UL 263

STANDARD FOR SAFETY

Fire Tests of Building Construction and Materials

UL Standard for Safety for Fire Tests of Building Construction and Materials, UL 263

Fourteenth Edition, Dated June 21, 2011

Summary of Topics

This revision to ANSI/UL 263 dated March 14, 2022 includes air-dry conditions for test assemblies with SFRM; 5.2A.9

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

The revised requirements are substantially in accordance with Proposal(s) on this subject dated December 31, 2021.

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Standard for Fire Tests of Building Construction and Materials

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This ANSI/UL Standard for Safety consists of the Fourteenth Edition including revisions through March 14, 2022.

The most recent designation of ANSI/UL 263 as an American National Standard (ANSI) occurred on March 14, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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 https://csds.ul.com.

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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:

a) 1000°F (538°C) at 5 min;

b) 1300°F (704°C) at 10 min;

c) 1550°F (843°C) at 30 min;

d) 1700°F (927°C) at 1 h;

e) 1850°F (1010°C) at 2 h;

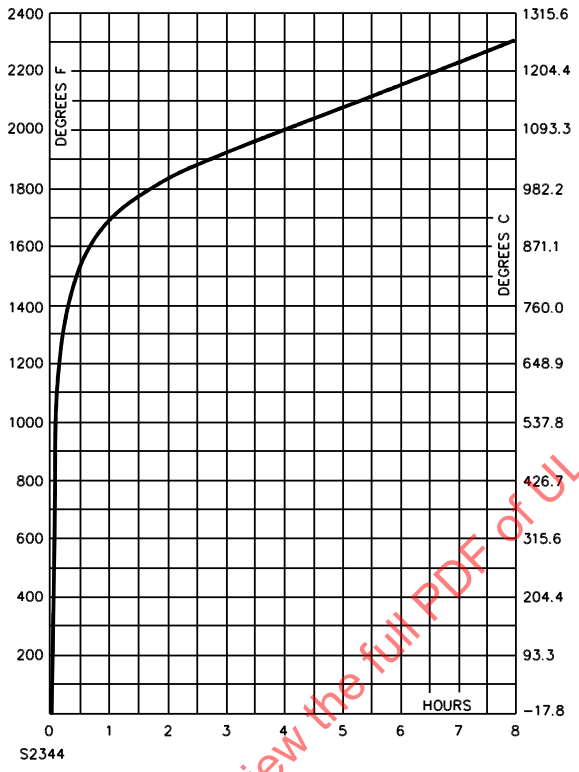
f) 2000°F (1093°C) at 4 h;

g) 2300°F (1260°C) at 8 h or over.

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

Figure 3.1

Time-temperature curve



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.

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-in [0.84-in (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 in (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 in (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 in (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 1 min.

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, partitions, and ceilings

3.3.1 Temperatures at unexposed surfaces are to be measured with thermocouples 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 are to have an immersion under the pad and be in contact with the unexposed surface for not less than 3-1/2 ins (88.9 mm). The hot junction of the thermocouple is to be placed approximately under the center of the pad. The pad is to be held firmly against the surface and is to fit closely about the thermocouples 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 in (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 in (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% of the area within any 5-in (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 1 min.

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% 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.

3.4 Furnace pressure

3.4.1 The furnace pressure shall be measured and recorded at least once every minute and shall be included in test reports.

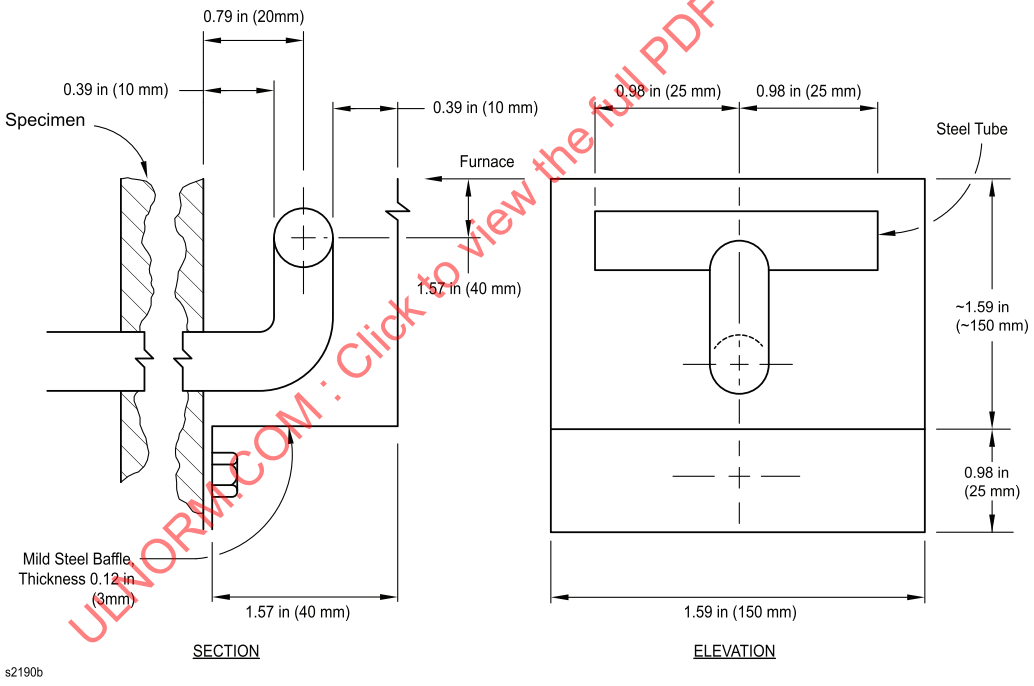
3.4.2 The pressure sensors shall be located where they will not be subject to direct impingement of convection currents from flames or in the path of the exhaust gases. Tubing connected to the pressure sensors shall be horizontal both in the furnace and as they exit through the furnace wall, such that the pressure is relative to the same positional height from the inside to the outside of the furnace.

3.4.3 The furnace pressure is to be measured by means of a manometer or equivalent transducer capable of reading pressure within an accuracy of 0.01 in of water (2.5 Pa) increments.

3.4.4 The pressure measuring probe tips are to be as illustrated in Figure 3.2 and Figure 3.3 and are to be manufactured from stainless steel or equivalent material.

Figure 3.2

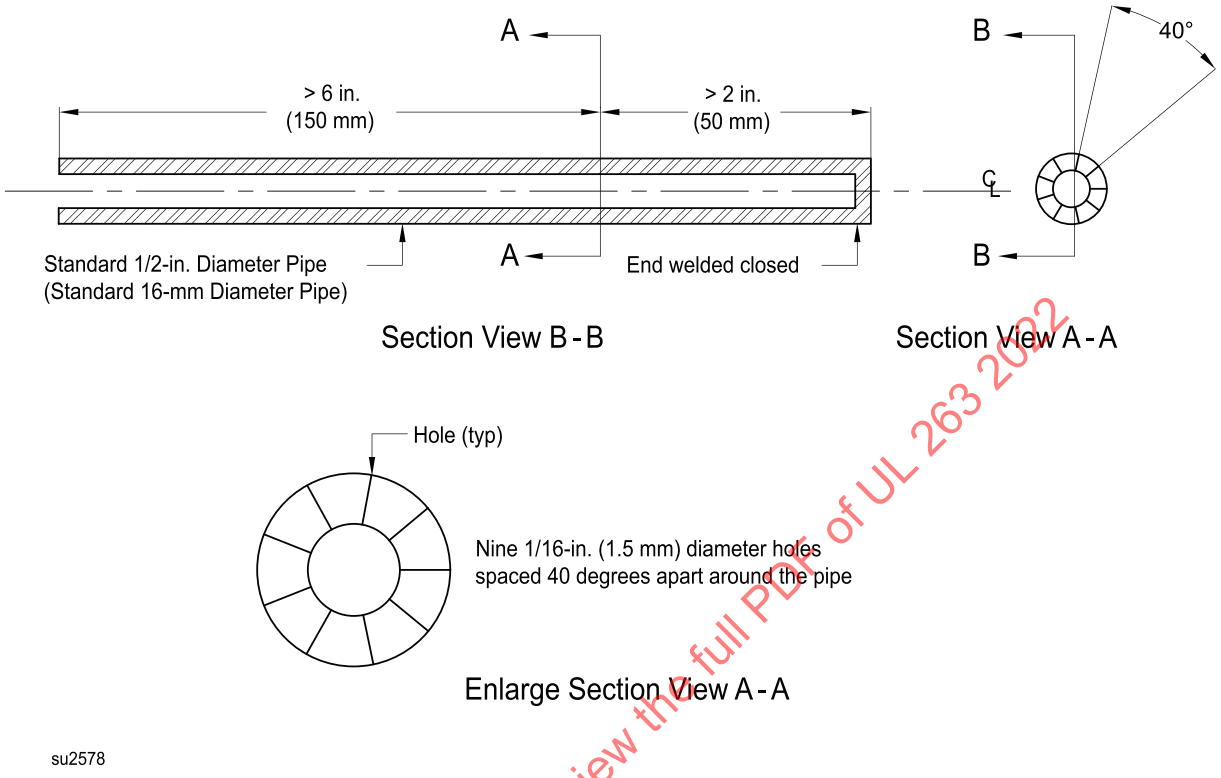
Pressure measurement probe



The "T" branches shall be horizontally oriented.

Figure 3.3

Pressure measurement probe



3.4.5 A minimum of two pressure sensors shall be used when testing vertical specimens. The pressure sensors shall be separated by a vertical distance of at least 3 ft (0.91 m).

3.4.6 A minimum of two pressure sensors shall be used when testing horizontal specimens. The pressure sensors shall be in the same horizontal plane but in different positions relative to the perimeter of the test specimen.

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-h 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-h or 30°C-h (3240°F-min or 1800°C-min), to compensate for the thermal lag of the furnace thermocouples during the first part of the test. For fire exposure in the test higher than 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:

$$C = \frac{2I\,(A - A_S)}{3\,(A_S + L)}$$

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°F-h or 30°C-h (3240°F-min or 1800°C-min)]

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 lbs per 100 ft^2 (5.86 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 *Deleted*

5.2.2 *Deleted*

5.2.3 *Deleted*

5.2.4 *Deleted*

5.2.5 *Deleted*

5.2.6 *Deleted*

5.2A Protection and conditioning of test specimen

5.2A.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.

5.2A.2 The specimen is not to be tested until a large portion of the specimen has attained its final strength, and, if it contains moisture, until the excess moisture has been removed to achieve an air-dry condition.

5.2A.3 Excess moisture is the difference in specimen moisture between the time when the specimen achieves its final strength condition and the specimen moisture which would be obtained after the specimen is located in a building having an ambient atmosphere of 50 % relative humidity at 73 °F (23 °C) for a period of 12 months.

5.2A.4 The excess moisture requirement is to be waived when:

a) A specimen has dried in a heated building for a 12-month conditioning period, but still does not comply with the excess moisture requirement; or

b) The nature of the construction is such that drying of the specimen interior will be prevented by hermetic sealing.

NOTE: CAUTION – Concrete spalling, including spalling of an explosive nature, has occurred during fire testing. It is generally accepted that concrete containing excessive moisture might increase spalling risks.

5.2A.5 For concrete and other similar materials, electronic measuring equipment can be used to indicate the material's relative humidity. The measuring probe is to be located at the specimen's dampest portion. A minimum of two locations, with each being in a different quadrant of the specimen, is to be selected to represent the dampest location.

NOTE 1: A method for determining the relative humidity within a hardened concrete specimen with electric sensing elements is described in Appendix I, Determination of Moisture Condition of Hardened Concrete at Surface and Interior of Large Specimens, 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).

NOTE 2: Guidance on determining the dampest portion of a test specimen is provided in Appendix D.

NOTE 3: A method that relates the occurrence of limiting unexposed surface temperatures when testing under non-standard moisture content conditions to testing under standard moisture content conditions is described in the appendix titled "Method of Correcting Fire Resistance for Concrete Slabs determined by Unexposed Surface Temperature Rise for Nonstandard Moisture Content" of ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials.

5.2A.6 For massive specimens, it may be difficult or impossible to achieve the equilibrium moisture condition within a reasonable period of time. These massive specimens are to be tested no sooner than when 6-in (152-mm) depth below the surface, has achieved a moisture content corresponding to drying to equilibrium with air in the range of 50 to 75 % relative humidity at 73 ±5 °F (23 ±3 °C).

5.2A.7 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 an atmosphere described in 5.2A.3.

5.2A.8 For wood, a moisture meter based on the electrical resistance method can be used to indicate the wood's moisture content.

NOTE: The table titled "Moisture content of wood in equilibrium with stated temperature and relative humidity" in the Centennial Edition of the "Wood Handbook" published by the Forest Products Laboratory, United States Dept. of Agriculture Forest Service, reports a moisture content of 9.2 % for an atmosphere of 50 % relative humidity at 70 °F (21.1 °C) and a moisture content of 13.1 % for an atmosphere of 70 % relative humidity at 70 °F (21.1 °C). Data in the table were primarily from Sitka spruce samples.

5.2A.9 For sprayed fire-resistive material, plaster and other similar materials, an air-dry condition shall be determined to have been reached when successive weekly weighing of a representative specimen, prepared at the same time as the fire test specimen, indicates that the representative specimen has stopped losing weight. The representative specimen used to determine an air-dry condition is to be maintained in the same environment as the fire test specimen.

NOTE: When the fire test specimen and representative specimen are being maintained in an environment that is not climate controlled, consideration shall be given that extended, excessive humidity (i.e. greater than 75 %) in the environment may require additional time (i.e. additional weeks) to confirm that the representative specimen has stopped losing weight.

5.2A.10 Within 72 h prior to the fire test, information on the actual moisture content and/or relative humidity distribution within the specimen is to be obtained. If the moisture condition of the test specimen is likely to change drastically from the 72 h sampling condition prior to test, the sampling is to be made not later than 24 h prior to the test. This information and the specimen's conditioning history are to be included in the test report.

5.2A.11 The testing equipment and the 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 ft/s (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.

5.3 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 h, 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.

Table 5.1
Pressure and duration of hose stream test

Resistance period	Water pressure at base of nozzle		Duration of application	
	PSIG	(kPa)	minutes per 100 ft^2 of exposed area	(minutes per m^2)
8 h and over	45	(310)	6	(0.65)
4 h and over, if less than 8	45	(310)	5	(0.54)
2 h and over, if less than 4	30	(207)	2-1/2	(0.27)
1-1/2 h and over, if less than 2	30	(207)	1-1/2	(0.16)
1 h and over, if less than 1-1/2	30	(207)	1	(0.11)
Less than 1 h, if desired	30	(207)	1	(0.11)

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 h.

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-in (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-in (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 ft (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 ft (6.1 m) by an amount equal to 1 ft (305 mm) for each 10° of deviation from the normal.

5.4A Conduct of cotton pad test

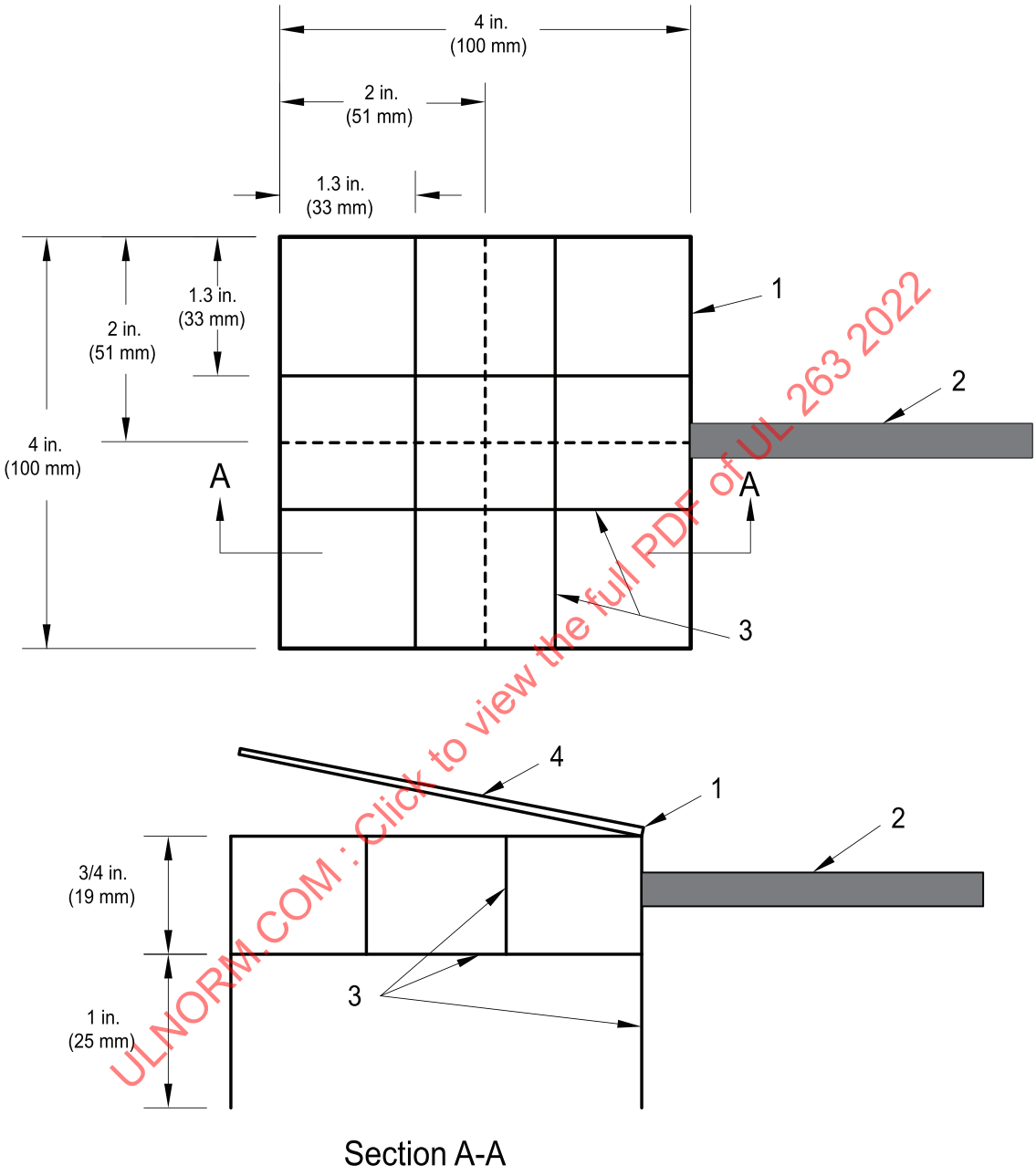
5.4A.1 The cotton pad test provides the means to confirm the passage of flame or the passage of gasses hot enough to ignite cotton waste.

5.4A.2 The cotton pad, measuring 4 in (100 mm) square by 3/4 in (20 mm) thick, shall consist of new undyed and soft cotton fibers without any admixture of artificial fibers and shall weigh 0.12 ± 0.02 oz (3.5 ± 0.5 g).

5.4A.3 The wire frame, used to hold and position the cotton pad, shall be constructed as shown in Figure 5A.1.

Figure 5A.1

Wire frame holder for cotton pad



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Note: All dimensions shall have a tolerance of ±1/16 in. (1.6 mm)

1. Hinge
2. Handle
3. 16 AWG (0.05 in.) (1.3 mm) diameter steel framework
4. Hinged lid with latch

5.4A.4 Prior to the fire test, the cotton pad shall be conditioned by drying in an oven at 212°F (100°C) for at least 30 minutes. Immediately upon removal from the drying oven, the cotton pad shall be stored in a desiccator, or other moisture proof container, until used for the fire test. The pad shall not be stored in the desiccator for more than 24 hr.

5.4A.5 Remove a cotton pad from the desiccator and place the pad in the wire frame holder.

5.4A.6 Position the frame containing the cotton pad directly over the observed crack, hole, opened joint, or other similar void or defect in the unexposed surface of the test specimen, approximately 1 ±1/8 in. (25 ±3 mm) from the surface, for a period of 30 ±1 s or until ignition of the cotton pad, whichever occurs first. Ignition of the cotton pad shall be defined as glowing, flaming or smoldering of the cotton pad. Charring of the cotton pad shall not be an indication of ignition.

5.4A.7 Record the time and location of the cotton pad test and the condition of the pad with respect to the occurrence of pad ignition. Also report the description of the crack, hole, opened joint, or other similar void or defect at the location of the cotton pad test.

5.4A.8 The cotton pad test shall not be conducted when the temperature on the unexposed surface, in the vicinity of the opening, has exceeded 572°F (300°C).

5.5 Furnace exposure

5.5.1 Measurement of furnace exposure

5.5.1.1 These measurements apply to furnaces used to expose a single surface of a test specimen such as furnaces used to test floors, roofs, walls and partitions.

5.5.1.2 The furnace exposure shall be measured following the practice described in Standard Practice for Measuring the Uniformity of Furnace Exposure on Tests Specimens, ASTM E2749.

5.5.1.3 The effective area of the furnace opening, as defined in ASTM E2749E, shall be equal to or greater than the area required on fire test specimens for the measurement of unexposed surface temperatures. The required unexposed surface area is defined in 3.3.

5.5.2 Frequency

5.5.2.1 After the initial measurement of the furnace exposure, the practice shall be repeated on the furnace when either of the following two conditions occurs:

a) A 5 year period has elapsed from the previous practice; or

b) Completion of a major modification to the furnace.
Note – A major modification would consist of replacement of burners, furnace linings or combustion control equipment.

5.5.3 Performance

5.5.3.1 After the initial 10 minute exposure period, the maximum temperature difference recorded by the plate the thermometers attached to the standardized test specimen described in ASTM E2749 shall not exceed 220°F (104°C).

5.5.3.2 After the initial 10 minute exposure period, the oxygen content obtained from the sample probe mounted on the standardized test specimen described in ASTM E2749 shall not be less than 1 percent.

5.5.4 Report on furnace exposure

5.5.4.1 The test report specified in Section 9 of ASTM E2749 shall be kept on file at the test laboratory for a minimum of 5 years.

5.5.5 Report on tests conducted in accordance with Sections 6, 7 and 10 – 16

5.5.5.1 Reports shall include:

a) Date when practice described in ASTM E2749 was conducted; and

b) Statement confirming requirements stated in 5.5.3 were met.

5.6 Recording and reporting data

5.6.1 Electronic measurements of temperature, deflection, and pressure are to be recorded and reported at intervals not exceeding 1 min.

5.6.2 Manual measurement of deflections shall be recorded and reported at intervals not exceeding 5 minutes, or until the laboratory personnel deems it to be an unsafe condition.

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 ft^2 (9.3 m^2), with neither dimension less than 9 ft (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 ft^2 (9.3 m^2), with neither dimension less than 9 ft (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 ft (2.7 m), the specimen length shall not be less than 9 ft (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 ft (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 ft (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 13.2.1.

10.2 Size and character of specimen

10.2.1 The area exposed to fire is not to be less than 180 ft^2 (16.7 m^2), with neither dimension less than 12 ft (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 in (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 ft (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 ft (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,

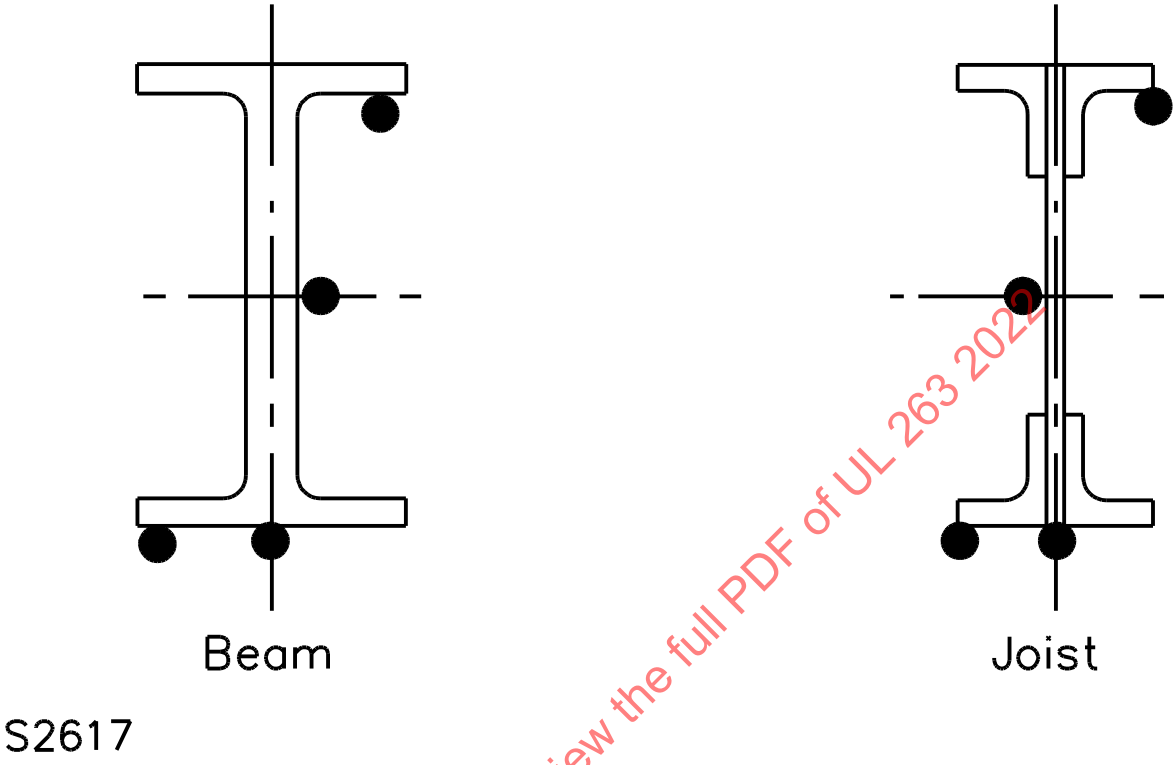
b) One on the web at the center, and

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

See Figure 10.1.

Figure 10.1

Location of thermocouples on steel structural members

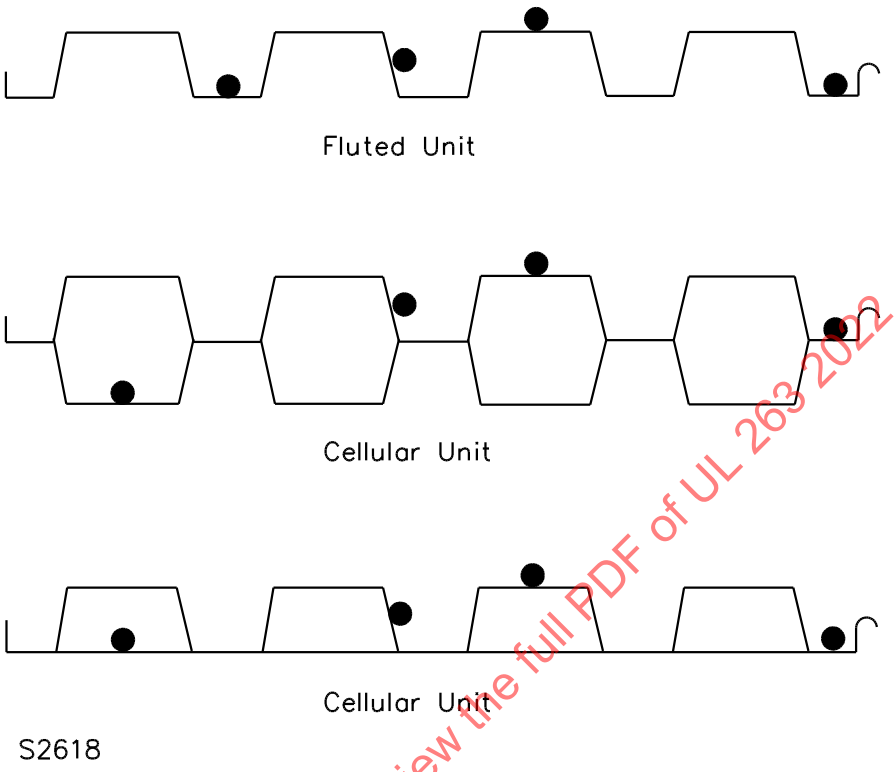


10.4.4 For reinforced or prestressed concrete structural members, thermocouples are to be located on each side of the tension reinforcing elements unless there are more than eight such elements, in which case thermocouples are to be placed on eight elements selected in such a manner as to obtain representative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



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 ft (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 h. For classifications greater than 1 h, this temperature criteria applies for a period of one-half the classification of the assembly or for 1 h, whichever is the greater.

d) For specimens employing steel structural members (beams, open-web steel joists, or the like) spaced 4 ft (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 h. For classifications greater than 1 h, this temperature criteria applies for a period of one-half the classification of the assembly or for 1 h, whichever is the greater.

e) For specimens employing conventionally designed concrete beams, spaced more than 4 ft (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 h. For

classifications greater than 1 h, this temperature criteria applies for a period of one-half the classification of the assembly or for 1 h, whichever is the greater.

10.5.2 As an alternate to 10.5.1(c), 10.5.1(d) and 10.5.1(e), the criteria stated in 12.4, Conditions of acceptance, shall be applied for the same time periods as stated in 10.5.1(c), 10.5.1(d) and 10.5.1(e) when:

a) The beam is tested in accordance with the Loaded Unrestrained Beams Test, Section 12;

b) The beam size tested in accordance with Section 12 is equal to or smaller than the beam included in the restrained beam specimen tested in accordance with Section 10; and

c) The capacity for heat dissipation from the beam to the floor or roof specimen tested in accordance with Section 10 is equal to or greater than the capacity for heat dissipation from the beam to the floor or roof specimen tested in accordance with Section 12.

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 ft (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 ft (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.

10.6.2 As an alternate to 10.6.1(c), 10.6.1(d) and 10.6.1(e), the criteria stated in 12.4, Conditions of acceptance, shall be applied for the same time periods as stated in 10.6.1(c), 10.6.1(d) and 10.6.1(e) when:

a) The beam is tested in accordance with the Loaded Unrestrained Beams Test, Section 12;

b) The beam size tested in accordance with Section 12 is equal to or smaller than the beam included in the restrained beam specimen tested in accordance with Section 10; and

c) The capacity for heat dissipation from the beam to the floor or roof specimen tested in accordance with Section 10 is equal to or greater than the capacity for heat dissipation from the beam to the floor or roof specimen tested in accordance with Section 12.

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 ft (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-ft (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 h, 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.

11.5.1.1 As an alternate to 11.5.1(b), the criteria stated in 12.4, Conditions of acceptance, shall be applied for the same time periods as stated in 11.5.1 (b), when:

a) The beam is tested in accordance with the Loaded Unrestrained Beams Test, Section 12;

b) The beam size tested in accordance with Section 12 is equal to or smaller than the beam included in the restrained beam specimen tested in accordance with Section 11; and

c) The capacity for heat dissipation from the beam to the floor or roof specimen tested in accordance with Section 11 is equal to or greater than the capacity for heat dissipation from the beam to the floor or roof specimen tested in accordance with Section 12.

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 (427°C) for cold-drawn prestressing steel or 1100°F (593°C) for reinforcing steel during the classification period.

12 Loaded Unrestrained Beams Test

12.1 Application

12.1.1 An individual classification of an unrestrained beam may be obtained by this test and based upon the conditions of acceptance specified in 12.4. 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.

12.2 Size and character of specimen

12.2.1 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.

12.2.2 The clear span (Lc) of beam exposed to the fire is to be not less than 12 ft (3.7 m), and the member is to be tested in its normal horizontal position.

12.2.3 For specimens tested with a representative section of a floor or roof construction, such sections shall be not more than 7-ft (2.1-m) wide, symmetrically located with reference to the beam.

12.2.4 The beam and the representative section of the floor or roof assembly shall not be restrained prior to the start of the test or restrained against the potential effects from thermally induced longitudinal movement at any time during the test.

12.2.5 Provide bearing support for the beam and the ends of the representative section of the floor or roof assembly along its edges perpendicular to the beam. The representative section of the floor or roof assembly shall not be supported along its edges parallel to the beam.

12.2.6 The total length of the specimen shall not exceed its clear span (Lc) and the total bearing length.

12.3 Loading

12.3.1 Throughout the fire endurance test, apply a superimposed load to the specimen to simulate a maximum load condition. This load shall be the maximum load condition allowed under nationally recognized structural design criteria unless limit design criteria are specified and a corresponding reduced load is applied.

12.4 Conditions of acceptance

12.4.1 To obtain an unrestrained beam classification, the specimen shall have sustained the applied load during the classification period. The specimen shall be deemed as not sustaining the applied load when both of the following limits are exceeded:

a) A maximum total deflection of:

$$(Lc^2) / (400\, d)$$

b) And after the deflection limit has been exceeded, a maximum rate of deflection per minute as determined over one-minute intervals of:

$$(Lc^2) / (9000\, d)$$

Where:

Lc equals the clear span of the beam, and

d equals the distance between the extreme fiber of the beam in the compression zone and the extreme fiber of the beam in the tensile zone.

12.4.2 With reference to 12.4.1, the units of deflection, Lc and d must be expressed in the same units such as inches or millimeters.

13 Alternate Test – Protection for Loaded Beams

13.1 Application

13.1.1 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.

13.2 Conditions of acceptance

13.2.1 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 (427°C) for cold-drawn prestressing steel or 1100°F (593°C) for reinforcing steel during the classification period.

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

14.1 Application

14.1.1 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.

14.2 Size and character of specimen

14.2.1 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 ft (3.7 m), and the member is to be tested in a horizontal position. A section of floor construction not less than 5-ft (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.

14.2.2 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.

14.2.3 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.

14.3 Temperature measurement

14.3.1 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 ft (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.

14.4 Conditions of acceptance

14.4.1 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.

14.5 Report of results

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

14.5.2 The test report shall state that the protection provided to the beam or girder was not designed to function structurally in resisting applied loads.

15 Tests of Protective Membranes in Wall, Partition, Floor, or Roof Assemblies

15.1 Application

15.1.1 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 15.2.1 – 15.4.1. 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.

15.2 Size and character of specimen

15.2.1 The area of a wall and partition protection specimen exposed to fire is to be not less than 100 ft^2 (9.3 m^2), with neither dimension less than 9 ft (2.7 m); the exposed area of a floor protection specimen is to be not less than 180 ft^2 (16.7 m^2), with neither dimension less than 12 ft (3.7 m).

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

15.3 Temperature performance of protective membranes

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

15.3.2 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 in (1.02 mm)]. The lead shall be electrically insulated with heat- and moisture-resistant coatings.

15.3.3 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 in (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.

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

15.3.5 Temperature readings are to be taken at intervals not exceeding 1 min.

15.4 Conditions of acceptance

15.4.1 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.

15.5 Report of results

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

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

15.5.3 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.

15.5.4 The test report shall record any visual observations that are pertinent to the performance of the protective membrane.

16 Ceiling Membrane Test

16.1 Application

16.1.1 This test is applicable to ceiling membranes and requires application of the fire exposure to the underside of the specimen under test.

16.1.2 *Deleted*

16.1.3 *Deleted*

16.1.4 *Deleted*

16.2 Size and character of specimen

16.2.1 The area exposed to fire is not to be less than 180 ft^2 (16.7 m^2), with neither dimension less than 12 ft (3.7 m) unless the ceiling membrane is designed to have its maximum dimension less than 12 ft (3.7 m) or designed to have an area less than 180 ft^2 (16.7 m^2). When the maximum designed dimension is less than 12 ft (3.7 m) or the designed area is less than 180 ft^2 (16.7 m^2), then the actual exposed dimensions shall be tested.

16.2.2 The support for the test specimen, when needed, shall be provided by steel structural sections spaced to suit the location of the suspension points for the ceiling. The steel structural sections shall be HSS 3x3x1/4 or other steel member having equal or greater stiffness.

16.2.3 HHS 3x3x1/4 is a designation for a hollow structural section published by the Steel Tube Institute. The dimension of the tube is 3 by 3 inch (76 by 76 mm) and the steel thickness is 1/4 inch (6 mm).

16.2.4 The perimeter of the test specimen shall be secured to the walls of the furnace or a furnace test frame with all provisions for expansion relief located within the area of the sample.

16.3 Test method

16.3.1 General

16.3.1.1 The fire test shall be conducted in accordance with Section 3, Control of Fire Tests with the thermocouple pads in accordance with 16.3.2.

16.3.2 Thermocouple pad

16.3.2.1 When the 6 by 6 inch (152 by 152 mm) pads specified in Appendix B cannot be used because of irregularities on the unexposed surface, the pad placed over thermocouples on the unexposed surface shall conform to the requirements in Appendix B except the length and width shall be 2 ±1/8 inch (51 ±3 mm). The 2 by 2 inch (51 by 51 mm) pad shall be centered over the thermocouple bead.

16.4 Conditions of acceptance

16.4.1 To obtain a ceiling membrane classification, the test specimen shall have complied with the following conditions:

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

b) Transmission of heat through the test 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) Transmission of heat through the test specimen during the classification shall not have raised an individual temperature on its unexposed surface to more than 325°F (181°C) above its initial temperature.

16.5 Report of results

16.5.1 In addition to the report requirements in Sections 3, 4 and 5, reports on tests of ceiling membranes shall include the following:

a) The name and location of the fire test laboratory and the date of the test.

b) Description of the test specimen and the method used to connect the ceiling membrane to the support members when support members were used.

c) All temperature and pressure data recorded during the test.

d) Any recorded visual observations that are pertinent to the performance of the test specimen.