UL 719

STANDARD FOR SAFETY

Nonmetallic-Sheathed Cables

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UL Standard for Safety for Nonmetallic-Sheathed Cables, UL 719

Thirteenth Edition, Dated September 8, 2015

SUMMARY OF TOPICS

This revision of ANSI/UL 719 dated July 8, 2021 includes an editorial update to 5.2.1 to include reference to UL 1581.

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.

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UL 719

Standard for Nonmetallic-Sheathed Cables

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September 8, 2015

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The most recent designation of ANSI/UL 719 as an American National Standard (ANSI) occurred on November 6, 2018. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

The Department of Defense (DoD) has adopted UL 719 on June 7, 1985. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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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1 Scope

1.1 These requirements cover nonmetallic-sheathed cables containing 2 – 4 thermoplastic-insulated circuit conductors, with a grounding conductor, in the constructions indicated in Table 1. These cables are intended for use in accordance with Article 334 and other applicable parts of the National Electrical Code, NFPA 70. Type NMC cable is for use in dry, moist, damp, and corrosive locations, and Type NM cable is for use in normally dry locations. Both types carry the suffix letter "-B" to designate the use of conductors with 90°C insulation.

1.2 A cable to which the designation "ST1" (signifying "limited smoke") is applied as a type-letter suffix complies with the test criteria for smoke release and for cable damage height stated in the Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables, UL 1685.

2 General

2.1 Units of Measurement

2.1.1 In addition to being stated in the inch/pound units that are customary in the USA, each of the requirements 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.

2.2 Reference publications

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.

UL Standards

UL 83
Thermoplastic-Insulated Wires and Cables

UL 514B
Conduit, Tubing, and Cable Fittings

UL 1581
Reference Standard for Electrical Wire, Cables, and Flexible Cords

UL 1685
Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables

UL 2556
Wire and Cable Test Methods

ASTM (American Society for Testing and Materials) Standards

B3-01
Standard Specification for Soft or Annealed Copper Wire

B8-11
Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

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G21-13
Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

NFPA (National Fire Protection Association) Publication

NFPA 70
National Electric Code

3 Definitions

3.1 The following definitions apply in this Standard:

3.2 DIRECTION OF LAY – the longitudinal direction, designated as left-hand (counterclockwise) or right-hand (clockwise), in which the wires of a member or units of a conductor run over the top of the member or conductor as they recede from an observer looking along the axis of the member or conductor.

3.3 EQUIPMENT-GROUNDING CONDUCTOR – a conductor that is defined in the National Electrical Code and the Standard for Electrical Installations as "Grounding Conductor, Equipment".

3.4 GROUNDED CIRCUIT CONDUCTOR – a circuit conductor that is intentionally grounded.

3.5 LENGTH OF LAY – the length along the longitudinal axis of the conductor or assembly for any component to complete one revolution.

3.6 NYLON – a thermoplastic compound whose main characteristic constituent is polyamide.

3.7 POLYPROPYLENE – a thermoplastic compound whose characteristic constituent is polypropylene, the crystalline copolymer of ethylene and propylene.

3.8 PVC – a thermoplastic compound whose characteristic constituent is polyvinyl chloride or a copolymer of vinyl chloride and vinyl acetate.

3.9 ROOM TEMPERATURE – 25 ±10°C (77 ±18°F)

3.9.1 SIGNAL/CONTROL CONDUCTORS – conductors installed as Class 2 and Class 3 in accordance with Article 725 of the National Electrical Code (NEC).

3.10 THERMOPLASTIC – a polymeric material that repeatedly can be softened by heating and hardened by cooling through a temperature range characteristic of the material, and that in the softened state can be shaped through the application of force.

4 Construction

4.1 Materials

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

4.2 Types of cables

4.2.1 A cable shall be one of the following types and shall comply in all respects with the applicable requirements for construction details, test performance, and marking.

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4.2.2 Type NMC cable is required to comply with a flame test and to be resistant to moisture, fungi, and corrosion and also to have some degree of inherent protection against mechanical abuse.

4.2.3 Type NM cable is required to comply with a flame test, to be resistant to moisture, and to have some degree of inherent protection against mechanical abuse.

4.2.4 Each of the materials used for the insulation, spacers, fillers, jacket, and other nonmetallic parts of a Type NMC cable shall be resistant to fungi, moisture, and corrosion.

4.2.5 Polypropylene, PVC, and glass are known to be resistant to fungi and hence, are acceptable in this respect without exposure tests. Tests to determine the degree of resistance to fungi are to be made as indicated in the American Society for Testing and Materials (ASTM) the Standard for Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi, ASTM G21, on materials not known to have the requisite property. Cotton, paper, jute, hemp, and the like are not acceptable in the construction of Type NMC cable.

4.2.6 The requirement in 4.2.4 that the insulation used in the construction of a Type NMC cable be resistant to moisture is intended to indicate that the insulation be acceptable for use where it is only occasionally and temporarily exposed to dampness or wetness. It is not intended that the insulation be for use in wet locations.

4.3 Conductors

4.3.1 Only soft-annealed copper, copper-clad aluminum, or an acceptable aluminum alloy shall be used for the conductor or conductors in a cable. Soft-annealed copper shall comply with the Standard Specification for Soft or Annealed Copper Wire, ASTM B3. Solid aluminum conductors in size 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 Aluminum Conductors of an 8000 Series Alloy", Section in the Reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581. Copper-clad aluminum conductors shall comply with the "Requirements for Copper-Clad Aluminum Conductors", Section in UL 1581. In a given cable, all conductors shall be of the same metal.

4.3.2 A copper circuit conductor shall not be smaller than 14 AWG and shall not be larger than 2 AWG. An aluminum or copper-clad aluminum circuit conductor shall not be smaller than 12 AWG and shall not be larger than 2 AWG. Signal/control conductors used within a Type NM-PCS cable shall be 18 or 16 AWG copper.

4.3.3 An 8 AWG or larger circuit conductor and a 6 AWG or larger grounding conductor shall be stranded. Conductors shall comply with the requirements in the "Conductors" Section of the Standard for Thermoplastic-Insulated Wires and Cables, UL 83 except as modified in this section.

4.3.4 A joint in a solid conductor or in one of the individual wires of a stranded conductor shall be made in a workmanlike manner and shall not increase the diameter of the solid conductor, the individual wire strand, or the overall stranded conductor. A joint shall not be made in a stranded conductor as a whole but shall be made by separately joining each individual wire. A joint shall be made only before coverings, if any, are applied to an insulated conductor. The insulation applied to such joints shall be equivalent to that removed and, if of PVC, shall have insulation-resistance (K = 4000 at 15.6°C or 60.0°F) and dielectric-withstand characteristics complying with the requirements for the thermoplastic-insulated wire.

4.4 Insulation

4.4.1 Both before and after assembly into finished cable, the insulation employed on the circuit conductors shall comply with (a) or (b) and the insulation employed on the control/signal conductor shall comply with (c):

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a) THHN Construction – Jacketed insulation for a Type NM or NMC cable shall have a nylon or similar jacket and shall comply with the thickness and other applicable requirements for Type THHN thermoplastic-insulated wire without (see 6.2.4) any surface marking of "THHN", "-B", or any ampacity or temperature rating.

b) TW Construction – Insulation without a nylon jacket shall comply with the thickness requirements for a Type TW thermoplastic-insulated wire. The insulation material shall comply with (1) or (2):

1) For TYPE NM or Type NMC Cable – The insulation material shall be a dry-locations PVC that complies with the requirements for Type THHN insulation without any surface marking of the ampacity or temperature rating (the surface marking "-B" is optional on the insulation). The tensile strength and elongation are to comply with the “Physical properties of PVC insulation from Type TFN and TFFN fixture wires" Table in UL 1581. The deformation test is to be conducted at 121.0 ±1.0°C (249.8±1.8°F) with a decrease of not more than 50 percent in the thickness of the PVC insulation.

2) For TYPE NM only – Type NM is eligible to use a thermoplastic insulating material other than PVC. The performance and ratings of the material as insulation shall be determined by investigation and shall be:

i) Electrically comparable to the PVC insulation in Type THHN wire, and

ii) Mechanically comparable to the nylon or similarly jacketed PVC insulation of Type THHN wire, and

iii) In accordance with “Physical properties of insulation of thermoplastic other than PVC from Type NM cables” Table in UL 1581.

c) Insulated Signal/Control Conductors – The insulation material shall be a dry-location PVC that complies with the requirements for Type TFN insulation without any surface marking of the temperature rating. The tensile strength and elongation shall comply with the Physical properties of PVC insulation from Type TFN and TFFN fixture wires in Table 50.155 in UL 1581. The deformation test is to be conducted at 121.0 ±1.0°C (249.8 ±1.8°F) with a decrease of not more than 50 percent in the thickness of the PVC insulation. The force to be used is 300 grams for 18 AWG and 400 grams for 16 AWG conductors.

4.4.2 The grounding conductor shall be bare or shall be insulated (with or without a nylon jacket) in compliance with 4.4.1 and 4.6.3.

4.4.3 An insulation or jacket that is of material generically different from any insulation or jacket material specified in 4.4.1 or 4.7.1 for the construction (new material), or that is of material specified in 4.4.1 or 4.7.1 yet does not comply with the short-term tests applicable to the insulation or jacket material, shall be of a material and in thicknesses and with the temperature rating required for the specific nonmetallic-sheathed cable type. The material shall be evaluated for the requested temperature rating as described in the "Long-Term Aging", Section of the Reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581. Investigation of the electrical, mechanical, and physical characteristics of the cable using the material shall show the material to be comparable in performance to the insulation or jacket material specified in 4.4.1 or 4.7.1 for the required temperature rating. The investigation shall include tests such as crushing, impact, abrasion, deformation, heat shock, insulation resistance, and dielectric voltage-withstand.

4.5 Protective sheath in type NM cable

4.5.1 Except for cable on which a 30 mil or 0.76 mm jacket is used, a continuous, tight-fitting, protective sheath (not the nylon or similar jacket on a Type THHN conductor) of tough, nonmetallic material shall

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cover either the insulation on each circuit conductor or the entire assembly of insulated conductors and (if any) the spacer, grounding conductor, or both in Type NM cable. The character, shape, and dimensions of the material used and the manner of application shall not damage the insulation either during manufacture of the cable or during the unwind test on the cable (see 7.11.1.1 – 7.11.4.1).

4.6 Assembly

4.6.1 General

4.6.1.1 At least two but not more than four circuit conductors, and an optional -PCS signal/control subassembly in accordance with 4.6.1A, shall be used in a Type NM cable. Two or three circuit conductors shall be used in a Type NMC cable. In a given cable all of the circuit conductors shall be of the same size.

4.6.1.2 One grounding conductor shall be used in every cable.

4.6.1A PCS Subassemblies

4.6.1A.1 A round or flat NM cable may employ a -PCS subassembly consisting of two 18 or 16 AWG signal/control conductors for use in Class 2 and Class 3 circuits with a thermoplastic jacket over the two 18 or 16 AWG conductors. The thermoplastic jacket shall be a minimum of 30 mils or 0.76 mm thick. The thermoplastic jacket shall meet the requirements of 5.2.

Exception: A flat NM cable may employ a -PCS subassembly consisting of two 18 or 16 AWG conductors for use in Class 2 and Class 3 circuits provided with an overall overall thermoplastic jacket that is a minimum of 60 mils or 1.52 mm thick where the -PCS subassembly is attached to the power conductor subassembly by a web or similar means. The thermoplastic jacket shall meet the requirements of 5.2.

4.6.2 Cabling Methods

4.6.2.1 In Type NM cables containing two circuit conductors, the circuit conductors shall either be laid parallel or shall be cabled with a length of lay that is not longer than indicated in Table 2. In Type NM cables containing more than two circuit conductors, the circuit conductors shall be cabled with a length of lay no longer than indicated in Table 2 except that, for sizes 14 – 10 AWG copper or 12 – 10 AWG aluminum or copper-clad aluminum, whether or not a binder is employed, the circuit conductors shall either be cabled with a length of lay which is not specified, shall be bundled together parallel to one another, or shall be laid parallel. In Type NMC cables, the circuit conductors shall be laid parallel. In a round cable, the direction of lay may be changed at intervals throughout the length of the cable. The intervals need not be uniform. In a cable in which the lay is reversed:

a) Each area in which the lay is right- or left-hand for not less than 5 complete twists (full 360° cycles) shall have the insulated conductors cabled with a length of lay that is not greater than indicated in Table 2, and

b) The length of each lay-transition zone (oscillated section) between these areas of right- or left-hand lay shall not exceed 1.8 times the maximum length of lay indicated in Table 2.

4.6.2.2 A flat NM-PCS cable shall consist of an NM cable where either (1) the NM cable is joined to the PCS subassembly by means of a web or similar method or (2) the power conductors and PCS subassembly are contained under the overall jacket. One of the following constructions is acceptable.

a) A flat NM-PCS cable may consist of an NM cable connected in parallel to a -PCS subassembly with an additional jacket of not less than 30 mils or 0.76 mm over the PCS subassembly as noted in 4.6.1A. There shall be no reduction in the overall jacket thickness when the PCS portion is separated from the circuit conductor portion.

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