

VERTICAL-TRAY FLAME TESTS: IEEE 1202, IEEE 383, AND UL 1685

Vertical-tray flame tests are commonly used in the wire and cable industry to analyze cable flame propagation for industrial control and power cables. These tests specifically examine the flame spread on cables installed in a vertical test chamber, simulating real-world industrial cable conditions when installed in a cable tray or other support systems.

Standard cable flame-propagation tests benefit cable manufacturers, electrical distributors and end-users. These procedures provide consistent, repeatable results and measurable test acceptance criteria that allow the selection of the correct product for the application. The standard flame tests commonly specified in the industry are UL 1685, IEEE 1202, and IEEE 383.

Overview of the UL 1685 Standard

UL 1685 *Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables* is an industry standard that provides the test methods for two types of vertical flame tests:

- UL Flame Exposure
- FT4/IEEE 1202 Type of Flame Exposure

The UL version and the FT4/IEEE 1202 version both measure flame propagation by testing groups of cables. These tests vary in the cable loading, spacing, burner angle, flame spread and optional smoke requirements. UL cable standards provided in Table 1 allow control and industrial cables to meet one of the UL 1685 vertical flame tests to be UL listed.

| Cable Standard | Cable Types |
|-------------------------------|--------------------|
| UL 13 Power Limited Cables | PLTC, CL3, CL2 |
| UL 1072 Medium Voltage Cables | Type MV-90, MV-105 |
| UL 1277 Tray Cables | Type TC |
| UL 1569 Metal-Clad Cables | Type MC |

Table 1: UL Control and Instrumentation Cable Standards Containing Vertical Flame Tests

The UL Flame Exposure test of UL 1685 measures the flame spread in groups of cables in a steel ladder tray. The tray is 12 inches wide, 3 inches deep and 96 inches long. The rungs measure 1 inch in the direction parallel to the length of the tray and are spaced 9 inches apart. The tray is mounted vertically on the floor of the test chamber or on an optional tray base and the center of the tray is filled with cable samples in one layer spaced ½ cable diameter apart. A mixture of air and propane

is burned using a ribbon burner. The burner is placed horizontally 3 inches from the surface of the cable, 18 inches from the bottom of the tray and midway between two rungs. The power output of the burner is 70,000 Btu/hr. The flame is applied for twenty minutes and then removed.

A cable passes the vertical-tray test if the cable char height is less than 8 feet. A cable may continue to burn after the burner is shut off; however, the test is not complete until the cable stops burning.

The UL Flame Exposure test also contains an optional smoke test. Cables that meet the smoke test have to meet the following requirements:

- The total smoke released is to be 95 m² or less
- The peak smoke release rate is to be 0.25 m²/s or less

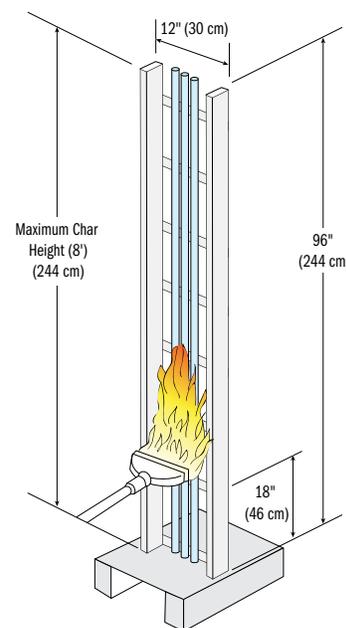


Figure 1: UL Flame Exposure Test Chamber

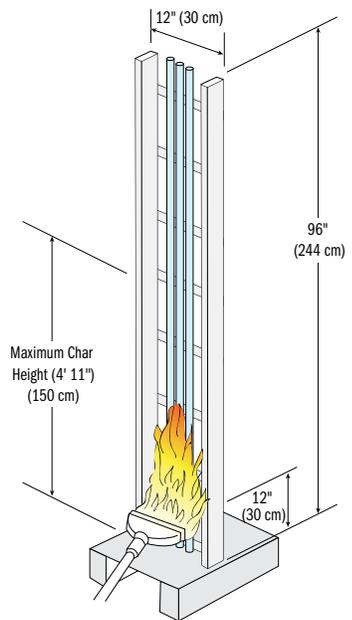


Figure 2: FT4/IEEE 1202 Test Chamber

UL 1685—FT4/IEEE 1202

The FT4/IEEE 1202 flame exposure version of UL 1685 is similar to the UL Flame Exposure version but contains a few variations. This test measures the flame spread in groups of cables in a steel ladder tray. The tray is 12 inches wide, 3 inches deep and 96 inches long. The rungs measure 1 inch in the direction parallel to the length of the tray and are spaced 9 inches apart. The tray is mounted vertically on the floor of

the test chamber or on an optional tray base. The tray is filled with cable samples. Depending on the outer diameter of the cable, different spacing requirements apply. A mixture of air and propane is burned using a ribbon burner. The burner is placed at a 20° angle 3 inches from the surface of the tray, 12 inches from the bottom of the tray. The power output of the burner is 70,000 Btu/hr. The flame is applied for twenty minutes and then removed.

A cable passes the vertical tray test if the cable char height is less than 4 feet, 11 inches. A cable may continue to burn after the burner is shut off; however, the test is not complete until the cable stops burning.

The FT4/IEEE 1202 also contains an optional smoke test. Cables that meet the smoke test have to meet the following requirements:

- a) The total smoke released is to be 150 m² or less
- b) The peak smoke release rate is to be 0.40 m²/s or less

IEEE 383 Flame Test Reference

IEEE 383 is a Class 1E Nuclear Standard and provides requirements for cables and installations used in nuclear power generation facilities. IEEE 383 previously contained a flame test in the 1974 version but was updated in 2003 and again in 2015. In 2003, the flame-test procedure was removed from the standard. Instead, IEEE 383-2003 Section 8 points users to IEEE 1202 as shown below:

Cables shall be flame retardant in accordance with the requirements of IEEE Std 1202-1991 or NFPA 262-2002. Switchboard cables, coaxial, twinaxial, and triaxial cables shall as a minimum pass the UL VW-1 flame test.*

Many existing cable specifications reference IEEE 383 in the cable flame-performance section for historical reasons. Based on the above reference, cables that meets the IEEE 1202 flame test meet the flame-requirements of IEEE 383.

* Source: IEEE 383-2003 Section 8