in a thickness of four inches, may be used for temperature-control applications up to a thickness of ten inches if the total floor area does not exceed 500 square feet, and providing the insulation is totally incased in a metal facing of not less than 0.032-inch aluminum or Number 26-gauge steel. Areas that exceed the 500 square feet limit shall, in addition, be protected with an approved automatic sprinkler system.

(e) Foam plastics having a flame spread of 75 or less may be used within a curtain wall panel when fully enclosed by a metal facing of not less than 0.032-inch aluminum or 26-gauge steel, and complying with code requirements contained in Chapters 13-60 and 13-76, and the interior surface of the panel is covered with an approved thermal barrier of material having a finish rating of not less than 15 minutes.

(Prior code § 65-9; Amend Coun. J. 5-17-00, p. 32653, § 4)

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