



UL 2251

STANDARD FOR SAFETY

Plugs, Receptacles, and Couplers for
Electric Vehicles

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UL Standard for Safety for Plugs, Receptacles, and Couplers for Electric Vehicles, UL 2251

Fourth Edition, Dated November 20, 2017

Summary of Topics

This revision of ANSI/UL 2251 dated December 15, 2022, is being issued to incorporate the following:

- ***Elimination of pin engagement lengths; [7.1.5](#) and [7.1.6](#)***
- ***Revision to the scope and increase of voltage limits; [1.1](#), [Table 24.1](#) and [30.4](#)***
- ***Addition of option for active cooling and dynamic control of output current; [1.1](#), [2.1A](#), [2.5A](#), [6.1](#) – [6.4](#), [45.2](#), [Table 45.1](#), [45.3](#), [Table 45.2](#), [Table 47.1](#) and [56.1.1](#)***
- ***Clarification of ground conductor sizing; [15.1](#)***
- ***Clarification of dielectric strength and humidity/isolation resistance/dielectric test series; [29.3](#), [30.1](#), [Table 30.1](#), [30.2](#), [30.4](#) and [30.5](#)***
- ***Correction of metric value; [33.1](#)***
- ***Clarification and revision for allowance of lower ambient temperature exposure; [34.4](#) and [34.6](#)***
- ***Clarification of the test to allow the use of manufacturer's ambient temperature ratings; [35.5](#)***
- ***Clarification to the short circuit test; [39.1.1](#), [Table 39.1](#), [39.2.6](#) and [Table 39.2](#)***
- ***Editorial change to correct references; [43.4](#)***
- ***Temperature test clarification for products with a manufacturer's recommended ambient above 40°C; [45.1](#)***
- ***Harmonization of ANCE NMX-J-678/CSA C22.2 No. 282/UL 2251 and IEC thermal cycling tests; [18.3](#), [18.4](#), [45.3](#), [Table 45.2](#), [Figure 45.1](#) and Sections [54A](#) – [54D](#)***
- ***Revision to the overload test; [43.1](#) – [43.4](#), [43.4A](#), [43.5A](#), [43.6](#), [43.7](#) and [43.11](#)***
- ***Addition of reference to UL 969A for alternate cord tag requirements; [56.1.7](#) and Annex [A](#)***

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 new and revised requirements are substantially in accordance with Proposal(s) on this subject dated August 26, 2022.

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This ANSI/UL Standard for Safety consists of the Fourth Edition including revisions through December 15, 2022.

The most recent designation of ANSI/UL 2251 as an American National Standard (ANSI) occurred on December 15, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <https://csds.ul.com>.

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Preface

This is the harmonized ANCE, CSA Group, and UL Standard for Plugs, Receptacles, and Couplers for Electric Vehicles. It is the Second edition of NMX-J-678-ANCE, the Second edition of CSA-C22.2 No. 282, and the Fourth edition of UL 2251. This edition of CSA-C22.2 No. 282 supersedes the previous edition published February 22, 2013. This edition of NMX-J-678-ANCE supersedes the previous edition published in 2013. This edition of UL 2251 supersedes the previous edition published February 22, 2013. This harmonized standard has been jointly revised on December 15, 2022. For this purpose, CSA Group and UL are issuing revision pages dated December 15, 2022, and ANCE is issuing a new edition dated December 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 Working Group for Electric Vehicle Couplers 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 reviewed and approved by the Comité de Normalización de la Asociación de Normalización y Certificación, A.C., CONANCE.

This standard was reviewed by the CSA Subcommittee on Electrical Vehicle–Safety of Plugs, Receptacles, and Couplers, 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.

Application of Standard

Where reference is made to a specific number of specimens 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 considered equivalent to, an IEC standard.

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

An equivalent standard is a standard that is substantially the same in technical content, except as follows: Technical national differences are allowed for codes and governmental regulations as well as those recognized as being in accordance with NAFTA Article 905, for example, because of fundamental climatic, geographical, technological, or infrastructural factors, scientific justification, or the level of protection that the country considers appropriate. Presentation is word for word except for editorial changes.

Reasons for differences from IEC

This standard provides general requirements for plugs, receptacles, and couplers for electric vehicles in accordance with the electrical installation codes of Canada, Mexico, and the United States. At present there is no IEC standard for these products 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.

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INTRODUCTION

1 Scope

1.1 These requirements cover EV plugs, EV receptacles, vehicle inlets, vehicle connectors, and EV breakaway couplings, rated up to 800 amperes and up to 1000 volts ac or 1500 V dc under conditions of continuous use. This standard applies to the devices which may also be intended for use in charging systems that provide for active cooling or dynamic current control when the device is rated only for DC voltages. These devices are intended for use with conductive electric vehicle supply equipment (EVSE), and are intended to facilitate the conductive connection from the EVSE to the vehicle. These devices are for use in either indoor or outdoor nonhazardous locations in accordance with Annex A, Ref. No. 1.

1.2 This Standard does not directly apply to any device that is not intended for use as described in [1.1](#).

1.3 In the text of this Standard, the term "device" refers to any product covered by this Standard. The letters "EV" refer to an electric vehicle, including plug-in hybrid vehicles, hybrid vehicles, electric vehicles, battery electric vehicles, and similar vehicles.

2 Definitions

2.1 For the purposes of this Standard, the following definitions apply.

2.1A ACTIVE COOLING – A mode of operation in which liquid coolants are used to cool the cable and EV connector contacts while high current is being passed through the cable.

2.2 BREAKAWAY COUPLINGS – A device located within a length of EV cable, between the electric vehicle supply equipment (EVSE) end and the vehicle connector end, that is intended to separate under a pull force, such that its separation will protect the end connections from a strain that could break wiring connections or rupture insulation. These devices are intended to be reconnectable, and may or may not be intended for current interruption.

2.3 CONTACT – A conductive element in a device that mates with a corresponding element in a mating device to provide an electrical conductive path.

2.4 CONTROL PILOT – The primary control conductor that is connected through the control circuitry. It may perform several functions, including assurance that the vehicle is present and connected, start/stop control, and supply equipment current rating; and it provides for continuous monitoring for the Personnel Protection System.

2.5 DELAYED ACTION – An arrangement that delays the separation of device housings to reduce the likelihood of exposure of arcing contacts during the breaking of the circuit when the EV plug or vehicle connector is withdrawn.

2.5A DYNAMIC CURRENT CONTROL – Increasing and/or decreasing the output current to the vehicle based on indicated temperatures (from thermal sensors) at the contacts of the EV connector. Higher current is used for a short time and when maximum temperatures are observed, the current is decreased to protect the cable and connector.

2.6 ENCLOSURE – The case or housing that is used to enclose all live parts and into which the insulator and contacts are assembled.

2.7 EV CABLE ASSEMBLY – A portable cable assembly consisting of a length of EV Cable and provided with a vehicle connector on one end and that may be provided with an EV plug on the other.

2.8 FIELD WIRING TERMINAL – A terminal to which power supply, control, or equipment grounding connections will be made in the field when the device is installed.

2.9 GROUNDED SYSTEM – A charging system that depends on reliable grounding of the circuitry to provide the basis for the Personnel Protection System. The ground connection is considered to be a protective earth connection, and the circuitry and conductors that make up the ground path are suitable for the potential ground fault currents expected for that product rating.

2.10 GROUNDING/BONDING CONDUCTOR – A conductor that is defined in Annex A, Ref. No. 1 (US and Mexico) as an equipment grounding conductor, and a conductor that is defined in Annex A, Ref. No. 1 (Canada) as a bonding conductor.

2.11 INSULATOR – That portion of a device that provides for separation and support of contacts.

2.12 ISOLATED SYSTEM – A charging system that depends on reliable isolation of the circuitry from all dead metal parts or circuits that can be contacted by the user. The isolation is monitored as part of the Personnel Protection System. The ground connection is not relied on for safety and is considered a functional or reference ground. The reference ground connection is used by the isolation monitor to monitor the isolation of the system. The functional or reference ground is not expected to carry ground fault current and, based on this, is not expected to be sized in accordance with the device rating.

2.13 PLUG, EV – A device intended to receive power when inserted into an EV receptacle. It establishes connection between conductors of the attached electric vehicle cable and the conductors connected to the EV receptacle.

2.14 RECEPTACLE, EV – A device that is intended to provide power to an inserted EV plug, and that is usually installed as a fixed outlet on equipment. These devices are not intended to be installed in building structures or as branch circuit devices. See [1.2](#).

2.15 TERMINAL – A conductive part provided on a contact for connecting a conductor.

2.16 VEHICLE CONNECTOR – A connector, that by insertion into a vehicle inlet, establishes an electrical connection to the electric vehicle for the purpose of providing power and information exchange, with means for attachment of electric vehicle cable. This device is a part of the vehicle coupler.

2.17 VEHICLE COUPLER – A means enabling the connection, at will, of an electric vehicle cable to the equipment. It consists of a vehicle connector and a vehicle inlet.

2.18 VEHICLE, ELECTRIC (EV) – An automotive-type vehicle for on-road use, such as passenger automobiles, buses, trucks, vans, neighborhood electric vehicles, and the like, primarily powered by an electric motor that draws current from a rechargeable storage battery, fuel cell, photovoltaic array, or other source of electric current. Plug-in hybrid electric vehicles (PHEV) are considered electric vehicles. For the purpose of this definition, off-road, self-propelled electric vehicles, such as industrial trucks, hoists, lifts, transports, golf carts, airline ground support equipment, tractors, boats, and the like, are not included.[§]

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2.19 VEHICLE INLET – The part incorporated in, or fixed to the vehicle, which receives power from a vehicle connector.

3 Components

3.1 Except as indicated in [3.2](#), a component of a product covered by this Standard shall comply with the requirements for that component.

3.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or
- b) Is superseded by a requirement in this standard.

3.3 A component shall be used in accordance with its rating established for the intended conditions of use.

3.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

4 Units of Measurement

4.1 The values given in SI (metric) units shall be normative. Any other values given shall be for information purposes only.

5 Normative References

5.1 Where reference is made to any standards, such reference shall be considered to refer to the latest editions and revisions thereto available at the time of printing, unless otherwise specified.

5.2 Products covered by this Standard shall comply with the referenced installation codes and standards noted in Annex [A](#) as appropriate for the country where the product is to be used. When the product is intended for use in more than one country, the product shall comply with the installation codes and standards for all countries where it is intended to be used.

5.3 For products intended for use in Canada, general requirements are given in Annex [A](#), Ref. No. 31. In Mexico and the US, this does not apply.

CONSTRUCTION

6 General

6.1 The ratings mentioned throughout this Standard represent maximum ampacity and voltage for a device under its conditions of expected use. Expected use considered the operational mode for which it is specified by manufacturer. This may include continuous use with no added features for control, active cooling as described in [6.2](#), or dynamic control as described in [6.3](#). A device is considered to be intended for use on alternating or direct current as indicated in its marked rating. See [56.5](#).

6.2 Active cooling is an operational mode in which a liquid is used to cool the cable and contacts during use while a maximum current is passed through the device, with that maximum current being in excess of the device rating. A device intended for use in a charging system that incorporates active cooling shall be provided with a means to monitor the temperature of each DC power contact, both DC+ and DC-. The leads from this monitoring means shall be passed through the cable and be available to the charger manufacturer. The device shall be provided with a non-cooled current rating, which is the rating of the