

Underwriters Laboratories (UL)

UL 50E – Enclosures for Electrical Equipment, Environmental Considerations

- 1.1** This standard applies to enclosures for electrical equipment intended to be installed and used in non-hazardous locations in accordance with the Canadian Electrical Code, Part I, CSA C22.1, the provisions of the National Electrical Code, NFPA 70, and the provisions of Mexico's Electrical Installations, NOM-001-SEDE, as follows:
- a) Enclosures for indoor locations, Types 1, 2, 5, 12, 12K, and 13; and
 - b) Enclosures for indoor or outdoor locations, Types 3, 3R, 3S, 4, 4X, 6, and 6P.
- 1.2** This standard covers additional environmental construction and performance requirements for enclosures. The general requirements for enclosures are contained in standard CSA C22.2 No. 94.1, UL 50, and NMX-J-235/1-ANCE (See Annex b, Ref. No. 10) or the end-use product standards that are to be used in conjunction with this standard.
- 1.3** This standard does not cover the requirements for protection of devices against conditions such as condensation, icing, corrosion, or contamination that may occur within the enclosure or that may enter via conduit or unsealed openings.
- 1.4** Where an individual product standard contains requirements that are at variance with those of this standard, the requirements of the individual product standard take precedence.

UL 62 – Flexible Cords and Cables

- 1.1 General** This standard specifies the requirements for flexible cords, elevator cables, and hoistway cables rated 600 V maximum and intended for use in accordance with CSA C22.1, *Canadian Electrical Code (CEC), Part I* and CAN/CSA-C22.2 No. 0, *General Requirements - Canadian Electrical Code, Part II*, 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 the following products:
- a) service cords;
 - b) elevator cables;
 - c) hoistway cables;
 - d) heater cords;
 - e) range and dryer cords;
 - f) cords for decorative lighting;
 - g) tinsel and lamp cords; and
 - h) special use cords.

1.3 National differences

In cases where product types are not approved in all three countries, a national difference is indicated by superscripts, as shown below:

| Superscript letter | National difference |
|--------------------|--|
| c | For use in Canada only |
| m | For use in Mexico only |
| u | For use in United States only |
| c,m | For use in Canada and Mexico only |
| c,u | For use in Canada and United States only |
| m,u | For use in Mexico and United States only |

UL 943 – Ground-Fault Circuit Interrupters

1.1 This Standard applies to Class A, single- and three-phase, ground-fault circuit-interrupters intended for protection of personnel, for use only in grounded neutral systems in accordance with the National Electrical Code (NEC), ANSI/NFPA 70, the Canadian Electrical Code, C22.1 (CEC), and Electrical Installations (Use), NOM-001-SEDE. These devices are intended for use on alternating current (AC) circuits of 120 V, 208Y/120 V, 120/240 V, 127 V, or 220Y/127 V, 60 Hz circuits.

Note: In Canada, the text "intended for protection of personnel" is excluded.

- 1.2 These requirements do not cover ground-fault circuit-interrupters intended for use in circuits served by a transformer having windings wholly insulated from each other.
- 1.3 This Standard applies to all Class A ground-fault circuit-interrupters. These Class A GFCIs are permitted to be integrated into other devices, in which case, besides complying with this Standard, these devices are to comply with the corresponding applicable Standard for the device in question.
- 1.4 This Standard includes minimum requirements for the function, construction, performance, and markings of ground-fault circuit-interrupters included in the scope.
- 1.5 This Standard is intended to cover only Class A GFCI devices.
- 1.6 This Standard also covers GFCIs of the self-contained type that are intended for installation in a counter, such as would be suitable for installation in a kitchen or bathroom counter top.

Compatible With:

CSA 22.2 No. 144 – Ground Fault Circuit Interrupters

- 1.1 This Standard applies to Class A, single- and three-phase, ground-fault circuit-interrupters intended for protection of personnel, for use only in grounded neutral systems in accordance with the National Electrical Code (NEC), ANSI/NFPA 70, the Canadian Electrical Code, C22.1(CEC), and Electrical Installations(Use), NOM-001-SEDE. These devices are intended for use on alternating current (AC)circuits of 120 V, 208Y/120 V, 120/240 V, 127 V, or 220Y/127 V, 60 Hz circuits. Note: In Canada, the text .intended for protection of personnel is excluded.
- 1.2 These requirements do not cover ground-fault circuit-interrupters intended for use in circuits served by a transformer having windings wholly insulated from each other.
- 1.3 This Standard applies to all Class A ground-fault circuit-interrupters. These Class A GFCIs are permitted to be integrated into other devices, in which case, besides complying with this Standard, these devices are to comply with the corresponding applicable Standard for the device in question.
- 1.4 This Standard includes minimum requirements for the function, construction, performance, and markings of ground-fault circuit-interrupters included in the scope.
- 1.5 This Standard is intended to cover only Class A GFCI devices.

UL 991 – Tests for Safety-Related Controls Employing Solid-State Devices

- 1.1 These requirements apply to controls that employ solid-state devices and are intended for specified safety-related protective functions.
- 1.2 These requirements address the potential risks unique to the electronic nature of a control. Equipment or components employing an electronic feature shall also comply with the basic construction and performance requirements contained in the applicable end-product or component standard. These requirements are intended to supplement applicable end-product or component standards and are not intended to serve as the sole basis for investigating the risks of fire, electric shock, or injury to persons associated with a control.
- 1.3 These requirements do not cover controls covered by end-product standards in which an electronic control investigation is specified.
- 1.4 Sections 9 - 22 contain standardized test methods for investigating the performance of an electronic control when subjected to particular environmental stresses. The suitability of each test to a given control shall be determined by the end-product standard(s). Determination shall include an assessment of:
 - a) Whether the control will be exposed to a particular environmental stress in its application, and
 - b) Whether the response of the control to a particular environmental stress is relevant to its intended safety-related protective function in its application.

UL 1053 – Ground-Fault Sensing and Relaying Equipment

- 1.1 These requirements cover ground-fault current sensing devices, relaying equipment, or combinations of ground-fault current sensing devices and relaying equipment or equivalent protection equipment for use in ordinary locations that will operate to cause a disconnecting device to open all ungrounded conductors at predetermined values of ground-fault current, in accordance with the National Electrical Code, ANSI/NFPA 70.
- 1.2 These requirements cover equipment intended for use in circuits that are solidly grounded.
- 1.3 These requirements do not cover equipment intended to be powered from single-phase circuits operating at more than 600 volts or three-phase circuits operating at more than 600 volts phase-to-phase.
- 1.4 These requirements do not cover ground-fault circuit-interrupters.
- 1.5 These devices are intended to operate with shunt-trip circuit breakers, electrically tripped bolted pressure contact switches and the like that constitute the disconnecting means.
- 1.6 A Class I ground-fault protection device is one that does not incorporate means to prevent opening of the disconnecting means at high levels of fault current and is intended for use with the following:
 - a) Circuit breakers,
 - b) Fused circuit breakers,
 - c) Fused switches having an interrupting rating not less than 12 times their ampere rating, or
 - d) Fused switches having integral means to prevent disconnecting at levels of fault current exceeding the contact interrupting rating of the switch.
- 1.7 A Class II ground-fault protection device is one that incorporates means to prevent initiation of opening of the disconnecting device if the fault current exceeds the contact interrupting capability of the disconnecting device with which it is intended to be used.
- 1.8 These requirements cover enclosed-type devices and also cover open-type devices that are intended for use in other equipment, such as panelboards, switchboards, and the like.
- 1.9 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

UL 1500 – Ignition-Protection Test for Marine Products

- 1.1 This test procedure covers the basic test methods for determining ignition protection and is not to be considered as a test standard that will determine the acceptability of a product or component for use in marine service. The acceptability of a product or component in the intended application is judged in accordance with applicable requirements and tests for that component or product.
- 1.2 This test procedure does not cover explosion proof or intrinsically safe equipment as required by the U. S. Coast Guard and applied to U. S. Coast Guard inspected vessels or as defined in the National Electrical Code, ANSI/NFPA No. 70.
- 1.3 Products and components classified as ignition protected are intended to be installed and used in accordance with the applicable requirements to the U. S. Coast Guard, the Fire Protection Standard for Pleasure and Commercial Motor Craft, ANSI/NFPA No. 302, and the American Boat and Yacht Council, Inc.
- 1.4 This test procedure does not cover ignition protection procedures for products or components that may operate in hydrogen and air mixtures.
- 1.5 This test procedure does not cover:
 - a) Mechanisms of ignition from external sources, such as static electricity, lightning, or other factors not related to the apparatus under test;
 - b) Apparatus based on the use of high voltage electrostatic principles;
 - c) The deterioration of external wiring; or
 - d) Connections installed in accordance with applicable installation standards.



- 1.6 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this Standard, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as required to maintain the level of safety as originally anticipated by the intent of this Standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this Standard is not judged to comply with this Standard. Where appropriate, revision of requirements are proposed and adopted in conformance with the methods employed for development, revision, and implementation of this Standard.

UL 1998 – Software in Programmable Components

- 1.1 These requirements apply to non-networked embedded microprocessor software whose failure is capable of resulting in a risk of fire, electric shock, or injury to persons.
- 1.2 This is a reference standard in which the requirements are to be applied when specifically referenced by other standards or product safety requirements.
- 1.3 These requirements address the risks unique to product hardware controlled by software in programmable components.
- 1.4 These requirements are intended to supplement applicable product or component standards and requirements, and are not intended to serve as the sole basis for investigating the risk of fire, electric shock, or injury to persons.
- 1.5 These requirements are intended to address risks that occur in the software or in the process used to develop and maintain the software, such as the following:
- a) Requirements conversion faults that cause differences between the specification for the programmable component and the software design;
 - b) Design faults such as incorrect software algorithms or interfaces;
 - c) Coding faults, including syntax, incorrect signs, endless loops, and other coding faults;
 - d) Timing faults that cause program execution to occur prematurely or late;
 - e) Microelectronic memory faults, such as memory failure, not enough memory, or memory overlap;
 - f) Induced faults caused by microelectronic hardware failure;
 - g) Latent, user, input/output, range, and other faults that are only detectable when a given state occurs; and
 - h) Failure of the programmable component to perform any function at all.
- 1.6 Product standard requirements may amend or supersede the requirements in this standard, as appropriate.

UL 2201 – Portable Engine-Generator Assemblies

- 1.1 These requirements address the electric shock, fire, and casualty aspects associated with the mechanical performance and the electrical features of portable engine-driven generator assemblies.
- 1.2 These requirements cover internal combustion engine-driven generators rated 15 kW or less, 250 V or less, which are provided only with receptacle outlets for the AC output circuits. The generators may incorporate alternating or direct current generator sections for supplying energy to battery charging circuits.
- 1.3 Generators covered by this standard are normally used by persons other than service personnel.
- 1.4 These requirements cover open ventilated generators having ventilating openings that permit the passage of external cooling air over or around the windings, or both.
- 1.5 These requirements cover generator components and combinations of such components.
- 1.6 These requirements do not cover generators for use in hazardous locations as defined in the National Electrical Code, NFPA 70.
- 1.7 These requirements do not cover generators for marine use. That equipment is covered by the Standard for Marine Electric Motors and Generators, UL 1112.
- 1.8 These requirements do not cover generators intended for installation in recreational vehicles. That equipment is covered by the Standard for Engine-Generator Assemblies for Use in Recreational Vehicles, UL 1248.
- 1.9 These requirements do not cover generators intended for stationary use. That equipment is covered by the Standard for Stationary Engine Generator Assemblies, UL 2200.
- 1.10 These requirements do not cover generator assemblies as part of welding and plasma cutting machines. That



- 1.11 These requirements cover products fueled by flammable and combustible liquids such as gasoline and diesel fuel, including gasoline with small amounts of additives such as detergents, solvents for detergents and anti-icing chemicals, and gasoline with up to 15% ethanol or methyl tertiary butyl ether (MTBE).

UL 2202 – Electric Vehicle (EV) Charging System Equipment

- 1.1 These requirements cover conductive charging system equipment intended to be supplied by a branch circuit of 600 volts or less for recharging the storage batteries in over-the-road electric vehicles (EV). The equipment includes off board and on board chargers. Off-board equipment may be considered for indoor use only or indoor/outdoor use. On board equipment is always considered outdoor use. Off board equipment is intended to be installed in accordance with the National Electrical Code, NFPA 70.

1.1 revised October 5, 2012

- 1.2 For the purposes of this standard, the term "electric vehicle", designated throughout by the initials "EV", is considered to cover electric vehicles, hybrid electric vehicles, and plug-in versions of these vehicles.
- 1.3 Electric vehicle charging system equipment that is not a complete assembly and depends upon installation in an end product for compliance with the requirements in this standard is investigated under the requirements of this standard and the standard for the end product. On board chargers that rely upon specific installation requirements within an EV for compliance with the requirements in this standard, are to be evaluated based on those installation requirements and equipment.

1.3 revised October 5, 2012

- 1.4 These requirements do not cover battery chargers covered by the Standard for Battery Chargers for Charging Engine-Starter Batteries, UL 1236, or the Standard for Industrial Battery Chargers, UL 1564.
- 1.5 The requirements for devices or systems intended to reduce the risk of electric shock to the user in grounded or isolated circuits for charging electric vehicles are covered in the Standard for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits; Part 1: General Requirements, UL 2231-1, and the Standard for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits; Part 2: Particular Requirements for Protective Devices for Use in Charging Systems, UL 2231-2.
- 1.6 The requirements in clauses 2 - 84 apply directly to off board charging equipment. Supplement SA applies directly to on board charging equipment.

1.6 added April 22, 2011

UL 2251 – Plugs, Receptacles, and Couplers for Electrical Vehicles

- 1.1 These requirements cover plugs, receptacles, vehicle inlets, vehicle connectors, and breakaway couplings, rated up to 800 amperes and up to 600 volts ac or dc, intended for conductive connection systems, for use with electric vehicles in accordance with National Electrical Code (NEC), ANSI/NFPA 70 for either indoor or outdoor nonhazardous locations.
- 1.2 This standard does not directly apply to the following:
- Devices produced integrally with flexible cord or cable that are covered by the Standard for Cord Sets and Power-Supply Cords, UL 817;
 - Devices solely intended for direct connection to the branch circuit in accordance with Articles 300, 400 and 410 of the NEC such as attachment plugs, cord connectors and receptacles, which can include 3 or more pilot contacts, that are covered by the Standard for Attachment Plugs and Receptacles, UL 498;
 - Single and multi-pole connectors, intended for connection to copper conductors, for use in data, signal, control and power applications within and between electrical equipment, where exposed, for use in accordance with the National Electrical Code, that are covered by the Standard for Attachment Plugs and Receptacles, UL 498;
 - Devices of the pin and sleeve type construction, intended to provide power from branch circuits to utilization equipment, or for direct connection of utilization equipment to the branch circuit, that are covered by the Standard for Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type, UL 1682;
 - Devices intended for use in hazardous locations that are covered by the Standard for Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations, UL 1010;
 - Devices consisting of wiring terminals and supporting blocks intended for the connection of wiring that are



- g) Devices such as modular jacks and plugs that are intended for use with telecommunications networks, that are covered by the Standard for Telephone Equipment, UL 1459, and the Standard for Communications Circuit Accessories, UL 1863;
- h) Devices such as wire connectors and soldering lugs, that are covered by the Standards for Wire Connectors, UL 486A-486B; Splicing Wire Connectors, UL 486C; or Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E;
- i) Devices such as quick-connect terminals that are covered by the Standard for Electrical Quick-Connect Terminals, UL 310;
- j) Products such as power outlet assemblies that are covered by the Standard for Power Outlets, UL 231;
- k) Products such as switched interlocks that are covered by the Standard for Industrial Control Equipment, UL 508.

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.

UL 2231-1 - Personal Protection Systems for Electric Vehicle (EV) Supply Circuits: General Requirements

- 1.1 These requirements cover devices and systems intended for use in accordance with Annex a, Ref. No. 1, to reduce the risk of electric shock to the user from accessible parts, in grounded or isolated circuits for charging electric vehicles. These circuits are external to or on board the vehicle.
- 1.2 The devices and systems covered by these requirements are compatible with the designs of charging systems and vehicles where use is intended and are rated accordingly. To assure compatibility, the charging system, the vehicle, or both, are in accordance with the features contained in 1.3 - 1.5.
- 1.3 The type of vehicle covered by these requirements, including all accessible conductive parts on the vehicle, has one or more of the following:
 - a) Provision for the connection of an equipment grounding conductor during battery charging, unless the vehicle has a system of reinforced or double insulation or all of the circuitry on the vehicle is electrically isolated from the supply circuit,
 - b) Provision for the connection of ground-monitoring conductors, where required,
 - c) Reinforced insulation, or is double-insulated from the supply circuit, or
 - d) No direct connection between current-carrying conductors and the vehicle chassis.
- 1.4 These requirements cover devices and systems where the grounding path impedance of the charging system to the vehicle is less than or equal to the impedance of the ungrounded conductor or conductors.
- 1.5 These requirements cover devices and systems where a continuous current less than 70mA RMS is available from any accessible part of the charging system.
- 1.6 Devices covered by these requirements are intended to interrupt the electric circuit to the load when:
 - a) A fault current to ground exceeds some predetermined value that is less than that required to operate the overcurrent protective device of the supply circuit,
 - b) The grounding path becomes open-circuited or becomes an excessively high impedance, or
 - c) A path to ground is detected on an isolated (ungrounded) system.
- 1.7 These devices and systems are intended to be applied on electrical systems or include derived systems that are:
 - a) Either end-grounded or centrally grounded when the operating voltage is 150 Vrms or less,
 - b) Centrally grounded when the operating voltage is greater than 150 Vrms, or
 - c) Isolated (ungrounded).
- 1.8 Charging circuit-interrupting devices covered by these requirements are investigated for their ability to provide protection based on:
 - a) The type of current (60 Hz AC, DC, a combination of AC and DC, or AC at frequencies greater than 60 Hz) present in the circuit to be protected, and
 - b) Voltage.

- 1.9 In Mexico and the US, these requirements do not cover ground-fault circuit-interrupters (GFCIs) intended for use as personnel protection in accordance with the national electrical codes on grounded 120 Vrms or 127 Vrms to ground, 60 Hz circuits. Such devices are covered under Annex a, Ref. No. 2. In Canada, these requirements do not cover ground-fault circuit-interrupters (GFCIs) in accordance with the national electrical code on grounded 120 Vrms or 127 Vrms to ground, 60 Hz circuits. Such devices are covered under Annex a, Ref. No. 2.
- 1.10 This Standard includes the Scope, Definitions, and Description of Requirements, including the required features of protection systems. The standards in Annex a, Ref. No. 3 contain the Performance and Construction requirements for protective devices that would become a part of a charging system

UL 2231-2 – Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: Particular Requirements for Protection Devices for Use in Charging Systems

- 1.1 This Standard is intended to be read together with Annex a, Ref. No. 1. The requirements of Annex a, Ref. No. 1 apply unless modified by this Standard.

UL 2594 – Electric Vehicle Supply Equipment

- 1.1 This outline covers electric vehicle (EV) supply equipment, rated a maximum of 250 V ac, with a frequency of 60 Hz, and intended to provide power to an electric vehicle with an on-board charging unit. This outline covers electric vehicle supply equipment intended for use where ventilation is not required.
- 1.2 With reference to 1.1, the products covered by this outline include:
- a) Portable EV Cord Sets - Rated 125 VAC maximum, 20 A maximum, cord connected, intended for indoor and outdoor use;
 - a) Stationary EV Cord Sets - Rated 125 VAC maximum, 20 A maximum, cord connected, intended for indoor and outdoor use;
 - c) Stationary EV Cord Sets - Rated more than 125 VAC, cord connected, intended for indoor use only;
 - d) Movable EV Charge Stations - Rated 125 VAC maximum, cord connected, intended for indoor or outdoor use;
 - e) Movable EV Charge Stations - Rated more than 125 VAC, cord connected, intended for indoor use only;
 - f) Permanent EV Charge Station - Rated 250 VAC maximum, permanently connected, intended for indoor or outdoor use; or
 - g) Permanent EV Power Outlet - Rated 250 VAC maximum, permanently connected, intended for indoor or outdoor use.

EV Power Outlets in item (g) are intended to provide a receptacle where one did not previously exist and are intended to be connected to the vehicle by use of an EV Cord Set from item (a). Therefore, the output of the EV Power Outlet should not exceed 125 VAC, 20 A maximum.

- 1.3 The products covered by this outline are intended for use in accordance with the National Electrical Code (NEC), ANSI/NFPA 70.
- 1.4 This outline does not cover cord sets or power supply cords for applications other than EV charging cord sets. Cord sets and power supply cords are covered by the Standard for Cord Sets and Power Supply Cords, UL 817. EV Cables are covered by the Standard for Flexible Cords and Cables, UL 62, and the Reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581.
- 1.5 With reference to 1.2, this outline does not cover electric vehicle charging units. EV Charging Units are covered by the Standard for Electric Vehicle (EV) Charging System Equipment, UL 2202.
- 1.6 This outline does not cover electric vehicle connectors, which are covered by the Standard for Plugs, Receptacles, and Couplers for Electric Vehicles, UL 2251.
- 1.7 This outline does not cover regular use power outlets, which are covered by the Standard for Power Outlets, UL 231.