

UL 493

Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables

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UL Standard for Safety for Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables, UL 493

Ninth Edition, Dated June 1, 2007

Summary of Topics:

This New Edition of UL 493 Includes the Following Significant Changes: a) Revision of SI Units for Tensile Strength and Addition of Minimum Ultimate Elongation for Specimens of Non-UF-B Cable; b) Clarification that the Option for the Continuous Eddy-Current Procedure is not Limited to Single Conductor Cable; c) Revision of the Edgewise Method to Reflect Present Practice; d) Clarification of Ungrounded Conductor Color Requirements; e) Clarification of Cable Types Additionally Permitted to be Marked for use on Type NMC-B Cable; f) Miscellaneous Editorial Revisions and Clarifications Including Updated Practices, Terminology, and Standards' References, and Various Improved Wordings

The new and/or revised requirements are substantially in accordance with UL's Proposal(s) on this subject dated November 24, 2006 and March 23, 2007.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

The UL Foreword is no longer located within the UL Standard. For information concerning the use and application of the requirements contained in this Standard, the current version of the UL Foreword is located on ULStandardsInfoNet at: <http://ulstandardsinfo.net/ulforeword.html>

The master for this Standard at UL's Northbrook Office is the official document insofar as it relates to a UL service and the compliance of a product with respect to the requirements for that product and service, or if there are questions regarding the accuracy of this Standard.

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New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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1-36	June 1, 2007

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UL 493



ANSI/UL 493-2007

**Standard for Thermoplastic-Insulated Underground Feeder and Branch-
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Ninth Edition

June 1, 2007

The most recent designation of ANSI/UL 493 as an American National Standard (ANSI) occurred on May 25, 2007.

This ANSI/UL Standard for Safety, which consists of the Ninth Edition is under continuous maintenance, whereby each revision is ANSI approved upon publication.

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

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. 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 <http://csds.ul.com>.

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INTRODUCTION

1 Scope

1.1 These requirements cover 14 – 4/0 AWG single-conductor PVC-insulated and -jacketed underground feeder and branch-circuit cable and flat multiple-conductor PVC-jacketed underground feeder and branch-circuit cables containing two or three 14 – 6 AWG PVC-insulated circuit conductors with or without a grounding conductor. These Type UF cables are intended for use in accordance with Article 340 and other applicable parts of the National Electrical Code, ANSI/NFPA-70 in wiring systems operating at a potential of 600 V or less. Submersible water-pump cables and multiple-conductor assemblies to which a type-letter designation is not assigned are also covered in these requirements.

1.2 Multiple-conductor cable that is marked "UF-B" has a 75°C (167°F) jacket and conductors with insulation of 90°C (194°F) dry and at least 60°C (140°F) wet locations. Multiple-conductor cable that is marked "UF" has a 60°C (140°F) jacket and conductors with insulation for 60°C (140°F) dry and wet locations. Single-conductor cable is marked "UF" and has an integral insulation and jacket for 60°C (140°F) dry and wet locations. The ampacity of all cables covered in these requirements is that of 60°C (140°F) conductors.

1.3 These requirements do not cover insulation other than PVC, round cables containing two or more circuit conductors, flat cables containing more than three circuit conductors, or multiple-conductor cables containing circuit conductors larger than 6 AWG.

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 in this standard is also stated in units that make the requirement conveniently usable in countries employing the metric system (practical SI). 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 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.

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CONSTRUCTION

4 General

4.1 Underground feeder and branch-circuit cable shall be designated as Type UF and shall comply in all respects with the applicable requirements for construction details and test performance.

4.2 Each of the materials used for the insulation, spacers, fillers, jacket, and other non-metallic parts of a cable shall be resistant to fungi, moisture, and corrosion. In addition, each of the materials used as insulation on the circuit conductors shall be acceptable for use in wet locations.

4.3 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 "Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi" ASTM G 21-96(2002) on materials not known to have the requisite property. Cotton, paper, jute, hemp, and the like are not acceptable whether treated or not.

5 Conductors

5.1 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 B 3-01. 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 semi-annealed 8000 series aluminum conductors in Section 10 of UL 1581. Copper-clad aluminum conductors shall comply with the requirements in Section 11 of UL 1581. In a given cable, all conductors shall be of the same metal.

5.2 The conductor in single-conductor cable shall not be smaller than 14 AWG and shall not be larger than 4/0 AWG if of copper, and shall not be smaller than 12 AWG and shall not be larger than 4/0 AWG if of aluminum or copper-clad aluminum. A copper circuit conductor in a multiple-conductor cable shall not be smaller than 14 AWG and shall not be larger than 6 AWG. An aluminum or copper-clad aluminum circuit conductor in a multiple-conductor cable shall not be smaller than 12 AWG and shall not be larger than 6 AWG.

5.3 The conductors in the 14 – 2 AWG single-conductor cables that comprise the pump cables mentioned in 10.1 shall be solid or stranded. The conductors in other 6 – 4/0 AWG single-conductor cable shall be stranded. Each 8 and 6 AWG circuit conductor in a multiple-conductor cable shall be stranded. Conductors shall comply with the requirements in the Standard for Thermoplastic-Insulated Wires and Cables, UL 83, except as modified in this Section.

5.4 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 shall have insulation-resistance and dielectric withstand-voltage characteristics complying with the Standard for Thermoplastic-Insulated Wires and Cables, UL 83.

6 Insulation

6.1 The circuit conductors in a finished multiple-conductor cable that is marked "UF-B" shall not have any surface marking of the ampacity or temperature rating and shall comply with one of the following:

a) NYLON JACKET OVER INSULATION – The insulation and the nylon jacket shall comply with the thickness and other applicable requirements for Types THWN-2, THWN, and THHN thermoplastic-insulated wires. The markings "THWN-2", "THWN", "THHN", "THWN OR THHN", and "-B" shall not be used.

b) NO NYLON JACKET – The insulation shall comply with the thickness requirements for a Type TW thermoplastic-insulated wire using a PVC that complies with the requirements for both Type TW and THHN insulation (tensile strength and elongation complying with Table 50.155 of UL 1581 and deformation test conducted at $121.0 \pm 1.0^\circ\text{C}$ or $249.8 \pm 1.8^\circ\text{F}$ with a decrease of not more than 50 percent in the thickness of the PVC insulation). The surface marking "-B" is optional on the insulation.

6.2 In all single- and multiple-conductor cables that are marked "UF" (without the suffix "-B"), the insulation employed on the circuit conductor or conductors shall comply with the applicable requirements for Type TW thermoplastic-insulated wire (the surface marking "TW" is optional on the insulation). In any cable, a grounding conductor shall be bare or shall be fully insulated in compliance with 7.3.3 and with the thickness and other requirements stated in this Section for the circuit conductors.

6.3 The insulation and jacket on single-conductor cable shall be integral with one another. The average and minimum-at-any-point thicknesses of the PVC determined on specimens of finished cable shall not be less than indicated in Table 6.1. The method of preparing specimens, taking the measurements, and determining compliance shall be as specified in the Standard for Thermoplastic Insulated Wires and Cables, UL 83.

6.4 An insulation or jacket that is of material generically different from PVC (new material), or that is of the PVC material specified in this Standard yet does not comply with the short-term tests for the PVC insulation in Specific Materials, Section 50 of UL 1581, or with the tests for the PVC jacket in Table 8.1 of this Standard, shall be of a material and in thicknesses and with the temperature rating required for the specific underground feeder and branch-circuit cable type. The material shall be evaluated for the requested temperature rating as described in Long-Term Aging, Section 481 of 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 PVC insulation or jacket material specified in this Standard. The investigation shall include tests such as crushing, impact, abrasion, deformation, heat shock, insulation resistance, and dielectric voltage-withstand.

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Table 6.1
Minimum acceptable thicknesses of integral insulation and jacket on single-conductor cable

AWG size of conductor	Minimum average of PVC		Minimum at any point of PVC	
	mils	mm	mils	mm
14 – 10	60	1.52	54	1.37
8 – 2	80	2.03	72	1.83
1 – 4/0	95	2.41	86	2.18

7 Assembly of Multiple-Conductor Cables

7.1 General

7.1.1 At least two but not more than three circuit conductors shall be used in a multiple-conductor cable. In a given cable, all of the circuit conductors shall be of the same size.

7.1.2 A grounding conductor in a multiple-conductor cable is acceptable but not required. A grounding conductor shall not be part of a single-conductor cable.

7.2 Circuit conductors

7.2.1 In multiple-conductor cable, the circuit conductors shall be laid parallel.

7.2.2 The metal of the circuit conductors in finished multiple-conductor cable, with or without a grounding conductor, shall be at least as far apart as indicated in Table 7.1. A spacer of applicable material is an acceptable means of maintaining the separation.

Table 7.1
Minimum acceptable separation of circuit conductors in multiple-conductor cable with or without a grounding conductor

AWG size of circuit conductors	Measured between adjacent surfaces of metal of the circuit Conductors		Measured between centers of the metal of the circuit conductors			
			Class B stranding or compressed stranding		Compact-stranded aluminum	
	inch	mm	inch	mm	inch	mm
14 – 10	0.125	3.2	–	–	–	–
8	–	–	0.328	8.3	0.313	8.0
6	–	–	0.406	10.3	0.391	9.9