



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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NMX-J-738-ANCE
First Edition



CSA Group
CSA C22.2 No. 332:22
First Edition



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UL 2263
First Edition

Electric Vehicle Cable

May 9, 2022

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CONTENTS

PREFACE	5
1 Scope	7
1.1 General	7
1.2 Products included	7
2 Reference Publications	7
3 Definitions and Units of Measurement	9
3.1 Definitions	9
3.2 Units of measurement	10
4 Construction Requirements	10
4.1 General construction requirements	10
5 Performance and Test Requirements	17
5.1 Physical properties	17
5.2 Electrical properties	20
5.3 Fluid resistance (optional)	23
6 Markings	24
6.1 General	24
6.2 Product marking	24
6.3 Optional markings	26
6.4 Package marking	26
Tables	28

Annex A (Informative) French and Spanish translations of caution markings

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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 Comité de Normalización de la Asociación de Normalización y Certificación, 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 mm² (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 mm² (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 mm² (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 mm² (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 mm² (9 AWG), the equipment grounding (bonding) conductor shall be 5.26 mm² (10 AWG) or larger.

4.1.1.8.3 For cable with conductor sizes 8.37 – 33.6 mm² (8 – 2 AWG), the reduction of the equipment grounding (bonding) conductor by not more than two AWG or equivalent mm² sizes from the largest ungrounded circuit conductor shall be permitted (e.g., a cable having an 8.37 mm² (8 AWG) ungrounded circuit conductor may have a minimum 5.26 mm² (10 AWG) equipment grounding (bonding) conductor).

4.1.1.8.4 For cable with conductor sizes larger than 33.6 mm² (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 mm² (18 AWG) and smaller shall comply with the requirements for 0.824 mm² (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](#).