



UL 444

Underwriters Laboratories Inc. Standard for Safety

Communications Cables



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UL Standard for Safety for Communications Cables, UL 444

Fourth Edition, Dated July 11, 2008

Revisions: This Standard contains revisions through and including July 17, 2008.

Revision pages have been issued for the Standard for Communications Cables, UL 444, to incorporate the following:

- ***The correction of the referenced ASTM standard number in paragraph 5.1.2.***
- ***The inclusion of the superseded requirements page relating to paragraph 9.1.8 which contains a 6 month future effective date.***

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The following table lists UL's future effective date with corresponding reference.

Future Effective Date	References
January 11, 2009	Paragraph 9.1.8

The revisions dated July 17, 2008 include a reprinted title page (page1) for this Standard.

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.

As indicated on the title page (page1), this UL Standard for Safety has been adopted by the Department of Defense.

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>

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the preface. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

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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This Standard consists of pages dated as shown in the following checklist:

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3-9	July 11, 2008
10	July 17, 2008
11-44	July 11, 2008
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Communications Cables

July 11, 2008

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These procedures are issued jointly by the Canadian Standards Association (CSA), and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the procedures may be submitted to CSA, or UL at any time. Revisions to these procedures will be made only after review and approval by CSA, and UL. Revisions of these procedures will be made by issuing revised or additional pages bearing their date of issue.

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The most recent designation of ANSI/UL 444 as an American National Standard (ANSI) occurred on July 11, 2008. The ANSI approval for this standard does not include the Cover Page, Transmittal Pages, Title Page, Preface, or Superseded Requirements Pages.

This ANSI/UL Standard for Safety, which consists of the Fourth edition including revisions through July 17, 2008, is under continuous maintenance, whereby each revision is ANSI approved upon publication.

The Department of Defense (DoD) has adopted UL 444 on June 12, 1987. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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Preface

This is the common CSA and UL standard for communications cables. It is the seventh edition of CSA C22.2 No. 214 and the fourth edition of UL 444. This edition of CSA C22.2 No. 214 supersedes the previous editions published in 2002, 1994, 1990, 1988, 1986, and 1984. This UL edition supersedes the previous editions published in 2002, 1994 and 1990.

This common Standard was prepared by the Canadian Standards Association and Underwriters Laboratories Inc. The efforts of the UL 444/CSA 214 Harmonization Committee are greatly appreciated.

This Standard is considered suitable for use for conformity assessment within the stated scope of the Standard.

This Standard was reviewed by the CSA Subcommittee on Communication Cable, under the jurisdiction of the Technical Committee on Wiring Products and the Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the Technical Committee.

This standard has been approved by the American National Standards Institute (ANSI) as an American National Standard.

Where reference is made to a specific number of samples to be tested, the specified number is considered a minimum quantity.

Note: *Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.*

Level of harmonization

This standard uses an IEC format, but is not based on, nor is it to be considered equivalent to, an IEC standard. This standard is published as an identical standard. An identical standard is a standard that is the same in technical content except for conflicts in codes and governmental regulations. Presentation is word for word except for editorial changes.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

CSA Effective Date

The effective date for CSA International will be announced through CSA *Informs* or a CSA certification notice.

UL Effective Date

As of July 11, 2008 all products Listed by UL must comply with the requirements in this standard except for Clause in the following list which is effective on the date indicated.

Clause 9.1.8 is effective January 11, 2009.

Between July 11, 2008 and January 11, 2009, new product submittals to UL may be evaluated under all requirements in this standard or, if requested in writing, evaluated under presently effective requirements only. The presently effective requirements are contained in the third edition of UL 444.

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Communication Cables

1 Scope

1.1 This standard applies to 60 – 250°C single- or multiple-conductor jacketed or unjacketed, integral or nonintegral cables and single or multiple coaxial cables for telephone and other communication circuits such as voice, data, and audio for on-premise customer systems. These cables are not prohibited from containing one or more optical fibre members. For the purpose of this standard, a coaxial cable or coaxial member conductor is a single conductor with a shield. For the purpose of this standard, a single- or multiple-conductor unjacketed cable is a cross-connect wire.

1.2 This standard applies to communications cables that are intended primarily for installation in accordance with Section 60 of the *Canadian Electrical Code (CEC), Part I*, and Article 800 of the *National Electrical Code (NEC), ANSI/NFPA 70*. They are rated for 300 V applications but are not so marked.

Note: See Appendix A for a complete list of wire types covered by this Standard and the specific electrical codes for which they are intended.

1.3 This standard does not apply to communications cords.

1.4 In Canada, Type CMUC, cross-connect communications cables, and the “-CI” circuit integrity markings are not recognized by the Canadian Electrical Code, Part I.

In the US, Type CMH is not recognized in the NEC.

1.5 If a value for measurement is followed by a value in other units in parenthesis, the second value may be only approximate. The first stated value is the requirement.

2 Reference publications

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.

CSA (Canadian Standards Association)

C22.1

Canadian Electrical Code, Part I

CAN/CSA-C22.2 No. 0

General Requirements – Canadian Electrical Code, Part II

C22.2 No. 0.3

Test Methods for Electrical Wires and Cables

CSA C22.2 No. 2556

Wire and Cable Test Methods

UL (Underwriters Laboratories)

UL 1581

Reference Standard for Electrical Wires, Cables, and Flexible Cords

UL 1666

Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts

UL 1685

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

UL 2196

Tests for Fire Resistive Cables

UL 2556

Wire and Cable Test Methods

ANSI (American National Standards Institute)

Z136 Series

Safe Use of Lasers.

ANSI/NFPA (American National Standards Institute/National Fire Protection Association)

NFPA 70

National Electric Code

ASTM (American Society for Testing and Materials)

B 33

Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes

B 189

Specification for Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes

B 298

Specification for Silver-Coated Soft or Annealed Copper Wire

B 355

Specification for Nickel-Coated Soft or Annealed Copper Wire

B 869

Specification for Copper-clad Steel Electrical Conductor for CATV Drop Wire

D 5374

Test Methods for Forced-Convection Laboratory Ovens for Evaluation of Electrical Insulation

D 5423

Specification for Forced-Convection Laboratory Ovens for Evaluation of Electrical Insulation

NFPA (National Fire Protection Association)

NFPA 262

Standard Method of Test for Fire and Smoke Characteristics of Wire and Cables

The requirements of CAN/CSA-C22.2 No. 0, when appropriate, apply to this standard.

3 Definitions

3.1 The following definitions apply in this standard:

3.2 **BONDED METAL SHIELD** – A covering over the cable core assembly consisting of a metal tape whose outer surface is adhesively bound to a polymeric jacket over it.

3.3 **CAPABILITY TEST** – A test that is conducted periodically on a cable component, or on a completed cable, intended to be proof of adequate construction and processing, and that is repeated for verification.

3.4 **COAXIAL CABLE** – A cable having one or more coaxial members, each consisting of a conductor centered inside one or more outer conductors consisting of metal tubes or shields, separated from the central conductor by a dielectric material.

3.5 **COVERING** – A jacket, sheath, or armour.

3.6 **CROSS-CONNECT WIRE (CABLE)** – A single- or multiple-conductor construction consisting of insulated conductors without an overall jacket.

3.7 **DIELECTRIC** – An insulating (nonconducting) medium.

3.8 **EQUIVALENT GAUGE** – A round conductor AWG number used to designate a flat conductor that has a cross-sectional area equal to that of the round conductor.

3.9 **GROUND PLANE** – A partially encompassing shield provided to reduce stray electrical fields.

3.10 **INTEGRAL COVERING** – A single extruded layer that serves as both insulation and jacket.

3.11 **JACKET** – A continuous nonmetallic outer covering.

3.12 **MANUFACTURING AND PRODUCTION TEST** – A test performed on a length of wire before further processing and/or on a completed cable before shipment.

3.13 **SEMICONDUCTING** – A material whose resistivity at room temperature is in the range of 10^{-2} – $10^9 \Omega \cdot \text{cm}$.

3.14 **SHIELD** – A conducting layer consisting of tape, braid, wire, or sheath, or a semiconducting layer.

3.15 **THERMOPLASTIC** – An insulation or jacket material that is capable of being repeatedly softened by heating and hardened by cooling through a temperature range characteristic of the material, and which in its softened state is capable of being shaped through the application of force.

Note: Examples of thermoplastic materials are polyethylene (PE), poly (vinyl chloride) (PVC), nylon, and polyethylene terephthalate (PET).

3.16 **THERMOSET** – A cross-linked insulating or jacketing compound that does not soften and flow on subsequent heating.

4 General Requirements

The requirements of CAN/CSA-C22.2 No. 0, when appropriate, apply to this standard.

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5 Construction

5.1 Conductors

5.1.1 The conductors shall be solid or stranded, annealed, bare or metal-coated copper. The centre conductor of CMP, CMR, CMG, CM, CMH and CMX coaxial cables made of copper-clad steel shall have 21 percent or higher conductivity in accordance with ASTM Standard B 869.

5.1.2 In the United States, the centre conductor of CMP, CMR, CMG, CM and CMX coaxial cables made of copper-clad aluminum shall be in accordance with ASTM B 566.

In Canada, this requirement does not apply.

5.1.3 If the insulation adjacent to the copper conductor is of a material that corrodes unprotected copper in the test described in Clause 7.1, the conductor shall be covered with a coating of tin complying with ASTM Standard B 33, of lead or lead-alloy complying with ASTM Standard B 189, of nickel complying with ASTM Standard B 355, of silver complying with ASTM Standard B 298, or of another metal or alloy. Evaluation of the effectiveness of these coatings shall be required. Metal-coating a conductor on which the coating is not required for corrosion protection shall be permitted. When this is done, the 100 per cent coverage requirement of the relevant ASTM Standard shall be waived.

The maximum temperature rating of cables relative to the diameter and coating of solid copper conductors or copper conductor strands shall not be higher than those shown in Table 1.

5.1.4 For stranded conductors, the length of lay of the strands shall not exceed 20 times the calculated diameter over the assembled conductor for 19 – 6 AWG conductor, or 30 times for 30 – 20 AWG conductor. The direction of lay of the strands may be right- or left-hand.

5.1.5 The conductors shall be continuous when tested in accordance with Clause 6.2.

5.1.6 The size of the copper conductor shall be determined either by means of the resistance shown in Tables 2 and 3, or by means of the dimensions shown in Table 5. In case of dispute, the resistance method shall be the referee method. Applications for various AWG sizes and conductor compositions are shown in Table 4.

5.1.7 Resistance shall be determined in accordance with Clause 7.16.

5.1.8 Dimensions shall be determined in accordance with Clause 7.17.

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

A joint in a stranded conductor may be made by:

- a) Separately joining each individual wire; or

- b) Machine brazing or welding of the conductor as a whole.

In either case, the resulting solid section of the stranded conductor shall be not longer than 13 mm (1/2 in), there shall be no sharp points, and the distance between brazes or welds in a single conductor shall not average less than 915 m (3000 ft) 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%.

The insulation applied to joints after insulating shall be equivalent to that removed (means of insulation such as heat-shrinkable tubing, bonded patch, and molding have been found acceptable, but taping has not) and shall comply with the requirements in this Standard.

5.1.10 Any section of a conductor that includes a factory joint shall have a breaking strength that is not less than 85% of the breaking strength of an adjacent section of the conductor without a joint.

5.2 Insulation

5.2.1 Each conductor shall be insulated with one or more continuous layers of solid and/or expanded material. The insulation shall be uniform and shall not have any defects (bubbles, open spots, rips, tears, cuts, or foreign material) that are visible without magnification to normal or corrected-to-normal vision. The average thickness of the insulation and the minimum thickness at any point of the insulation are not specified. The average thickness of insulation used, including the average thickness of the tube portion of an air-gap coaxial member, shall be determined by means of an optical device. The method for measuring the thickness of insulation and for rounding off the results shall be as described in Clause 7.15.

5.2.2 The insulation in an air-gap coaxial member shall consist of a solid tube over a solid spacer (thread) that has a nominally circular cross-section, applied to the conductor helically in a continuous length (length of lay is not specified).

5.2.3 Each conductor, including the centre conductor for a coaxial member, shall meet the dc or ac spark test as described in Clause 6.1 after being insulated and before any subsequent operation. One hundred per cent of product shall be tested by the manufacturer at the factory.

5.2.4 The thickness of insulation at any point in a cable with a separable jacket (non-integral construction) shall be sufficient to meet the applicable manufacturing and production tests of Clause 6 and the capability tests of Clause 7. The thicknesses of the integral insulation (solid) and jacket in 2-, 3-, or 4-conductor flat, parallel cable shall be not less than as indicated in Table 6.

5.2.5 The insulated conductors shall be distinctly identified.

5.2.6 The insulated conductors shall be suitable for indoor use where normal conditions are such that cables may be subjected to maximum operating conditions from 60 – 250°C, inclusive. See Clause 7.3 for temperature rating requirements.

5.3 Optical fibre members

5.3.1 One or more glass fibres that are individually coated and buffered, jacketed either singly in a tight jacket, or in a group in a loose tube, or enclosed in a nonmetallic tape, wrap, or braid that provides complete coverage may be included along with the copper conductors.

5.3.2 An optical fibre member, or group of members, may include one or more metallic or nonmetallic strength members.

5.3.3 The construction of the glass fibre, the coatings, and the fibre jacket is not specified. The construction of nonmetallic tape, wrap, or braid is not specified. The construction of nonmetallic or non-current-carrying metal strength members is not specified.

5.3.4 Non-current-carrying metallic members included in optical fibre member(s) shall be electrically continuous, and shall meet the requirements of Clause 6.2.

5.4 Core assembly

5.4.1 A communications cable shall be essentially round or flat.

5.4.2 Two or more insulated conductors with or without one or more coaxial or optical fibre members shall be assembled to form a cable core. A cable may also consist of one or more coaxial member with or without optical fibre members. A round cable core consisting of 12 or fewer pairs, or 2, 3, or 4 single insulated conductors, may have the pairs or insulated conductors laid straight, but otherwise all conductors, groups of conductors, members, and groups of members shall not be laid straight. In any case, the length of lay is not specified. The direction of lay may be right- or left-hand and may be changed at intervals throughout the length of the cable. The use of fillers is optional. Different conductors and coaxial members may be insulated with different materials if the materials comply with Clause 5.2 on conductor insulation. The conductors in the cable may be of any mixture of sizes and stranding.

5.4.3 When optical fibre member(s) are assembled with other electrical conductors in a common layer, they shall be cabled with the same direction and length of lay as the electrical conductors; otherwise the direction and the length of lay is not specified.

Optical fibre members may include one or more non-current-carrying, electrically conductive members such as a metal strength element or a metal vapour barrier. The construction of these parts is not specified.

5.5 Defective Pairs

5.5.1 The cable is not acceptable if the applicable factory dielectric strength test described in Clause 6.3 shows any defective pair having a breakdown of the insulation of either conductor to a shield.

5.5.2 A defective pair shall be any pair in which the following discontinuity and/or dielectric faults are revealed in testing by the cable manufacturer at the cable factory:

- a) Discontinuity in either conductor of the pair determined by means of the test described in Clause 6.2;
- b) One or more of the following dielectric breakdowns of the insulation determined by means of the applicable dielectric strength test described in Clause 6.3:
 - i) Conductor to conductor within the pair;