



FROM: Codes & Standards

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RE: Flame Tests

Technical Document

This Technical Paper from Codes & Standards will focus on a few of the more common Flame Tests associated with the wire and cable products as required by Underwriters Laboratories (UL). The Flame Tests required by UL are designed to test the flame retardancy in wire and cable products and to evaluate the resiliency of the material when a fire or heat source is applied. It is the goal of the flame test to determine if the material will cease burning once the heat source is removed. These tests are designed to protect the end-user if a fire involves the wire and cable. In the tables below, you will find some of Encore’s products and the flame tests it meets as well as a description of the various flame tests.

UL 1685 Standard, Vertical-Tray Fire Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables is an industry standard that provides two test methods for two type of vertical flames tests:

- UL 1685 Flame Exposure
- FT4/IEEE 1202 Type of Flame Exposure

UL 1685 Standard and the FT4/IEEE 1202 version both measure flame propagation by testing groups of cables. The difference in the two tests consists of the following:

UL 1685 measures the flame spread in groups of cables in a steel ladder tray, 12 inches wide, 3 inches deep, and 96 inches long. The tray is mounted vertically, a burner is placed 3 inches from vertical surface of cables, 18 inches from the bottom, a 70,000 BTU/HR is applied, flame applied for 20 minutes, and then removed. A cable passes if char height is less than 8 ft, and cable stops burning once burner is shut off. Optional smoke test includes total smoke release is less than 95 m² and the peak smoke release rate is .25 m²/s or less.

FT4 is the Canadian equivalent Flame Test for cables in Cable Trays (CT) and is similar to the UL-1685, but a little more severe. FT4 and IEEE 1202 are equivalent, and both have similar test set up for UL 1685 cables, with a steel ladder tray, 12 inches wide, 3 inches deep, and 96 inches long, and are spaced 9 inches apart. However, the burner is placed at a 20° degree angle 3 inches from the surface of the tray, 12 inches from the bottom of the tray, with 70,000 BTU/HR applied. A cable passes this test if the cable char height is less than 4 feet 11 inches, and the cable stops burning once the burner is shut off. Optional smoke test includes smoke release is less than 150 m² or less and the peak smoke rate is .40 m²/s or less.

	FLAME TESTS					
Product	FT2/FH/ HORIZONTAL FLAME TEST	FV-1 / VERTICAL FLAME TEST	FV-2 / VW-1 VERTICAL FLAME TEST	FT4 / IEEE 1202	UL 1685 VERTICAL TRAY FLAME TEST (Method 1)	UL 1685 VERTICAL TRAY FLAME TEST (Method 2)
THHN/THWN-2		X	X	X	X	X
XHHW-2	X				X	
MC CABLE**				X	X	X
PV	X	X			X	
TRAY CABLE**				X	X	X

** For Both MC Cable and Tray Cable, ONLY with Encore’s THHN/THWN-2 inners, it will pass the FT4/IEEE 1202**

		TEST REQUIREMENTS	
Flame Test	Flame Temperature (°F)	Time Applied (Seconds)	Number of Flame Applications
FT2/FH/Horizontal Flame Test (UL 44, 83)	Horizontal sample in a special enclosure. Tirrill Gas Burner with a 1500°F	Flame applied for 30 seconds. Flame must not progress beyond a 2" left or right of point of application.	The total number of applications is 1.
FV-1/Vertical Flame Test (UL 83) FT1	Vertical sample in a special enclosure. Tirrill Gas Burner with a 1500°F	Flame applied for 15 seconds., removed for 15 seconds, and re-applied. A paper flag is positioned 10" above point of application. Sample fails if Flame consumes more than 25% of paper flag or burns for longer than 60 seconds, or drop flaming particles that ignite cotton. (FT1 is the Canadian equivalent Flame Test which does not evaluate ignited particles)	The total number of flame applications is 5.
FV-2/VW-1 (Vertical-Wire Flame Test UL-83)	Vertical sample in a special enclosure. Tirrill Gas Burner with a 1500°F	Flame applied for 15 seconds and removed. No further application. Flame must extinguish on its own and not burn longer than 60 seconds. Char on specimen shall not exceed 4 inches and shall not ignite cotton on the floor.	The total number of applications is 1.
Vertical Tray Test (FT4 / IEEE 1202) UL 1685 Method 2 – Vertical Tray	Stringent Test applied to jacketed cables in a vertical tray 8 ft high. Flame temperature is 1500°F with a heat source of 70,000 BTUs per hour	Flame applied for 20 minutes. Flame should not propagate to the top of the tray or beyond 5 ft from the application point. Total smoke released in 20 min shall not exceed 150 m ² /s and peak smoke release rate shall not exceed .40 m ² /s	The total number of applications is 1.
Vertical Tray Flame Test (UL 83, UL 1277) UL 1685 Method 1 – Vertical Tray	Stringent Test applied to jacketed cables in a vertical tray 8 ft high. Flame temperature is 1600 - 1750°F with a heat source of 70,000 BTUs per hour	Flame applied for 20 minutes. Flame should not propagate to the top of the tray or beyond 8 ft from the application point. Total smoke released in 20 min shall not exceed 95 m ² and peak smoke release rate shall not exceed .25 m ² /s	The total number of applications is 1.
Vertical Tray Flame Test (210,000 BTU)	Stringent Test applied to jacketed cables in a vertical tray 8 ft high. Flame temperature is 1500°F with a heat source of 210,000 BTUs per hour	Flame applied for 20 minutes. Flame should not propagate to the top of the tray or beyond 6 ft from the application point.	The total number of applications is 1.



Frequently Asked Question

1. Why do some products have multiple Flame ratings?

Depending on the size, product, and requirements, there may be more than one flame rating that a product will be rated for. For example, THHN/THWN-2 Meets VW-1; for 1/0 AWG and Larger meets UL 1685 Method 1 and Method 2 (FT4/IEEE 1202)

2. What Flame Test does a product have to pass for Cable Tray (CT) rating?

For most single conductors, it must be 1/0 AWG and Larger, and pass UL 1685 Method 1 test.

Summary Facts About Flame Tests

- FT2/FH/Horizontal Flame Test is a Requirement for XLPE (Cross-link Polyethylene) insulated conductors
- UL 1685 Method 1 is only required for conductors 1/0 and larger for Cable Tray (CT) use; However, the Equipment Ground Conductor (EGC) can be as small as 4 AWG if used in CT.
- UL 1685 Method 2 is also referred to as IEEE 1202 or FT4 and it is an optional Flame Test
- THHN/THWN-2 is only required to have FV-1; VW-1 is optional; FT-4 is optional; UL 1685 Method 1 for CT use;
- Encore's THHN/THWN-2 inners (VW-1 rated) for MC Cable and Tray Cable allow it to pass the FT4/IEEE 1202
- Encore's XHHW-2 inners for MC Cable and Tray Cable ONLY passes UL 1685 Method 1 NOT FT4 or IEEE 1202
- Tray Cable must pass UL Flame Test (Method 1) or FT4/IEEE 1202 or UL 1685 Flame Test (Method 2)
- UL 1685 Method 1 allows up to 8' of char
- UL 1685 Method 2 allows up to 4'11" of char