

UL 1277

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Electrical Power and Control Tray Cables with Optional Optical-Fiber Members

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Revisions of this standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

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F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements cover electrical power and control cables consisting of either two or more current-carrying copper, aluminum, or copper-clad aluminum circuit conductors, or one or more pairs of thermocouple-extension wires. Thermocouple-extension wires and circuit conductors shall not be mixed in the same cable. These cables are constructed with or without either or both:

- a) One bare or one or more insulated grounding conductor(s), and
- b) One or more individually jacketed optical-fiber members, all under an overall jacket.

These electrical and composite electrical/optical-fiber cables are intended for use (optical and electrical functions associated in the case of a composite cable) in accordance with Article 336 and other applicable parts of the National Electrical Code (NEC), ANSI/NFPA 70-2002 in cable trays, in raceways, and where supported in outdoor locations by a messenger wire.

1.2 The conductors for these cables are described in Sections 8.2 (NEC types) and 8.3 (other conductors). Cables are surface marked with the conductor type letters and/or with the temperature and “wet”, “dry”, or “wet or dry” ratings applicable to the insulation. Cables for direct burial are so marked on the surface. Cables that have a sunlight-resistant jacket are surface marked “sun res” or “sunlight resistant”. Cables may include one or more optical-fiber member(s) and are surface marked to so indicate. Cables that are surface marked “oil resistant II” have a jacket that is for exposure to mineral oil at temperatures not in excess of 75°C (167°F). Cables that are surface marked “oil resistant I” have a jacket that is for exposure to mineral oil at temperatures not in excess of 60°C (140°F). Each insulated conductor that is oil resistant II, oil resistant I, VW-1, gasoline-resistant, or has another individual conductor use is individually so marked.

1.3 The overall jacket on these cables is a “gas/vapor-tight continuous sheath” in the sense discussed in Sections 501.5(D) and 501.5(E) of the NEC (see 11.1.1). However, these requirements do not cover investigation of these cables for transmission of gases or vapors through the core so, when these cables are used in a hazardous location, they may need to be sealed as described in the NEC.

1.4 These cables may contain one or more metal shields but do not have a metal sheath or armor. Electrical cables with a metal sheath or armor are covered as Type MC in the Standard for Metal-Clad Cables (UL 1569).

1.5 Connectors and other fittings for these cables are covered in the Standard for Fittings for Cable and Conduit (UL 514B).

1.6 These requirements do not cover the optical or other performance of any optical-fiber member or group of such members.

2 Units of Measurement

2.1 In addition to being stated in the inch/pound units that are customary in the USA, each numerical requirement in this standard 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

3.1 *Deleted November 14, 2001*

3.2 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).

CONSTRUCTION

4 Materials

4.1 Only materials that are acceptable for the particular use shall be employed in a cable.

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

5 General

5.1 Power and control tray cable shall be designated as Type TC and shall comply in all respects with the applicable requirements for construction details, test performance, and markings.

5.2 The electrical insulation in each of the following cables shall be of a material that is acceptable for use in wet locations:

- a) Cable that is marked for direct burial.
- b) Cable that is intended for use in wet locations.

6 All Conductors

6.1 Except for the thermocouple alloy for thermocouple exterior cables, only copper, copper-clad aluminum, or an acceptable aluminum alloy shall be used for the conductors in a cable. Soft-annealed copper shall comply with ASTM B 3-01. Solid aluminum conductors in sizes 12 – 8 AWG shall comply with the requirements for aluminum-wire stock (aluminum-alloy conductor material). All other aluminum conductors shall comply with the requirements for semi-annealed 8000 series aluminum conductors in Requirements for Aluminum Conductors of an 8000 Series Alloy, Section 10, of the Reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581. Copper-Clad aluminum conductors shall comply with the requirements in Requirements for Copper-Clad Aluminum Conductors, Section 11 of UL 1581.

6.2 A copper conductor shall not be smaller than 18 AWG and shall not be larger than 1000 kcmil. An aluminum or copper-clad aluminum conductor shall not be smaller than 12 AWG and shall not be larger than 1000 kcmil.

6.3 Each 6 – 4/0 AWG and 250 – 1000 kcmil conductor shall be stranded. An 18 or 16 AWG copper conductors shall comply with the requirements for fixture wire conductors in the Standard for Fixture Wire, UL 66. A 14 AWG or larger copper, or 12 AWG or larger aluminum conductor shall comply with the requirements in the Standard for Thermoset-Insulated Wires and Cables, UL 44, or in the Standard for Thermoplastic-Insulated Wires and Cables, UL 83, except as modified in this section.

6.4 Any joint in a conductor shall comply with the applicable standard indicated in 8.2, except that a splice is acceptable in an 18 – 10 AWG stranded conductor as a whole if the splice (butt splice) is made by machine brazing or welding such that the resulting solid section of the stranded conductor is not longer than 1/2 inch or 13 mm, the splice does not increase the diameter of the conductor, there are no sharp points, and the distance between splices in a single conductor does not average less than 3000 ft or 915 m in any reel length of that single insulated conductor. A butt splice shall be made before insulating or after insulating and prior to further processing. Butt splices of stranded conductors made after insulating and splices of insulated solid conductors made with other than the original insulation shall be the subject of an investigation that includes tests to determine that all electrical, physical, and mechanical properties of the original system of insulation and any jacket on the conductor have been restored at the point of each splice. All finished, insulated stranded conductors containing a butt splice or splice made with other than the original insulation shall not be marked as an NEC type but, for polarity identification, color coding and/or surface printing of hash marks, numbers, color names, or the like are acceptable.

7 Grounding Conductors

7.1 The cable may contain one or more grounding conductors. Each grounding conductor that is provided shall be of copper, aluminum, or copper-clad aluminum and shall not be smaller than indicated in the applicable Table 7.1 (90°C or 194°F conductors), Table 7.2 (75°C or 167°F conductors), or Table 7.3 (60°C or 140°F conductors). See 10.4.2(b) (shield as grounding conductor).

7.2 One grounding conductor (bare or insulated) in a flat cable (see 10.1.6 for round cable) may be in one location or in several sections (see size limits in 7.3) or may be distributed helically (concentric— see size limits in 7.4) over all of the conductors in the cable. Every other grounding conductor in a flat cable shall not be sectioned or distributed helically.

7.3 A grounding conductor smaller than 14 AWG shall not be sectioned. A sectioned grounding conductor shall not have any part (section) smaller than 18 AWG. See 6.2.

7.4 A copper grounding conductor smaller than 14 AWG shall not be distributed helically (concentric). A helically distributed grounding conductor shall not have any of its wires smaller than 26 AWG (15.9 mils or 0.404 mm in diameter) if of copper or 22 AWG (25.3 mils or 0.643 mm in diameter) if of aluminum.

7.5 One grounding conductor may be bare. All others shall be insulated. Grounding-conductor insulation and any individual covering over that insulation shall comply with Circuit Conductors, Section 8, as if the insulated grounding conductor were a circuit conductor and shall comply with 10.1.2 (insulation ratings) and 10.1.3 (assembly limits). See 10.1.4 (placement in a flat cable), 10.1.6 (placement in a round cable), 25.1 (color), and Insulated Equipment-Grounding Conductors, Section 32 and Isolated-Grounding Conductors, Section 33, (differentiation).

7.6 Any or all insulated grounding conductors may be designated as isolated-grounding conductors, with the outer surface of each such conductor marked as indicated in Isolated-Grounding Conductors, Section 33. See 10.1.4, 10.1.6 (cabling), 25.1 (color), and 29.1(l) (tag marking).

Table 7.1
Smallest grounding conductor in cable containing 90°C (194°F) circuit conductors

Size of largest ungrounded circuit conductor in cable		Grounding conductor		Maximum D-C resistance of sectioned or concentric grounding conductor			
		Copper	Aluminum or copper-clad aluminum	20°C (68°F)		25°C (77°F)	
		Smallest AWG size of unsectioned grounding conductor	Smallest AWG size of unsectioned grounding conductor	Ohms based on 1000 feet	Ohms based on 1000 meters	Ohms based on 1000 feet	Ohms based on 1000 meters
Copper	Aluminum or copper-clad aluminum						
18 AWG	—	18	—	7.06	23.2	7.19	23.6
17	—	17	—	5.59	18.3	5.70	18.7
16	—	16	—	4.45	14.6	4.53	14.9
15	—	15	—	3.44	11.3	3.51	11.5
14	12 AWG	14	12	2.73	8.96	2.78	9.14
13	11	13	11	2.16	7.10	2.20	7.24
12	10	12	10	1.72	5.64	1.75	5.75
11	9	11	9	1.37	4.48	1.39	4.56
10 – 8	8 – 6	10	8	1.080	3.546	1.102	3.615
7 – 4	5 – 2	8	6	0.6795	2.230	0.6929	2.274
3 – 2/0	1 – 3/0	6	4	0.4276	1.403	0.4359	1.430
3/0 AWG – 250 kcmil	4/0 AWG – 350 kcmil	4	2	0.2689	0.8820	0.2742	0.8993
300 – 400	400 – 600	3	1	0.2132	0.6996	0.2175	0.7133
450 – 650	700 – 1000	2	1/0	0.1691	0.5548	0.1724	0.5657
700 – 900	—	1	2/0	0.1340	0.4398	0.1367	0.4485
1000	—	1/0	3/0	0.1063	0.3487	0.1084	0.3556