# UL 493

## STANDARD FOR SAFETY

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

Tenth Edition, Dated December 10, 2018

***Summary of Topics***

***This revision of ANSI/UL 493 dated March 11, 2021 includes a modification to 4.6.3.2.***

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 revised requirements are substantially in accordance with Proposal (s) on this subject dated November 6, 2020.

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# UL 493

## Standard for Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables

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The most recent designation of ANSI/UL 493 as an American National Standard (ANSI) occurred on March 11, 2021. 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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Document Sharing Hub

Full document details: UL 493 2021

## CONTENTS


1 Scope ....5
2 General ....5
2.1 Units of measurement ....5
2.2 Reference publications ....5
3 Definitions ....5
4 Construction ....5
4.1 General ....5
4.2 Materials ....6
4.3 Conductors ....6
4.4 Insulation and coverings ....6
4.5 Alternative materials ....7
4.6 Assembly of mutiple-conductor cables ....7
4.7 Outer covering on multiple-conductor cables ....8
4.8 Assemblies that include single-conductor type UF cables ....9
5 Test Requirements ....9
5.1 General ....9
5.2 Continuity ....9
5.3 Vertical flame test ....9
5.4 Vertical-tray flame test ....10
5.5 Dielectric voltage-withstand test ....10
5.6 Tension and elongation test ....10
5.7 Unwinding test at low temperature ....10
5.8 Pulling-through-joist test ....10
5.9 Impact test ....11
5.10 Crushing resistance test ....11
5.11 Overload test ....11
5.12 Sunlight resistance test ....11
5.13 Durability of ink printing ....12
6 Markings ....12
6.1 Markings on product ....12
6.2 Markings on package ....15
7 Deep-Well Submersible Pump Cable ....16
7.1 Conductors ....16
7.2 Assembly ....16
7.3 Marking ....17
7.4 Tests ....17
8 Test Methods ....17
8.1 General ....17
8.2 Continuity test ....17
8.3 Vertical flame test ....18
8.4 Vertical-tray flame test ....18
8.5 Dielectric voltage-withstand test ....18
8.6 Tension and elongation test ....18
8.7 Unwinding test at low temperature ....19
8.8 Pulling-through-joists test ....20
8.9 Impact test ....21
8.10 Crushing resistance ....22
8.11 Overload test ....22
8.12 Sunlight resistance test ....23
8.13 Durability of ink printing ....23


Documents
Document Sharing Hub

Full document details: UL 493 2021

No Text on This Page

Documents
Document Sharing Hub

Full document details: UL 493 2021

## 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 an equipment 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 jacket and conductors with insulation of 90°C dry and at least 60°C wet locations. Multiple-conductor cable that is marked "UF" has a 60°C jacket and conductors with insulation for 60°C dry and wet locations. Single-conductor cable is marked "UF" and has an integral insulation and jacket for 60°C dry and wet locations. The ampacity of all cables covered in these requirements is that of 60°C 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 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 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.

### 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.

## 3 Definitions

3.1 The following definitions apply in this Standard:

**Composite insulation system** – a multiple-layer system of materials that fulfills the requirements for both electrical and mechanical integrity of the cable or wire.

**Thermoplastic** – a jacket or insulation 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 General

4.1.1 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.

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## 4.2 Materials

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

4.2.2 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.

4.2.3 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 Standard 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 whether treated or not.

## 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 WireASTM 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 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.

4.3.2 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.

4.3.3 Single conductors sized 14 – 8 AWG may be solid or stranded, and single conductors sized 6 – 4/0 AWG shall be stranded. In multiple-conductor cable constructions, 14 – 10 AWG conductors may be solid or stranded, and 8 – 4/0 AWG conductors shall be stranded. See 7.1.1 for single-conductor cables that comprise pump cables.

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

4.3.5 Conductors shall comply with the requirements in the Standard for Thermoplastic-Insulated Wires and Cables, UL 83.

## 4.4 Insulation and coverings

4.4.1 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

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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 complying 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 ±1.0° C 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.

4.4.2 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, an equipment grounding conductor shall be bare or shall be fully insulated in compliance with 4.5 and with the thickness and other requirements stated in this Section for the circuit conductors.

4.4.3 The insulation and jacket on single-conductor cable shall be integral with one another. The average and minimum-at-any-point thicknesses of the thermoplastic insulation determined on specimens of finished cable shall not be less than indicated in Table 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.

### 4.5 Alternative materials

4.5.1 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 2, 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 the test, Dry temperature rating of new materials (long-term aging test) of UL 2556.

4.5.2 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.

### 4.6 Assembly of mutiple-conductor cables

#### 4.6.1 General

4.6.1.1 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.

4.6.1.2 An equipment grounding conductor in a multiple-conductor cable is acceptable, but not required. An equipment grounding conductor shall not be part of a single-conductor cable.

#### 4.6.2 Cabling methods

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

4.6.2.2 The metal of the circuit conductors in finished multiple-conductor cable, with or without an equipment grounding conductor, shall be at least as far apart as indicated in Table 3. A spacer of applicable material is an acceptable means of maintaining the separation.

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4.6.2.3 The insulated circuit conductor or conductors, any equipment grounding conductor, and any insulation on the equipment grounding conductor shall be readily separable from one another and from the rest of the finished cable without damage to the insulation, covering, or any other part of the cable.

### 4.6.3 Equipment grounding conductor

4.6.3.1 If an equipment grounding conductor is used in multiple-conductor cable, it shall be entirely in one location in the cable, that is, it shall not be divided into two or more parts located separately or distributed helically.

4.6.3.2 In multiple-conductor cable, the equipment grounding conductor shall be placed in the valley between two of the circuit conductors. In all constructions in which a bare equipment grounding conductor is used, this conductor shall be kept from coming into contact with circuit-conductor insulation. The cable shall be constructed so that the equipment grounding conductor maintains its location between the two circuit conductors.

4.6.3.3 The color of an insulated equipment-grounding conductor shall be as described in 6.1.2.

4.6.3.4 An equipment grounding conductor shall not be smaller than indicated in Table 4 or Table 5.

4.6.3.5 Finished multiple-conductor cable shall be essentially void-free and shall have a smooth, even, firm exterior. Fillers may be integral with the jacket or may be separate.

## 4.7 Outer covering on multiple-conductor cables

4.7.1 Assembled multiple-conductor cable shall be enclosed completely by a PVC jacket.

4.7.2 The physical properties of specimens of PVC jackets prepared from finished multiple-conductor cables shall comply with the requirements in Table 2. See 4.5.1 for the long-term evaluation of a jacket material other than PVC or of a PVC that does not comply with the short-term tests specified in Table 2.

4.7.3 The average and minimum point thicknesses of the PVC jacket shall not be less than indicated in Table 6. The method of preparing specimens, taking the measurements, and determining compliance is not specified however, in the event of disagreement, the referee method specified in 4.7.4 – 4.7.6 is to be used.

4.7.4 The minimum average thickness and the minimum thickness at any point of the jacket on finished multiple-conductor cable are to be determined by means of a pin-gauge dial micrometer whose presser foot exerts 25 ±2 gf (0.25±0.02 N) on a specimen. The pin is to be 0.437 inches (11.10 mm) long and 0.043 inches (1.09 mm) in diameter, and the rectangular end of the presser foot that makes contact with a specimen is to be 0.043 inches (1.09 mm) wide and 0.312 inches (7.92 mm) long. Specimens 2 – 6 inches (50 – 150 mm) long are to be cut from the finished cable and the metal circuit and equipment grounding conductors are to be withdrawn (not the insulation). The ends of each specimen are then to be sliced off perpendicular to the longitudinal axis of the specimen. The conductor insulation and any separable fillers are then to be withdrawn leaving only the undeformed jacket.

4.7.5 For cable with separable fillers, a total of 16 measurements [each estimated to the nearest 0.1 mil (0.001 mm)] is to be made (see upper drawing in Figure 1) at both ends of each specimen. For cable having two circuit conductors and filler integral with the jacket, 10 measurements [each estimated to the nearest 0.1 mil ( 0.001 mm)] are to be made (see center drawing in Figure 1) at both ends of each specimen. For cable having three circuit conductors and fillers integral with the jacket, 12 measurements [each estimated to the nearest 0.1 mil (0.001 mm)] are to be made (see lower drawing in Figure 1) at both ends of each specimen. The specimen of the jacket is to be placed on the pin and so located on the pin that the entire length of the presser foot makes contact with it. The presser foot is to be brought to rest

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