UL 2263

STANDARD FOR SAFETY

Electric Vehicle Cable

UL Standard for Safety for Electric Vehicle Cable, UL 2263

First Edition, Dated May 9, 2022

Summary of Topics

This revision of ANSI/UL 2263 dated July 15, 2022 corrects the format of Table 26 to align Column 1 item D with the associated items in Columns 2 and 3.

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 requirements are substantially in accordance with Proposal(s) on this subject dated November 13, 2020.

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First Edition

CSA Group
CSA C22.2 No. 332:22
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Underwriters Laboratories Inc.
UL 2263
First Edition

Electric Vehicle Cable

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ANSI/UL 2263-2022

Commitment for Amendments

This standard is issued jointly by the Association of Standardization and Certification (ANCE), the Canadian Standards Association (operating as “CSA Group”), and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to ANCE, CSA Group, or UL at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of ANCE, CSA Group, and UL. CSA Group and UL will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue. ANCE will incorporate the same revisions into a new edition of the standard bearing the same date of issue as the CSA Group and UL pages.

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This Standard is subject to review within five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to inquiries@csagroup.org and include "Proposal for change" in the subject line: Standard designation (number); relevant clause, table, and/or figure number; wording of the proposed change; and rationale for the change.

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This ANSI/UL Standard for Safety consists of the First Edition including revisions through July 15, 2022. The most recent designation of ANSI/UL 2263 as an American National Standard (ANSI) occurred on May 9, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

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PREFACE

This is the harmonized ANCE, CSA Group, and UL standard for electric vehicle cable. It is the first edition of NMX-J-738-ANCE, CSA C22.2 No. 332, and UL 2263. This harmonized standard has been revised by UL on July 15, 2022. CSA Group are issuing an Errata dated July 15, 2022, and ANCE on July 15, 2022.

This harmonized standard was prepared by the Association of Standardization and Certification, (ANCE), CSA Group and Underwriters Laboratories Inc. (UL). The efforts and support of the Technical Harmonization Subcommittee, TC 20 Electrical Wires and Cables on the Harmonization of Electrotechnical Standards of the Nations of the Americas (CANENA), are gratefully acknowledged.

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

The present Mexican standard was developed by the CT 20 Conductores from the Comite de Normalizacion de la Asociacion de Normalizacion y Certificacion, A.C., CONANCE, with the collaboration of the manufacturers and users of electric conductors.

This standard was reviewed by the CSA Subcommittee on Flexible Cords/Equipment and Appliance Wires and Cables, under the jurisdiction of the CSA Technical Committee on Wiring Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee. This standard has been developed in compliance with the Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is to be 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 the IEC format but is not based on, nor is it considered equivalent to, an IEC standard.

This standard is published as an identical standard for ANCE, CSA Group and UL.

An identical standard is a standard that is exactly the same in technical content except for national differences resulting from conflicts in codes and governmental regulations. Presentation is word for word except for editorial changes.

Reasons for Differences From IEC

This standard provides requirements for insulated cords and cables in accordance with the codes of Canada, Mexico, and the United States. At present there is no IEC standard for cords and cables for use in accordance with these codes. Therefore, this standard does not employ any IEC standard for base requirements.

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.

1 Scope

1.1 General

This standard specifies the requirements for electric vehicle cables rated up to 1000V AC and DC intended to be part of a cord set carried in the vehicle for connection to a charging station or for permanent or temporary connection to Electric Vehicle Supply Equipment (EVSE) or for connection to the branch circuit supplying the EVSE or vice versa for use in accordance with CSA C22.1, Canadian Electrical Code (CE Code), Part I in Canada, NOM-001-SEDE, La Norma de Instalaciones Electricas (Mexican Electrical Code [MEC]), in Mexico, and NFPA 70, National Electrical Code (NEC), in the United States.

1.2 Products included

This standard covers sunlight and oil resistant electric vehicle cables rated 300V, 600V and 1000V AC and DC, and 60 °C, 75 °C, 90 °C, or 105 °C cables meeting the construction requirements for Electric Vehicle cables designated EV, EVE, EVJ, EVJT, EVT, EVJE as appropriate. These cables may contain data, signal, communications and/or optical fiber cables.

2 Reference Publications

For undated references to standards, such reference shall be considered to refer to the latest edition and all revisions to that edition up to the time when this standard was approved. For dated references to standards, such reference shall be considered to refer to the dated edition and all revisions published to that edition up to the time the standard was approved.

ANCE (Association of Standardization and Certification)

NMX-J-008-ANCE
Wires and Cables – Tinned Soft or Annealed Copper Wire for Electrical Purposes – Specifications

NMX-J-036-ANCE
Wires and Cables – Soft or Annealed Copper Wire for Electrical Purposes – Specifications

NMX-J-040-ANCE
Wires and Cables – Determination of the Moisture Absorption in Insulations of Electrical Conductors – Test Method

NMX-J-066-ANCE
Wires and Cables – Determination of the Diameter of Electrical Conductors – Test Method

NMX-J-177-ANCE
Wires and Cables – Determination of the Thicknesses in Semiconducting Shields, Insulations and Jackets of Electrical Conductors – Test Method

NMX-J-178-ANCE
Wires and Cables – Ultimate Strength and Elongation of Insulation, Semiconducting Shields and Jackets of Electrical Conductors – Test Method

NMX-J-190-ANCE
Wires and Cables –Thermal Shock Resistance of PVC Insulations and Protective Coverings of Electrical Conductors – Test Method

NMX-J-191-ANCE
Wire and Cables – Heat Distortion of Insulations And Protective Coverings of Electrical Conductors – Test Method

NMX-J-192-ANCE
Wires and Cables – Flame Test on Electrical Cables – Test Methods

NMX-J-193-ANCE
Wires and Cables – Cold Bend of Insulation and Non Metallic Protective Jackets Used on Insulated Wire and Cable – Test Method

NMX-J-205-ANCE
Wires and Cables – Determination of Dissipation Factor, Ionization Factor, on Insulated Electrical Conductors – Test Methods

NMX-J-212-ANCE
Wires and Cables – Electrical Resistance, Resistivity and Conductivity – Test Method

NMX-J-293-ANCE
Wires and Cables - Dielectric Voltage Withstand - Test Method

NMX-J-294-ANCE
Wires and Cables – Insulation Resistance – Test Method

NMX-J-436-ANCE
Conductors Flexible Cords and Cables Specification

NMX-J-473-ANCE
Wires and Cables – Spark Test – Test Method

NMX-J-516-ANCE

Wires and Cables – Determination of Direction and Length of Lay for Bare and Insulated Conductors – Test Method

NMX-J-553-ANCE
Wires and Cables – Weather Resistance of Insulation or Jacket of Electrical Conductors – Test Method

NMX-J-556-ANCE
Wires and Cables Test Methods

CSA Group

C22.1
Canadian Electrical Code, Part I

CAN/CSA-C22.2 No. 0
General Requirements – Canadian Electrical Code, Part II

CAN/CSA-C22.2 No 49
Flexible cords and cables

CAN/CSA-C22.2 No. 2556
Wire and cable test methods

UL (Underwriters Laboratories Inc.)

UL 62
Flexible Cords and Cables

UL 2556
Wire and Cable Test Methods

ASTM (American Society for Testing and Materials)

ASTM B3
Standard Specification for Soft or Annealed Copper Wire

ASTM B33
Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes

Government of Mexico

NOM-001-SEDE
La Norma de Instalaciones Electricas (Mexican Electrical Code)

NFPA (National Fire Protection Association)

NFPA 70
National Electrical Code

3 Definitions and Units of Measurement

3.1 Definitions

The following definitions apply in this standard:

Equipment grounding (bonding) conductor – a conductor that is defined in Mexico, in NOM-001-SEDE, and in the United States, in the *NEC*, as "Grounding Conductor, Equipment", and in Canada, in the *Canadian Electrical Code Part I*, as "Bonding conductor".

Bunch stranding – a group of wires twisted together without a predetermined pattern.

Data, communication, and signal cables – a complete manufactured assembly of one or more insulated conductor which may also include optical fiber member(s), strength member(s), insulating and protecting material having a continuous overall covering providing electrical, mechanical and environmental protection to the assembly used for transmitting data or signals.

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.

Electric vehicle cable – a cable intended to connect the electric vehicle supply equipment to the electric vehicle or vice versa.

Grounded conductor – a system or circuit conductor that is intentionally grounded.

Neutral conductor – a circuit conductor that normally carries current, and is connected to ground (earth) at the main electrical panel. The conductor of a 2-wire circuit connected to the supply neutral point and earth ground is referred to as the "neutral".

Normal vision – vision without any aid other than the examiner's normal corrective lenses, if any.

Room temperature – 25 ±10 °C (77 ±18 °F)

Rope-lay-stranded conductor – a conductor composed of groups of twisted strands having one or more layers.

Thermoplastic – a polymeric-based material that can be repeatedly softened by heating and hardened by cooling, and that in the softened state can be shaped through the application of force.

Thermoplastic elastomer (TPE) – a thermoplastic that complies with the deformation test in 5.1.3 for compound classes 14, 15, 16, 1.9, 1.10, 1.11 and the heat-shock resistance test in 5.1.8 for TPE materials.

Thermoset – a cross-linked polymeric-based material that will not soften to the point of flowing with subsequent application of heat.

Ungrounded Conductor – circuit conductor that is not connected to ground.

3.2 Units of measurement

The values given in SI (metric) units shall be normative. Any other values are for information only. Except for conductor sizes, the equivalent "inch/pound" values are in parentheses.

4 Construction Requirements

4.1 General construction requirements

These cables have a temperature rating of 60 °C – 105 °C dry and 60 °C wet; 300, 600 or 1000V AC and DC, employing oil-resistant and sunlight-resistant jacket suitable for use in wet locations.

4.1.1 Conductors

4.1.1.1 General

All conductors shall be stranded in accordance with Table 2.

4.1.1.2 Material

Conductors shall be of annealed copper in compliance with ASTM B3 or NMX-J-036-ANCE, or annealed coated copper in compliance with ASTM B33 or NMX-J-008-ANCE.

4.1.1.3 Size

4.1.1.3.1 The conductor size shall be determined by both items (a) and (b):

a) The cross-sectional area shall not exceed the maximum values given in Table 1. The cross-sectional area shall be determined in accordance with the method specified in the test, Cross-sectional area, by diameter method described in CAN/CSA-C22.2 No. 2556, UL 2556, or Annex C of NMX-J-066-ANCE. The diameter shall be determined in accordance with the method specified in the test, Conductor Diameter, described in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-066-ANCE.

b) The DC resistance of each uncoated copper or tin-coated copper conductor in a finished cable shall be as specified in Table 4, Table 5, Table 6, and Table 7. A plus tolerance of 2 percent shall be permitted in the case of a conductor in a twisted multiconductor construction having a single layer of conductors. For a twisted multiconductor construction having more than one layer, a plus tolerance of 3 percent shall be permitted. Compliance shall be determined in accordance with the test, DC Resistance, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-212-ANCE. If results of any measurement in a twisted multiconductor product are not acceptable, the results of referee measurements made by using a straight specimen of the conductor from the cable without the plus tolerance shall be permitted.

4.1.1.3.2 The individual wires used in a stranded conductor are usually drawn to a specified diameter, which in some cases does not correspond with the diameter of any standard size. Not all of the individual strands of the completed conductor are required to have the same diameter.

4.1.1.4 Joints

A joint or splice in one of the individual wires of a stranded conductor shall neither increase the diameter nor decrease the strength of the conductor or the individual wire. A joint or splice shall not be made in a stranded conductor as a whole. For rope-lay- stranded conductor construction, the splicing of a stranded member (primary group) as a unit shall be permitted provided that no joints are made closer than two lay lengths apart.

4.1.1.5 Coating

If the conductor and insulation have been shown to be mutually compatible in accordance with 5.2.6, omission of the coating shall be permitted. Otherwise, if a separator is not provided over the conductor, all the individual wires of the conductor shall be separately tinned.

4.1.1.6 Separator

4.1.1.6.1 When the conductor is neither coated nor shown to be mutually compatible with the insulation in accordance with 5.2.6, a separator as described in 4.1.1.6.3 shall be provided over the conductor.

4.1.1.6.2 A separator shall be permitted on other constructions, but is not required.

4.1.1.6.3 A separator, when provided, is not required to cover the conductor completely unless it is required in order to comply with the copper corrosion test specified in 5.2.6. It shall be of a color contrasting to that of the conductor, except clear or green or green/yellow shall not be permitted. The separator shall consist of

a) Close spiraling of fine fibrous yarn or tape;

b) Braid of fine fibrous yarn; or

c) Longitudinally applied tape.

4.1.1.7 Stranding

4.1.1.7.1 General

Flexible conductors shall be bunch-stranded or rope-lay-stranded and shall be composed of wires as shown in Table 2, except that conductors 13.3 mm^2 (6 AWG) and larger shall be rope-lay-stranded.

4.1.1.7.2 Lay of strands

4.1.1.7.2.1 The length of lay of rope-stranded and bunch-stranded conductors shall be not greater than the values shown in Table 3, when tested in accordance with the test, Length of Lay (uncovered components), in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-516-ANCE. The direction of lay is not specified.

4.1.1.7.2.2 The length of lay of the individual strands comprising each bunch-stranded member in a rope-lay conductor shall be not more than 30 times the overall diameter of the member. The direction of lay of the individual strands comprising each bunch-stranded member is not specified.

4.1.1.7.2.3 For 8.37 mm^2 (8 AWG) and larger conductors with rope-lay-stranded conductors, the conductor shall be laid up as follows:

a) The length of lay of the outer layer of a rope-lay-stranded conductor shall be as specified in Table 3. The length of lay of other layers is not specified.

b) The length of lay of the individual strands comprising each concentric-lay - stranded member in a rope-lay conductor shall be neither less than 8 nor more than 16 times the outside diameter of the member. The direction of lay of the individual strands comprising each concentric-lay-stranded member is not specified. Bunch-stranded members shall be in accordance with 4.1.1.7.2.2.

4.1.1.7.2.4 The length of lay of the wires of a seven-strand 0.325 mm^2 (22 AWG) conductor shall be not less than 8 nor more than 16 times the overall diameter of the conductor.

4.1.1.8 Equipment grounding (bonding) and grounded (neutral) conductors

4.1.1.8.1 For cable with conductor sizes 5.26 mm^2 (10 AWG) and smaller, the equipment grounding (bonding) conductor shall be the same size or larger than the largest circuit conductors.

4.1.1.8.2 For cable with conductor sized 6.63 mm^2 (9 AWG), the equipment grounding (bonding) conductor shall be 5.26 mm^2 (10 AWG) or larger.

4.1.1.8.3 For cable with conductor sizes 8.37 – 33.6 mm^2 (8 – 2 AWG), the reduction of the equipment grounding (bonding) conductor by not more than two AWG or equivalent mm^2 sizes from the largest ungrounded circuit conductor shall be permitted (e.g., a cable having an 8.37 mm^2 (8 AWG) ungrounded circuit conductor may have a minimum 5.26 mm^2 (10 AWG) equipment grounding (bonding) conductor).

4.1.1.8.4 For cable with conductor sizes larger than 33.6 mm^2 (2 AWG), the equipment grounding (bonding) conductor shall not be smaller than indicated in Table 25 and may be sectioned.

4.1.1.8.5 A grounded circuit conductor (oversized neutral) larger than the largest ungrounded circuit conductor shall be permitted.

4.1.2 Insulation

4.1.2.1 General

4.1.2.1.1 The classes of insulation materials covered in this standard are shown in Table 8. The insulation shall be applied directly over the conductor or the separator if one is used; if applied in more than one layer of the same insulation grade or combination thereof, adjacent layers shall not be readily separable. The insulation shall be applied concentrically about the conductor. Insulation from one of the following three groups – PVC, TPE, or thermoset – may be interchanged within their groups from classes shown in Table 8 provided that the insulation materials to be substituted are included in the construction tables for use on the same product.

Higher temperature rated insulation materials may be substituted when a lower temperature rated insulation material is specified.

NOTE: Due to possible incompatibility, TPE material of the styrenic type is in some cases not suitable for use in cables where direct contact with PVC can occur. A separator is one acceptable means of avoiding direct contact. Other combinations of materials that could be incompatible, if any, have yet to be detected.

4.1.2.1.2 The classes, thickness, and required testing of insulation to be used on a particular type shall be as shown in Table 12. Insulation thickness of signal and communication conductors 0.824 mm^2 (18 AWG) and smaller shall comply with the requirements for 0.824 mm^2 (18 AWG) circuit conductors.

4.1.2.1.3 The minimum average and minimum thickness at any point of insulation shall be determined in accordance with the test Thickness in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-177-ANCE.

4.1.2.2 New materials

Insulation materials that are generically different from those named in the index tables shown in Table 8 shall be evaluated for the requested temperature rating as described in 5.1.12. Investigation of the electrical, mechanical, and physical characteristics of the construction using the new material shall show comparable performance to the materials currently indicated for the application.

4.1.3 Covering

4.1.3.1 General

The application of a covering over the insulation of individual conductors shall be permitted. When a covering is used, the requirements of 4.1.3.2 and 4.1.3.3 apply.

4.1.3.2 Tapes

4.1.3.2.1 Tape shall not be used as the final outer covering.

4.1.3.3 Nylon covering

An extruded nylon covering applied over the individual insulated conductors of jacketed cables shall have a minimum thickness of 0.05 mm (0.002 in) at any point or the insulation thickness and nylon thickness shall comply with the requirements in Table 12. The nylon-covered conductor shall comply with the bend test specified in 5.1.9.

4.1.4 Conductor assembly

4.1.4.1 Lay of conductors

4.1.4.1.1 Cables shall have the individual conductors twisted together with a length of lay not greater than 15 times the overall diameter of the conductor assembly under the jacket. For multiple-layer cables, the conductors in each layer shall be twisted, but the lay is not specified, except that in the outer layer the lay shall be not more than 15 times the overall diameter of that layer.

4.1.4.1.2 When fiber optic member(s), data, communication, and/or signal cables are assembled with circuit conductors, they shall be cabled in the same direction and with the same length of lay as the circuit conductors. These cables may be individual(s) or pairs or groups and either shielded or unshielded and jacketed or unjacketed. The jacket, if present, shall meet the requirements of SV, SVE or SVT for wall thickness, tensile, elongation, heat shock, deformation, cold bend, jacket resistance, as applicable as described in CAN/CSA-C22.2 No. 49, UL 62, NMX-J-436-ANCE.

4.1.4.1.3 Length of lay shall be determined in accordance with the test, Length of Lay (covered components), in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-516-ANCE.

4.1.4.2 Fillers

If fillers are used, they shall be of suitable material and shall be twisted with the individual conductors to form a compact assembly having an essentially circular cross-section.

4.1.4.3 Binder

The application of a binder, consisting of a braid, tape, or wrap of suitable material over the conductor assembly, shall be permitted.

4.1.5 Shielding

4.1.5.1 A shield shall be permitted over one or more conductors or over the entire assembly under the jacket.

4.1.5.2 The shield shall be a braid of copper wires, copper wire wrapped shields, a metallized polyester tape with a drain wire, or a metal tape with or without a drain wire.

4.1.5.3 A braided or wrapped shield shall be composed of 0.013 mm^2 or 0.020 mm^2 (36 AWG or 34 AWG) copper wires for cables with conductors of 5.26 mm^2 (10 AWG) and smaller, and of 0.032 mm^2 or 0.051 mm^2 (32 AWG or 30 AWG) copper wires for cables with conductors larger than 5.26 mm^2 (10 AWG). If the shield wires and contacting compounds have been shown to be mutually compatible in accordance with 5.2.7, bare copper wires shall be permitted. Otherwise, if a separator is not provided, all the individual wires of the shield shall be separately tinned. The braided or wrapped shield shall provide a minimum coverage of 85 percent when calculated in accordance with Calculation of Coverage of Shielding – Annex G, in CAN/CSA C22.2 No. 2556, UL 2556, NMX-J-556-ANCE.

4.1.5.4 A laminated tape of polyester film and aluminum foil shall be applied longitudinally or helically so that it has at least a 1.52 mm (0.060 in) overlap. The total thickness of the tape shall be 0.038 mm (0.0015 in) minimum for cables with conductors 6.63 mm^2 (9 AWG) and smaller and 0.0635 mm (0.0025 in) for cables with conductors 8.37 mm^2 (8 AWG) and larger. The minimum size of drain wire shall be 0.325 mm^2 (22 AWG) seven-strand minimum tinned copper for cables with conductors 2.63 mm^2 (13 AWG) and smaller, 0.519 mm^2 (20 AWG) seven-strand minimum tinned copper for cables with conductors of 3.31 mm^2 to 6.63 mm^2 (12 – 9 AWG), and 0.824 mm^2 (18 AWG) seven-strand minimum tinned copper for

cables with conductors of 8.37 mm^2 (8 AWG) and larger. The drain wire shall be in contact with the aluminum.

4.1.5.5 Cables employing shields of different materials or constructions than those described in 4.1.5.3 and 4.1.5.4 shall be examined and tested in accordance with 5.2.8.

4.1.6 Jackets

4.1.6.1 General

4.1.6.1.1 The classes, thickness, and required testing of jackets to be used on a particular type shall be as shown in Table 12.

4.1.6.1.2 The conductor assembly of the cable shall be covered by and properly centered within the jacket. The jacket shall be applied directly to the conductor assembly or binder, if one is used, and shall fill all the spaces, if any, around the conductor assembly.

4.1.6.1.3 Jackets with a total thickness of 1.52 mm (0.060 in) and greater may have a reinforcement consisting of an open weave or the like, placed between adjacent layers of the same class, that shall not be readily separable. Jackets with a total thickness of 2.41 mm (0.095 in) and greater may consist of separable or non-separable adjacent layers of the same class. If separable, the outside layer shall be at least 50 percent of the total thickness measured. If applied in more than one layer, both layers shall be of the same class. Adjacent layers shall not be readily separable when the total jacket thickness is less than 2.41 mm (0.095 in).

4.1.6.1.4 The jacket on a cable containing at least one conductor larger than 33.6 mm^2 (2 AWG) shall be reinforced by a tape, two servings, or braid of natural or synthetic material. If two servings are used, they shall be applied in opposite directions of lay. The reinforcing layer shall be under the single layer jacket, or between the layers of the two-layered construction. The total jacket thickness shall be in accordance with Table 23 and Table 24.

4.1.6.1.5 All jackets shall provide an essentially circular cross-section for the finished cable. The classes of jacket are shown in Table 10.

4.1.6.1.6 The minimum average and minimum thickness at any point of the jacket shall be determined in accordance with the test Thickness in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-177-ANCE.

4.1.6.2 Interchangeable jackets

Jackets in the PVC, TPE, and thermoset groups may be interchanged within their group from classes shown in Table 10 provided that the material to be substituted is included in the construction tables for use on the same product type having a higher temperature rating.

NOTE: Due to possible incompatibility, TPE material of the styrenic type is in some cases not suitable for use in cables where direct contact with PVC can occur. A separator is one acceptable means of avoiding direct contact. Other combinations of materials that could be incompatible, if any, have yet to be detected.

4.1.6.3 New materials

Jacket materials that are generically different from those named in the index tables shown in Table 10, if selected for use, shall be evaluated for the requested temperature rating as described in 5.1.12. Investigation of the electrical, mechanical, and physical characteristics of the construction using the new material shall show comparable performance to the materials indicated for the application.

4.1.7 Coiled cables

4.1.7.1 Coiled cables shall comply with the requirements specified for the standard construction and, except as noted in 4.1.7.2, all tests and measurements shall be conducted on specimens obtained from the straight ends at each end of the coiled portion of the cable.

4.1.7.2 The dielectric strength test of 5.2.2 shall be conducted on the entire length of the coiled cable. The mechanical strength test of 5.1.4 shall be conducted on the coiled portion of the cable. The minimum average thickness of the jacket on the coiled portion of round cables shall be not less than the applicable value given in this standard.

4.1.8 Method of distinguishing conductors

4.1.8.1 Conductors shall be distinguished as follows:

a) Grounded (neutral) conductors shall be distinguished by one of the following methods, and these colors shall be restricted to such use:

1) White or grey colored braid;

2) White or grey colored insulation;

b) Bonding / Equipment Grounding conductors shall be distinguished by the color green or a combination of the colors green and yellow. On a bonding / equipment grounding conductor colored green, one or more yellow stripes that cover no less than 5 percent and not more than 70 percent of the calculated circumference of the finished conductor insulation shall be permitted.

4.1.8.2 The use of a thin, non-separable colored coating of a suitable material that is compatible with the insulation over the surface of the insulation on the individual conductors, in lieu of colored insulation, shall be permitted.

4.1.9 Support members

4.1.9.1 The incorporation of a supporting member(s) in the center or cabled with conductors shall be permitted. Supporting members of metallic, nonmetallic, fibrous, or other suitable material shall be permitted.

4.1.9.2 When metal is used, the support member shall consist of a flexible, stranded metal that is insulated with the same grade and thickness of insulation as used on the circuit conductors and surface marked “support member” at intervals of 1 m (39 in). The color of the insulation shall not be white, grey, green or green with yellow stripe.

4.1.9.3 The overall jacket shall be marked to show that a metal support member is present (see 6.2.4(c)).

4.1.10 Optical fiber members

4.1.10.1 Cables may have optical fiber members incorporated in their construction.

4.1.10.2 The cables containing fiber optic members shall comply with all of the requirements for the standard construction of these cables. The optical fiber members shall be cabled with the insulated conductors. See 4.1.4.1.2.

4.1.10.3 Optical fiber members shall not contain any current-carrying or electrically conductive elements and may contain nonmetallic strength members.

5 Performance and Test Requirements

5.1 Physical properties

5.1.1 Insulation

The physical properties of the various classes of insulation, when tested before and after accelerated aging, shall comply with the applicable requirements given in Table 9. Compliance shall be determined in accordance with the test, Physical Properties (ultimate elongation and tensile strength), in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-178-ANCE.

5.1.2 Jackets

The physical properties of the various classes of jackets, when tested before and after accelerated aging, shall comply with the applicable requirements given in Table 11. Compliance shall be determined in accordance with the test, Physical Properties (ultimate elongation and tensile strength), in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-178-ANCE on die-cut samples.

5.1.3 Deformation

5.1.3.1 Insulation

The insulation on individual conductors (with nylon and any other covering removed), shall not decrease by more than 50 percent in thickness when subjected to a force caused by a mass as shown in Table 13, and while maintained at the temperature shown in Table 13 for 1 h.

5.1.3.2 Jacket

Smoothed specimens of jackets from finished cables and cables shall not decrease by more than 50 percent in thickness when subjected to a force caused by a mass of 2000 g, and while maintained at the temperature shown in Table 13 for 1 h.

5.1.3.3 Method

Compliance with 5.1.3.1 and 5.1.3.2 shall be determined in accordance with the test, Deformation, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-191-ANCE.

5.1.4 Mechanical strength

5.1.4.1 General

The mechanical strength of finished jacketed two- or three-conductor 0.824 mm^2 (18 AWG) cables shall be such that no conductor will break when subjected to a force caused by a mass of 68 kg (150 lbs) for 1 min. For two- or three-conductor 1.04 mm^2 (17 AWG) finished cables, no conductor shall break when subjected to a force caused by a mass of 77 kg (170 lbs) for 1 min.

5.1.4.2 Test method

Compliance shall be determined in accordance with the test, Mechanical Strength, in CAN/CSA-C22.2 No 2556, UL 2556, or NMX-J-178-ANCE. The weight method shall be considered the referee method.

5.1.5 Flame tests

5.1.5.1 Vertical flame tests – FT1 or FV-1 (optional)

Finished cables shall not convey flame, continue to burn for more than 60 s after five 15 s applications of a standard test flame, and in the case of the FV-1 test, drop flaming particles that ignite cotton. Compliance shall be determined in accordance with the test FT1 or the test FV-1, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-192-ANCE. A specimen shall be considered to have conveyed flame if more than 25 percent of the extended portion of the indicator is burned.

5.1.5.2 Horizontal flame test – FT2 or FH

The length of the charred portion of the specimen of cable shall not exceed 100 mm (3.9 in), nor shall flaming particles ignite the cotton. Compliance shall be determined when tested in accordance with the test, FT2/FH/Horizontal Flame, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-192-ANCE.

5.1.5.3 Vertical flame test – VW-1 or FV-2 (optional)

When the finished cable and the finished individual insulated conductors (including any nylon or other covering) within the cable are tested separately, they shall not convey flame, drop flaming particles that ignite cotton, or continue to burn for more than 60 s after any of five 15 s applications of a standard test flame. Compliance shall be determined in accordance with the test, FV-2/VW-1, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-192-ANCE. A specimen shall be considered to have conveyed flame if more than 25 percent of the extended portion of the indicator is burned.

5.1.5.4 Coiled cables

Where sufficient straight (non-coiled) length is not available, coiled cables shall be positioned for testing by pulling the specimen taut, without any unwinding, and then clamping the specimen in place.

5.1.6 Cold bend

The insulation (including any nylon or other covering) and jacket shall show no cracks when a specimen of the finished cable is conditioned for 4 h at the cold bend test temperature corresponding to the low temperature rating marked on the cable in Table 14 and, while still at the specified temperature, wound the required number of turns around the mandrel having a diameter as specified in Table 15. Compliance shall be determined in accordance with the test, Cold Bend, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-193-ANCE.

5.1.7 Weather resistance

After conditioning for 720 h in a xenon arc weatherometer as described in the test, Weather (sunlight) resistant, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-553-ANCE, the jacket of the finished cable shall:

a) Show no cracks when wound one complete turn around a mandrel having a diameter as shown in Table 15 while at a temperature of minus 30 °C ±1 °C for a period of 1 h. During the bending, the conditioned surface shall be opposite the surface contacting the mandrel. The specimen shall be allowed to rest 16 h to 96 h at room temperature before conducting the cold bend test.

b) Retain an average tensile strength and elongation of not less than 80 percent. Conditioned and unaged sets (five specimens each) shall be allowed to rest 16 h to 96 h at room temperature, followed by physical properties testing. Conditioned surfaces required to be die-cut shall not be buffed or skived away.

5.1.8 Heat-shock resistance

5.1.8.1 PVC and TPE insulations

The insulation shall show no cracks when specimens of the individual conductors from jacketed cables are exposed to a temperature of 121 ±2 °C for all temperature ratings of PVC and TPE rated at 60 °C, or 150 ±2 °C for TPE rated in excess of 60 °C, for 1 h while wound six close turns around a mandrel having a diameter as shown in Table 16. The specimen shall show no cracks when unwound from the mandrel after cooling to room temperature.

5.1.8.2 PVC and TPE jacketed cables

The jacket and insulation on specimens of the finished cables shall show no cracks after being subjected to a temperature of 121 ± 2 °C for all temperature ratings of PVC and TPE rated at 60 °C, or 150 ±2°C for TPE rated higher than 60 °C, for 1 h while wound around a mandrel having a diameter as shown in Table 17. The jacket and insulation shall show no cracks when unwound from the mandrel after cooling to room temperature.

5.1.8.3 Test method

Compliance with 5.1.8.1 and 5.1.8.2 shall be determined in accordance with the test, Heat shock resistance, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-190-ANCE.

5.1.9 Bend test on nylon-covered conductors

A nylon covering over an individual insulated conductor (see 4.1.3.3) shall not show any cracks when wound six complete close turns around a mandrel having the same diameter as the finished conductor after specimens have been subjected to the air-oven aging test applicable to the insulation class. Following the air-oven test, the specimen shall be allowed to cool for 16 h to 96 h prior to flexing. Wrinkles or folds in the nylon do not constitute failures.

Compliance with this test shall be in accordance with the test, Bend test on nylon covered conductors, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-556-ANCE.

5.1.10 Swelling and blistering – thermoset jacket

The jacket of a 10 m (33 ft) length of finished cable shall neither blister nor increase the cable diameter by more than 20 percent after the specimen of finished cable has been immersed continuously in water for two weeks at 50 °C ±1 °C. Compliance shall be determined with the apparatus and in accordance with the test, Swelling and blistering when immersed in liquid, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-556-ANCE.

5.1.11 Durability of printing

Surface-printed markers shall be complete and legible after two samples have been tested in accordance with the test, Durability of ink printing, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-556-ANCE. One sample shall be conditioned at the rated temperature of the sample for 24 h.

5.1.12 Dry temperature rating of new materials (long-term aging test)

5.1.12.1 Scope

This test verifies the dry temperature rating of new materials and establishes short -term air-oven aging parameters and requirements.

NOTES:

1) The long-term aging test evaluates a material for its dry temperature rating only. Other properties are evaluated based on requirements in the applicable wire and cable standard.

2) For the product standard, after sufficient experience with a new material has been compiled, the material will be submitted for inclusion in the standard in a timely manner.

5.1.12.2 Test method

Compliance shall be determined in accordance with the test, Dry temperature rating of new material (Long-term aging test), in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-556-ANCE.

5.1.13 Low-temperature impact test

5.1.13.1 Cables shall not exhibit cracks or ruptures visible to normal or corrected-to-normal vision in the overall jacket component insulation or component shield coverings on at least 8 out of 10 specimens of finished cable when tested in accordance with the test, Cold Impact, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-556-ANCE, after conditioning for 4 h at the cold impact test temperature corresponding to the low temperature rating marked on the cable in Table 14.

5.1.14 Crush resistance test

5.1.14.1 Finished cable shall be subjected to the test, Crush Resistance, in accordance with CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-556-ANCE; Method 2 (drill rod and plate).

5.1.14.2 Results and calculations – each finished cable shall comply with the minimum average crush force as indicated below:

a) For cable with at least one conductor up to and including 3.31 mm^2 (12 AWG) – 4.45 kN (1,000 lbs).

b) For cable with at least one conductor larger than 3.31 mm^2 (12 AWG), up to and including 33.6 mm^2 (2 AWG) – 11.1 kN (2,500 lbs).

c) For cable with at least one conductor larger than 33.6 mm^2 (2 AWG) – 15.6 kN (3,500 lbs).

5.2 Electrical properties

5.2.1 Spark test

5.2.1.1 All finished individual insulated conductors (including the equipment grounding (bonding) conductor and any nylon or other covering) intended for incorporation in completed cables shall withstand a spark test using an AC or DC test voltage as shown in Table 18.

5.2.1.2 Compliance shall be determined in accordance with the test, Spark, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-473-ANCE. As an alternative to the spark test, the finished cable shall comply with the dielectric strength test in 5.2.2.

5.2.2 Dielectric strength

5.2.2.1 Finished cable

5.2.2.1.1 The finished individual insulated conductors (including any nylon or other covering) of finished cables shall be capable of withstanding for 1 min, without breakdown, the application of an alternating (rms) voltage as indicated in Table 19 between each insulated conductor and between the insulated conductors and any other conductive components and ground, on a specimen of any finished length.

5.2.2.1.2 The dielectric strength test shall be performed in accordance with the test, Dielectric Voltage-Withstand Method 2, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-293-ANCE.

5.2.2.2 Insulated conductors

5.2.2.2.1 Before assembly into a jacketed cable, finished individual insulated conductors at least 15 m (50 ft) in length (circuit and equipment grounding (bonding) and including any nylon or other covering) shall be capable of withstanding for 1 min, without breakdown, the application of an alternating (rms) voltage as indicated in Table 19 between insulated conductor and water after immersion for 6 h.

5.2.2.2.2 The dielectric strength test shall be performed in accordance with the test, Dielectric Voltage-Withstand Method 1, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-293-ANCE.

5.2.3 Insulation resistance

5.2.3.1 Insulation resistance at 15 °C

5.2.3.1.1 Before assembly into a jacketed cable, finished individual insulated conductors (circuit and equipment grounding (bonding) and including any nylon or other covering) shall be capable of exhibiting an insulation resistance of not less than shown in Table 20 or Table 21, when a specimen at least 15 m (50 ft) long is tested in water at 15 °C immediately following the dielectric strength test described in 5.2.2.2.

5.2.3.1.2 If tested at temperatures different than 15 °C, the values shall be corrected to 15 °C.

5.2.3.2 Test method

Compliance with the insulation resistance tests shall be determined in accordance with the test, Insulation resistance, and Annex E (Determination of temperature correction factor) in CAN/CSA-C22.2 No. 2556, UL 2556, or Annex B in NMX-J-294-ANCE.

5.2.4 Permittivity and stability factor

5.2.4.1 Permittivity

5.2.4.1.1 When tested in accordance with the test, Capacitance and relative permittivity, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-040-ANCE, the permittivity of the insulation (with nylon and any other covering removed), shall be as follows:

a) After 14 d of immersion, the capacitance shall not be more than 10 percent greater than the capacitance measured after the first day.

b) After 14 d of immersion, the capacitance shall not be more than 3 percent greater than the capacitance measured after 7 d.

5.2.4.1.2 Tests shall be made using three specimens 5 m (16 ft) long. Specimens shall be:

a) Tested without any polyester tape or similarly non-absorptive separator; and

b) Selected before assembly into finished cable.

The middle 3 m (10 ft) of each specimen shall be immersed continuously in tap water in a temperature of 50 °C ±1 °C for thermoset insulation or 60 °C ±1 °C for thermoplastic insulations for 14 d. The 1 m (3 ft) end portions of each specimen shall be kept dry above the water as leakage insulation. A cover for the tank shall be placed directly above the surface of the water. The water level shall be kept constant.

5.2.4.2 Stability factor

When tested in accordance with test, Stability factor, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-205-ANCE, the insulation (with nylon and any other covering removed), on 3 specimens of 5 m (16 ft) each shall meet one of the following requirements:

a) The stability factor (the numerical difference between the percentage power factors measured with current at average stresses of 3150 V/mm and 1575 V/mm (80 V/mil and 40 V/mil)) after the fourteenth day of immersion shall not be greater than 1.0; or

b) The absolute value of the difference between the stability factors measured after 24 h and fourteen days shall not be greater than 0.5.

5.2.5 Continuity of conductors

The conductors in every length of finished cable shall be continuous. Compliance shall be determined in accordance with the test, Continuity, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-556-ANCE.

5.2.6 Copper corrosion of insulated conductor

A bare (uncoated) copper insulated conductor shall show no evidence of corrosion when tested in accordance with the test, Copper Corrosion, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-556-ANCE, and when performed at the temperature and for the duration under air oven test describedin Table 9.

5.2.7 Copper corrosion of shield

5.2.7.1 An uncoated copper shield in direct contact with an insulation, jacket, and/or tape shall show no evidence of corrosion when tested as noted in 5.2.7.2 – 5.2.7.5, using the forced-circulation air oven described in the Apparatus under Physical properties (ultimate elongation and tensile strength) in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-556-ANCE. The temperature and duration of the air oven test shall be as follows:

a) Cable rated 60 °C, tested at 7 days at 100 °C;

b) Cable rated 75 °C, tested at 10 days at 100 °C;

c) Cable rated 90 °C, tested at 7 days at 121 °C; and

d) Cable rated 105 °C, tested at 7 days at 136 °C.

5.2.7.2 Preparation of specimens

A complete cable employing the uncoated copper shield in contact with the insulation, jacket and/or tape shall be cut to lengths not less than 300 mm (12 in) that allow for at least one specimen to be placed in the oven vertically.

5.2.7.3 Procedure

5.2.7.3.1 One specimen shall be conditioned at room temperature. The second specimen shall be conditioned in the oven at the specified temperature. Oven temperatures shall be recorded throughout the period of conditioning. The specimen shall then be removed from the oven and allowed to cool to room temperature.

5.2.7.3.2 The cable shall be dissected and the shield on both specimens examined with normal vision.

5.2.7.4 Results and calculations

Any evidence of corrosion of the copper shield (normal oxidation or discoloration not caused by the insulation, jacket and/or any tape shall be disregarded) shall be noted.

5.2.7.5 Report

The report shall include, as a minimum, the following:

a) Test temperature;

b) Test duration; and

c) Evidence of corrosion on conditioned and unconditioned specimens.

5.2.8 Flexing of shielded cords (see 4.1.5.5)

The cable shall not be acceptable if any copper conductor or fiber optic member opens in fewer than 15 000 cycles in any of the six specimens when tested in accordance with the test, Flexing of Shielded Cables, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-556-ANCE. The weight, pulleys, and current used in the test shall be as indicated in Table 27.

5.2.9 Jacket resistance

A jacket of thermoplastic or thermosetting material shall exhibit 100 MΩ or more resistance when a specimen of the finished cable is tested in accordance with the test, Jacket resistance, in CAN/CSA-C22.2 No. 2556, UL 2556, or NMX-J-556-ANCE.

5.3 Fluid resistance (optional)

5.3.1 General

This test establishes the method for determining resistance of electric vehicle (EV) cable jackets to standard automotive fluids and other chemicals.

5.3.2 Sample preparation

Individual, finished, samples of cable, a minimum of 600 mm (24 in) in length, shall be prepared for each fluid immersion.

5.3.3 Fluid exposure

5.3.3.1 Except for 150 mm (6 in) at each end, which shall remain above the level of the fluid (not immersed in the fluid), test samples shall be fully immersed for 1 h in each fluid specified in Table 26 at 20 °C ± 1 °C.

5.3.3.2 After exposure to the fluid, the sample shall be removed, and excess fluids wiped off. The sample shall be allowed to rest for a period of 24 h to 48 h, at room temperature, prior to the continuation of testing.

5.3.4 Requirements to the resistance against fluids

The specimen shall show no cracks when examined with normal or corrected-to-normal vision, without magnification, after bending around a mandrel with a diameter of five times the outer diameter of the cable before immersion, or smaller, at room temperature at the rate of 1 completed turn per second for 6 completed turns.

6 Markings

6.1 General

In addition to the required markings for finished cables covered in 6.2 and 6.3, additional marks necessary for specific national applications shall be permitted. See Annex A for marking translations.

6.2 Product marking

6.2.1 General

6.2.1.1 Unless otherwise specified, the marking shall consist of surface printing, indent marking, embossing, laser printing or a marker tape under the jacket. For all marking methods, the jacket requirements shall be maintained. No ampacity or other current designation nor the word "outdoor" shall appear on the cable.

6.2.1.2 Laser printing shall be acceptable if:

a) it does not reduce the thickness of the underlying material below the minimum allowed by the standard;

b) it does not reduce the tensile strength and elongation below the minimum allowed for the material. The laser-imprinted area shall not be buffed or skived during sample preparation.

6.2.2 Intervals

If the marking is not continuous, it shall appear at a maximum interval of 600 mm (24 in).

6.2.3 Required markings on all cables

All cables covered by this standard shall have the following markings:

a) A durable distinctive marking throughout its entire length by which the organization responsible for the product is readily identified (examples of acceptable means are name or trademark;

b) Type designation;

c) The maximum temperature rating;

d) The number of conductors and sizes: In Canada and Mexico, the size marking shall be mm^2 (AWG or kcmil) only, in the United States, the size marking shall be AWG or kcmil with optional mm^2.

The "mm^2" may be replaced by "mm2". The use of either a comma or a period signifies a decimal. For example:

1) 3 X 3.31 mm^2 (12 AWG) or 3 X 3,31 mm2 (12 AWG);

2) 3/C 3.31 mm^2 (12 AWG) or 3/C 3.31 mm2 (12 AWG);

3) 3 X 12 AWG or 3/C 12 AWG (US only); and

4) 3 X 12 AWG (3.31 mm^2) or 3/C 12 AWG (3.31 mm^2).

e) voltage rating.

f) The low temperature rating indicated in Table 14 when tested in accordance with 5.1.6 and 5.1.13; shall be marked according to Table 14.

6.2.4 Additional surface markings on finished product

The following markings, where applicable, shall be surface-marked on the finished product:

a) The word “shielded” for cables that are provided with a shield”

b) The words "metal support member(s)" for cables that are provided with a metal support member(s) in accordance with 4.1.9.3.

6.2.5 Flame test marking

In Canada and the United States, the following applies. Products complying with the applicable flame test shall be marked with at least one of the following:

a) The legend “FT1”, to indicate compliance with the flame test requirements of 5.1.5.1;

b) The legend “FT2”, to indicate compliance with the flame test requirements of 5.1.5.2; or

c) The legend “VW-1”, to indicate compliance with the flame test requirements of 5.1.5.3.

NOTE: Products marked with “VW-1” need not be marked “FT1” or “FT2”. Products marked with “FT1” need not be marked “FT2”.

In Mexico, the following applies. Products complying with the applicable flame test shall be marked with at least one of the following:

a) The legend “FH”, to indicate compliance with the flame test requirements of 5.1.5.2; or

b) The legend “FV-1”, to indicate compliance with the flame test requirements of 5.1.5.1; or

c) The legend “FV-2”, to indicate compliance with the flame test requirements of 5.1.5.3.

6.3 Optional markings

The following additional information may be printed on the finished product if desired by the manufacturer:

a) A part, specification, or catalog designation or other required information, provided that it is in no way confusing or misleading

b) “Fluid resistant A“, “Fluid Res A” or “FL Res A” for products complying with the test in 5.3 for all the fluids in group A in Table 26.

c) “Fluid resistant B“, “Fluid Res B” or “FL Res B” for products complying with the test in 5.3 for all the fluids in group B in Table 26.

d) “Fluid resistant C“, “Fluid Res C” or “FL Res C” for products complying with the test in 5.3 for all the fluids in group C in Table 26.

e) “Fluid resistant D“, “Fluid Res D” or “FL Res D” for products complying with the test in 5.3 for all the fluids in group D in Table 26.

f) “Fluid resistant E“, “Fluid Res E” or “FL Res E” for products complying with the test in 5.3 for all the fluids in group E in Table 26.

For products complying with more than one of the markings in (b) through (f), the letter designations may be combined. For example, cables complying with groups A and C may be marked “FL Res AC”.

6.4 Package marking

NOTE: See Annex A for information on translation of caution markings.

6.4.1 A tag on which the information specified in Items (a) to (e) is indicated plainly shall be attached to every shipping length of finished cable. However, if the cable is wound on a reel or coiled in a carton, the tag shall be glued, tied, stapled, or otherwise acceptably attached to the reel or carton instead of to the cable, or the tag shall be eliminated, and the information printed or stenciled directly onto the reel or carton. The required information is as follows:

a) Manufacturer’s name, assigned file number, registered trade name, or trademark;

b) Date of manufacture by month and year (a code is acceptable);

c) Type designation;

d) Voltage rating; and

e) The number of conductors and size(s): the marking shall be in accordance with 6.2.3(d).

6.4.2 A cable that contains one or more optical fiber member shall be tagged, marked, or otherwise labelled with the following statement or another statement to the same effect:

“Optical-fiber member portion(s) of cable are for installation (optical and electrical functions associated) as described in applicable parts of the Canadian Electrical Code (CE Code), Part I in Canada, NOM-001-SEDE, La Norma de Instalaciones Electricas (Mexican Electrical Code [MEC]), in Mexico, and NFPA 70, National Electrical Code (NEC), in the United States. With levels of energy transmitted not exceeding those of Class I laser radiation (21 CFR Part 1040).”

6.4.3 For a cable that contains one or more optical-fiber members with any individual optical fiber member or group of such members with a metal or other electrically conductive part, the following wording or other wording to the same effect shall be provided:

“Optical-fiber portion(s) of cable contain non-current-carrying metal or other electrically conductive parts”.

6.4.4 Optional markings

The following additional information may be printed on the package if desired by the manufacturer:

a) “Fluid resistant A“, “Fluid Res A” or “FL Res A” for products complying with the test in 5.3 for all the fluids in group A in Table 26.

b) “Fluid resistant B“, “Fluid Res B” or “FL Res B” for products complying with the test in 5.3 for all the fluids in group B in Table 26.

c) “Fluid resistant C“, “Fluid Res C” or “FL Res C” for products complying with the test in 5.3 for all the fluids in group C in Table 26.

d) “Fluid resistant D“, “Fluid Res D” or “FL Res D” for products complying with the test in 5.3 for all the fluids in group D in Table 26.

e) “Fluid resistant E“, “Fluid Res E” or “FL Res E” for products complying with the test in 5.3for all the fluids in group E in Table 26.

For products complying with more than one of the above markings, the letter designations may be combined. For example, cables complying with groups A and C may be marked “FL Res AC”.

Tables

Table 1
Cross-sectional area of stranded conductors

(See 4.1.1.3.1 and Table 12)

Conductor size		Nominal circular mil area	Maximum cross-sectional area of stranded conductors	
mm^2	(AWG)	(circular mils)	mm^2	(circular mils)
0.325	(22)	(640)	0.330	(653)
0.519	(20)	(1 020)	0.525	(1 040)
0.824	(18)	(1 620)	0.836	(1 652)
1.04	(17)	(2 050)	1.06	(2 091)
1.31	(16)	(2 580)	1.34	(2 632)
1.65	(15)	(3 260)	1.68	(3 325)
2.08	(14)	(4 110)	2.12	(4 192)
2.63	(13)	(5 180)	2.68	(5 283)
3.31	(12)	(6 530)	3.37	(6 661)
4.17	(11)	(8 230)	4.25	(8 395)
5.26	(10)	(10 380)	5.36	(10 588)
6.63	(9)	(13 090)	6.76	(13 352)
8.37	(8)	(16 510)	8.53	(16 840)
10.6	(7)	(20 820)	10.75	(21 236)
13.3	(6)	(26 240)	13.57	(26 765)
16.8	(5)	(33 090)	17.09	(33 752)
21.2	(4)	(41 740)	21.55	(42 575)
26.7	(3)	(52 620)	27.18	(53 672)
33.6	(2)	(66 360)	34.27	(67 687)
42.4	(1)	(83 690)	43.27	(85 398)
53.3	(1/0)	(105 600)	54.59	(107 755)
67.4	(2/0)	(133 100)	68.78	(135 816)
85.0	(3/0)	(167 800)	86.73	(171 224)
107.2	(4/0)	(211 600)	109.39	(215 918)
	kcmil	kcmil		
127	(250)	(250)	129.59	(255 102)
152	(300)	(300)	155.10	(306 122)
177	(350)	(350)	180.61	(357 143)
203	(400)	(400)	207.14	(408 163)
228	(450)	(450)	232.65	(459 184)
253	(500)	(500)	258.16	(510 204)

Table 2
Stranding

(See 4.1.1.1, 4.1.1.7.1)

Conductor size	Diameter of individual wires			
	Minimum		Maximum	
	mm	(in)	mm	(in)
2.63 mm^2 (13 AWG) and smaller	0.125	(0.0049)	0.260	(0.010)
3.31 – 33.6 mm^2 (12 – 2 AWG)	0.125	(0.0049)	0.410	(0.016)
1 – 2/0 AWG	Minimum 133 strands, strand size not specified			
3/0 AWG – 500 kcmil	Minimum 259 strands, strand size not specified			

Table 3
Lay of conductor strands

(See 4.1.1.7.2.1, 4.1.1.7.2.3)

Conductor size, mm^2 (AWG)	Maximum length of lay	
	Bunch-stranded (lay of wires), mm (in)	Rope-stranded (lay of rope), mm (in)
0.325 (22)	32 (1.25)*	–
0.519 (20)	32 (1.25)	44 (1.75)
0.824 (18)	32 (1.25)	44 (1.75)
1.04 (17)	32 (1.25)	44 (1.75)
1.31 (16)	38 (1.50)	57 (2.25)
1.65 (15)	38 (1.50)	57 (2.25)
2.08 (14)	44 (1.75)	64 (2.50)
2.63 (13)	44 (1.75)	64 (2.50)
3.31 (12)	51 (2.00)	76 (3.00)
4.17 (11)	51 (2.00)	76 (3.00)
5.26 (10)	64 (2.50)	76 (3.00)
6.63 (9)	64 (2.50)	76 (3.00)
8.37 (8)	70 (2.75)	76 (3.00)
10.6 (7)	–	89 (3.50)
13.3 (6)	–	89 (3.50)
16.8 (5)	–	114 (4.50)
21.2 (4)	–	114 (4.50)
26.7 (3)	–	140 (5.50)
33.6 (2)	–	140 (5.50)
42.4 (1) or larger	–	16 times finished stranded conductor diameter

Table 4
Maximum direct current resistance of stranded* conductors at 20 °C, Ω/km

(See 4.1.1.3.1)

Conductor size		Bare copper	Coated copper
mm^2	(AWG)		
0.325	(22)	56.8	59.7
0.519	(20)	35.7	37.6
0.824	(18)	22.4	23.6
1.04	(17)	17.8	18.7
1.31	(16)	14.1	14.9
1.65	(15)	11.2	11.5
2.08	(14)	8.88	9.34
2.63	(13)	7.02	7.39
3.31	(12)	5.58	5.88
4.17	(11)	4.43	4.79
5.26	(10)	3.51	3.70
6.63	(9)	2.78	3.03
8.37	(8)	2.23	2.35
10.6	(7)	1.77	1.86
13.3	(6)	1.40	1.48
16.8	(5)	1.11	1.17
21.2	(4)	0.882	0.928
26.7	(3)	0.700	0.736
33.6	(2)	0.555	0.584
42.4	(1)	0.440	0.463
53.5	(1/0)	0.351	0.368
67.4	(2/0)	0.279	0.293
85.0	(3/0)	0.220	0.231
107.2	(4/0)	0.174	0.183
127	(250)	0.148	0.156
152	(300)	0.125	0.131
177	(350)	0.105	0.111
203	(400)	0.092	0.097
228	(450)	0.082	0.086
253	(500)	0.075	0.079

* Applicable for all types of stranding.

Table 5
Maximum direct current resistance of stranded* conductors at 25 °C, Ω/km

(See 4.1.1.3.1)

Conductor size		Bare copper	Coated copper
mm^2	(AWG)		
0.325	(22)	57.9	60.9
0.519	(20)	36.4	38.4
0.824	(18)	22.8	24.1
1.04	(17)	18.2	19.1
1.31	(16)	14.4	15.2
1.65	(15)	11.4	11.8
2.08	(14)	9.06	9.53
2.63	(13)	7.38	7.77
3.31	(12)	5.69	6.00
4.17	(11)	4.64	4.89
5.26	(10)	3.58	3.77
6.63	(9)	2.93	3.09
8.37	(8)	2.27	2.40
10.6	(7)	1.80	1.90
13.3	(6)	1.43	1.51
16.8	(5)	1.13	1.19
21.2	(4)	0.900	0.947
26.7	(3)	0.714	0.746
33.6	(2)	0.566	0.596
42.4	(1)	0.449	0.473
53.5	(1/0)	0.358	0.376
67.4	(2/0)	0.285	0.300
85.0	(3/0)	0.224	0.236
107.2	(4/0)	0.178	0.187
127	(250)	0.151	0.159
152	(300)	0.128	0.134
177	(350)	0.107	0.113
203	(400)	0.094	0.099
228	(450)	0.083	0.088
253	(500)	0.077	0.080

* Applicable for all types of stranding.

Table 6
Maximum direct current resistance of stranded* conductors at 20 °C, Ω/1000 ft

(See 4.1.1.3.1)

Conductor size		Bare copper	Coated copper
mm^2	(AWG)		
0.325	(22)	17.3	18.2
0.519	(20)	10.9	11.5
0.824	(18)	6.83	7.20
1.04	(17)	5.43	5.70
1.31	(16)	4.30	4.54
1.65	(15)	3.41	3.55
2.08	(14)	2.71	2.85
2.63	(13)	2.21	2.32
3.31	(12)	1.70	1.79
4.17	(11)	1.39	1.46
5.26	(10)	1.07	1.13
6.63	(9)	0.880	0.923
8.37	(8)	0.690	0.716
10.6	(7)	0.547	0.568
13.3	(6)	0.427	0.451
16.8	(5)	0.339	0.358
21.2	(4)	0.269	0.283
26.7	(3)	0.213	0.224
33.6	(2)	0.169	0.178
42.4	(1)	0.134	0.141
53.5	(1/0)	0.107	0.113
67.4	(2/0)	0.085	0.090
85.0	(3/0)	0.067	0.071
107.2	(4/0)	0.053	0.056
127	(250)	0.045	0.048
152	(300)	0.038	0.040
177	(350)	0.033	0.035
203	(400)	0.029	0.031
228	(450)	0.026	0.027
253	(500)	0.023	0.025

* Applicable for all types of stranding.

Table 7
Maximum direct current resistance of stranded* conductors at 25 °C, Ω/1000 ft

(See 4.1.1.3.1)

Conductor size		Bare copper	Coated copper
mm^2	(AWG)		
0.325	(22)	17.7	18.6
0.519	(20)	11.1	11.7
0.824	(18)	6.95	7.35
1.04	(17)	5.55	5.82
1.31	(16)	4.39	4.63
1.65	(15)	3.47	3.62
2.08	(14)	2.76	2.91
2.63	(13)	2.25	2.37
3.31	(12)	1.73	1.83
4.17	(11)	1.41	1.49
5.26	(10)	1.09	1.15
6.63	(9)	0.865	0.941
8.37	(8)	0.692	0.732
10.6	(7)	0.548	0.580
13.3	(6)	0.436	0.460
16.8	(5)	0.345	0.364
21.2	(4)	0.274	0.289
26.7	(3)	0.217	0.229
33.6	(2)	0.173	0.182
42.4	(1)	0.137	0.144
53.5	(1/0)	0.109	0.115
67.4	(2/0)	0.087	0.092
85.0	(3/0)	0.069	0.073
107.2	(4/0)	0.055	0.058
127	(250)	0.046	0.049
152	(300)	0.039	0.041
177	(350)	0.033	0.035
203	(400)	0.029	0.031
228	(450)	0.026	0.027
253	(500)	0.023	0.025

* Applicable for all types of stranding.

Table 8
Insulations

(See 4.1.2.1.1, 4.1.2.2)

Class no.	Material type	Material description	Temperature rating, maximum, °C	
			Dry	Wet
1	Thermoset	NR or IR, SBR, EP or a blend thereof	60	60
2	Thermoset	NR or IR, SBR, EP or a blend thereof	75	60
3	Thermoset	NR or IR, SBR, IIR, EP, or a blend thereof	90	60
4	Thermoplastic	PVC	60	60
5	Thermoplastic	PVC	75	60
6	Thermoplastic	PVC	90	60
7	Thermoplastic	PVC	105	60
8	Reserved			
9	Reserved			
10	Reserved			
11	Reserved			
12	Thermoset	CR, CSM, CPE, NBR/PVC	90	60
13	Thermoset	CR, CSM, CPE, NBR/PVC	60	60
14	Thermoplastic	TPE	60	60
15	Thermoplastic	TPE	90	60
16	Thermoplastic	TPE	105	60
17	Reserved			
18	Thermoset	CPE, CSM	105	60
19	Thermoset	EP	105	60
20	Reserved			

Legend:

NR or IR = natural rubber or polyisoprene rubber
SBR = styrene-butadiene rubber
EP = ethylene propylene rubber
IIR = isobutylene-isoprene rubber
CPE = chlorinated polyethylene
CR = polychloroprene
CSM = chloro-sulphonyl-polyethylene
TPE = thermoplastic elastomer
PVC = polyvinyl chloride or copolymer of vinyl chloride and vinyl acetate
NBR = acrylonitrile butadiene rubber

Table 9
Physical properties – insulation

(See 5.1.1, 5.2.6, Table 12)

Class no.	Temperature rating, maximum, °C			Material type	Before aging		Air oven test			
									Minimum percentage of unaged value	
	Dry	Wet	Oil		Minimum elongation percent	Tensile strength, MPa (lbf/in^2)	Oven temp., °C ±2	Time, d	Elongation, percent	Tensile strength, percent
1	60	60	60	Thermoset	200	3.4 (500)	70	7	65	60
2	75	60	60	Thermoset	200	3.4 (500)	100	10	50	50
3	90	60	60	Thermoset	200	3.4 (500)	110	10	50	50
4	60	60	60	Thermoplastic	100	10.3 (1500)	100	7	65	85
5	75	60	60	Thermoplastic	100	10.3 (1500)	100	10	65	85
6	90	60	60	Thermoplastic	100	10.3 (1500)	121	7	65	85
7	105	60	60	Thermoplastic	100	10.3 (1500)	136	7	65	85
8	Reserved									
9	Reserved									
10	Reserved									
11	Reserved									
12	90	60	60	Thermoset	200	8.3 (1200)	110	10	50	50
13	60	60	60	Thermoset	200	8.3 (1200)	70	7	65	75
14	60	60	60	Thermoplastic	200	5.5 (800)	100	7	75	75
15	90	60	60	Thermoplastic	200	5.5 (800)	121	7	75	75
16	105	60	60	Thermoplastic	200	5.5 (800)	136	7	75	75
17	Reserved									
18	105	60	60	Thermoset	200	8.3 (1200)	136	7	50	50
19	105	60	60	Thermoset	200	3.4 (500)	136	7	50	50
20	Reserved									

Table 10
Jackets

(See 4.1.6.1.5, 4.1.6.2, 4.1.6.3)

Class no.	Material type	Material description	Temperature ratings, maximum, °C	
			Dry	Oil
1.1	Reserved			
1.2	Thermoset	CR, CSM, EP, NBR/PVC, CPE	60	60
1.3	Thermoset	CR, CSM, EP, NBR/PVC, CPE	75	60
1.4	Thermoset	CR, CSM, EP, NBR/PVC, CPE	90	60
1.5	Thermoplastic	PVC	60	60
1.6	Thermoplastic	PVC	75	60
1.7	Thermoplastic	PVC	90	60
1.8	Thermoplastic	PVC	105	60
1.9	Thermoplastic	TPE	60	60
1.10	Thermoplastic	TPE	90	60
1.11	Thermoplastic	TPE	105	60
1.12	Thermoset	CPE, CSM, EP	105	60

Legend:

EP	= ethylene propylene rubber
CPE	= chlorinated polyethylene
CR	= polychloroprene
CSM	= chloro-sulphonyl-polyethylene
TPE	= thermoplastic elastomer
PVC	= polyvinyl chloride or copolymer of vinyl chloride and vinyl acetate
NBR	= acrylonitrile butadiene rubber

Note: Due to possible incompatibility, TPE material of styrenic type is in some cases not suitable for use in cables where direct contact with PVC can occur. A separator is one acceptable means of avoiding direct contact. Other combinations of materials that could be incompatible, if any, are as yet undetected.

Table 11
Physical properties – Jackets

(See 5.1.2, Table 12)

Class no.	Temperature rating, maximum, °C		Material type	Before aging		After aging							
						Air oven test				Oil immersion test			
								Minimum percentage of unaged value		IRM 902 Oil		Minimum percentage of unaged value	
	Dry	Oil		Minimum elongation, percent	Tensile strength, MPa (lbf/in^2)	Oven temp., °C ±2	Time, d	Elongation, percent	Tensile strength, percent	Oil temp., °C ±2	Time, h	Elongation, percent	Tensile strength, percent
1.1	Reserved												
1.2	60	60	Thermoset	200	8.3 (1200)	70	7	70	75	121	18	60	60
1.3	75	60	Thermoset	200	8.3 (1200)	100	10	50	50	121	18	60	60
1.4	90	60	Thermoset	200	8.3 (1200)	110	10	50	50	121	18	60	60
1.5	60	60	Thermoplastic	100	10.3 (1500)	100	7	45	85	60	168	75	75
1.6	75	60	Thermoplastic	100	10.3 (1500)	100	10	45	70	60	168	75	75
1.7	90	60	Thermoplastic	100	10.3 (1500)	121	7	45	85	60	168	75	75
1.8	105	60	Thermoplastic	100	10.3 (1500)	136	7	45	85	60	168	75	75
1.9	60	60	Thermoplastic	200	8.3 (1200)	100	7	75	75	60	168	75	75
1.10	90	60	Thermoplastic	200	8.3 (1200)	121	7	75	75	60	168	75	75
1.11	105	60	Thermoplastic	200	8.3 (1200)	136	7	75	75	60	168	75	75
1.12	105	60	Thermoset	200	8.3 (1200)	136	7	65	70	121	18	60	60

Note: Interchanging jacket materials within the table shall be permitted (see 4.1.6.2).

Table 12
Electric vehicle cable types

(See 4.1.2.1.2, 4.1.3.3, 4.1.6.1.1, 5.1.2)

	Type					
	Hard usage			**Extra hard usage**		
	EVJ	**EVJE**	**EVJT**	**EV**	**EVE**	**EVT**
Temperature ratings, °C	60, 75, 90, 105	60, 90, 105	60, 75, 90, 105	60, 75, 90, 105	60, 90, 105	60, 75, 90, 105
Maximum voltage, V	300			600, 1000		
Size of circuit conductors, mm^2 (AWG)	0.824 – 3.31 (18 – 12)			0.824 – 253 (18 AWG – 500 kcmil)		
Number of circuit conductors	2 – 6			2 or more		
Data, signal and communications cables	Optional, any conductor sizes indicated in Table 1					
Optical fiber members	Optional (4.1.10)					
Covering, Clause	4.1.3	4.1.3	4.1.3	4.1.3	4.1.3	4.1.3
Grounding conductor, Clause	4.1.1.8	4.1.1.8	4.1.1.8	4.1.1.8	4.1.1.8	4.1.1.8
Circuit conductor:						
Material	Soft, annealed copper (4.1.1.2)					
Size	Cross-sectional area/DC resistance (4.1.1.3.1)					
Stranding	Size of wires (4.1.1.7.1), lay of wires (4.1.1.7.2)					
General	Joints, coatings, separators (4.1.1.4, 4.1.1.5, and 4.1.1.6)					
Data/signal/communications conductor:						
Material	Soft, annealed copper (4.1.1.2)					
Size	Diameter or cross-sectional area (4.1.1.3.1)					
Stranding	Size of wires (4.1.1.7.1), lay of wires (4.1.1.7.2)					
General	Joints, coatings, separators (4.1.1.4, 4.1.1.5, and 4.1.1.6)					
Insulation class, Clause	4.1.2	4.1.2	4.1.2	4.1.2	4.1.2	4.1.2
Circuit and signal conductors:						
60 °C	1, 13	14	4	1, 13	14	4
75 °C	2	N/A	5	2	N/A	5
90 °C	3, 12	15	6	3, 12	15	6
105 °C	18, 19	16	7	18, 19	16	7
Equipment grounding (bonding) conductor:						
60 °C	1, 13	14	4	1, 13	14	4
75 °C	2	N/A	5	2	N/A	5
90 °C	3, 12	15	6	3, 12	15	6
105 °C	18, 19	16	7	18, 19	16	7
Insulation thickness when covering is not employed:						
Minimum average thickness, mm (mils)	0.76 (30)			0.325 – 1.65 mm^2 (22 – 15 AWG) 0.76 (30)		
				2.08 – 6.63 mm^2 (14 – 9 AWG) 1.14 (45)		
				8.37 – 33.6 mm^2 (8 – 2 AWG) 1.52 (60)		
				42.4 – 107.2 mm^2 (1 – 4/0 AWG) 2.03 (80)		

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Table 12 Continued

	Type					
	Hard usage			Extra hard usage		
	EVJ	EVJE	EVJT	EV	EVE	EVT
				127 – 253 mm^2 (250 – 500 kcmil) 2.41 (95)		
Minimum thickness at any point, mm (mils)	0.68 (27)			90 percent of the minimum average thickness		
Minimum thickness at point of contact, mm (mils)	0.61 (24)			80 percent of the minimum average thickness		
Insulation thickness when covering is employed:						
Minimum average thickness, mm (mils)	0.51 (20)			0.325 – 1.65 mm^2 (22 – 15 AWG) 0.51 (20)		
				2.08 – 6.63 mm^2 (14 – 9 AWG) 0.76 (30)		
				8.37 – 33.6 mm^2 (8 – 2 AWG) 1.14 (45)		
				42.4 – 107.2 mm^2 (1 – 4/0 AWG) 1.52 (60)		
				127 – 253 mm^2 (250 – 500 kcmil) 1.90 (75)		
Minimum thickness at any point, mm (mils)	0.45 (18)			90 percent of the minimum average thickness		
Minimum thickness at point of contact of insulation, mm (mils)	0.40 (16)			80 percent of the minimum average thickness		
Minimum nylon thickness, mm (mils) over insulation	0.10 (4)			0.325 – 1.65 mm^2 (22 – 15 AWG) 0.10 (4)		
				2.08 – 6.63 mm^2 (14 – 9 AWG) 0.13 (5)		
				8.37 – 33.6 mm^2 (8 – 2 AWG) 0.15 (6)		
				42.4 – 107.2 mm^2 (1 – 4/0 AWG) 0.18 (7)		
				127 – 253 mm^2 (250 – 500 kcmil) 0.20 (8)		
Assembly, Clause	4.1.4	4.1.4	4.1.4	4.1.4	4.1.4	4.1.4
Optional shielding, Clause	4.1.5	4.1.5	4.1.5	4.1.5	4.1.5	4.1.5
Jacket class:						
60 °C	1.2	1.9	1.5	1.2	1.9	1.5
75 °C	1.3	N/A	1.6	1.3	N/A	1.6
90 °C	1.4	1.10	1.7	1.4	1.10	1.7
105 °C	1.12	1.11	1.8	1.12	1.11	1.8
Minimum average and minimum thickness at any point of jacket, Table	22			23, 24		
Jackets Clause	4.1.6	4.1.6	4.1.6	4.1.6	4.1.6	4.1.6
Conductor identification, Clause	4.1.8	4.1.8	4.1.8	4.1.8	4.1.8	4.1.8
Tests, Clause						
Cold bend	5.1.6	5.1.6	5.1.6	5.1.6	5.1.6	5.1.6
Heat-shock resistance	N/A	5.1.8	5.1.8	N/A	5.1.8	5.1.8
Spark	5.2.1	5.2.1	5.2.1	5.2.1	5.2.1	5.2.1
Dielectric strength of insulated conductor	5.2.2.2	5.2.2.2	5.2.2.2	5.2.2.2	5.2.2.2	5.2.2.2

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Table 12 Continued

	Type					
	Hard usage			Extra hard usage		
	EVJ	EVJE	EVJT	EV	EVE	EVT
Dielectric strength of finished cable	5.2.2.1	5.2.2.1	5.2.2.1	5.2.2.1	5.2.2.1	5.2.2.1
Continuity	5.2.5	5.2.5	5.2.5	5.2.5	5.2.5	5.2.5
Mechanical strength	5.1.4	5.1.4	5.1.4	5.1.4	5.1.4	5.1.4
Flexing of shielded cords	5.2.8	5.2.8	5.2.8	5.2.8	5.2.8	5.2.8
Jacket resistance	5.2.9	5.2.9	5.2.9	5.2.9	5.2.9	5.2.9
Durability of printing	5.1.11	5.1.11	5.1.11	5.1.11	5.1.11	5.1.11
Copper corrosion of insulation	5.2.6	5.2.6	5.2.6	5.2.6	5.2.6	5.2.6
Copper corrosion of shield	5.2.7	5.2.7	5.2.7	5.2.7	5.2.7	5.2.7
Bend test on nylon-covered conductors	5.1.9	5.1.9	5.1.9	5.1.9	5.1.9	5.1.9
Deformation	N/A	5.1.3	5.1.3	N/A	5.1.3	5.1.3
Low-temperature impact	5.1.13	5.1.13	5.1.13	5.1.13	5.1.13	5.1.13
Crush resistance	5.1.14	5.1.14	5.1.14	5.1.14	5.1.14	5.1.14
Flame FT2 or FH	5.1.5.2	5.1.5.2	5.1.5.2	5.1.5.2	5.1.5.2	5.1.5.2
Flame (Optional) FT1 or FV-1	5.1.5.1	5.1.5.1	5.1.5.1	5.1.5.1	5.1.5.1	5.1.5.1
Flame (Optional) VW-1 or FV-2	5.1.5.3	5.1.5.3	5.1.5.3	5.1.5.3	5.1.5.3	5.1.5.3
Weather resistance	5.1.7	5.1.7	5.1.7	5.1.7	5.1.7	5.1.7
Insulation resistance	5.2.3	5.2.3	5.2.3	5.2.3	5.2.3	5.2.3
Permittivity and stability factor	5.2.4	5.2.4	5.2.4	5.2.4	5.2.4	5.2.4
Swelling and blistering	5.1.10	N/A	N/A	5.1.10	N/A	N/A
Fluid resistance (optional)	5.3	5.3	5.3	5.3	5.3	5.3
Physical properties, Table						
Insulation	Table 9	Table 9	Table 9	Table 9	Table 9	Table 9
Jacket	Table 11	Table 11	Table 11	Table 11	Table 11	Table 11