



UL 1709

STANDARD FOR SAFETY

Rapid Rise Fire Tests of Protection Materials for Structural Steel

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UL Standard for Safety for Rapid Rise Fire Tests of Protection Materials for Structural Steel, UL 1709

Fifth Edition, Dated February 24, 2017

Summary of Topics

The Fifth Edition of UL 1709, the Standard for Safety for Rapid Rise Fire Tests of Protection Materials for Structural Steel is being issued.

The requirements are substantially in accordance with Proposal(s) on this subject dated February 12, 2016 and December 9, 2016.

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UL 1709

**Standard for Rapid Rise Fire Tests of Protection Materials for Structural
Steel**

First Edition – February, 1989
Second Edition – February, 1994
Third Edition – March, 2005
Fourth Edition – August, 2011

Fifth Edition

February 24, 2017

This ANSI/UL Standard for Safety consists of the Fifth Edition.

The most recent designation of ANSI/UL 1709 as an American National Standard (ANSI) occurred on February 24, 2017. 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 This standard describes a test method for measuring the resistance of protective materials to rapid-temperature-rise fires.

1.2 The test method covers a full-scale fire exposure, intended to evaluate the thermal resistance of protective material applied to structural members and the ability of the protective material to withstand the fire exposure.

1.3 The standard describes the minimum testing requirements for classification, the limits of applicability of test results and acceptable methodology to determine the classification achieved.

1.4 The test method includes a supplementary test method for beams, intended to evaluate the ability of protective materials to perform when subject to significant deflections, for use in conjunction with the full-scale exposure test and applicable for beams and other sections subject to bending. Information published in accordance with this test method may also include product design tables for beams and sections subject to bending derived from the supplementary test method and accompanying methodology.

1.5 Information published in accordance with this test method may also include supplementary product design tables for alternate limiting temperatures derived from a multi-temperature analysis. Such tables are provided to aide in conditions where a performance-based-design approach is implemented, but are not part of the classification.

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.

2.3 Terms of abbreviation

D or DFT = thickness of fire protection material (in)

D_{min} = minimum thickness of fire protective coating (in)

D_{max} = maximum thickness of fire protection coating (in)

D_{mid} = an intermediate thickness of fire protection coating lying within the mid third between D_{min} and D_{max} (in)

t = the period or duration of classification (minutes)

T = the temperature (°F or °C) used as the criteria in an engineering assessment (engineering analysis or study) intended to provide supplementary information to the classification

W/D where W is the weight of the open steel section per lineal foot and D is the perimeter of protection material at the interface between the open steel section and the protection material

A/P where A is the cross-sectional area of the hollow section and P is the perimeter of protection material at the interface between the hollow steel section and the protection material

2.4 Definitions

2.4.1 Configuration of section: The type of section, defined by reference to its shape and structural use. For example: open column, open beam, hollow column, hollow beam.

2.4.2 Hollow section: A tube or pipe or similar shape that has a cross section containing enclosed space.

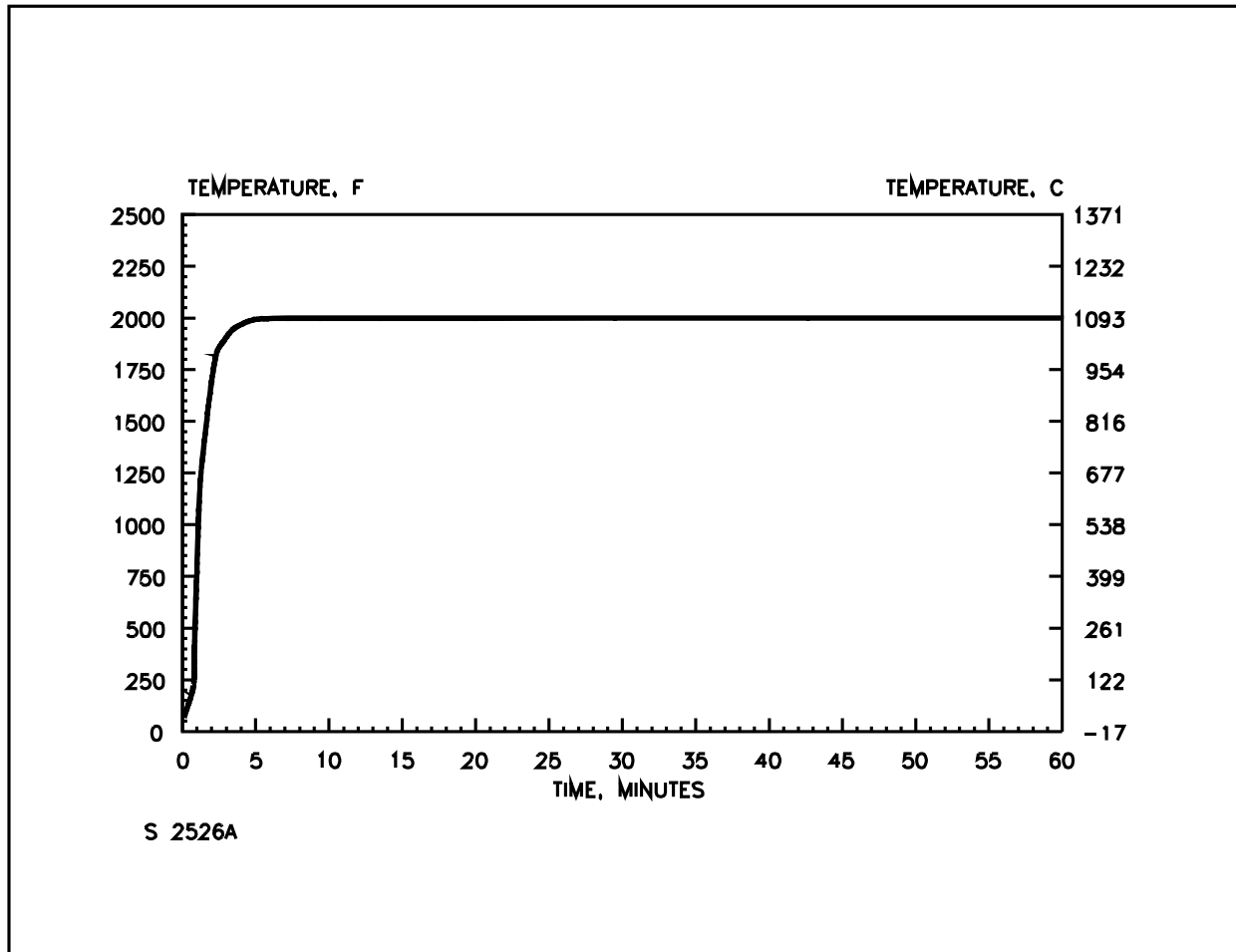
2.4.3 Open section: A wide flange similar shape section that has a cross-section containing no enclosed space.

FULL-SCALE TEST METHOD

3 Furnace Control

3.1 The fire environment within the furnace is to develop a total heat flux of 65,000 ±5000 Btu/h·ft² (204 ±16 kW/m²) and an average temperature of 2000 ±100°F (1093 ±56°C) within 5 min from the start of the test. The fire environment is to be controlled by reproducing the furnace temperatures recorded during the furnace calibration method specified in Furnace Calibration, Section 4. This temperature is to be maintained throughout the remainder of the fire test as shown in Figure 3.1.

Figure 3.1
Time-temperature curve



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3.2 The furnace is to be controlled to maintain the area under the time-temperature curve to within 10% of the corresponding area under the standard time-temperature curve shown in Figure 3.1 for fire tests of 60 min or less duration; to within 7.5% for tests longer than 60 min but not longer than 120 min; and to within 5% for tests exceeding 120 min in duration. The area under the time-temperature curve is to be obtained by averaging the results from the pyrometer or thermocouple readings.

3.3 A correction is to be applied for variation of the furnace exposure from the prescribed, where such variation will affect the test results, by multiplying the indicated time period by two-thirds of the value obtained by dividing the difference in area between the curve of average furnace temperature and the standard curve for the first three-fourths of the period by the area between the standard curve above a base line of 68°F (20°C) for the same part of the indicated period during the first part of the test. For fire exposure times longer than standard, the indicated rating period is to be increased by the amount of the correction and for fire exposure times less than standard, the indicated rating period is to be similarly decreased. The correction can be expressed by the following formula:

$$C = \frac{2}{3} \frac{(A - A_s)}{A_s}$$

In which:

C is the correction in the same units as I,

I is the indicated fire-resistance period,

A is the area under the curve of indicated average furnace temperature for the first three-fourths of the indicated period, and

A_s is area under the standard furnace curve for the same part of the indicated period.

3.4 The temperature fixed by the requirements of Furnace Calibration, Section 4, is to be the average temperature obtained from the readings of no fewer than eight thermocouples symmetrically disposed and distributed within the test furnace to show the temperature near all parts of the assembly or assemblies.

3.5 The thermocouples are to be fabricated by fusion-welding the twisted ends of 0.064-in (1.6-mm) diameter (No. 14 B&S gauge) chromel-alumel wires having a time constant of 2 min or less, and mounting the wires in porcelain insulators. The thermocouple assembly is to be inserted through a standard weight, nominal 1/2 in iron, steel or inconel pipe, and the end of the pipe from which the welded junction protrudes is to be open. The thermocouple junction is to protrude 1/2 in (12.7 mm) from the open end of the pipe.

3.6 The junction of each thermocouple is to be placed 4 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.

3.7 Each thermocouple within the furnace shall be read at intervals not exceeding 1 min during the first 30 min of the test and at intervals not exceeding 5 min during the remainder of the test.

4 Furnace Calibration

4.1 A furnace calibration record is to be maintained and the column furnace is to be recalibrated after completion of any repair that could alter the heat generation, retention or flow characteristics of the furnace. The calibration shall be conducted at a frequency not to exceed 10 years.

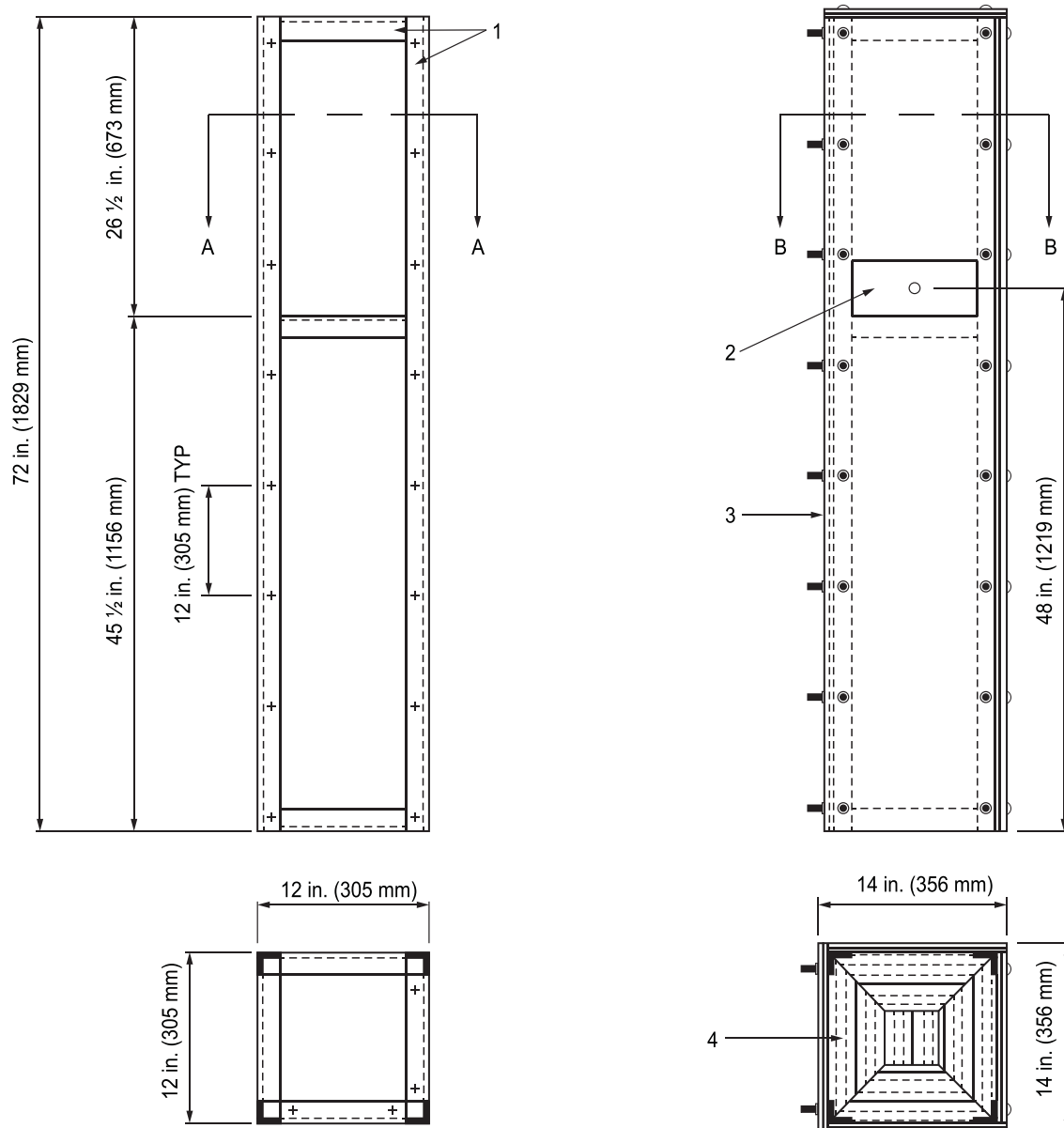
4.2 The exposure of the furnace is to be measured with thermocouples and calorimeters mounted within a nominal 14 by 14 in by 6 ft high (357 by 357 by 1829 mm) vertical calibration column centered within the furnace chamber. The calibration column is to be fabricated from noncombustible materials, constructed and instrumented as shown in Figures 4.1 and 4.2.

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Figure 4.1
Calibration column I



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- 1 2" x 2" x 3/16" (51 x 51 x 4.8 mm) steel angles welded to form framework
- 2 Instrumentation block (2 required)
- 3 Two layers of nom. 1.2" (13 mm) Marinite or equivalent inorganic insulation boards installed on four sides and top of calibration column, secured to framework with No. 1/4 - 20 steel bolts with nuts and 1 1/4 (32 mm) diameter steel washers
- 4 Entire cavity of calibration column filled with nom. 6 lb/ft³ (3484 kg/m³) density mineral wool batts

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