



UL 1424

STANDARD FOR SAFETY

Cables for Power-Limited Fire-Alarm Circuits

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UL Standard for Safety for Cables for Power-Limited Fire-Alarm Circuits, UL 1424

Fourth Edition, Dated January 22, 2015

Summary of Topics

This revision to ANSI/UL 1424 dated June 26, 2020 includes the addition of ST-1; [23.4](#), and [44.1\(q\)](#).

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 new and revised requirements are substantially in accordance with Proposal(s) on this subject dated January 14, 2020 and March 27, 2020.

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The most recent designation of ANSI/UL 1424 as an American National Standard (ANSI) occurred on June 5, 2020. 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 requirements cover 60 – 250°C (140 – 482°F) single- and multiple-conductor cables for use as fixed wiring within buildings (some are also marked for direct burial) principally for power-limited fire-alarm circuits as described in Article 760 and other applicable parts of the National Electrical Code (NEC). Cables covered by these requirements are:

- a) Type FPLP (plenum cable),
- b) Type FPLR (riser cable), and
- c) Type FPL (cable for other than plenum and riser uses in general and in trays).

1.2 The cables covered in these requirements are rated for 300 volts but are not so marked. See [44.1\(h\)](#).

1.3 A cable that contains one or more electromagnetic shields may be surface marked or have a marker tape to indicate that it is "shielded". A cable that contains one or more optical-fiber members has "-OF" supplementing the type letters and is marked in accordance with [45.1\(d\)](#). A cable may consist of or contain one or more coaxial members.

1.4 The overall jacket on a cable that has "sun res" or "sunlight resistant" in a surface marking or on a marker tape complies with a 720-h sunlight-resistance test.

1.5 A cable that has "dir bur", "direct burial", or "for direct burial" in a surface marking or on a marker tape complies with a 1000-lbf crushing test. Direct-burial cable with wire armor, a metal braid, interlocked metal armor, or a smooth or corrugated metal sheath has a jacket over the metal covering.

1.6 Smoke and fire considerations are as follows for the cables covered in these requirements:

a) TYPE FPLP CABLE – Cable that is intended for installation in accordance with section 760-154 (A) of the National Electrical Code (ANSI/NFPA 70) in a duct, plenum, or other space used to transport environmental air without the cable being enclosed in a raceway in that space is to be tested for smoke and flame characteristics in accordance with the National Fire Protection Association Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces, ANSI/NFPA 262. A cable that complies exhibits a maximum flame-propagation distance that is not greater than 5 ft, 0 inch or 152 cm, a peak optical density of smoke produced of 0.50 or less (32 percent light transmission), and an average optical density of smoke produced of 0.15 or less.

b) TYPE FPLR CABLE – Cable that is intended for use in vertical runs in a shaft, or for installations in which the cable penetrates more than one floor, as specified in section 760-154 (B) of the National Electrical Code ANSI/NFPA 70. This cable is to be tested for flame-propagation characteristics in accordance with the Standard Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts, UL 1666. A cable that complies has a flame-propagation height less than 12 ft, 0 inch or 366 cm and temperatures are 850.0°F (454.4°C) or less at a height of 12 ft, 0 inch or 366 cm.

c) TYPE FPL CABLE – Type FPL cable complies with a 70,000 Btu/h (20.5 kW) vertical-tray flame test. The cable manufacturer chooses one of the following tests:

- 1) THE UL TEST REFERENCED IN [23.2.1](#) – This paragraph applies the test method described as the UL Flame Exposure (smoke measurements are not applicable) in the Standard Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables, UL 1685, to cable that is surface marked or designated by a marker tape as

"FPL". A cable of a given construction shall not exhibit char that reaches the upper end of any specimen (a maximum of 8 ft, 0 inch or 244 cm).

2) THE FT4/IEEE 1202 TEST REFERENCED IN [23.3.1](#) – This paragraph applies the test method described as the FT4/IEEE 1202 Type of Flame Exposure (smoke measurements are not applicable) in the Standard Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables, UL 1685. This test differs from the UL tests in loading (more cables are used, with small cables bundled, and the spacing between cables or bundles is limited), burner angle, and failure criterion. For compliance, this test damages less than 150 cm (59 inches) of cable. A cable that complies either is not marked or it bears the designation "FT4/IEEE 1202" or "FT4" legible on or through the outer surface or on a marker tape [see marking in [44.1\(i\)](#)].

d) Deleted

1.7 Deleted

1.8 Deleted

1.9 These requirements do not cover cables that contain conductors for electric-light, power, or Class 1 circuits. These requirements do not cover cables for Class 3 or Class 2 power-limited circuits (see the Standard for Power-Limited Circuit Cables, UL 13), communications cables (see the Standard for Communications Cables, UL 444), or cables for non-power-limited fire-alarm circuits (NPLF types).

1.10 These requirements do not cover the optical or other performance of any optical-fiber member or group of such members. See [8.3](#).

2 Units of Measurement

2.1 In addition to being stated in the inch/pound units that are customary in the USA, each of the requirements is also stated in units that make the requirement conveniently usable in countries employing the various metric systems (practical SI and customary). Equivalent – although not necessarily exactly identical – results are to be expected from applying a requirement in USA or metric terms. Equipment calibrated in metric units is to be used when a requirement is applied in metric terms.

3 References and Terms

3.1 Wherever the designation "UL 1581" is used in this wire standard, reference is to be made to the designated part(s) of the Reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581. Whenever the designation "UL 2556" is used in this standard, reference is to be made to the designated parts of the Standard for Wire and Cable Test Methods, UL 2556.

3.2 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.

3.3 Nylon designates a thermoplastic material whose characteristic constituent is a polyamide formed by the condensation of dibasic organic acids and diamines. Nylon used as a covering is unfilled and without reinforcement but may contain stabilizers, flame retardants, pigment, and/or other additives.

3.4 PBT designates a thermoplastic polyester material whose characteristic constituent is polybutylene terephthalate. PBT used as a covering is unfilled and without reinforcement but may contain flame retardants, pigment, and/or other additives.

CONSTRUCTION

4 Materials

4.1 Each material used in a cable shall be compatible with all of the other materials used in the cable.

4.2 The power-limited fire-alarm circuit cables covered in these requirements shall comply in all respects with the applicable requirements for construction details, test performance, and markings.

5 Conductors

5.1 The center conductor of a coaxial member shall be solid or stranded, shall be round, and either shall be of soft-annealed copper or shall be of copper-clad steel having 21 percent or higher conductivity in accordance with ASTM B 869. All other conductors in a cable shall be of round soft-annealed copper. A solid copper conductor and the individual wires (strands) of a stranded copper conductor shall be round and shall comply with ASTM B 3. The wires (strands) of a stranded conductor shall have a right- or left-hand direction of lay. The length of lay of the wires (strands) of a stranded conductor shall not exceed 20 times the calculated diameter over the assembled conductor for 19 – 10 AWG conductors and shall not exceed 30 times the calculated diameter over the assembled conductor for 26 – 20 AWG conductors. The nominal diameters of solid and stranded conductors that are indicated in [Table 5.1](#) are not requirements but are for use in calculating the dimensions required for various parts of the cable when using [Table 13.1](#), [Table 13.2](#), [Table 14.1](#), [Table 14.2](#) and [Table 18.1](#).

**Table 5.1
Conductor diameters**

AWG size of conductor	Solid conductor				Nominal diameter of stranded conductor	
	Nominal diameter		Minimum diameter		inch	mm
	inch	mm	inch	mm		
26 ^b	0.0159	0.404	0.0151 ^a	0.384 ^a	0.0180	0.457
25 ^b	0.0179	0.455	0.0170 ^a	0.432 ^a	0.0203	0.516
24	0.0201	0.511	0.0191 ^a	0.485 ^a	0.0228	0.579
23	0.0226	0.574	0.0215 ^a	0.546 ^a	0.0256	0.650
22	0.0253	0.643	0.0240 ^a	0.610 ^a	0.0287	0.729
21	0.0285	0.724	0.0271 ^a	0.688 ^a	0.0323	0.820
20	0.0320	0.813	0.0304 ^a	0.772 ^a	0.0362	0.919
19	0.0359	0.912	0.0341 ^a	0.866 ^a	0.0407	1.03
18	0.0403	1.02	0.0399	1.103	0.0456	1.16
17	0.0453	1.15	0.0448	1.138	0.0513	1.30
16	0.0508	1.29	0.0503	1.278	0.0576	1.46
15	0.0571	1.45	0.0565	1.435	0.0647	1.64
14	0.0641	1.63	0.0635	1.613	0.0727	1.85
13	0.0720	1.83	0.0713	1.81	0.0816	2.07
12	0.0808	2.05	0.0800	2.03	0.0915	2.32
11 ^c	0.0907	2.30	0.0900	2.28	0.103	2.62
10 ^c	0.102	2.59	0.1010	2.56	0.116	2.95

^a The diameter (0.95 x nominal) and resistance (1.1 x nominal) requirements for the solid copper 26 – 19 AWG sizes are as established by the communications-cable industry. The diameter (0.99 x nominal) and resistance (1.02 x nominal) requirements for the solid copper 18 – 10 AWG sizes are the same as those established for other cables. The resistance values for stranded copper conductors in all sizes are the same as those established for other cables.

Table 5.1 Continued on Next Page

Table 5.1 Continued

AWG size of conductor	Solid conductor				Nominal diameter of stranded conductor	
	Nominal diameter		Minimum diameter		inch	mm
	inch	mm	inch	mm		
<p>^b 26 and 25 AWG copper conductors are only for either of the following:</p> <p>a) In a cable that has a breaking strength shown by test to be at least 25.0 lbf or 111 N or 11.3 kgf in accordance with 41. The strength test is not required for cables with four or more conductors.</p> <p>b) As the central conductor in a coaxial member.</p> <p>^c 11 and 10 AWG copper conductors and 10 and smaller AWG copper-clad steel conductors are only for the central conductor in a coaxial member.</p>						

5.2 Each conductor shall be continuous throughout the entire length of the finished cable – see test in [16.1](#) and [16.2](#).

5.3 All solid and stranded conductors are to be identified in the cable, tag, reel, and carton size markings as a particular AWG size. The size of the copper conductor shall be verified either by determination of the d-c resistance or, as described in [5.4](#), by determination of the diameter. The size of a stranded conductor shall be verified either by determination of the d-c resistance or by determination of the cross-sectional area as described in [5.4](#). Determination of the conductor size by measurement of the d-c resistance is to be as described in D-C Resistance Test of Copper Conductors, Section [17](#), and is the referee method in all cases.

5.4 In place of complying with the d-c resistance requirement in [17.1](#), at the cable manufacturer's option, a copper conductor may instead comply with the following requirement:

a) SOLID CONDUCTOR – The diameter of a solid copper conductor shall not be smaller than the minimum acceptable diameter indicated for the size in [Table 5.1](#) (see [5.3](#)) when the diameter of the conductor is determined from measurements as follows:

1) Measurements of the diameter of a solid copper conductor are to be made over the metal-coated (see [6.1](#) and [6.2](#)) or uncoated copper by optical means or by means of a machinist's micrometer caliper having flat surfaces both on the anvil and on the end of the spindle. In either case, the equipment is to be calibrated to read directly to at least 0.001 inch or 0.01 mm, with each division of a width that facilitates estimation of each measurement to 0.0001 inch or 0.001 mm. The maximum and minimum diameters at a given point on the solid conductor are each to be recorded to the nearest 0.0001 inch or 0.001 mm, added together, and divided by 2 without any rounding off of the sum or resulting average.

2) Each minimum acceptable diameter indicated in [Table 5.1](#) is an absolute minimum. The unrounded average of the two diameter readings is therefore to be compared directly with the minimum in the table for the purpose of determining whether the solid conductor does or does not comply with the diameter requirement.

b) STRANDED CONDUCTOR – The cross-sectional area of a stranded copper conductor of a standard (see [5.3](#)) AWG size and having only round strands shall not be smaller than the minimum acceptable area indicated for the size in the 0.98 x nominal column in Table 20.1 of UL 1581. The cross-sectional area of the stranded conductor is to be determined as the sum of the areas of its component round strands.

5.5 A joint in a solid conductor or in one of the individual wires of a stranded conductor shall be made in a workmanlike manner, shall be smooth, and shall not have any sharp projections. A joint in a stranded

conductor is to be made by separately joining each individual wire, or is to be made by machine brazing or welding of the conductor as a whole provided that the resulting solid section of the stranded conductor is not longer than 1/2 inch or 13 mm, there are no sharp points, and the distance between brazes or welds in a single conductor does not average less than 3000 ft or 915 m in any reel length of insulated single conductor. A joint made before insulation is applied to a conductor shall not increase the diameter of the solid conductor or individual wire (strand). A joint made after insulating shall not increase the diameter of the solid conductor or individual wire (strand) by more than 20 percent. Joints made after insulating shall be made prior to further processing and shall be insulated by heat-shrinkable tubing or by applying the original or investigated comparable insulation by means of a bonded patch or molding, and shall comply with the requirements in this Standard. A jacket that is damaged to the point that the underlying assembly is exposed or that is opened for the purpose of repairing a conductor either:

- a) Shall be stripped and replaced in its entirety, or
- b) A second duplicate jacket shall be applied over the first for the entire length of the cable.

The total jacket thickness shall not exceed any limitation determined for a particular cable in an applicable flame or smoke-and-flame test or other test specified in this Standard.

6 Metal Coating

6.1 If the insulation adjacent to a solid copper conductor or a conventional (not bunch-tinned) stranded copper conductor is of a material that corrodes unprotected copper in the test Copper Corrosion described in UL 2556, the solid conductor or the individual wires (strands) of the stranded conductor that is not bonded shall be individually covered with a coating of tin complying with ASTM B 33, of a tin/lead alloy complying with ASTM B 189, of nickel complying with ASTM B 355, of silver complying with ASTM B 298, or of another metal or alloy (evaluation required).

6.2 It is acceptable to metal-coat a solid conductor or the individual wires (strands) of a stranded conductor on which a coating is not needed for corrosion protection.

6.3 The maximum temperature rating of the cable is not specified relative to the diameter of copper wires used in the serving, wrap, or braid shielding described in 10.2 (c). Otherwise, copper strands and solid copper conductors shall not be used in a cable with a temperature rating higher than indicated in Table 6.1.

Table 6.1
Maximum temperature rating of cable relative to diameter and coating of solid copper conductors or of copper conductor strands

Metal coating of copper strands or of solid copper conductor	Diameter of each strand or of the solid conductor	
	Smaller than 0.015 inch or 0.38 mm	At least 0.015 inch or 0.38 mm
Uncoated or coated with tin or a tin/lead alloy	150°C (302°F)	200°C (392°F)
Coated with silver	200°C (392°F)	200°C (392°F)
Coated with nickel	over 200°C (392°F)	over 200°C (392°F)

7 Insulation

7.1 Material and application

7.1.1 Each conductor shall be insulated for its entire length with one or more of the insulation materials indicated in Table 7.1 or referenced in note ^a to Table 7.1. The insulation shall be solid or, in the cases indicated in the second column of Table 7.1, may be expanded (foamed). In any case, a solid dielectric