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Battery Chargers

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Battery Chargers

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Preface

This is the second edition of CSA Standard C22.2 No. 107.2, *Battery Chargers*. It supersedes the first edition, published in 1989. It is one of a series of Standards issued by the Canadian Standards Association under Part II of the *Canadian Electrical Code.*

This Standard incorporates and updates the requirements for household, commercial, and industrial battery chargers given in the first edition. This Standard also includes requirements for marine battery chargers and battery chargers for special applications, and requirements for transformerless nonisolated battery chargers for charging special-purpose battery packs.

For general information on the Standards of the Committee on CE Code, Part II, see the preface of CSA Standard CAN/CSA-C22.2 No. 0.

This Standard was prepared by the Subcommittee on C22.2 No. 107.2 under the jurisdiction of the Technical Committee on Industrial Products and the Strategic Resource Group, and has been formally approved by the Technical Committee. It will be submitted to the Standards Council of Canada for approval as a National Standard of Canada.

Interpretations: The Strategic Resource Group has provided the following direction for the interpretation of standards under its jurisdiction: "The literal text shall be used in judging compliance of products with the safety requirements of this Standard. When the literal text cannot be applied to the product, such as for new materials or construction, and when a relevant committee interpretation has not already been published, CSA's procedures for interpretation shall be followed to determine the intended safety principle."

November 2001

Notes:

(1) *Use of the singular does not exclude the plural (and vice versa) when the sense allows.*

(2) *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.*

(3) *This publication was developed by consensus, which is defined by* CSA Policy governing standardization — Code of good practice for standardization *as "substantial agreement. Consensus implies much more than a simple majority, but not necessarily unanimity". It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all clauses of this publication.*

(4) *CSA Standards are subject to periodic review, and suggestions for their improvement will be referred to the appropriate committee.*

(5) *All enquiries regarding this Standard, including requests for interpretation, should be addressed to Canadian Standards Association, 178 Rexdale Boulevard, Toronto, Ontario, Canada M9W 1R3.*

Requests for interpretation should

(a) define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;

(b) provide an explanation of circumstances surrounding the actual field condition; and

(c) be phrased where possible to permit a specific "yes" or "no" answer.

Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization *and are published in CSA's periodical* Info Update. *For subscription details, write to CSA Sales Promotion,* Info Update, *at the address given above.*

Foreword

The Canadian Standards Association (CSA) develops standards under the name Canadian Standards Association, and provides certification and testing under the name CSA International. CSA International provides certification services for manufacturers who, under license from CSA, wish to use the appropriate registered CSA Marks on certain products of their manufacture to indicate conformity with CSA Standards.

CSA Certification for a number of products is provided in the interest of maintaining agreed-upon standards of quality, performance, interchangeability and/or safety, as appropriate. Where applicable, certification may form the basis for acceptance by inspection authorities responsible for enforcement of regulations. Where feasible, programs will be developed for additional products for which certification is desired by producers, consumers, or other interests. In performing its functions in accordance with its objectives, CSA does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of the Association represent its professional judgement given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed.

Products in substantial accord with this Standard but which exhibit a minor difference or a new feature may be deemed to meet the Standard providing the feature or difference is found acceptable utilizing appropriate CSA International Operating Procedures. Products that comply with this Standard shall not be certified if they are found to have additional features which are inconsistent with the intent of this Standard. Products shall not be certifiable if they are discovered to contravene applicable laws or regulations.

Testing techniques, test procedures, and instrumentation frequently must be prescribed by CSA International in addition to the technical requirements contained in Standards of CSA. In addition to markings specified in the Standard, CSA International may require special cautions, markings, and instructions that are not specified by the Standard.

Some tests required by CSA Standards may be inherently hazardous. The Association neither assumes nor accepts any responsibility for any injury or damage that may occur during or as the result of tests, wherever performed, whether performed in whole or in part by the manufacturer or the Association, and whether or not any equipment, facility, or personnel for or in connection with the test is furnished by the manufacturer or the Association.

Manufacturers should note that, in the event of the failure of CSA International to resolve an issue arising from the interpretation of requirements, there is an appeal procedure: the complainant should submit the matter, in writing, to the Secretary of the Canadian Standards Association.

If this Standard is to be used in obtaining CSA Certification please remember, when making application for certification, to request all current Amendments, Bulletins, Notices, and Technical Information Letters that may be applicable and for which there may be a nominal charge. For such information or for further information concerning CSA Certification, please address your inquiry to Applications and Customer Service, CSA International, 178 Rexdale Boulevard, Toronto, Ontario, Canada M9W 1R3.

C22.2 No. 107.2-01
Battery Chargers

1. Scope

1.1
This Standard applies to battery chargers for use on nominal system voltages not exceeding 600 V intended for household, commercial, or industrial use in accordance with the rules of the *Canadian Electrical Code, Part I.*

1.2
This Standard applies to
(a) portable, mobile, and stationary battery chargers for indoor and outdoor use;
(b) fixed battery chargers for indoor use;
(c) battery chargers for special applications such as wheelchairs and other medical applications, as covered in Clause 7;
(d) marine battery chargers intended to be permanently installed on a boat, as covered in Clause 8; and
(e) transformerless nonisolated battery chargers for charging special-purpose battery packs, as covered in Clause 9.

1.3
This Standard does not apply to
(a) battery chargers that are not a complete assembly and that depend on installation in an end product to comply with the requirements of this Standard;
(b) direct plug-in battery chargers or cord-connected battery chargers having an extra-low-voltage (ELV) Class 2 output, as covered by CSA Standard CAN/CSA-C22.2 No. 223; and
(c) battery chargers for use
    (i) with an internal combustion engine driving a centrifugal pump;
    (ii) in a marina, boatyard, or other marine applications other than those intended for permanent installation on a boat; or
    (iii) in a fire-protection signalling system.

2. Definitions and Reference Publications

2.1 Definitions
The following definitions apply in this Standard:

Automotive charger — a battery charger used to charge batteries in automobiles, trucks, and other vehicles; it includes battery chargers for use in homes and commercial garages.

Commercial charger — a battery charger other than a household or industrial type (eg, an automotive charger used in a gas station).

External-ignition protection — the design and construction of a device is such that, under design operating conditions,
(a) it will not ignite a flammable hydrocarbon mixture* surrounding the device when an ignition source causes an internal explosion;
(b) it is incapable of releasing sufficient electrical or thermal energy to ignite a hydrocarbon mixture; or

(c) the source of ignition is hermetically sealed.

**A flammable hydrocarbon mixture is a mixture of gasoline and air or propane and air between the lower explosive limit (LEL) and the upper explosive limit (UEL).*

Notes:

(1) *It is not the intention of this Standard to require such devices to be "explosion-proof" as that term is defined in the* Canadian Electrical Code, Part I*, pertaining to shore systems. It is intended that the protection provided be generally equivalent to that of wiring permitted by this Standard wherein a definite short or break would be necessary to produce an open spark.*

(2) *Nonincendive equipment complying with CSA Standard CAN/CSA-C22.2 No. 157 is considered to be in compliance with this Standard.*

Fixed battery charger — a battery charger that is intended to be permanently connected to the supply circuit.

Fully automatic battery charger — a battery charger in which the output current is proportional to the state of battery charge and system load, with automatic compensation for input voltage variations.

Household automotive charger — a battery charger having an output rating of not more than 10 A, normally used to charge automotive batteries in residential applications.

Industrial charger — a battery charger intended to charge batteries of industrial trucks, golf carts, personnel carriers, and similar motive equipment.

Mobile battery charger — a cord-connected, commercial, or industrial battery charger with wheels and/or casters for moving from place to place.

Nonautomotive charger — a charger intended to be used to charge nickel-cadmium, sealed lead-acid, or gel-cell type batteries, where the current output is in excess of that required by CSA Standard CAN/CSA-C22.2 No. 223, and to charge battery packs used for household appliances, portable tools, and similar appliances.

Operational maintenance — maintenance performed by persons other than those trained to maintain and service the equipment. It includes such things as inspection, marking records, and altering control settings. It does not include maintenance that is normally performed by a qualified service provider who is familiar with the construction and operation of the apparatus and the hazards involved (eg, cleaning slide wires, locating causes of faulty performance, and replacing parts).

Output ratings (automotive chargers) —

Boost charging output rating — a rating that applies only to chargers capable of providing a high-current output for a short time to quick-charge a battery.

Cranking assist output rating — a rating that applies only to chargers capable of providing a high-current output for a short time to supplement the battery output current in order to assist in starting an automotive engine.

Maximum continuous output current rating — a rating signifying the maximum output current that the charger is intended to provide continuously.

Portable battery charger — a cord-connected battery charger designed to be hand-carried from place to place.

Semi-automatic battery charger — a battery charger in which the output current is proportional to the state of battery charge and system load, with the input voltage manually adjusted.

Shock hazard — any condition that would permit a voltage greater than 42.4 V peak to appear at accessible output connections of a battery charger, or the failure of a battery charger to meet
(a) the dielectric strength test requirements of Clause 6.7;
(b) the leakage current test requirements of Clause 6.5; or
(c) the abnormal test requirements of Clauses 6.8 and 6.9.

Stationary battery charger — a cord-connected battery charger intended to be fastened in place or located in a dedicated place.

Tool — a screwdriver, wrench, key, or any other object that may be used to operate a screw, latch, lock, or similar means of fastening.

2.2 Reference Publications

This Standard refers to the following publications and where such reference is made it shall be to the edition listed below, including all amendments published thereto.

CSA Standards

C22.1-02,
Canadian Electrical Code, Part I;

CAN/CSA-C22.2 No. 0-M91 (R1997),
General Requirements — Canadian Electrical Code, Part II;

C22.2 No. 0.4-M1982 (R1999),
Bonding and Grounding of Electrical Equipment (Protective Grounding);

CAN/CSA-C22.2 No. 0.17-00,
Evaluation of Properties of Polymeric Materials;

C22.2 No. 8-M1986 (R1999),
Electromagnetic Interference (EMI) Filters;

C22.2 No. 14-95 (R2000),
Industrial Control Equipment;

C22.2 No. 42-99,
General Use Receptacles, Attachment Plugs, and Similar Wiring Devices;

C22.2 No. 55-M1986 (R1999),
Special Use Switches;

C22.2 No. 66-1988 (R1997),
Specialty Transformers;

C22.2 No. 77-95 (R1999),
Motors with Inherent Overheating Protection;

CAN/CSA-C22.2 No. 94-M91 (R1997),
Special Purpose Enclosures;

C22.2 No. 100-95 (R2000),
Motors and Generators;

C22.2 No. 111-00,
General-Use Snap Switches;

CAN/CSA-C22.2 No. 157-92 (R1997),
Intrinsically Safe and Non-incendive Equipment for Use in Hazardous Locations;

C22.2 No. 183.1-M1982 (R1999),
Alternating-Current (AC) Electrical Installations on Boats;

CAN/CSA-C22.2 No. 223-M91 (R1999),
Power Supplies with Extra-Low-Voltage Class 2 Outputs;

CAN3-C235-83 (R2000),
Preferred Voltage Levels for AC Systems, 0 *to* 50 000 V.

ASTM* Standard
E 28-99,
Standard Test Methods for Softening Point of Resins Derived from Naval Stores by Ring-and-Ball Apparatus.

**American Society for Testing and Materials.*

3. General Requirements
General requirements applicable to this Standard are given in CSA Standard CAN/CSA-C22.2 No. 0.

4. Construction

4.1 General

4.1.1
Except as permitted in Clauses 4.1.2 to 4.1.4, electrical components of a battery charger shall be suitable for the intended application and shall
(a) be approved; or
(b) comply with those requirements of the particular CSA Standard applying to such components.

4.1.2
A component not complying with an applicable Standard may be acceptable as a component part for a particular charger, provided that it has been investigated with respect to the potential hazard involved in the application.

4.1.3
Where components are connected only in limited energy circuits that are not safety circuits, and where failure of the component does not result in a shock or fire hazard, investigation may not be required.

4.1.4
Components that are surface-mounted on a printed wiring board shall be acceptable, provided that investigation shows that no shock or fire hazard is involved.

4.2 Enclosures

4.2.1 General

4.2.1.1
Battery chargers shall have enclosures that are suitable for the application and that enclose all live parts except input leads and output leads or terminals.

4.2.1.2
Enclosures for battery chargers shall be formed and assembled so that they will have the strength and rigidity necessary to resist the abuse to which they may be subjected, without increasing their fire and accident hazards due to partial collapse and without reduction of spacings, loosening or displacement of parts, or other serious defects.

4.2.1.3
If an electrical instrument, such as a meter, forms part of the enclosure, the face or the back of the instrument housing, or both together, shall comply with the requirements for an enclosure.

4.2.1.4
Clause 4.2.1.3 shall not apply to instruments connected in secondary circuits if damage to or deterioration of the materials of which the housing is made will not result in a risk of fire or electric shock.

4.2.1.5
The enclosure of a battery charger intended to be permanently mounted under the hood of an automobile shall comply with the water test specified in Clause 6.20.

4.2.1.6
For applications where a battery charger may be subjected to the action of oil, acid fumes, moisture, dust, or other injurious materials in normal operation, the protection afforded the enclosed components shall be subject to investigation.

4.2.1.7
Iron or steel parts shall be protected against rusting, as required by CSA Standard CAN/CSA-C22.2 No. 0.

4.2.2 Thickness of Enclosures

4.2.2.1
Except as specified in Clauses 4.2.2.2 and 4.2.2.3, the thickness of sheet metal for enclosures shall be not less than that specified in Tables 1 and 2.

4.2.2.2
At points to which a wiring system is to be connected, uncoated steel shall be at least 0.78 mm thick and zinc-coated steel at least 0.88 mm thick.

4.2.2.3
The thickness of sheet metal for enclosures at points other than where a wiring system is to be connected may be less than that specified in Tables 1 and 2, provided that the enclosure complies with the compression test specified in Clause 6.14 and the deflection test specified in Clause 6.15.

4.2.2.4
With reference to Tables 1 and 2, a supporting frame shall consist of a structure of angles, channels, or folded rigid sections of sheet metal that is rigidly attached to and has essentially the same outside dimensions as the enclosure surface, and that has sufficient torsional rigidity to resist the bending moments that may be applied by the enclosure surface when it is deflected. A structure that is as rigid as one built with a frame of angles or channels shall be considered to have equivalent reinforcement.

Constructions without a supporting frame shall be considered to include

(a) a single sheet with single formed flanges or formed edges;

(b) a single sheet that is corrugated or ribbed;
(c) an enclosure surface loosely attached to a frame (eg, with spring clips); and
(d) an enclosure surface having an unsupported edge.

4.2.3 Thickness of Cast Metal Enclosures for Live Parts

The minimum thickness of metal for cast enclosures shall comply with Table 3.

4.2.4 Polymeric Enclosures

4.2.4.1

Polymeric enclosures shall comply with the requirements of the impact test specified in Clause 6.17.1.

4.2.4.2

Polymeric enclosures shall be moulded from a compound having a flammability classification rating not less than V-1 in accordance with CSA Standard CAN/CSA-C22.2 No. 0.17 for the minimum thickness used in the enclosure or shall comply with the test requirements for the flame test specified in Clause 6.18.1.

4.2.4.3

Notwithstanding Clause 4.2.4.2, material either having a flammability classification not less than V-2 in accordance with CSA Standard CAN/CSA-C22.2 No. 0.17 or tested in accordance with the flame test specified in Clause 6.18.2 may be used if the components in the secondary circuit of a charger comply with the abnormal operation test specified in Clause 6.9.3.2.

4.2.5 Openings in Enclosures

4.2.5.1

The enclosure shall have no openings through which the articulated probe (see Figure 1) can be inserted so as to touch moving parts (eg, fan blades) or any uninsulated live parts (including film-coated wire) operating at a voltage of more than 42.4 V peak to any other part or to ground (see Clause 4.2.7.2).

4.2.5.2

The probe (see Figure 1) shall be inserted to any depth that the opening will permit, using an applied force of not greater than 4.4 N. The probe shall be rotated or angled before, during, and after insertion through the opening to any necessary position, using any possible configuration. If necessary, the configuration shall be changed after insertion through the opening.

4.2.5.3

Openings in the top of an enclosure that are directly over uninsulated live parts involving a risk of shock or energy hazard shall not exceed 5 mm in any dimension unless the construction is such that straight access to those uninsulated live parts is prevented. See Figure 2 for examples of top cover designs that prevent straight access. This requirement shall not apply to a battery charger over 1.8 m high.

4.2.5.4

Openings in the vertical sides of an enclosure for 120 V cord-connected battery chargers rated 1500 W and less shall
(a) not exceed 5 mm in any dimension;
(b) not exceed 1 mm in width, regardless of length;
(c) be provided with louvres that are shaped to deflect outwards an external vertically falling object (see Figure 3 for examples); and
(d) be so located that an object, upon entering the enclosure, is unlikely to fall on uninsulated live parts, resulting in a shock or energy hazard (see Figure 4).

4.2.5.5
A battery charger having an enclosure with openings that are located directly beneath live parts shall
(a) be provided with a barrier or bottom panel complying with Clause 4.2.5.7 located beneath such live parts so as to prevent molten or flaming particles from falling on the surface on or over which the battery charger is mounted; or
(b) be marked as specified in Clause 5.16, if intended for floor mounting.

4.2.5.6
If a portion of a vertical side panel falls within the area D of the required bottom enclosure as traced out by the 5° angle in Figure 5, that portion of the vertical panel shall be evaluated as a bottom enclosure.

4.2.5.7
If a barrier is provided to comply with Clause 4.2.5.5, the barrier shall
(a) be made of metal or nonmetallic material complying with the flame test specified in Clause 6.18;
(b) not contain perforations or openings except as specified in Items (d) and (e);
(c) be so located and be of such extent as to conform to Figure 5 and the legend appended thereto;
(d) have one of the following constructions, if made of perforated metal:
(i) a metal screen, or the equivalent, that has a mesh* not greater than 2 × 2 mm (14 × 14 mesh per inch) and wire with a minimum diameter of 0.46 mm;
(ii) a panel in accordance with Table 4; or
(iii) a perforated metal panel that complies with the flaming oil test specified in Clause 6.23; and
(e) be permitted to have openings not larger than 6.4 mm^2 if the barrier is located under areas containing only materials classified at least V-1 in accordance with CSA Standard CAN/CSA-C22.2 No. 0.17. Openings that are not square may be provided if they do not have an area greater than 40 mm^2 (see also Clause 4.16.4).
**A mesh or screen described in Clause 4.2.5.7(d)(i) is not intended to be used to form the side of an enclosure.*

4.2.5.8
The diameter of the wires of a metal screen used for other than the bottom of an enclosure shall be not less than
(a) 1.2 mm when the screen openings are 320 mm^2 or less in area; and
(b) 2 mm for larger screen openings.

4.2.5.9
Sheet metal employed for expanded metal mesh and perforated sheet metal used for other than the bottom of an enclosure shall have an uncoated thickness of not less than
(a) 1.2 mm if the mesh openings or perforations are 320 mm^2 or less in area; and
(b) 2 mm for larger openings.

4.2.5.10
Glass that covers openings shall
(a) be reliably secured in place so that the glass cannot be readily displaced;
(b) provide mechanical protection for the enclosed parts; and
(c) comply with the impact test specified in Clause 6.17.2.

4.2.5.11
Material other than glass that is employed as the only covering over an opening that forms part of the enclosure and is relied upon to prevent contact with bare live parts shall be of adequate mechanical strength and shall comply with the requirements of the flame test specified in Clause 6.18 and the impact test specified in Clause 6.17.2.

4.2.5.12
Components that have a flammability classification of at least HB, and that form part of the enclosure, need not comply with Clause 4.2.4.2 under any one of the following conditions:
(a) The component covers an opening that has no dimension greater than 25 mm.
(b) The component covers an opening that has no dimension greater than 100 mm, and there is no source of fire hazard closer than 100 mm from the surface of the enclosure.
(c) There is a barrier or a device that forms a barrier having a flammability classification of at least V-0 between the component and a source of fire hazard.

4.2.6 Baffles for Industrial Chargers

4.2.6.1
The diameter of the wires of a steel screen used as a baffle for ventilating openings in an enclosure to prevent access to live parts shall be not less than 1.2 mm when the screen opening is 320 mm^2 or less in area, and shall be not less than 2 mm for larger openings.

4.2.6.2
Sheet steel employed for expanded metal mesh and perforated sheet steel used as baffles for ventilating openings shall be not less than 1.2 mm thick if the ventilating opening is 320 mm^2 or less in area, and shall be not less than 2 mm thick for larger openings. Sheet metal of other material shall provide mechanical strength equivalent to that of steel.

4.2.6.3
Wire screens, expanded metal mesh, and perforated metal baffles shall be securely fastened in place.

4.2.7 Doors, Covers, and Guards

4.2.7.1
If it is necessary to open a door to perform operational maintenance, the door shall be hinged or secured in an equivalent manner, and all parts that present a shock hazard shall be located or guarded so that the operator is protected from accidental contact while performing such maintenance. Any barriers or guards that are provided to comply with this requirement shall be secured in place so that the use of a tool or other deliberate action is required for their removal.

4.2.7.2
Enclosures and parts of enclosures, such as doors and covers, shall be provided with the means to secure them firmly in place. If bare live parts that may cause electric shock are exposed by the opening of such doors or covers, as determined by the use of the articulated probe (see Figure 1), a means requiring the use of a tool shall be provided to hold such doors or covers closed.

4.2.7.3
When a hinged door is required by Clause 4.2.7.1, it shall be provided with a catch or spring latch.

4.2.8 Enclosures for Outdoor Use or Wet Locations
Enclosures for equipment used in other than clean, dry, indoor locations shall comply with the requirements for Enclosure 3 or Enclosure 4 given in CSA Standard CAN/CSA-C22.2 No. 94. If a supplementary housing is added to make the equipment suitable for outdoor use, the effect on the temperature rise shall be investigated.

4.3 Mechanical Assembly

4.3.1
An uninsulated live part shall be secured to the base or surface so that it will be prevented from rotating or shifting in position as the result of normal stresses if such movement might result in a reduction of spacings below the minimum acceptable values. (See Clause 4.17.)

4.3.2
Electrical components such as switches that are subjected to turning moments in normal operation or servicing shall be fastened securely and prevented from turning by means other than friction between surfaces if turning could result in the reduction of the spacings specified in Clause 4.17 or in a contravention of other requirements of the Standard. A lockwasher shall not be considered acceptable for devices that require turning moments for their operation.

4.4 Supply Connections

4.4.1 Fixed Battery Chargers

4.4.1.1
Fixed battery chargers shall have provision for the connection of armoured cable or conduit to the source of supply, as required by CSA Standard CAN/CSA-C22.2 No. 0.

4.4.1.2
If a terminal or connection box is used instead of fastening the armoured cable or conduit in the wall of the enclosure, it shall comply with the requirements of CSA Standard CAN/CSA-C22.2 No. 0.
Note: *Terminal boxes may be either built into a device enclosure or attached to it externally.*

4.4.1.3
If leads are provided instead of terminals for connection to supply circuit conductors, they shall be of approved wire, no smaller than No. 18 AWG, and at least 152 mm long.

4.4.2 Cord-Connected Chargers

4.4.2.1
The input cord for all types of chargers shall be not less than 1.8 m long when measured from the face of the attachment plug to the plane of the cord-entry hole in the charger, except that
(a) a charger intended for mounting in a fixed location may have a shorter cord length; and
(b) a nonautomotive charger with a mass of 455 g or less shall be acceptable if the total combined length of the input and output cords is 1.8 m or more and the length of the input cord is at least 1 m.

4.4.2.2
The current and voltage rating of a flexible cord and attachment plug shall be not less than the rating of the charger, except that
(a) for a charger intended for industrial use where the charger load is continuous for 3 h or more, the ampacity of the attachment plug shall be not less than 125% of the input rating;
(b) other chargers having a rating more than 15 A that are intended to be continuously loaded for 3 h or more shall meet the requirements of Item (a); and
(c) the ampacity of the flexible cord and attachment plug cap for a battery charger having an engine-cranking or boost rating and marked with a duty cycle shall be calculated by using the following equation:

$$I = \sqrt{I_1^2\, d + I_2^2\, (1 - d)}$$

where
I = the ampacity of the cord as given in the *Canadian Electrical Code, Part I*
I_1 = the input engine-cranking or boost current in amperes
I_2 = the input current in amperes measured while maximum continuous-duty output current is being delivered
d = the rated duty cycle expressed as a fraction of the total time

4.4.2.3
For a charger rated 125 or 125/250 V (3-wire) or less, the screwshell of an Edison screwshell lampholder, if used, shall be electrically connected to the identified circuit conductor intended to be grounded. A switch or overcurrent-protective device of the single-pole type, other than an automatic control without a marked OFF position, shall be connected to the ungrounded circuit conductor.

4.4.2.4
The type of supply cord shall be as follows:
(a) for nonautomotive chargers: Type SPT-2 or equivalent;
(b) for household, automotive, and battery chargers intended to be permanently mounted under the hood of an automobile: Type SJTW or SJOW, or equivalent;
(c) for commercial chargers
  (i) for use where oil is a consideration: Type SJT or SJO, or equivalent; and
  (ii) for use where oil is not a consideration: Type SJ or equivalent; and
(d) for industrial chargers
  (i) for use where oil is a consideration: Type SO or ST, or equivalent; and
  (ii) for use where oil is not a consideration: Type S or SPT3, or equivalent.

4.5 Terminal Parts and Leads

4.5.1
Terminal parts and the identification of terminal parts and leads shall comply with the requirements of CSA Standard CAN/CSA-C22.2 No. 0.

4.5.2
Screwshells of lampholders shall be connected to the identified conductors.

4.5.3
Fixed wiring terminals shall be prevented from turning.

4.5.4
If a screw and washer construction is used at a wiring terminal, the screw shall be not smaller than No. 10, except that a No. 8 screw may be used at a terminal intended only for the connection of one No. 14 AWG conductor, and a No. 6 screw may be used for the connection of one No. 16 or No. 18 AWG conductor.

4.6 Current-Carrying Parts

4.6.1
Current-carrying parts shall have adequate mechanical strength and ampacity for the service, and shall be of metal that is suitable for the particular application.

4.6.2
Bare live parts (including conductors) shall be secured to their bases or mounting surfaces so that they will be prevented from turning or shifting so as to reduce the spacings required by Clause 4.17. Friction between surfaces shall not be an acceptable means of preventing the turning of live parts, but a suitable lockwasher shall be acceptable, if properly applied.

4.6.3
The security of contact assemblies shall be such as to ensure the continued alignment of contacts.

4.7 Internal Wiring

4.7.1
The space within enclosures of equipment shall be sufficient to provide ample room for the distribution of wires and cables required for the proper wiring of the equipment.

4.7.2
The wire connections and wires between parts of equipment shall be adequately protected or enclosed. (See also CSA Standard CAN/CSA-C22.2 No. 0.)

4.7.3
Wireways shall be smooth and entirely free from sharp edges, burrs, etc.

4.7.4
Cords and insulated conductors, either single, bunched, or cabled, when passing through openings in sheet metal walls, shall be effectively protected by suitable bushings or well-rounded surfaces against which the cords or conductors may bear.

4.7.5
Rubber-insulated conductors, except those with oil-resistant compounds, shall not be used where they may be exposed to oil, grease, oily vapour, or other substances having a deleterious effect on rubber.

4.7.6
The internal wiring of equipment shall consist of suitably insulated conductors having adequate ampacity, voltage rating, and temperature for the service.

4.7.7
Extra-low-voltage wiring may be cabled together with, or run in the same wireway as, wiring of low-voltage circuits, provided that all the wiring has insulation suitable for use at the highest voltage.

4.7.8
Bare conductors shall be so supported that adequate spacings are maintained as required by Clause 4.17.

4.7.9
Joints in conductors and connectors shall have good and permanent contact, and the insulation therein shall comply with the requirements of CSA Standard CAN/CSA-C22.2 No. 0, unless they are held so securely and rigidly that the spacings required by Clause 4.17 will not be decreased.

4.8 Electrical Insulation

4.8.1

Insulating material shall be judged with respect to its acceptability for the application. Materials such as mica, ceramic, and some moulded compounds are usually acceptable for the sole support of live parts. If an investigation is necessary to determine whether a material is acceptable, consideration shall be given to

(a) its mechanical strength, resistance to ignition, dielectric strength, insulation resistance, and heat-resistance qualities in both the aged and unaged conditions;

(b) the degree to which it is enclosed; and

(c) any other feature affecting the risk of fire, electric shock, or injury to persons.

All factors shall be considered with respect to conditions of service.

4.8.2

Insulating material in contact with or likely to contact bare live parts shall

(a) be a material having a flammability classification of not less than V-2 in accordance with CSA Standard CAN/CSA-C22.2 No. 0.17 or meet the requirements of the flame test specified in Clause 6.18.2;

(b) have adequate mechanical and electrical strength for the application;

(c) be unlikely to deteriorate unduly due to its operating temperature under normal and abnormal test conditions (see Clauses 6.6 and 6.9); and

(d) comply with the test specified in Clause 6.22.

4.9 Transformers

4.9.1

Transformers shall comply with the requirements of CSA Standard C22.2 No. 66, so far as they apply.

4.9.2

A transformer shall have its primary winding electrically isolated from its secondary winding and shall be constructed so that no electrical connection can result, under both normal and overload conditions, between

(a) the primary and secondary windings;

(b) the primary winding and the core; or

(c) separate adjacent secondary windings, if such a connection might result in a risk of fire or electric shock.

4.10 Motors (Fans)

4.10.1

Fan motors shall be suitable for their particular application.

4.10.2

Fan motors shall comply with the requirements of CSA Standard C22.2 No. 100, so far as they apply.

4.10.3

Fan motors, other than those connected in secondary circuits that operate at extra-low-voltage and are supplied by Class 2 circuits, shall be provided with either of the following:

(a) inherent overheating protection complying with the requirements of CSA Standard C22.2 No. 77; or

(b) overload protection rated or set at not more than 125% of the motor's current rating.

4.11 Capacitors

4.11.1
Materials used in, and the construction of, capacitors shall be such that there will be no undue fire hazard.

4.11.2
Capacitors shall not be affected injuriously by the temperatures attained by the device under the most severe conditions of normal use.

4.11.3
Paper capacitors shall be impregnated or otherwise enclosed to exclude moisture.

4.11.4
Electrolytic or other special types of capacitors and capacitors intended for connection directly across the line shall be made the subject of investigation.

4.12 Suppressors

4.12.1
Suppressors used for suppressing radio interference shall comply with the requirements of CSA Standard C22.2 No. 8.

4.12.2
Suppressors shall be enclosed in suitable housings of noncombustible, moisture-absorption-resistant material. If sheet steel is used, it shall not be thinner than 0.52 mm. Other kinds of metal or material shall provide equivalent protection.

4.12.3
The housing required by Clause 4.12.2 may be dispensed with if a suppressor is mounted in an enclosure that affords protection equivalent to that of the housing.

4.13 Fuses and Fuseholders

4.13.1
Except as permitted by Clause 4.13.2, a fuse that requires removal or replacement shall be in a readily accessible location.

4.13.2
Clause 4.13.1 shall not apply to a fuse that would ordinarily be unknown to the user because of its location and the omission of a reference to this fuse in the operating instructions, circuit diagrams, and other instructional material provided with the battery charger.

4.13.3
Except for extra-low-voltage circuits, fuseholders shall be of either the cartridge-enclosed or the plug fuse type.

4.13.4
Plug fuses shall not be used in circuits exceeding 150 V to ground.

4.13.5
Screwshells of plug-fuse fuseholders shall be connected to the load side of the circuit.

4.13.6
A fuse that is used for short-circuit protection of the output leads shall not be interchangeable with a fuse of a higher ampere rating.

4.13.7
A fuse, if provided, shall be mounted in a fuseholder of the proper type and rating.

4.13.8
Either a caution in accordance with Clause 5.13 shall be provided, or the design shall be such that bare live parts of a fuse or fuseholder that may be a shock hazard cannot be contacted by the probe shown in Figure 1 when the fuse is completely inserted or when the fuse is tilted at any angle during insertion or removal.
Note: *Accessibility is not to be considered with the fuse completely removed.*

4.13.9
A panel-mounted in-line fuseholder shall be wired such that the line end is connected to the terminal that is the least accessible from outside the enclosure.

4.13.10
A permanently mounted under-the-hood automotive charger that has output leads or a cord longer than 46 cm, in accordance with Clause 4.15.2.2, shall be provided with an in-line fuse and fuseholder assembly. The fuse shall be connected in the positive lead and shall be located within 46 cm from the terminal-connecting end of the leads. The type and rating of the fuse shall be marked in accordance with Clause 5.12.

4.14 Overload Relays and Protectors

4.14.1
Household automotive and nonautomotive chargers shall be provided with a manually or automatically reset protector or other overload protective device that complies with the requirements of the abnormal operation test specified in Clause 6.9.

4.14.2
Overload relays shall be so designed and connected as to ensure reliable and positive electrical and mechanical performance for their intended purpose under all conditions of operation.

4.14.3
Automatic tripping of overload relays shall be independent of manipulation of the handle.

4.14.4
If overload relays are adjustable, they shall be suitably marked, or directions for setting them shall be furnished with the battery charger.

4.14.5
A protective device of the manual-reset or automatic-reset type rated 6 V, 12 V, or 24 V dc shall
(a) comply with the applicable performance requirements of Clause 6.21, if rated 50 A or less; or
(b) be the subject of investigation, if rated more than 50 A.

4.15 Output Connections

4.15.1 Industrial Chargers

4.15.1.1
A connector for the output circuit shall have a voltage rating equal to the output rating of the charger and shall comply with the requirements of CSA Standard C22.2 No. 42, except that a connector shall
(a) have a nonstandard pin configuration; and
(b) be polarized.

4.15.1.2
Battery leads shall be attached to or provided with the product and shall be
(a) neoprene-insulated, or the equivalent;
(b) of a size and rating acceptable for the application;
(c) resistant to acid and alkalis; and
(d) capable of withstanding flexing, handling, and impact in the temperature range of –29 to +54°C.

The minimum average insulation thickness shall not be less than 1.52 mm for No. 8 to No. 2 AWG wire and 2.03 mm for No. 1 to No. 4/0 AWG wire.

4.15.2 Other Types of Chargers

4.15.2.1
A cord-connected battery charger shall be provided with
(a) an integral output cord or leads terminating in a battery connector (see Clause 4.15.2.5); or
(b) an integral output receptacle directly attached to the charger enclosure and a cord set, except that a nonautomotive battery charger having Class 2 output characteristics may employ terminals for output connections.

4.15.2.2
Except for special-application chargers, the output cord or leads required by Clause 4.15.2.1, whether permanently attached to the battery charger or provided as a separate cord set, as measured from the point of exit, shall be
(a) not less than 1.8 m long for chargers other than those specified in Items (b) to (d);
(b) not less than 3.7 m long for plug-in automotive chargers;
(c) not less than 0.6 m long for commercial nonautomotive chargers for which a shorter length of cord or leads is utilized to meet conditions of use; or
(d) not greater than 46 cm for battery chargers intended for permanent mounting under the hood of an automobile, unless overcurrent protection in accordance with Clause 4.13.10 is provided.

In addition, the manufacturer's instructions provided with a charger intended to charge other than sealed rechargeable cells shall specify that the batteries are to be placed as far away from the charger as the output leads will permit during charging.

4.15.2.3
The output wiring of a household automotive charger may be either
(a) a flexible cord equivalent to the power-supply cord; or
(b) individual conductors that comply with the requirements in Clause 4.15.2.8.

4.15.2.4
The output wiring of a nonautomotive charger may be parallel cord insulated with rubber, neoprene, or thermoplastic and shall have a wall thickness not less than 0.33 mm.

4.15.2.5
The output leads of a battery charger intended for permanent mounting under the hood of an automobile shall be of an approved, oil-resistant type having a temperature rating suitable for a temperature range of –35°C to +85°C, and shall terminate in closed-loop terminal connectors to facilitate permanent connections.

4.15.2.6
The output leads and connectors of a battery charger, other than a nonautomotive household type, shall be of adequate size and have insulation thick enough to withstand the mechanical abuses to which they are subjected. The insulation of the output connectors on a battery charger with an output voltage of 42.4 V peak or less shall be reliably secured and substantially cover the connector, except that the portion of a connector that attaches to battery terminals need not be covered. A battery charger having an output voltage greater than 42.4 V peak, designed for charging more than two automotive-type batteries connected in series, shall employ closed-loop lugs or the equivalent for connection to the battery terminals.

4.15.2.7
A spring clip shall not be considered to be equivalent to a closed-loop lug unless provided with an insulator that is reliably secured so that grounding or short-circuiting is not likely to result if the connector is displaced.

4.15.2.8
The wall thickness of the insulation on the leads shall not be less than
(a) for an automotive charger not exceeding 42.4 V output, 0.8 mm if thermoplastic, 1.2 mm if oil-resistant rubber or neoprene, or 1.6 mm if rubber or neoprene; and
(b) for an automotive charger exceeding 42.4 V output, 1.6 mm if thermoplastic or 2.0 mm if oil-resistant rubber or neoprene.

4.15.2.9
The wall thickness of insulation on a connector guard shall not be less than
(a) for an automotive charger not exceeding 42.4 V output, 0.8 mm if thermoplastic or 1.6 mm if rubber or neoprene; and
(b) for an automotive charger exceeding 42.4 V output, 1.6 mm if thermoplastic or 2.0 mm if rubber or neoprene.

4.15.2.10
A household nonautomotive charger shall have output connections supplied from the secondary of a Class 2 transformer or shall have an impedance in the secondary circuit to provide Class 2 characteristics at the output connections, except where an interlock switch is provided within the charger enclosure to de-energize accessible live parts such as battery terminals or clips, or an output cord is provided and terminated by means of an insulated connector having recessed live parts.

4.15.2.11
A metal enclosure of a battery charger shall not be connected to an electrical circuit of the charger.

4.16 Printed Wiring Boards

4.16.1
Except as specified in Clauses 4.16.2, 4.16.4, and 4.16.5, printed wiring boards, including those with conformal coatings, shall be equivalent to Class V-2, as determined by the test specified in CSA Standard CAN/CSA-C22.2 No. 0.17.

4.16.2
The requirements of Clause 4.16.1 shall not apply to a printed wiring board that only contains components in Class 2 circuits.

4.16.3
Printed wiring boards involving primary circuits, or those located in secondary circuits where failure of the bond between the conductor and the base material could result in contact with uninsulated primary circuit parts, shall be investigated to determine if they are acceptable for the application.

4.16.4
Printed circuit boards used in enclosures that have openings in accordance with the requirements of Clause 4.2.5.7(e) shall have a flammability classification of at least V-1 in accordance with CSA Standard CAN/CSA-C22.2 No. 0.17.

4.16.5
Electronic components in the primary circuit, such as IC packages, transistor packages, and capacitors, shall be exempt from the Class V-2 flammability requirement of Clause 4.16.1 if they are mounted on material of at least flammability Class V-1.

4.17 Spacings

4.17.1
Spacings for battery chargers, except for household indoor types, shall be as specified in Table 5.
Spacings for household cord-connected or plug-in chargers shall be as specified in Table 6.
The spacings in a Class 2 secondary circuit that is not a shock hazard are not specified.

4.17.2
Except as provided for in Clauses 4.17.3 and 4.17.4, an insulating liner or barrier of material such as vulcanized fibre or thermoplastic employed in lieu of required spacings shall not be less than 0.71 mm thick and shall be so located or of such material that it will not be adversely affected by arcing.

4.17.3
Vulcanized fibre not less than 0.33 mm thick or mica not less than 0.165 mm thick may be used
(a) in conjunction with an air spacing of not less than 50% of the minimum acceptable through-air spacing;
(b) in a single-plate rectifier element of an isolated secondary circuit rated 50 V rms or less; and
(c) between a heat sink and a metal mounting surface, including the enclosure, of an isolated secondary circuit rated 50 V rms or less.

4.17.4
An insulating material having a thickness less than that specified in Clause 4.17.2 or 4.17.3 may be used if, upon investigation, it is found to be acceptable for the application and is equivalent in all respects.

4.17.5
On printed wiring boards, their connectors, and board-mounted electrical components wired on the load side of line filters or similar voltage-peak reduction networks and components, the spacings may be less than those specified in Tables 5 and 6, provided that
(a) there are no openings in either the enclosure or the wiring board, and its components have a conformal coating;
(b) the wiring board complies with the requirements of Clause 6.19; or

(c) a minimum spacing of 0.580 mm plus 0.005 mm per V peak is maintained through air and over surface between uninsulated live parts and any conductor parts (live or dead) not of the same polarity. Enamel wire shall be considered a bare live part, and an oscilloscope with adequate frequency response shall be used to determine peak voltages.

4.17.6
Smaller spacings than those specified in Clause 4.17.5(c) may be permitted between bare live parts within the primary circuit after rectification if the evaluation of the number of components and the impedance of the circuit, or abnormal tests (if deemed necessary), indicate that there is no risk of fire or shock hazard.

4.18 Strain Relief

4.18.1
Strain relief shall be provided on the supply cord or output cord to prevent mechanical stress, such as a pull or twist, from being transmitted to terminals, splices, or interior wiring. (See Clause 6.13.)

4.18.2
A metal strain-relief clamp or band shall be acceptable without supplementary protection on Type SJ or heavier cord.

4.18.3
Means shall be provided to prevent the flexible cord from being pushed into the product enclosure through the cord-entry hole if such displacement may
(a) result in mechanical damage to the cord;
(b) expose the cord to a temperature higher than that for which it is rated; or
(c) reduce spacings, such as to a metal strain-relief clamp, below the minimum acceptable values.

4.18.4
If a knot in a flexible cord serves as a strain relief, the surface against which the knot may bear or with which it may come into contact shall be free from projections or sharp edges.

4.18.5
A power-supply cord shall not pass through the same strain relief as an output cord.

4.19 Bushings

4.19.1
A bushing or the equivalent shall be provided at a point where a flexible cord passes through an opening in a wall, barrier, or enclosing case. The bushing shall be substantial and reliably secured in place, and it shall have a smooth, rounded surface against which the cord may bear. For a cord hole in wood, porcelain, phenolic composition, or other acceptable nonconductive material, a smooth, rounded surface is considered to be the equivalent of an insulating bushing.

4.19.2
Ceramic materials and some moulded compositions shall be acceptable for insulating bushings.

4.19.3
Vulcanized fibre may be employed if the bushing is
(a) not less than 1.2 mm thick; and

(b) formed and secured in place so that it will not be adversely affected by conditions of ordinary moisture.

4.19.4
A separate soft-rubber, neoprene, or polyvinyl chloride bushing may be used if
(a) the bushing is at least 1.2 mm thick;
(b) the bushing is located so that it will not be exposed to oil, grease, oily vapour, or other substances having a deleterious effect on the compound; and
(c) the hole in which the bushing is mounted is smooth and free from sharp edges.

4.19.5
An insulating bushing moulded integrally with the supply cord shall be acceptable, provided that the built-up section is not less than 1.6 mm thick where the cord passes through the enclosure.

4.19.6
An insulating metal grommet shall be acceptable as an insulating bushing if the insulating material is not less than 0.8 mm thick and completely fills the space between the grommet and the metal in which it is mounted.

4.20 Switches

4.20.1
Switches shall comply with the requirements of CSA Standards C22.2 No. 14, C22.2 No. 55, and C22.2 No. 111, so far as they apply.

4.20.2
A switch provided as a part of a battery charger shall be suitable for the particular application and shall have a current and voltage rating not less than that of the circuit that it controls when the battery charger is operated under any condition of normal service.

4.20.3
If the circuit that is controlled has a power factor of less than 75%, the switch shall
(a) have a horsepower rating based on the full-load ampere equivalent rating;
(b) have a current rating of not less than twice the rated input current; or
(c) withstand the overload and endurance tests specified in Clauses 6.10 and 6.11.

4.21 Receptacles

4.21.1
If a battery charger has one or more output receptacles and is intended to be connected to a branch-circuit in which the overcurrent protection exceeds the rating of the receptacle(s), overcurrent protection rated or set at not more than the rating of the receptacle(s) shall be installed as an integral part of the charger.

4.21.2
With reference to Clause 4.21.1, a fuseholder shall be for Type S fuse construction, or Edison-based with a factory-installed nonremovable adapter for Type S fuse construction.

4.21.3
The grounding member of a 15 or 20 A general-use attachment-plug receptacle in a battery charger shall be positively and reliably electrically connected to the grounding means of the battery charger.

4.22 Grounding and Bonding
Grounding and bonding shall be provided in accordance with CSA Standard C22.2 No. 0.4.

4.23 Strength and Stability

4.23.1
If the breakage or damage of a part such as an enclosure, a frame, a guard, or the like may result in a risk of injury to persons, its material shall have properties suitable for the expected loading conditions as determined by the applicable test specified in Clause 6.16.1.1.

4.23.2
The requirements of Clause 4.23.1 shall apply to those portions of a part adjacent to a moving part or an exposed live part that may involve a risk of injury to persons.

4.23.3
Under the conditions of normal use, a portable battery charger weighing more than 0.5 kg and intended for floor or table use shall not become physically unstable to the degree that it may pose a risk of injury to persons, as determined by the test specified in Clause 6.16.2.

5. Marking

5.1
The equipment shall be plainly marked with the following in a permanent manner, in a place where the details will be readily visible after installation:
(a) manufacturer's name, trademark, trade name, or other recognized symbol of identification;
(b) catalogue, style, model, or other type designation;
(c) rated input voltage;
(d) frequency;
(e) number of phases, except for equipment obviously intended for single-phase use only;
(f) input in amperes, volt-amperes, or kilovolt-amperes;
(g) output voltage;
(h) output current, including the boost charging current and/or cranking assist current rating, if intended for boost charging and/or cranking assist; and
(i) duty cycle for units with boost charging and/or cranking assist ratings, specified in minutes and/or seconds of ON time and OFF time.

5.2
Markings shall comply with the requirements of CSA Standard CAN/CSA-C22.2 No. 0.

5.3
The polarity of the output leads shall be indicated.

5.4
The month and year of manufacture, as a minimum, shall be marked on each product in a location visible without the use of tools. Date coding, serial numbers, or equivalent means may be used.

5.5
All required cautions, warnings, and safety instructions shall appear in both English and French.

5.6
The minimum dimensions for all letters in the words CAUTION or WARNING and ATTENTION or AVERTISSEMENT shall be 2.8 mm, and for all other words following CAUTION or WARNING and ATTENTION or AVERTISSEMENT, the letters shall not be less than 1.6 mm.

5.7
A portable or mobile automotive battery charger shall be provided with explicit
(a) important safety instructions (see Clause 5.14);
(b) operating instructions;
(c) maintenance instructions, if applicable; and
(d) assembly, moving, and storage instructions, if applicable.

Note: *These instructions may appear on the charger, on a permanent tag (made of durable material such as cloth, plastic, or the equivalent) attached to the charger, in an instruction manual accompanying the charger, or in any combination of these methods.*

5.8
Portable or mobile automotive battery chargers having enclosures that do not comply with the requirements for Enclosure 3 in CSA Standard CAN/CSA-C22.2 No. 94 shall be marked with the following or equivalent wording:
CAUTION: DO NOT EXPOSE TO RAIN
and
ATTENTION : NE PAS EXPOSER À LA PLUIE.

5.9
A nonautomotive charger shall be marked, where readily visible to the user when charging batteries, with the following or equivalent wording:
CAUTION: CHARGE ONLY _____TYPE BATTERIES. OTHER TYPES OF BATTERIES MAY BURST CAUSING PERSONAL INJURY AND DAMAGE
and
ATTENTION : UTILISER POUR CHARGER UNIQUEMENT LES ACCUMULATEURS DU TYPE _____. D'AUTRES TYPES D'ACCUMULATEURS POURRAIENT ÉCLATER ET CAUSER DES BLESSURES OU DOMMAGES.

5.10
A battery charger having a peak output voltage of 42.4 V or greater shall be marked with the following or equivalent wording:
DANGER: RISK OF ELECTRIC SHOCK. DO NOT TOUCH UNINSULATED PORTION OF OUTPUT CONNECTOR OR UNINSULATED BATTERY TERMINAL
and
DANGER : RISQUE DE CHOCS ÉLECTRIQUES. NE PAS TOUCHER LES PARTIES NON ISOLÉES DU CONNECTEUR DE SORTIE OU LES BORNES NON ISOLÉES DE L'ACCUMULATEUR.

5.11
A portable or mobile automotive battery charger shall be marked with the following or equivalent wording:
WARNING: RISK OF EXPLOSIVE GAS MIXTURE. READ INSTRUCTIONS _____* BEFORE USING CHARGER
and

AVERTISSEMENT : RISQUE DE MÉLANGE GAZEUX EXPLOSIF. LIRE LES INSTRUCTIONS _____* AVANT D'UTILISER LE CHARGEUR.
**In the blank space insert the location of the important safety instructions required by Clause 5.7(a).*

5.12

If a fuse is used to reduce a fire hazard, a marking shall be provided adjacent to the fuseholder to indicate the type, if necessary, and the rating of the fuse that is required.

5.13

When required by Clause 4.13.8, the following marking or its equivalent shall be provided:
CAUTION: DISCONNECT SUPPLY BEFORE CHANGING FUSE
and
ATTENTION : COUPER L'ALIMENTATION AVANT DE REMPLACER LES FUSIBLES.

5.14

The important safety instructions for battery chargers required by Clause 5.7(a) shall include those items in the following list that are applicable to the particular battery charger. The statement IMPORTANT SAFETY INSTRUCTIONS and INSTRUCTIONS IMPORTANTES CONCERNANT LA SÉCURITÉ shall precede the list. Equivalent wording of the listed instructions is acceptable:
(a) SAVE THESE INSTRUCTIONS. THIS MANUAL CONTAINS IMPORTANT SAFETY AND OPERATING INSTRUCTIONS
and
CONSERVER CES INSTRUCTIONS. CE MANUEL CONTIENT DES INSTRUCTIONS IMPORTANTES CONCERNANT LA SÉCURITÉ ET LE FONCTIONNEMENT.
(b) WORKING IN THE VICINITY OF A LEAD-ACID BATTERY IS DANGEROUS. BATTERIES GENERATE EXPLOSIVE GASES DURING NORMAL BATTERY OPERATION. FOR THIS REASON IT IS OF THE UTMOST IMPORTANCE THAT EACH TIME BEFORE USING YOUR CHARGER, YOU READ AND FOLLOW THE INSTRUCTIONS PROVIDED EXACTLY
and
IL EST DANGEREUX DE TRAVAILLER A PROXIMITÉ D'UNE BATTERIE AU PLOMB. LES BATTERIES PRODUISENT DES GAZ EXPLOSIFS EN SERVICE NORMAL. IL EST AUSSI IMPORTANT DE TOUJOURS RELIRE LES INSTRUCTIONS AVANT D'UTILISER LE CHARGEUR ET DE LES SUIVRE À LA LETTRE.
(c) TO REDUCE RISK OF BATTERY EXPLOSION, FOLLOW THESE INSTRUCTIONS AND THOSE MARKED ON THE BATTERY
and
POUR RÉDUIRE LE RISQUE D'EXPLOSION, LIRE CES INSTRUCTIONS ET CELLES QUI FIGURENT SUR LA BATTERIE.
(d) NEVER SMOKE OR ALLOW AN OPEN SPARK OR FLAME IN THE VICINITY OF THE BATTERY OR ENGINE
and
NE JAMAIS FUMER PRÈS DE LA BATTERIE OU DU MOTEUR ET ÉVITER TOUTE ÉTINCELLE OU FLAMME NUE À PROXIMITÉ DE CES DERNIERS.
(e) USE CHARGER FOR CHARGING A LEAD-ACID BATTERY ONLY. IT IS NOT INTENDED TO SUPPLY POWER TO AN EXTRA-LOW-VOLTAGE ELECTRICAL SYSTEM OR TO CHARGE DRY-CELL BATTERIES. CHARGING DRY-CELL BATTERIES MAY CAUSE THEM TO BURST AND CAUSE INJURY TO PERSONS AND DAMAGE TO PROPERTY
and
UTILISER LE CHARGEUR POUR CHARGER UNE BATTERIE AU PLOMB UNIQUEMENT. CE CHARGEUR N'EST PAS CONÇU POUR ALIMENTER UN RÉSEAU ÉLECTRIQUE TRÈS BASSE TENSION NI POUR CHARGER DES PILES SÈCHES. LE FAIT D'UTILISER LE CHARGEUR POUR CHARGER DES PILES SÈCHES

POURRAIT ENTRAÎNER L'ÉCLATEMENT DES PILES ET CAUSER DES BLESSURES OU DES DOMMAGES;
(f) NEVER CHARGE A FROZEN BATTERY
and
NE JAMAIS CHARGER UNE BATTERIE GELÉE.
(g) IF IT IS NECESSARY TO REMOVE BATTERY FROM VEHICLE TO CHARGE IT, ALWAYS REMOVE GROUNDED TERMINAL FROM BATTERY FIRST. MAKE SURE ALL ACCESSORIES IN THE VEHICLE ARE OFF IN ORDER TO PREVENT AN ARC
and
S'IL EST NÉCESSAIRE DE RETIRER LA BATTERIE DU VÉHICULE POUR LA CHARGER, TOUJOURS DÉBRANCHER LA BORNE DE MISE À LA MASSE EN PREMIER. S'ASSURER QUE LE COURANT AUX ACCESSOIRES DU VÉHICULE EST COUPÉ AFIN D'ÉVITER LA FORMATION D'UN ARC.
(h) STUDY ALL BATTERY MANUFACTURER'S SPECIFIC PRECAUTIONS SUCH AS REMOVING OR NOT REMOVING CELL CAPS WHILE CHARGING AND RECOMMENDED RATES OF CHARGE
and
PRENDRE CONNAISSANCE DES MESURES DE PRÉCAUTION SPÉCIFIÉES PAR LE FABRICANT DE LA BATTERIE, P. EX., VÉRIFIER S'IL FAUT ENLEVER LES BOUCHONS DES CELLULES LORS DU CHARGEMENT DE LA BATTERIE, ET LES TAUX DE CHARGEMENT RECOMMANDÉS.
(i) FOR A CHARGER HAVING AN OUTPUT VOLTAGE SELECTOR SWITCH, REFER TO THE CAR OWNER'S MANUAL IN ORDER TO DETERMINE THE VOLTAGE OF THE BATTERY AND TO MAKE SURE THE OUTPUT VOLTAGE IS SET AT THE CORRECT VOLTAGE. IF AN OUTPUT VOLTAGE SELECTOR SWITCH IS NOT PROVIDED, DO NOT USE THE BATTERY CHARGER UNLESS THE BATTERY VOLTAGE MATCHES THE OUTPUT VOLTAGE RATING OF THE CHARGER
and
SI LE CHARGEUR COMPORTE UN SÉLECTEUR DE TENSION DE SORTIE, CONSULTER LE MANUEL DE L'USAGER DE LA VOITURE POUR DÉTERMINER LA TENSION DE LA BATTERIE ET POUR S'ASSURER QUE LA TENSION DE SORTIE EST APPROPRIÉE. SI LE CHARGEUR N'EST PAS MUNI D'UN SÉLECTEUR, NE PAS UTILISER LE CHARGEUR À MOINS QUE LA TENSION DE LA BATTERIE NE SOIT IDENTIQUE À LA TENSION DE SORTIE NOMINALE DU CHARGEUR.
(j) NEVER PLACE THE CHARGER DIRECTLY ABOVE OR BELOW THE BATTERY BEING CHARGED; GASES OR FLUIDS FROM THE BATTERY WILL CORRODE AND DAMAGE THE CHARGER. LOCATE THE CHARGER AS FAR AWAY FROM THE BATTERY AS DC CABLES PERMIT
and
NE JAMAIS PLACER LE CHARGEUR DIRECTEMENT SOUS LA BATTERIE À CHARGER OU AU-DESSUS DE CETTE DERNIÈRE. LES GAZ OU LES FLUIDES QUI S'ÉCHAPPENT DE LA BATTERIE PEUVENT ENTRAÎNER LA CORROSION DU CHARGEUR OU L'ENDOMMAGER. PLACER LE CHARGEUR AUSSI LOIN DE LA BATTERIE QUE LES CABLES C.C. LE PERMETTENT
(k) DO NOT OPERATE CHARGER IN A CLOSED-IN AREA OR RESTRICT VENTILATION IN ANY WAY
and
NE PAS FAIRE FONCTIONNER LE CHARGEUR DANS UN ESPACE CLOS ET/OU NE PAS GÊNER LA VENTILATION.
(l) CONNECT AND DISCONNECT DC OUTPUT CLIPS ONLY AFTER SETTING ANY CHARGER SWITCHES TO THE OFF POSITION AND REMOVING AC CORD FROM THE ELECTRIC OUTLET. NEVER ALLOW CLIPS TO TOUCH EACH OTHER
and
METTRE LES INTERRUPTEURS DU CHARGEUR HORS CIRCUIT ET RETIRER LE CORDON C.A. DE LA PRISE AVANT DE METTRE ET D'ENLEVER LES PINCES DU CORDON C.C. S'ASSURER QUE LES PINCES NE SE TOUCHENT PAS.
(m) FOLLOW THESE STEPS WHEN BATTERY IS INSTALLED IN VEHICLE. A SPARK NEAR BATTERY MAY CAUSE A BATTERY EXPLOSION. TO REDUCE RISK OF A SPARK NEAR BATTERY:
(i) POSITION AC AND DC CORDS TO REDUCE RISK OF DAMAGE BY HOOD, DOOR, OR MOVING ENGINE PART;

(ii) STAY CLEAR OF FAN BLADES, BELTS, PULLEYS, AND OTHER PARTS THAT CAN CAUSE INJURY TO PERSONS;

(iii) CHECK POLARITY OF BATTERY POSTS. A POSITIVE (POS, P, +) BATTERY POST USUALLY HAS A LARGER DIAMETER THAN A NEGATIVE (NEG, N, –) POST;

(iv) DETERMINE WHICH POST OF BATTERY IS GROUNDED (CONNECTED) TO THE CHASSIS. IF NEGATIVE POST IS GROUNDED TO CHASSIS (AS IN MOST VEHICLES), SEE ITEM (v). IF POSITIVE POST IS GROUNDED TO THE CHASSIS, SEE ITEM (vi);

(v) FOR A NEGATIVE-GROUNDED VEHICLE, CONNECT THE POSITIVE (RED) CLIP FROM BATTERY CHARGER TO POSITIVE (POS, P, +) UNGROUNDED POST OF BATTERY. CONNECT THE NEGATIVE (BLACK) CLIP TO VEHICLE CHASSIS OR ENGINE BLOCK AWAY FROM BATTERY. DO NOT CONNECT CLIP TO CARBURETOR, FUEL LINES, OR SHEET-METAL BODY PARTS. CONNECT TO A HEAVY GAUGE METAL PART OF THE FRAME OR ENGINE BLOCK;

(vi) FOR A POSITIVE-GROUNDED VEHICLE, CONNECT THE NEGATIVE (BLACK) CLIP FROM BATTERY CHARGER TO NEGATIVE (NEG, N, –) UNGROUNDED POST OF BATTERY. CONNECT THE POSITIVE (RED) CLIP TO VEHICLE CHASSIS OR ENGINE BLOCK AWAY FROM BATTERY. DO NOT CONNECT CLIP TO CARBURETOR, FUEL LINES, OR SHEET-METAL BODY PARTS. CONNECT TO A HEAVY GAUGE METAL PART OF THE FRAME OR ENGINE BLOCK;

(vii) CONNECT CHARGER AC SUPPLY CORD TO ELECTRIC OUTLET; AND

(viii) WHEN DISCONNECTING CHARGER, TURN SWITCHES TO OFF, DISCONNECT AC CORD, REMOVE CLIP FROM VEHICLE CHASSIS, AND THEN REMOVE CLIP FROM BATTERY TERMINAL

and

SUIVRE LES ÉTAPES SUIVANTES LORSQUE LA BATTERIE SE TROUVE DANS LE VÉHICULE. UNE ÉTINCELLE PRÈS DE LA BATTERIE POURRAIT PROVOQUER L'EXPLOSION DE CETTE DERNIÈRE. POUR RÉDUIRE LE RISQUE D'ÉTINCELLE À PROXIMITÉ DE LA BATTERIE :

(i) PLACER LES CORDONS C.A. ET C.C. DE MANIÈRE À ÉVITER QU'ILS SOIENT ENDOMMAGÉS PAR LE CAPOT, UNE PORTIÈRE OU LES PIÈCES EN MOUVEMENT DU MOTEUR ;

(ii) FAIRE ATTENTION AUX PALES, AUX COURROIES ET AUX POULIES DU VENTILATEUR AINSI QU'À TOUTE AUTRE PIÈCE SUSCEPTIBLE DE CAUSER DES BLESSURES ;

(iii) VÉRIFIER LA POLARITÉ DES BORNES DE LA BATTERIE. LE DIAMÈTRE DE LA BORNE POSITIVE (POS, P, +) EST GÉNÉRALEMENT SUPÉRIEUR À CELUI DE LA BORNE NÉGATIVE (NÉG, N, –) ;

(iv) DÉTERMINER QUELLE BORNE EST MISE À LA MASSE (RACCORDÉE AU CHÂSSIS). SI LA BORNE NÉGATIVE EST RACCORDÉE AU CHÂSSIS (COMME DANS LA PLUPART DES CAS), VOIR LE POINT (v). SI LA BORNE POSITIVE EST RACCORDÉE AU CHÂSSIS, VOIR LE POINT (vi) ;

(v) SI LA BORNE NÉGATIVE EST MISE À LA MASSE, RACCORDER LA PINCE POSITIVE (ROUGE) DU CHARGEUR À LA BORNE POSITIVE (POS, P, +) NON MISE À LA MASSE DE LA BATTERIE. RACCORDER LA PINCE NÉGATIVE (NOIRE) AU CHÂSSIS DU VÉHICULE OU AU MOTEUR, LOIN DE LA BATTERIE. NE PAS RACCORDER LA PINCE AU CARBURATEUR, AUX CANALISATIONS D'ESSENCE NI AUX PIÈCES DE LA CARROSSERIE EN TÔLE. RACCORDER À UNE PIÈCE DU CADRE OU DU MOTEUR EN TÔLE DE FORTE ÉPAISSEUR ;

(vi) SI LA BORNE POSITIVE EST MISE À LA MASSE, RACCORDER LA PINCE NÉGATIVE (NOIRE) DU CHARGEUR À LA BORNE NÉGATIVE (NÉG, N, –) NON MISE À LA MASSE DE LA BATTERIE. RACCORDER LA PINCE POSITIVE (ROUGE) AU CHÂSSIS DU VÉHICULE OU AU MOTEUR, LOIN DE LA BATTERIE. NE PAS RACCORDER LA PINCE AU CARBURATEUR, AUX CANALISATIONS D'ESSENCE NI AUX PIÈCES DE LA CARROSSERIE EN TÔLE. RACCORDER À UNE PIÈCE DU CADRE OU DU MOTEUR EN TÔLE DE FORTE ÉPAISSEUR ;

(vii) BRANCHER LE CORDON D'ALIMENTATION C.A. DU CHARGEUR ;

(viii) POUR INTERROMPRE L'ALIMENTATION DU CHARGEUR, METTRE LES INTERRUPTEURS HORS CIRCUIT, RETIRER LE CORDON C.A. DE LA PRISE, ENLEVER LA PINCE RACCORDÉE AU CHÂSSIS ET EN DERNIER LIEU CELLE RACCORDÉE À LA BATTERIE.

(n) FOLLOW THESE STEPS WHEN BATTERY IS OUTSIDE VEHICLE. A SPARK NEAR THE BATTERY MAY CAUSE A BATTERY EXPLOSION. TO REDUCE RISK OF A SPARK NEAR BATTERY:

(i) CHECK POLARITY OF BATTERY POSTS. A POSITIVE (POS, P, +) BATTERY POST USUALLY HAS A LARGER DIAMETER THAN A NEGATIVE (NEG, N, –) POST;

(ii) ATTACH AT LEAST A 60 CM 6-GAUGE (AWG) INSULATED BATTERY CABLE TO A NEGATIVE (NEG, N, –) BATTERY POST;

(iii) CONNECT THE POSITIVE (RED) CHARGER CLIP TO THE POSITIVE (POS, P, +) POST OF BATTERY;
(iv) POSITION YOURSELF AND THE FREE END OF CABLE AS FAR AWAY FROM BATTERY AS POSSIBLE, THEN CONNECT THE NEGATIVE (BLACK) CHARGER CLIP TO FREE END OF CABLE;
(v) DO NOT FACE BATTERY WHEN MAKING FINAL CONNECTION;
(vi) CONNECT CHARGER AC SUPPLY CORD TO ELECTRICAL OUTLET; AND
(vii) WHEN DISCONNECTING CHARGER, ALWAYS DO SO IN REVERSE SEQUENCE OF CONNECTING PROCEDURE AND BREAK FIRST CONNECTION WHILE STANDING AS FAR AWAY FROM BATTERY AS PRACTICAL
and
SUIVRE LES ÉTAPES SUIVANTES LORSQUE LA BATTERIE EST À L'EXTÉRIEUR DU VÉHICULE. UNE ÉTINCELLE PRÈS DE LA BATTERIE POURRAIT PROVOQUER L'EXPLOSION DE CETTE DERNIÈRE. POUR RÉDUIRE LE RISQUE D'ÉTINCELLE À PROXIMITÉ DE LA BATTERIE :
(i) VÉRIFIER LA POLARITÉ DES BORNES DE LA BATTERIE. LE DIAMÈTRE DE LA BORNE POSITIVE (POS, P, +) EST GÉNÉRALEMENT SUPÉRIEUR À CELUI DE LA BORNE NÉGATIVE (NÉG, N, –) ;
(ii) RACCORDER UN CÂBLE DE BATTERIE ISOLÉ N° 6 AWG MESURANT AU MOINS 60 CM DE LONGUEUR À LA BORNE NÉGATIVE (NÉG, N, –) ;
(iii) RACCORDER LA PINCE POSITIVE (ROUGE) À LA BORNE POSITIVE (POS, P, +) DE LA BATTERIE ;
(iv) SE PLACER ET TENIR L'EXTRÉMITÉ LIBRE DU CÂBLE AUSSI LOIN QUE POSSIBLE DE LA BATTERIE, PUIS RACCORDER LA PINCE NÉGATIVE (NOIRE) DU CHARGEUR À L'EXTRÉMITÉ LIBRE DU CÂBLE ;
(v) NE PAS SE PLACER FACE À LA BATTERIE POUR EFFECTUER LE DERNIER RACCORDEMENT ;
(vi) RACCORDER LE CORDON D'ALIMENTATION C.A. DU CHARGEUR À LA PRISE ;
(vii) POUR INTERROMPRE L'ALIMENTATION DU CHARGEUR, METTRE LES INTERRUPTEURS HORS CIRCUIT, RETIRER LE CORDON C.A. DE LA PRISE, ENLEVER LA PINCE RACCORDÉE AU CHÂSSIS ET EN DERNIER LIEU CELLE RACCORDÉE À LA BATTERIE. SE PLACER AUSSI LOIN QUE POSSIBLE DE LA BATTERIE POUR DÉFAIRE LA PREMIÈRE CONNEXION.

(o) When the instructions refer to adapters, the following statement shall be included:
USE OF AN ADAPTER IS NOT ALLOWED IN CANADA. IF A GROUNDING TYPE RECEPTACLE IS NOT AVAILABLE, DO NOT USE THIS APPLIANCE UNTIL THE PROPER OUTLET IS INSTALLED BY A QUALIFIED ELECTRICIAN
and
L'UTILISATION D'UN ADAPTATEUR EST INTERDITE AU CANADA. SI UNE PRISE DE COURANT AVEC MISE À LA TERRE N'EST PAS DISPONIBLE EN FAIRE INSTALLER UNE PAR UN ÉLECTRICIEN QUALIFIÉ AVANT D'UTILISER CET APPAREIL.

5.15

The following caution, or the equivalent, shall be shown at or near the point where the field connection will be made if the temperature in the terminal box or compartment intended for the field connections exceeds 60°C in the normal temperature test (see Clauses 6.6 and 7.5.3):
USE WIRES SUITABLE FOR AT LEAST ___ DEG C
and
EMPLOYER DES FILS POUR AU MOINS ___ DEG C

The value of temperature to be marked in the caution shall be
(a) 75°C for temperatures in the range of over 60–75°C; and
(b) 90°C for temperatures in the range of over 75–90°C.

5.16

Notwithstanding Clause 4.18.2 of CSA Standard CAN/CSA-C22.2 No. 0, battery chargers for floor mounting that do not conform with Clause 4.2.5.5 shall be marked with the following or equivalent statement:
DO NOT INSTALL ON OR OVER COMBUSTIBLE SURFACES
and
NE PAS INSTALLER SUR DES SURFACES COMBUSTIBLES OU AU-DESSUS DE TELLES SURFACES.

6. Tests

6.1 General

The tests specified in Clauses 6.3 to 6.9 shall be conducted at the test voltage specified in Clause 6.2.1 and the test frequency specified in Clause 6.2.2.

6.2 Rated Conditions

6.2.1

The test supply voltage shall be the nominal voltage for each voltage for which the battery charger is intended, as specified in CSA Standard CAN3-C235.

6.2.2

If the frequency rating has both a minimum and a maximum value (eg, 50–60 Hz), the rated frequency shall be the lower value of the two.

6.3 Power Input Test

6.3.1

The input current and power factor shall be measured with the charger operating while connected to the test load specified in Table 7 for the type of charger being tested. The input current shall not be more than 110% of the rated value.

6.3.2

The input current of a household automotive charger rated 10 A and less shall be measured with the charger connected to a resistive-capacitive load having a capacitance of 200 000 μF. The input current measured during this test shall not be more than 110% of the marked value when delivering rated output (see Table 7).

6.3.3

In regard to Clause 6.3.1, the input current for an automotive charger shall be measured with the load adjusted to draw the maximum rated continuous output current. If the charger is intended for boost charging or is provided with a tap switch or another means of adjusting the output current or voltage, measurements of the primary input current shall also be made with the output load adjusted to draw maximum continuous output current rating or boost charging output rating.

6.3.4

An automotive charger intended for cranking assist shall comply with Clause 6.3.1 while connected to a load adjusted to draw a current equal to the maximum cranking assist output rating.

6.3.5

If a charger is to be tested using a battery or batteries in parallel with a resistor as the load, the size of the battery shall be the minimum size indicated by the 8 h rating marked on the battery. The battery shall be connected to the proper load and then discharged to 1.75 V per cell at a rate not exceeding the discharge rate assigned by the battery manufacturer and not exceeding 1/6 of the ampere-hour capacity of the battery, except that the discharge rate of not more than 1/6 of the ampere-hour capacity of the battery shall not apply to a specific-purpose battery charger, eg, a nonautomotive charger used to charge a small rechargeable battery such as a nickel-cadmium battery.

6.3.6
Output current measurements shall be based on the average current.

6.4 Output Voltage Measurement

6.4.1 General

6.4.1.1
The output characteristics of an automotive charger shall comply with the requirements of Clauses 6.4.2 to 6.4.4.

6.4.1.2
Average reading meters shall be used for making the measurements specified in Clauses 6.4.2 to 6.4.4.

6.4.2 Continuous Output Current

6.4.2.1
The output voltage of an automotive charger shall be not less than the value specified in Table 8 while delivering a load current equal to the maximum continuous output current rating. The output voltage of a charger designed to charge a series of either 6 or 12 V batteries shall be a direct multiple of the voltage for the corresponding rated output current specified in Table 8.

6.4.2.2
To determine whether an automotive charger complies with the requirements of Clause 6.4.2.1, a variable RC load or a battery with a resistor in parallel shall be connected to the output terminals. The RC load shall consist of a 200 000 µF capacitor in parallel with an adjustable resistor. The battery charger shall be at room temperature at the beginning of the test, and the output measurements shall be made approximately 5 min after the energization of the primary.

6.4.3 Boost Charging

6.4.3.1
The output voltage of an automotive charger intended for boost charging shall be not less than the value specified in Table 8 while delivering a current equal to the maximum boost charging output rating.

6.4.3.2
To determine compliance with Clause 6.4.3.1, the variable RC load specified in Clause 6.4.2.2 or a battery with a resistor in parallel shall be connected to the output terminals. The battery charger shall be at room temperature at the beginning of the test and the output measurements shall be made 5 s after the energization of the primary.

6.4.4 Cranking Assist

6.4.4.1
The output voltage of a battery charger intended for cranking assist shall be not less than 1.2 V per cell (3.6 V and 7.2 V for 6 V and 12 V battery chargers, respectively) while delivering a current equal to the maximum cranking assist output rating.

6.4.4.2
To determine compliance with Clause 6.4.4.1, the test procedure described in Clause 6.4.3.2 shall be followed.

6.5 Leakage Current Test

6.5.1
Except as permitted by Clause 6.5.8, the leakage current of a cord-connected battery charger, when tested in accordance with Clauses 6.5.2 to 6.5.7, shall not be more than
(a) 0.5 mA for a portable battery charger; and
(b) 0.75 mA for a stationary battery charger employing a standard attachment plug rated 15 A or less.

6.5.2
All exposed conductive surfaces shall be tested for leakage currents. The leakage currents from these surfaces shall be measured to the grounded supply conductor individually as well as collectively if simultaneously accessible, and from one surface to another if simultaneously accessible. Surfaces are considered to be simultaneously accessible if they can be readily contacted at the same time by one or both hands. These measurements do not apply between output terminals operating at voltages less than 30 V rms (42.4 V peak).

6.5.3
If a conductive surface other than metal is used for the enclosure or part of the enclosure, the leakage current shall be measured using a metal foil with an area of 10 × 20 cm in contact with the surface. If the surface has an area less than 10 × 20 cm, the metal foil shall be the same size as the surface. The metal foil shall not remain in place long enough to affect the temperature of the battery charger.

6.5.4
The meter may be electronic or a direct-indicating type, average responding, calibrated at 60 Hz, and indicating the rms value of a pure sine wave with an accuracy of 5%, at an indication of 0.5 mA. The meter terminal impedance shall be 1500 Ω shunted by a 0.15 µF capacitor.

6.5.5
The voltage applied shall be that specified in Clause 6.2.1. The frequency shall be 60 Hz.

6.5.6
The grounding conductor shall be open at the attachment plug or at its termination at the charger, and the charger shall be isolated from ground.

6.5.7
The test sequence shall be as follows (see Figure 6):
(a) With switch S1 open, the battery charger shall be connected to the measuring circuit. The leakage current shall be measured using both positions of switch S2, and with the product switching devices in all their normal operating positions.
(b) Switch S1 shall then be closed, energizing the product, and within 5 s the leakage current shall be measured using both positions of switch S2, and with the product switching devices in all their normal operating positions.
(c) The leakage current shall be monitored until thermal stabilization is reached. Both positions of switch S2 shall be used in determining this measurement. Thermal stabilization shall be attained by operating the battery charger as specified in Clause 6.6 until thermal equilibrium is reached as described in Clause 6.6.12.

6.5.8
Notwithstanding Clause 6.5.1, a cord-connected battery charger that is required to have primary circuit filtering to meet electromagnetic compatibility (EMC) regulations may have higher leakage current levels

at accessible parts, provided that the leakage current does not exceed 5.0 mA and the battery charger complies with the grounding requirements of Clause 4.22.

6.6 Temperature Test

6.6.1

A charger shall be tested as described in Clauses 6.6.2 to 6.6.12 using the load specified in Table 7, and it shall not reach a temperature at any point high enough to cause a risk of fire, to damage any material used, or to exceed the temperatures specified in Table 9. The load for the temperature test shall be adjusted after 15 min and no further adjustments shall be made.

6.6.2

The temperature of an automotive charger provided with a tap switch or another means to adjust the output current or voltage shall be made with the output adjusted to a value resulting in the output voltage nearest the value specified in Table 8. The temperature test of an industrial charger shall be conducted with the switch set to obtain the maximum output current marked on the charger.

6.6.3

In the temperature test of a battery charger using a battery load, the battery shall be discharged as specified in Clause 6.3.5, then charged until temperatures on the charger reach a maximum and begin to decrease. The temperature test shall be continued using a second battery, also discharged as specified in Clause 6.3.5, until maximum temperatures are attained. An industrial charger provided with a timer and a marked charging time based on the ampere-hour capacity of the battery shall be tested for the marked time period. A second battery shall then be charged unless the marked charging time is such that only one battery can be charged during an 8 h period.

6.6.4

An automatic protector or other recycling device shall not operate during the normal temperature test.

6.6.5

In regard to Clause 6.6.1, an automotive charger shall be loaded to a current equal to the maximum continuous output current rating. If the charger is intended for boost charging, cranking assist, or both, the test specified in Clause 6.6.6 shall also be conducted.

6.6.6

When required by Clause 6.6.5, the load specified in Clause 6.4.2.2 shall be connected to the output terminals of the charger, and adjusted to draw rated boost current or cranking assist current, as applicable. The charger shall supply rated output current during the OFF time for the boost and crank assist duty cycle. The test shall be performed immediately following the temperature test described in Clause 6.6.1 at the duty cycle specified for the following conditions in Item (a) or (b), whichever is applicable, and shall be continued until all temperatures have become constant:

(a) when a momentary-contact switch is provided to automatically interrupt the boost or cranking assist current: the duty cycle specified by the manufacturer. A circuit protector shall not cycle during this test; or

(b) when either a two-position switch or no switch is provided to interrupt the boost or cranking assist current:

(i) the duty cycle specified by the manufacturer. A circuit protector shall not cycle during this test; and

(ii) continuously in the boost or cranking assist mode of operation. A circuit protector may cycle during this test. This test shall be performed without regard to temperature and the unit shall comply with the requirements of Clause 6.9.1.8.

6.6.7
A battery charger designed for mounting or support in more than one position, or in a confined location, shall be tested in a manner representing the most severe conditions. An adjacent mounting or supporting surface shall consist of nominal 25 mm thick, soft-pine boards.

6.6.8
A battery charger employing a discharge resistor for battery testing shall be subjected to a discharge temperature test. Starting within 1 min after completion of the temperature test described in Clause 6.6.1, a fully charged battery of the required capacity shall be discharged through the discharge circuit. The length of the discharge time shall be as specified in Table 10.

6.6.9
The discharge test shall be repeated at 2 min intervals until a total of five discharges have occurred. The temperatures measured during the first two discharges shall not exceed the temperatures specified in Table 9. There shall be no emission of flame or molten metal from the charger during any of the five discharges.

6.6.10
Coil and winding temperatures shall be measured by thermocouples located on exposed surfaces, except that the rise-of-resistance method* may be used for a coil that is inaccessible for mounting thermocouples, such as a coil
(a) immersed in sealing compound;
(b) wrapped with thermal insulation such as asbestos; or
(c) wrapped with more than two layers of material such as cotton, paper, or rayon more than 0.8 mm thick. In an alternating-current motor, the thermocouple shall be mounted on the integrally applied insulation of the coil wire.
**See CSA Standard CAN/CSA-C22.2 No. 0.*

6.6.11
All values of temperature in Table 9 are based on an assumed ambient temperature of 25°C and apply to battery chargers intended for use in ambient temperatures normally prevailing in occupiable spaces, which usually are not higher than 25°C but may be as high as 40°C occasionally and for brief periods. Tests of battery chargers for service in such ambient temperatures may be conducted at any ambient temperature between 10 and 40°C, and the variation below or above 25°C shall be respectively subtracted from, or added to, the permissible limiting temperatures specified in Table 9.

Allowable temperatures for industrial chargers shall be based on an assumed ambient temperature of 40°C. The test, however, may be conducted at an ambient temperature lower than 40°C, in which case the allowable temperatures specified in Table 9 shall be reduced by the amount equal to the difference between 40°C and the test ambient temperature.

6.6.12
For a test that is to be continued until constant temperatures are attained, thermal equilibrium is considered to exist when three successive readings taken at intervals of 10% of the previously elapsed duration of the test, but not less than 5 min, indicate no further increase.

6.7 Dielectric Strength

6.7.1
A battery charger at the maximum operating temperature shall withstand for 1 min without breakdown the application of the following 60 Hz ac voltages:

(a) 1000 V plus twice the maximum rated voltage between
    (i) the primary circuit and non-current-carrying metal parts;
    (ii) the primary and secondary circuits; and
    (iii) all secondary windings, including any ferro-resonant windings;
(b) 500 V between a secondary circuit operating at 50 V or less and non-current-carrying metal parts; and
(c) 1000 V plus twice the maximum rated secondary circuit voltage between a secondary circuit, including any ferro-resonant windings, operating at more than 50 V and non-current-carrying metal parts.

6.7.2
To determine whether a charger complies with the requirements in Clause 6.7.1, it shall be tested using a transformer of 500 V•A capacity or larger, having an output voltage that is essentially sinusoidal and that can be regulated. Starting at zero, the applied voltage shall be increased gradually and at a uniform rate until either the required test value is reached or a breakdown occurs.

6.8 Intermediate Abnormal Test

6.8.1
A battery charger tested with a battery in accordance with Clause 6.6.3 shall be subjected to the intermediate abnormal test described in Clause 6.8.2 immediately following the temperature test. The charger shall not emit flame or molten metal or result in a risk of fire or electric shock during the test. The test shall be followed by a dielectric strength test, as described in Clause 6.7, applied between the primary and secondary windings of the transformer.

6.8.2
The rated output current of the charger shall be continuously maintained by an adjustable resistor connected in parallel with the battery. The test shall be continued
(a) until the ultimate result occurs;
(b) for 7 h if cycling of an automatically reset protector occurs; or
(c) for 50 cycles of resetting a manually reset protector.

6.9 Abnormal Operation

6.9.1 General

6.9.1.1
A charger shall not become a fire hazard, shall emit neither flame nor molten metal, and shall not fail mechanically or become a shock hazard because of electrical failure when operated continuously under any reasonably anticipated abnormal load condition, including the short-circuit of the output connections and reversal of the battery leads, except that a battery charger that has output terminals or leads for fixed wiring, or leads terminating in a polarized plug or plugs, shall not be subjected to the reverse polarity test. Its operation shall be without regard to temperatures attained on any part of the battery charger.

6.9.1.2
The abnormal test specified in Clause 6.9.1.1 shall be made at the primary voltage specified in Clause 6.2.1, and the enclosure of the charger shall be grounded as described in Clause 6.10.3. Protective devices provided as part of the charger shall remain in the circuit.

6.9.1.3
For fixed battery chargers, the branch-circuit protection shall be in accordance with that required by the *Canadian Electrical Code, Part I.* The opening of the protection shall be an acceptable termination of the test.

6.9.1.4
For cord-connected chargers, the supply circuit shall be protected by a fuse rated at least 400% of the ampacity of the branch-circuit conductors intended to be used with the charger. The fuse shall not open during this test.

6.9.1.5
The following test procedure shall be used to determine compliance with Clause 6.9.1.1:
(a) Only one fault at a time shall be introduced.
(b) The charger shall be set up as for the normal temperature test described in Clause 6.6, except that
(i) the secondary of the transformer shall be connected to ground;
(ii) for cord-connected chargers rated 15 A and less, a ground fault circuit interrupter of the Class A type shall be connected in the test circuit; and
(iii) for cord-connected chargers rated over 15 A, and all chargers intended for permanent connection to the supply, the enclosure shall be connected to ground through a 3 A fuse.
(c) The test shall be continued as long as necessary to establish steady-state conditions, or up to the interruption of the circuit due to the failure of a component (eg, burnout), the opening of a fuse, or other consequences of the simulated fault conditions, whichever occurs first.

6.9.1.6
If a fuse is provided as part of the charger, the output short-circuit test shall be made using the largest fuse that the fuseholder will accept. The short-circuit test shall be continued
(a) until the ultimate result occurs;
(b) for 7 h if cycling of an automatic-reset protector occurs; or
(c) for 50 cycles of resetting a manual-reset protector.

6.9.1.7
For the reverse polarity test, the output leads shall be connected in reverse polarity to a fully charged lead-acid battery. The test shall be continued
(a) until the ultimate result occurs; or
(b) for 4 h if cycling of an automatic-reset protector occurs.

6.9.1.8
The results of all tests shall be considered acceptable if there is
(a) no opening of the supply circuit fuse for cord-connected chargers;
(b) no opening of the 3 A ground fuse or tripping of the Class A ground fault circuit interrupter (when used);
(c) no emission of flame or molten material from the overall enclosure;
(d) no resulting openings in the overall enclosure that would expose live or current-carrying parts, as determined by Clause 4.2.5; and
(e) no breakdown when the dielectric strength test specified in Clause 6.7 is applied
(i) after the charger has cooled to room temperature if a ground fault circuit interrupter is used; or
(ii) within 10 s after burnout if a ground fuse is used.

6.9.1.9
If a cooling fan is provided, the possibility of a fire hazard due to fan failure shall be investigated.

6.9.1.10
Automotive chargers shall be subjected to the tests specified in Clause 6.9.1.1 when the negative terminal of the charger is bonded to the charger enclosure. The tests shall be repeated with the positive terminal of the charger bonded to the charger enclosure.

6.9.2 Transformers

6.9.2.1
A transformer, other than a transformer used in an industrial charger complying with Clause 6.9.2.5, shall not emit flame or molten metal or cause a risk of fire or electric shock when tested in accordance with Clauses 6.9.2.2 to 6.9.2.4.

6.9.2.2
A resistance load shall be connected directly to the transformer secondary winding with the charger connected to the supply circuit. Except as specified in Clause 6.9.2.4, the test voltage shall be 100% of the value specified in Clause 6.2.1, and the resistance shall be adjusted to cause the primary winding to draw three times the normal value. The charger enclosure shall be connected directly to ground through a fuse as specified in Clause 6.10.3. The transformer shall be operated continuously
(a) until the ultimate result is observed;
(b) for 7 h if cycling of an automatically reset protector occurs; or
(c) for 50 cycles of resetting a manually reset protector.

The test shall be followed by a dielectric strength test, as required by Clause 6.7.1, applied between the primary and secondary windings of the transformer.

6.9.2.3
For a transformer having a centre-tapped secondary winding, a single load shall be connected across the full winding.

6.9.2.4
For a ferro-resonant transformer, the resistive load shall be adjusted to draw maximum power input at a test voltage of 106% of the value specified in Clause 6.2.1.

6.9.2.5
Clause 6.9.2.1 shall not apply to the transformer of an industrial charger, provided that
(a) overcurrent protection rated at least 125%, but not exceeding 150%, of the rated input current is provided as an integral part of the charger; and
(b) when tested under normal rated load, the overcurrent protective device does not trip when tested for three successive ON-OFF operations at intervals of not more than 5 s.

6.9.3 Components

6.9.3.1
The need to test specific electronic components in the primary circuit and the simulated fault condition (open- or short-circuited) shall be determined by an analysis of the total system. The possible effect of one component fault on another, encapsulation, and the like are factors to be considered.

6.9.3.2
When required by Clause 4.2.4.3, the need to test specific electronic components in the secondary circuit and the simulated fault condition (open- or short-circuited) shall be determined by an analysis of the total system. The possible effect of one component fault on another, encapsulation, and the like are factors to be considered.

6.10 Switch Overload

6.10.1
A switch supplied as part of a charger shall be capable of making and breaking, for 50 cycles of operation at intervals of 10 s, a current equal to 150% of the maximum load current at the actual power factor involved.

6.10.2
The current-interrupting test specified in Clause 6.10.1 shall be made at the voltage specified in Clause 6.2.1. The open-circuit voltage of the supply circuit shall be not less than 100% nor more than 105% of the test voltage, except that a higher voltage may be employed if agreeable to the testing agency and the submitter. The current-carrying capacity of the supply circuit shall be such that the closed circuit voltage with rated current flowing is within 2.5% of the test voltage.

6.10.3
The enclosure of a charger designed for use on a system having one conductor grounded shall be connected during the test through a suitable fuse to the grounded conductor of the circuit. If a charger is designed for use on other types of systems, the frame shall be connected through such a fuse to the live pole least likely to arc to ground.

6.10.4
The test cycle shall be 1 s ON and 9 s OFF, if the nature of the switch permits the test to be so made.

6.10.5
There shall be no electrical or mechanical failure of the switch nor undue pitting, burning, or welding of the contacts, and there shall be no flashover to the enclosure.

6.11 Switch Endurance

6.11.1
A switch supplied as part of a charger shall be capable of making and breaking, for 6000 cycles of operation at intervals of 10 s, a current equal to the maximum load current at the actual power factor involved. There shall be no electrical or mechanical failure of the switch nor undue pitting, burning, or welding of the contacts.

6.11.2
The conditions for the endurance test shall be the same as the conditions for the overload test, as indicated in Clauses 6.10.2 to 6.10.4.

6.12 Multi-Voltage Operation
A charger that is intended for operation at two or more supply-voltage levels or with a varying number of battery cells, or both, shall be connected in such a way as to produce the most adverse conditions when connected to the highest ac input voltage specified for the charger (eg, 480 V on a 240 V tap with the product connected for 12-cell charging to a six-cell battery). The charger shall be connected to a discharged battery. All normally supplied protective devices shall be left in the circuit, and the charger energized. The test shall be continued until the internal protection opens, constant temperatures are attained, or the circuitry opens. If an automatically reset protector is provided, the test shall be continued for 7 h. A manually reset protector shall be operated for 50 cycles.

6.13 Strain Relief

The means of strain relief provided on a flexible cord shall withstand for 1 min, without displacement, a direct pull of 156 N applied to the cord, with the connections within the battery charger disconnected. The strain relief shall not be acceptable if, at the point of disconnection of the conductors, there is such movement of the cord as to indicate that stress on the connections would have resulted.

6.14 Compression (Metal Enclosures)

6.14.1

When required by Clause 4.2.2.3, an enclosure constructed of metal that is thinner than that specified in Table 1 shall be reinforced so that its deflection is not more than that of a reference sheet-metal enclosure of the maximum length and width constructed of the minimum required sheet metal thickness.

6.14.2

The enclosure shall rest on a flat, unyielding, horizontal surface. A vertical force shall be applied at any point on the surfaces of the enclosure except for the door or cover, using a flat face of steel bar having a 13 mm^2 cross-section. Force shall be applied to the end, side, and rear walls of each enclosure. The value of force and limit of deflection, both of which shall be measured and recorded, are not specified, but the force on each wall of both the test and reference enclosures shall be sufficient to result in a measurable deflection on the test enclosure.

6.15 Deflection (Metal Enclosures)

6.15.1

A drawn, embossed, flanged, or similarly strengthened door, front, or cover made of metal having a thickness less than that specified in Table 1 shall not deflect inward more than 6.4 mm when a vertical force of 445 N is applied at any point on the door, front, or cover.

6.15.2

The force shall be applied through a bar having a flat, square face, 13 mm on an edge.

6.15.3

The test shall be conducted with the door or cover mounted on the enclosure in the intended manner. The enclosure shall rest on its back on a flat, unyielding, horizontal surface with the door closed and the front or cover secured as intended. The force shall be applied through the bar described in Clause 6.15.2.

6.16 Strength and Stability

6.16.1 Strength

6.16.1.1

Compliance with Clause 4.23.1 shall be determined as follows:

(a) Portable battery chargers having a mass of 18 kg and less: Three samples of the battery charger shall be dropped from a height of 0.9 m to strike a surface in the positions most likely to produce adverse results. An automotive battery charger shall be dropped on a concrete surface. All other battery chargers shall be dropped on a hardwood surface consisting of a layer of tongue-and-groove oak flooring, with a nominal thickness of 25 mm, mounted on two layers of 19 mm thick plywood. The assembly shall rest on a concrete floor or an equivalent support during the test.

(b) Portable battery chargers having a mass over 18 kg, mobile battery chargers, and stationary battery chargers: A smooth steel sphere, 50.8 mm in diameter, with a mass of 0.5 kg, shall be allowed to fall vertically from rest through a distance of 129.5 cm to strike the part being tested. If it is impossible to strike the part from above with the free-falling sphere, the sphere shall be suspended by a cord and allowed to fall as a pendulum through the required vertical distance.

6.16.1.2

The results of the tests specified in Clause 6.16.1.1 shall be considered acceptable if
(a) no uninsulated live parts or moving parts that may involve a risk of injury to persons become accessible, using the probe of Figure 1; and
(b) the sample complies with the dielectric strength test specified in Clause 6.7, with the test potential applied between live parts and accessible non-current-carrying metal parts.

6.16.2 Stability

6.16.2.1

To comply with Clause 4.23.3, a portable or stationary battery charger having a mass more than 0.5 kg shall not tip over, and shall return to its normal at-rest position, when
(a) tipped through an angle of 10° from the at-rest position on a horizontal surface;
(b) placed on a plane inclined at an angle of 10° from the horizontal; or
(c) subjected to an externally applied horizontal force of 20% of the mass of the charger or 22.7 kg, whichever is less.

6.16.2.2

The force specified in Clause 6.16.2.1(c) shall be applied in a horizontal direction at that point on the charger most likely to cause it to overturn, but the force shall not be applied more than 1.5 m above floor level. The legs or points of support may be blocked to prevent the charger from sliding during the application of the force.

6.16.2.3

The battery charger shall not be energized during the tests described in Clauses 6.16.2.1 and 6.16.2.2. The test shall be conducted under conditions of least stability that are judged most likely to cause the battery charger to overturn, which include
(a) varying the position of all adjustable or movable parts such as doors, drawers, or casters;
(b) placing the supply and output cords in either the stored position or on the surface supporting the battery charger, whichever is more severe;
(c) provision of or omission of any normal mechanical load in the battery charger such as stored parts; and
(d) varying the direction in which the battery charger is tipped or the supporting surface is inclined.

6.16.2.4

If the battery charger is constructed so that a part or surface of the charger that is not normally in contact with the horizontal supporting surface touches the supporting surface before the charger has been tipped through an angle of 10°, the tipping shall be continued until the surface or plane of the surface of the charger originally in contact with the horizontal supporting surface is at an angle of 10° from the horizontal supporting surface.

6.17 Resistance to Impact

6.17.1 Polymeric Enclosures

6.17.1.1
Samples of the equipment shall be subjected to the impact tests described in Clauses 6.17.1.2 and 6.17.1.3. The impact shall not
(a) reduce spacings below the minimum acceptable values;
(b) make any bare live parts or internal wiring accessible to contact;
(c) have an undue adverse effect on the insulation; or
(d) produce any other condition that might increase the risk of shock, fire, or casualty of the equipment.

6.17.1.2
Each of three samples of the equipment shall be subjected to an impact on any surface that would be exposed to a blow during normal use or during installation. The impact shall not cause any of the conditions specified in Clause 6.17.1.1 to occur. Tests may be conducted at any ambient temperature within the range of 10 to 40°C. The impact shall be as follows:
(a) For an enclosure having no surface area exceeding 25 800 mm^2, the impact shall be 7 ± 0.2 J, produced by dropping a steel sphere 50 ± 1 mm in diameter and having a mass of 0.53 kg from a height of 1300 mm.
(b) For an enclosure having any surface area of more than 25 800 mm^2, the impact shall be 13.56 J, produced by dropping a steel sphere 50 ± 1 mm in diameter and having a mass of 0.53 kg from a height of 2600 mm.

6.17.1.3
Each of three samples of the equipment shall be cooled to 0°C and maintained at that temperature for 3 h. Immediately following removal from the cold chamber, the sample shall be subjected to the impact test described in Clause 6.17.1.2.

6.17.2 Covers over Openings in Enclosures

6.17.2.1
When required by Clauses 4.2.5.10 and 4.2.5.11, covers over openings in enclosures shall be subjected to the test specified in Clauses 6.17.2.2 and 6.17.2.3. The test shall be conducted on a single sample at any ambient temperature in the range of 10 to 40°C.

6.17.2.2
The test shall be made with an impact of 7 ± 0.2 J for materials relied upon for protection against shock, fire, or mechanical hazards.

6.17.2.3
A single impact shall be applied at right angles to the surface with the equipment in its normal position.

6.17.2.4
The impact shall not cause any of the conditions specified in Clause 6.17.1.1 to occur.

6.17.2.5
The impact shall be applied by a solid, smooth, steel sphere, 50 ± 1 mm in diameter, having a mass of 0.53 kg, as follows:
(a) For top surfaces, the steel sphere shall be allowed to fall freely from rest through the distance required to cause it to strike the enclosure when the sphere has the specified energy.

(b) For surfaces other than the top, the steel sphere shall be suspended by a fine wire and allowed to fall as a pendulum through the distance required to cause it to strike the surface with the specified impact. The enclosure shall be placed so that the surface to be tested is vertical and in the same vertical plane as the point of support of the pendulum.

6.18 Flame Test (Polymeric Enclosures)

6.18.1
When required by Clause 4.2.4.2, nonmetallic enclosures shall be tested in accordance with the vertical burning test specified in Clause 4.2.2 of CSA Standard CAN/CSA-C22.2 No. 0.17 and be classified as having a rating of at least V-1.

6.18.2
When required by Clauses 4.2.4.3 and 4.8.2(a), nonmetallic enclosures and insulating material in contact with or likely to contact bare live parts shall be tested in accordance with the vertical burning test specified in Clause 4.2.2 of CSA Standard CAN/CSA-C22.2 No. 0.17 and be classified as having a rating of at least V-2.

6.19 Coated Printed Wiring Boards

6.19.1
When reduced spacings are permitted on printed wiring boards protected by a conformal coating in accordance with Clause 4.17.5, each of three samples shall be subjected to the following tests:
(a) The sample shall be conditioned by being flexed slightly four times to simulate conditions of handling.
(b) Following the conditioning requirements of Item (a), a voltage of 1000 V plus twice the circuit voltage and at circuit frequency shall be applied between traces with reduced spacing.
(c) The sample shall then be conditioned for 96 h at a temperature of 90 ± 5°C. On completion of this conditioning, the sample shall again be subjected to the tests specified in Items (a) and (b).
(d) Following the test specified in Item (c), the sample shall be conditioned for 96 h in air having a temperature of 23 ± 1°C and a relative humidity of 96 ± 2%. On completion of this conditioning, the sample shall again be subjected to the tests specified in Items (a) and (b).

6.19.2
At the completion of the tests specified in Clause 6.19.1(d), adhesion of the coating to the sample shall be such that there is no flaking when the coating is cut or scraped.

6.20 Water Test
When required by Clause 4.2.1.5, a battery charger intended to be mounted under the hood of an automobile shall be subjected to the water test specified in CSA Standard CAN/CSA-C22.2 No. 94 for Enclosure 2, except that the spray shall be applied from the direction most likely to cause water to enter the enclosure, with the enclosure mounted as intended. Water shall not come in contact with the enclosed electrical equipment during the test.

6.21 Performance (Protectors)

6.21.1
Manual-reset and automatic-reset protectors rated 50 A and less, 24 V dc and less, shall comply with the requirements of the performance tests described in Clauses 6.21.5 and 6.21.6 under the test conditions specified in Clauses 6.21.2 to 6.21.4.

6.21.2
A storage battery of the rating specified in Table 11 shall be used for all tests. Means shall be provided for maintaining the specified voltage at the battery terminals during the open-circuit portions of the tests.

6.21.3
The protector shall be connected in series with the battery and a resistor that can be adjusted to obtain the required load of the protector. The test leads shall be copper wire of the size specified in Table 12. The total length of the leads shall be
(a) 1 m for protectors rated 6 or 12 V; and
(b) 2 m for protectors rated 24 V.

6.21.4
The test current for the short-circuit test shall be greater than 500% of the rated current of the protector but shall not exceed
(a) 700 A for protectors rated 6 or 12 V; and
(b) 525 A for protectors rated 24 V.

6.21.5
Automatic-reset protectors shall be subjected to the following tests in the sequence specified:
(a) cycled for 30 min, making and breaking the short-circuit current of the battery;
(b) operated for 1 h at 80% rated current of the protector, after which the millivolt drop at 80% rated current of the protector shall not exceed the value specified in Figure 7;
(c) cycled to failure, making and breaking the short-circuit current of the battery. Failure shall result in an open circuit in the protector*; and
(d) subjected to an ac voltage of 500 V applied between both terminals and the case of the protector for 1 min without breakdown at the completion of the test in Item (c), for those protectors having a metal case bonded to the charger enclosure.
**In some field applications, a high current resistance and/or a low current power source may not provide enough current to ensure that the ultimate failure will always result in an open circuit in the protector.*

6.21.6
Manual-reset protectors shall be subjected to the following tests in the sequence specified:
(a) cycled for 20 ON-OFF cycles, making and breaking the short-circuit current of the battery;
(b) operated for 1 h at 80% rated current of the protector, after which the millivolt drop at 80% rated current of the protector shall not exceed the value specified in Figure 7; and
(c) subjected to an ac voltage of 500 V applied between both terminals and the case of the protector for 1 min without breakdown at the completion of the test in Item (b), for those protectors having a metal case bonded to the charger enclosure.

6.22 Insulating Material
Insulating material in contact with bare live parts shall withstand the application of an ac voltage of 3000 V for 1 min when placed between two 6.35 mm diameter probes after being conditioned for 96 h in moist air having a relative humidity of 90 ± 5% and a temperature of 35 ± 2°C.

6.23 Flaming Oil Test (Perforated Panels)

6.23.1
This test shall be conducted on perforated metal panels that are to be investigated for suitability to use as a barrier or the bottom of an enclosure as specified in Clause 4.2.5.7(d)(iii).

6.23.2
The apparatus for this test shall consist of a metal ladle, no more than 65 mm in diameter, with a pouring lip, a heat-resistant glass dish, a stand for supporting the test specimen, a quantity of bleached cheesecloth running approximately 34 g/m^2 and having a thread count in the range of 10–13 by 9–12 threads/cm, a supply of No. 2 furnace oil, and a stop-clock.

6.23.3
The tests shall be made in a room free from all drafts of air. A specimen of the material shall be supported horizontally 50 mm above a layer of cheesecloth placed in a dish.

6.23.4
Ten millilitres of No. 2 furnace oil poured into a ladle shall be ignited and allowed to burn for at least 1 min. It shall then be poured at a rate of not less than 1 mL/3 s on the specimen from 100 mm above it.

6.23.5
Means shall be provided to ensure that only oil that passes through the test specimen makes contact with the cheesecloth.

6.23.6
The cheesecloth shall not be ignited through the application of the burning oil during three applications at 5 min.

7. Chargers Intended to be Used for Special Applications

7.1 Scope

7.1.1
Clause 7 applies to battery chargers rated at 300 V or less intended to be used for special applications such as recharging batteries for life-support systems, wheelchairs, mobility aids, or other similar types of medical equipment. This Clause does not apply to direct plug-in chargers with Class 2 output characteristics.

7.1.2
The requirements of Clause 7 supplement or amend the requirements of Clauses 1 to 6.

7.2 Construction

7.2.1 Openings in Enclosures
Ventilating openings shall be permitted only in the sides of the charger, with individual openings limited to 40 mm^2, and there shall be no evidence of a fire hazard as determined by the secondary circuit protection test specified in Clause 7.5.4.

7.2.2 Power-Supply Cord

7.2.2.1
The power-supply cord attachment plug shall have a voltage rating suitable for the voltage marked on the charger and a current rating not less than 125% of the total input marked on the charger.

7.2.2.2
The power-supply cord shall be hard-usage Type SJ, SJO, SJT, or the equivalent, and shall be at least 1.5 m long.

7.2.3 Secondary Cord
The secondary cord shall be hard-usage Type SJ, SJO, SJT, or the equivalent, terminating in a special-purpose polarized connector to prevent reverse polarity connection. The special-purpose connector shall have no exposed current-carrying pins that could be short-circuited accidentally.

7.2.4 Primary Overcurrent and Overload Protection
The internal wiring shall have protection against injury to insulation resulting from any overload or short-circuit condition that can occur at the output of the battery charger.

7.2.5 Secondary Circuit Protection

7.2.5.1
Short-circuiting or overloading the output shall not result in a fire or shock hazard.

7.2.5.2
Reverse polarity protection shall be provided.

7.2.6 Overcharge Protection
The charger shall have a means provided to prevent overcharging of the battery, as required by Clause 7.5.3.3(d).

7.2.7 Transformer
In addition to the transformer requirements of Clause 4.9, the maximum temperature of the transformer primary winding shall not exceed 130°C for Class A insulation under transformer fault conditions, except that if protection is provided by a nonreplaceable, nonresettable protection integral within the transformer, the temperature may exceed 130°C, but not more than 150°C. The allowable limits for Class B insulation are 160°C and 180°C, respectively.

7.3 Marking

7.3.1
In addition to the markings required by Clause 5, the charger shall be marked SPECIAL APPLICATION and UTILISATION SPÉCIALE.

7.3.2
Where a charger is not designed and approved for charging batteries of equipment that is in operation, it shall have the following marking:
WARNING: CHARGER IS NOT TO BE USED WHILE THE EQUIPMENT IS OPERATING
and
ATTENTION : NE PAS UTILISER LE CHARGEUR PENDANT QUE L'ÉQUIPEMENT EST EN MARCHE.

7.4 Instruction Manual
Unless the charger is designed and approved for use while the equipment is operating, the instruction manual shall include a warning not to use the charger while the equipment is operating.

7.5 Tests

7.5.1 Normal Load

The load to be used for the rating (input) test and the temperature test shall be a recommended discharged battery, with an adjustable resistor in parallel to maintain the charger in a fully loaded condition.

7.5.2 Rating (Input)

The input in amperes and volt amperes shall be measured under the conditions specified in Clause 6.2 and shall not exceed the marked rating by more than 10%.

7.5.3 Temperature (Normal)

7.5.3.1

The test conditions shall be in accordance with the test supply voltage and load specified in Clauses 6.2 and 7.5.1.

7.5.3.2

Temperatures shall be determined either by thermocouples or the rise-of-resistance method when the equipment is tested under the load conditions specified in Clause 7.5.1 until thermal equilibrium is reached.

7.5.3.3

The charger shall be considered to comply with the requirements when

(a) temperatures at specified points do not exceed the values in Table 9;

(b) there is no other evidence of fire hazard or injury to materials in the charger;

(c) overheating protective devices for any of the loads in the charger do not operate during the normal test; and

(d) it has been determined that the battery overcharge protection feature has prevented damaging overcharge of the battery, as required by Clause 7.2.6.

Note: *Overcharging is normally accompanied by a rapid increase in temperature with little or no change in the specific gravity level of the battery.*

7.5.4 Secondary Circuit Protection

7.5.4.1

The battery charger shall be tested as prescribed in Clauses 7.5.4.2 to 7.5.4.4. Compliance with the tests shall be determined by the requirements specified in Clause 7.5.4.5.

7.5.4.2

To test for a fire or shock hazard, the battery charger shall be operated with its output short-circuited. The duration of the test or the number of test cycles depends upon the type of protective device that operates to provide protection and shall be one of the following:

(a) 24 h for automatic-reset devices or current-limiting devices;

(b) 50 cycles for manual-reset devices; and

(c) 1 cycle if a fuse or a one-shot thermal protector opens.

Protecting the circuit by other means, such as current regulators or the opening of semiconductor devices, shall be investigated to determine the acceptability of the means employed. Opening a trace on a printed wiring board shall not be considered an acceptable means.

7.5.4.3
The battery charger shall be operated for the duration and at the output current loading specified in Items (a) or (b), as applicable:
(a) 7 h at the maximum continuous current permitted by an automatic-reset protector, by a current-limiting device, or by a semiconductor device; or
(b) 1 h at 135% of the current rating of the fuse or manual-reset device with the protective device bypassed.

7.5.4.4
The charger shall be connected in reverse polarity to a recommended fully charged battery. The test shall be continued for 4 h. During this test, a polarity protection circuit that prevents output current flow until a battery is correctly connected to the output shall be made inoperative.

7.5.4.5
On completion of the tests described in Clauses 7.5.4.2 to 7.5.4.4, there shall be
(a) no opening of the branch-circuit overcurrent protection, except for the reverse polarity test. The branch-circuit overcurrent protection shall be rated or set at 15 A;
(b) no opening of a 3 A fuse connected in the ground circuit; and
(c) no dielectric breakdown, as determined by the dielectric strength test described in Clause 6.7.

8. Marine Battery Chargers

8.1 Scope

8.1.1
Clause 8 applies to battery chargers rated 300 V or less and intended for fixed installation on boats that are not required to be certified by Transport Canada.

8.1.2
These requirements cover semi-automatic and fully automatic battery chargers for charging batteries in service from an on-board ac power-supply source.

8.1.3
These requirements do not cover battery chargers in which the output current is manually controlled, requiring constant attention; nor do they apply to portable battery chargers, except those battery chargers that employ demountable brackets to facilitate removal when not in use.

8.1.4
The requirements of Clause 8 supplement or amend the requirements in Clauses 1 to 6.

8.2 Construction

8.2.1 General

8.2.1.1
A battery charger shall employ mounting means such that it will be held securely in position when subjected to vibration, shock, pitching, yawing, and rolling.

8.2.1.2
A battery charger shall be provided with an ammeter for measuring the output current. A battery charger incorporating means for a manual input voltage adjustment shall also employ an input voltmeter.

8.2.1.3
With reference to Clause 8.2.1.2, a meter may be located in an area remote from the charger, provided that
(a) the meter shunt is located within the charger enclosure; and
(b) overcurrent protection for external meter leads is provided within the charger enclosure.

8.2.2 Frame and Enclosure

8.2.2.1
A battery charger intended to be mounted on a bulkhead or other vertical surface shall be provided with mounting holes of the same nominal size as the mounting screws.

8.2.2.2
A battery charger having both ordinary mounting holes and keyhole slots not intended for marine use shall be provided with installation instructions in accordance with Clause 8.4.3.

8.2.2.3
The enclosure of a battery charger intended to be installed in an open cockpit or on a weather deck shall comply with the requirements for weatherproof enclosures as specified in CSA Standard CAN/CSA-C22.2 No. 94.

8.2.3 Supply Connections

8.2.3.1
A cord-connected battery charger shall be provided with at least a Type SJT or SJTO cord, or the equivalent.

8.2.3.2
A battery charger employing demountable brackets shall be provided with a power-supply cord having a grounding conductor and an attachment plug.

8.2.3.3
A fixed battery charger shall have a terminal or lead for connecting the metal enclosure and enclosure parts to ground.

8.2.4 Output Connections

8.2.4.1
Connections between a battery charger and a battery shall be made by means of terminals or an equivalent permanent connection, or by the use of plug connectors, as described in Clause 8.2.4.2. Clips shall not be used for output connections.

8.2.4.2
Plug connections shall be used for direct-current wiring connections to a battery charger employing demountable brackets in order to provide separation of the positive and negative leads when the charger is removed.

8.2.5 External-Ignition Protection

8.2.5.1
A battery charger intended for installation in an area where external-ignition-protected equipment is required shall be
(a) subjected to the test specified in Clause 8.5.3.1; and
(b) marked in accordance with Clause 8.3.4.

8.2.5.2
A battery charger intended for use in an area in which ignition-protected-equipment is not required shall be marked in accordance with Clause 8.3.5.

8.2.5.3
The areas where external-ignition-protected equipment is required are described in CSA Standard C22.2 No. 183.1.

8.2.6 Receptacles
An attachment-plug receptacle shall not be employed in a battery charger intended for use in an area in which external-ignition-protected equipment is required.

8.2.7 Arcing Parts

8.2.7.1
Except as provided for in Clause 8.2.7.2, a component that can produce an arc, such as a snap switch or a relay, shall not be employed in a battery charger intended for use in an area in which external-ignition-protected equipment is required. The equipment shall be marked in accordance with Clause 8.3.4.

8.2.7.2
A component that complies with the test specified in Clause 8.5.3.2 shall be acceptable.

8.2.8 Vibration and Shock
The battery charger shall withstand the vibration test prescribed in Clause 8.5.1 and the shock test prescribed in Clause 8.5.2.
Note: *Clause 8.2.8 does not apply to chargers marked for use on vessels more than* 20 m *long (see Clause 8.3.7).*

8.3 Marking

8.3.1
A battery charger that complies with the requirements of Clause 8 shall be marked
FOR MARINE USE
and
POUR UTILISATION MARINE.

8.3.2
A battery charger shall be marked to indicate that it is rated for continuous duty.

8.3.3
A semi-automatic battery charger shall be marked with the following or equivalent wording:
CAUTION: TO PREVENT OVERCHARGING, COMPENSATE INPUT VOLTAGE. SEE INSTRUCTIONS.
and

ATTENTION : ÉQUILIBRER LA TENSION D'ENTRÉE POUR ÉVITER LA SURCHARGE. CONSULTER LA NOTICE.

8.3.4
A battery charger that complies with the requirements for external-ignition protection of Clause 8.5.3 shall be marked
IGNITION PROTECTED
and
PROTÉGÉ CONTRE L'EXPLOSION.

8.3.5
A battery charger not subjected to the external-ignition protection test specified in Clause 8.5.3 shall be marked with the following or equivalent wording:
WARNING: DO NOT INSTALL IN MACHINERY SPACE IN WHICH IGNITION-PROTECTED EQUIPMENT IS REQUIRED. SEE INSTALLATION INSTRUCTIONS
and
AVERTISSEMENT : NE PAS INSTALLER DANS UNE ZONE OÙ IL EST EXIGÉ QUE LE MATÉRIEL SOIT PROTÉGÉ CONTRE L'EXPLOSION. CONSULTER LA NOTICE D'INSTALLATION.

8.3.6
A battery charger not intended for use on a weather deck shall be marked with the following or equivalent wording:
WARNING: DO NOT EXPOSE TO RAIN OR SPRAY
and
AVERTISSEMENT : NE PAS EXPOSER AUX INTEMPÉRIES.

8.3.7
Unless subjected to the vibration and shock tests specified in Clauses 8.5.1 and 8.5.2, a battery charger shall be marked with the following or equivalent wording:
FOR USE ON VESSELS OVER 20 M LONG
and
CONVIENT AUX BATEAUX DE PLUS DE 20 M DE LONGUEUR.

8.4 Installation and Operating Instructions

8.4.1
Installation and operating instructions shall be provided with each battery charger.

8.4.2
Operating instructions shall include a description of the function of an automatic or a semi-automatic battery charger, whichever is applicable.

8.4.3
Installation instructions for a charger having keyhole slots shall include a statement that the keyhole slots are not to be used for installing the charger. (See Clause 8.2.2.2.)

8.4.4
Installation instructions for a battery charger not marked IGNITION PROTECTED and PROTÉGÉ CONTRE L'EXPLOSION in accordance with Clause 8.3.4 shall list the potential sources of ignition, as described in CSA Standard C22.2 No. 183.1.

8.5 Tests

8.5.1 Vibration

8.5.1.1
A battery charger shall withstand the vibration test specified in Table 13 for 12 h, when tested as described in Clauses 8.5.1.2 and 8.5.1.3, without structural damage to the mounting means or the enclosure that might result in

(a) an increase in the risk of fire, electric shock, or injury to persons;
(b) a reduction of spacings to a value less than the minimum specified in Clause 4.17; or
(c) exposure of a live part.

The intended operation of the battery charger shall not be impaired.

8.5.1.2
The charger shall be mounted as intended on a rigid test fixture that is secured to the vibration table. The battery charger shall be wired so as to permit the device to be monitored in accordance with Clause 8.5.1.4 during the last hour of vibration in each plane and after the complete vibration test.

8.5.1.3
The charger shall be subjected to a variable frequency test in each of three rectilinear axes — horizontal, lateral, and vertical — for 4 h in each plane (total of 12 h) at the peak-to-peak amplitude specified in Table 13. The vibration frequency shall be automatically cycled at a constant rate from 10 to 60 to 10 Hz every 4 min.

8.5.1.4
To determine whether a battery charger operates as intended, the charger shall be connected to a supply adjusted to rated voltage, and the output shall be connected to a fully charged battery. A variable resistive load adjusted to draw the maximum rated output of the battery charger shall be connected in parallel with the battery. With the variable resistive load both connected and disconnected, the output voltage of the battery charger shall be maintained at 2.15–2.35 V per cell.

8.5.2 Shock

8.5.2.1
A battery charger that has been subjected to the vibration test in Clause 8.5.1 shall withstand 5000 impacts of 10 *g* peak with a duration of 20–25 ms — measured at the zero reference line of the half-sine wave shock pulse — without structural damage to the mounting means or the enclosure that might result in

(a) an increase in the risk of fire, electric shock, or injury to persons;
(b) a reduction of spacings to a value less than the minimum specified in Clause 4.17; or
(c) exposure of a live part.

The intended operation of the battery charger shall not be impaired, and the charger shall comply with the requirements in Clause 8.5.1.4 upon completion of the test.

8.5.2.2
The battery charger shall be mounted as intended on a rigid test fixture secured to the shock table. The charger need not be operable during the test.

8.5.3 External-Ignition Protection

8.5.3.1
Battery chargers shall be subjected to the spark ignition test for nonincendive circuits specified in CSA Standard CAN/CSA-C22.2 No. 157.

8.5.3.2
A component that can produce an arc shall be subjected to the spark ignition test for nonincendive components specified in CSA Standard CAN/CSA-C22.2 No. 157.

9. Transformerless Nonisolated Battery Chargers for Special-Purpose Battery Packs

9.1 Scope

9.1.1
These requirements apply to cord-connected transformerless nonisolated battery chargers designed to charge special-purpose battery packs, where the battery pack is detachable and is not connected to the end-usage power-consuming device when recharging.

9.1.2
These requirements apply to battery chargers that have output connectors designed to prevent user contact with live parts.

9.1.3
The requirements of Clause 9 supplement or amend the requirements of Clauses 1 to 6.

9.2 Construction

9.2.1 General

9.2.1.1
A charger shall have
(a) a supply circuit voltage not exceeding 120 V rms;
(b) an output circuit limited to 240 V•A; and
(c) provision for connecting only to a specified battery pack, containing batteries suitable for recharging, investigated in conjunction with the charger.

9.2.1.2
Component parts of a battery charger shall either be of a type specifically approved for the use intended or shall be investigated as an integral part of the assembly.

9.2.1.3
All internal circuits of the battery charger shall be considered to be input circuits.

9.2.2 Enclosures

9.2.2.1
Enclosures shall prevent access to live parts and current-carrying parts that operate at voltages over 4.4 V peak (20 V rms), and shall prevent access, without the use of a tool, to parts that can present a hazard.

9.2.2.2
Nonmetallic enclosures shall comply with the requirements of the flame test described in Clause 9.4.6.

9.2.2.3
Enclosures shall meet the requirements of the drop test described in Clause 9.4.7.

9.2.3 Openings in Enclosures
Except as specified in Clause 9.2.8.2, an enclosure containing a wire, a splice, a connection, or an electrical component having a voltage of more than 42.4 V peak to ground shall have no opening that will permit the entry of a straight rod 6.4 mm in diameter.

9.2.4 Supply Connection

9.2.4.1
A supply cord and attachment plug cap or a cord set shall be provided for connection to the power-supply circuit.

9.2.4.2
The supply cord shall be Type SPT-2 or equivalent, not smaller than No. 18 AWG.

9.2.5 Internal Wiring

9.2.5.1
Internal wiring shall have a type of insulation recognized as suitable for the application when considered with respect to the voltage, current, and temperature to which the wiring may be subjected.

9.2.5.2
All conductors shall be insulated for the highest voltage available in the device.

9.2.5.3
Soldered connections shall be made mechanically secure before soldering.

9.2.5.4
Internal quick-disconnect terminals and connectors of the blade-and-jaw configuration shall maintain continuity when subjected to the drop test specified in Clause 9.4.7.

9.2.6 Electrical Insulating Materials

9.2.6.1
Materials on which bare live parts are mounted shall comply with the requirements of CSA Standard CAN/CSA-C22.2 No. 0.

9.2.6.2
Materials that contact live parts and exposed metal parts shall comply with the requirements of Clause 9.2.6.3.

9.2.6.3
Insulating material shall withstand a 3000 V dielectric withstand test for 1 min when placed between two 6.25 mm diameter probes after being conditioned for 96 h in moist air having a relative humidity of 90 ± 5% and a temperature of 35 ± 2°C.

9.2.7 Electrical Spacings

9.2.7.1
Except as specified in Clause 9.2.7.2, the spacings specified in Tables 5 and 6 shall be maintained between
(a) bare live parts of the opposite polarity; and
(b) bare live parts and non-current-carrying metal parts.

9.2.7.2
Spacings within components such as lampholders shall comply with the requirements of the applicable Standard of the *Canadian Electrical Code, Part II*.

9.2.7.3
If live parts are not rigidly supported, or if movable non-current-carrying metal parts are in proximity to bare live parts, the construction shall be such that the minimum spacings specified will be maintained under all conditions.

9.2.7.4
As an alternative to the spacings referenced in Clause 9.2.7.1, the spacings shall comply with the requirements of Clauses 4.17.5 and 4.17.6.

9.2.8 Output Connections

9.2.8.1
Receptacles of the configurations identified in the *Canadian Electrical Code, Part I*, shall not be used as output connectors.

9.2.8.2
The output connectors shall not allow a 2.4 mm rod of any convenient length to contact a live part.

9.2.8.3
There shall be a minimum spacing over surface and through air of 6.0 mm between live parts and foil stretched over the opening(s) providing access to the connector.

9.2.9 Output Circuit Protection
The battery charger shall comply with the requirements of Clause 9.4.5.

9.2.10 Battery Pack

9.2.10.1
The battery pack shall meet the same requirements for construction and performance as the battery charger when connected to the charger.

9.2.10.2
The battery pack shall be a permanently sealed nonserviceable unit.

9.2.10.3
The battery pack shall be vented in order to provide protection from explosion hazard.

9.3 Marking

9.3.1
The battery charger shall be marked in a permanent and visible manner with the following information, in addition to markings required by Clause 5:
(a) input (may be in watts);
(b) identification of rechargeable battery pack(s) suitable for use with the charger; and
(c) warning markings in English and French (see Clause 9.3.2).

9.3.2
The following warnings or equivalent shall appear on the battery charger:
(a) WARNING: 120 V AC PRESENT AT CHARGER TERMINALS. DO NOT PROBE WITH CONDUCTIVE OBJECTS
and
AVERTISSEMENT : LA TENSION AUX BORNES DU CHARGEUR EST DE 120 V C.A. NE PAS INSÉRER DES OBJETS POUVANT ÊTRE CONDUCTEURS D'ÉLECTRICITÉ.
(b) FOR USE INDOORS ONLY (or DO NOT EXPOSE TO RAIN)
and
UTILISER À L'INTÉRIEUR (or NE PAS EXPOSER À LA PLUIE).

9.3.3
The battery pack shall be marked with a statement FOR USE WITH _____ and POUR USAGE AVEC LE CHARGEUR DE PILES _____ that includes the manufacturer's name and model number of the compatible power supply.

9.4 Tests

9.4.1 Test Conditions

9.4.1.1
The load for test purposes shall be the supplied battery pack, which is to be discharged before tests.

9.4.1.2
The current and voltage at the output terminals of the battery charger shall be measured using an average-indicating-type (permanent magnet moving-coil-type) meter. For all other current, voltage, and power measurements, a true root-mean-square (rms) meter shall be used. Peak voltage measurements may be made with a peak-indicating instrument or oscilloscope.

9.4.2 Rating

9.4.2.1
The input in amperes, watts, or volt-amperes shall be measured when the battery charger is operated under rated load conditions at the test voltage and frequency specified in Clause 6.2 until temperatures of components have stabilized. The measured value shall not exceed the marked rating by more than 20%.

9.4.2.2
The rated total output shall not exceed 100 V•A.

9.4.3 Dielectric Strength

9.4.3.1
With the battery charger at normal operating temperature, an ac voltage of 1000 V rms shall be applied

for 1 min, without breakdown, between line-voltage current-carrying parts and ground.

9.4.3.2
In the case of a power supply with an enclosure of insulating material, the test voltage shall be applied between line-voltage current-carrying parts and foil wrapped around the enclosure.

9.4.4 Leakage Current
The leakage current of a battery charger shall not exceed 0.5 mA when tested in accordance with Clause 6.5 while the equipment is at operating temperature.

9.4.5 Abnormal

9.4.5.1
The battery charger shall be investigated for overload, short-circuit, and component failure, as follows:
(a) Overload: 4 h at the maximum continuous load permitted by the circuitry;
(b) Short-circuit: 15 d with the output terminals shorted-circuited; and
(c) Component failure: components such as resistors, capacitors, and semiconductor devices such as rectifiers, thyristors, thermistors, and transistors, or circuits containing these components, shall be short-circuited or open-circuited one at a time to determine that a fire hazard will not occur.

9.4.5.2
The following test procedure shall be used to determine compliance with Clause 9.4.5.1:
(a) Only one fault (opening or shorting) at a time shall be introduced.
(b) The battery charger shall be set up as for the normal temperature test described in Clause 6.6.
(c) The test voltage and frequency shall be those specified in Clause 6.2.
(d) The test shall be continued as long as necessary to establish steady state conditions, or up to the point of interruption of the circuit due to failure of the component, or to other consequences of the simulated fault condition, whichever occurs first.

9.4.5.3
Rectifiers and capacitors shall be short-circuited to simulate failure. The battery charger shall be energized before the fault is applied.

9.4.5.4
The results of all tests shall be considered acceptable if there is
(a) no opening of the branch-circuit protection;
(b) no emission of flame or molten material from the overall enclosure;
(c) no resultant opening in the overall enclosure that would expose live or current-carrying parts, as determined by the rod tests described in Clause 9.2.3; and
(d) no failure when the dielectric strength test described in Clause 9.4.3 is applied.

9.4.5.5
The battery pack shall be investigated for short-circuit and overcharge as follows:
(a) Short-circuit: the output terminals of a fully charged battery pack with exposed terminals shall be short-circuited for 4 h. After removing the short-circuit, the battery pack shall be recharged.
(b) Overcharge: the battery pack shall be charged in the charger. After charging, the battery pack shall be removed from the charger for 0.5 h. The battery pack shall be reinserted into the battery charger and allowed to charge.

9.4.5.6
The results of the test described in Clause 9.4.5.5 shall be considered acceptable if there is
(a) no emission of flame or molten material from the battery pack;
(b) no leakage of electrolyte from the battery pack; and
(c) no resultant openings in the battery pack that could expose live or current-carrying parts as determined by the rod tests described in Clause 9.2.3.

9.4.6 Flame (Nonmetallic Enclosures)
Nonmetallic enclosures shall be tested in accordance with the vertical burning test specified in Clause 4.2.2 of CSA Standard CAN/CSA-C22.2 No. 0.17 and be classified as having a rating of at least V-0.

9.4.7 Drop

9.4.7.1
A battery charger shall be subjected to a drop test. No live part shall be made accessible as a result of this test, as determined by the rod test specified in Clause 9.2.3, and no condition shall exist that would increase the shock hazard of the battery charger.

9.4.7.2
A battery charger shall be dropped three times in succession from a height of 900 mm on the test floor. Each of the three drops shall result in the impact's occurring at a different point on the battery charger enclosure.

9.4.7.3
The test floor shall be concrete covered with a nominal 3.2 mm thick vinyl tile. At the completion of the drop test, the battery charger shall withstand the dielectric strength test described in Clause 9.4.3.

Table 1
Thickness of Sheet Metal for Enclosures — Carbon Steel or Stainless Steel

(See Clauses 4.2.2.1, 4.2.2.3, 4.2.2.4, 6.14.1, and 6.15.1.)

Maximum without supporting frame, cm*		Maximum with supporting frame or equivalent reinforcement, cm*		Minimum acceptable thickness, mm	
Width†	Length‡	Width†	Length‡	Uncoated	Metal-coated
10.2 12.1	Not limited 14.6	15.9 17.1	Not limited 21.0	0.52	0.59
15.2 17.8	Not limited 22.2	24.1 25.4	Not limited 31.8	0.68	0.75
20.3 22.9	Not limited 29.2	30.5 33.0	Not limited 40.6	0.78	0.88
31.8 35.6	Not limited 45.7	49.5 53.3	Not limited 63.5	1.02	1.16
45.7 50.8	Not limited 63.5	68.6 73.7	Not limited 91.4	1.34	1.43
55.9 63.5	Not limited 78.7	83.8 88.9	Not limited 109.2	1.52	1.62
63.5 73.7	Not limited 91.4	99.1 104.1	Not limited 129.5	1.69	1.79
83.8 88.9	Not limited 119.4	129.5 137.2	Not limited 167.6	2.00	2.14
106.7 119.4	Not limited 149.9	162.6 172.7	Not limited 213.4	2.30	2.47
132.1 152.4	Not limited 188.0	203.2 213.4	Not limited 261.6	2.73	2.85
160.0 185.4	Not limited 228.6	246.4 261.6	Not limited 322.6	3.11	3.23

**See Clause 4.2.2.4.*

†*The width is the smaller dimension of a rectangular piece of sheet metal that is part of an enclosure. Adjacent surfaces of an enclosure may have supports in common and be made of a single sheet.*

‡*"Not limited" applies only if the edge of the surface is flanged at least* 12.7 mm *or fastened to adjacent surfaces not normally removed in use.*

Table 2
Thickness of Sheet Metal for Enclosures — Aluminum, Copper, or Brass

(See Clauses 4.2.2.1, 4.2.2.3, and 4.2.2.4.)

Maximum without supporting frame, cm*		Maximum with supporting frame or equivalent reinforcement, cm*		Minimum acceptable thickness, mm
Width†	Length‡	Width†	Length‡	
7.6 8.9	Not limited 10.2	17.8 21.6	Not limited 24.1	0.58
10.2 12.7	Not limited 15.2	25.4 26.7	Not limited 34.3	0.74
15.2 16.5	Not limited 20.3	35.6 38.1	Not limited 45.7	0.91
20.3 24.1	Not limited 29.2	48.3 53.3	Not limited 63.5	1.14
30.5 35.6	Not limited 40.6	71.1 76.2	Not limited 94.0	1.47
45.7 50.8	Not limited 63.4	106.7 114.3	Not limited 139.7	1.91
63.5 73.7	Not limited 91.4	152.4 162.6	Not limited 198.1	2.41
94.0 106.7	Not limited 134.6	221.0 236.2	Not limited 289.6	3.10
132.1 152.4	Not limited 188.0	312.4 330.2	Not limited 406.4	3.89

**See Clause 4.2.2.4.*

†*The width is the smaller dimension of a rectangular piece of sheet metal that is part of an enclosure. Adjacent surfaces of an enclosure may have supports in common and be made of a single sheet.*

‡*"Not limited" applies only if the edge of the surface is flanged at least* 12.7 mm *or fastened to adjacent surfaces not normally removed in use.*

Table 3
Minimum Thickness of Cast Metal Enclosures for Live Parts

(See Clause 4.2.3.)

	Plain walls, mm	
Method of fabrication	Maximum area 15 500 mm^2 and maximum length 150 mm	Area over 15 500 mm^2 or length over 150 mm
Die-cast	1.6*†	2.4
Other	3.2	3.2

**Area and length limitations may be complied with by subdividing larger areas by means of suitable reinforcing ribs.*

†*Thickness may be reduced to* 0.9 mm *if the enclosure will not be used as a splice box. This thickness may be reduced to* 0.7 mm *minimum for enclosures housing only extra-low-voltage circuits.*

Note: *Thinner metal may be accepted, provided that the enclosure is of such thickness or shape or so reinforced as to give strength and protection at least equivalent to that provided by metal of the thickness specified in this Table.*

Table 4
Acceptable Perforated Metal Plates, mm

(See Clause 4.2.5.7(d)(ii).)

Thickness	Diameter of holes	Spacing of holes centre-to-centre
0.66	1.14	1.70
0.66	1.19	2.36
0.76	1.15	1.70
0.76	1.19	2.36
0.81	1.91	3.18
0.89	1.90	3.18
0.91	1.60	2.77
0.91	1.98	3.18
1.00	1.60	2.77
1.00	2.00	3.00

Table 5
Spacings for Battery Chargers (Other than Household Types)

(See Clauses 4.17.1, 4.17.5, and 9.2.7.1.)

		Minimum spacing, mm		
		Between live parts of opposite polarity and between bare live parts and non-current-carrying metal parts*		Between bare live parts and walls of enclosure through air and over surface
Voltage, V rms	Location	Through air	Over surface	
50 or less	Other than at wiring terminals	1.6	1.6	1.6
51–150	" " "	3.2*	6.4†	6.4
151–300	" " "	6.4†	9.5†	12.7
301–600	" " "	9.5	12.7	12.7
0–150	At wiring terminals	6.4	6.4	6.4
151–300	" " "	6.4	9.5	12.7
301–600	" " "	9.5	12.7	12.7

**Including conduit fittings.*

†*At fixed parts of rigidly clamped assemblies of live parts and insulated separators (such as on relays and printed circuit panels that are wired at the factory), the spacings may be less than those specified, subject to all of the following conditions:*

(a) a fire or shock hazard (see Note 3) will not result from a short-circuit;

(b) the power is limited to

(i) 5 A *or less by an included fuse, rated* 5 A *or less, or by suitable continuously rated resistors; or*

(ii) 1500 V•A *or less by a transformer (determined by multiplying the secondary open-circuit voltage by the secondary short-circuit current); and*

(c) the spacings, through air and over surface, are not less than 1.6 mm *nor less than* 0.8 mm *on printed circuit panels having a suitable coating.*

Notes:

(1) *In a Class 2 secondary circuit that is not a shock hazard, the spacings are not specified between live parts of opposite polarity and between live parts and dead metal that is grounded.*

(2) *On printed circuit boards where power is not limited (see † note above), spacings may be one-half that shown in this Table, if suitably coated.*

(3) *A shock hazard is considered to exist where*

(a) a bare live part of a secondary ELV circuit that leaves the enclosure is adjacent to a low-voltage bare live part and the available fault current from the low-voltage circuit is greater than 5 mA*; and*

(b) breakdown of insulation (as determined by the dielectric strength test) between primary and secondary windings results from a short-circuit in the secondary circuit.

Table 6
Spacings for Household Indoor-Type, Cord-Connected, and Plug-In Battery Chargers

(See Clauses 4.17.1, 4.17.5, and 9.2.7.1.)

	Minimum spacing, mm		
	Between bare live parts of opposite polarity and between bare live parts and non-current-carrying metal parts		Between bare live parts and walls of a metal enclosure
Voltage, V rms	Through air	Over surface	Shortest distance
50 or less	1.6*	1.6*	1.6
Over 50 to 150	3.2*	6.4*	6.4

**Smaller spacings are allowed*

(a) on printed wiring boards, their connectors, and board-mounted electrical components subject to the conditions specified in Clause 4.17.5; and

(b) where spacings will be rigidly maintained (eg, at pins of cable connectors), but not less than half the value specified.

Table 7
Test Conditions for Rating and Temperature Tests

(See Clauses 6.3.1, 6.3.2, and 6.6.1.)

Type of charger	Test load	Test conditions
Nonautomotive		
(a) Battery type not specified	RC* (22 000 μF)	Continuous (rated output)
(b) Battery type specified	Intended battery fully discharged	Taper charge
Automotive		
(a) Household rated 10 A output and less (see Clauses 6.3.2 and 6.6.2)	RC* (200 000 μF)	Continuous (rated output)
(b) Commercial rated over 10 A output	RC* (200 000 μF)	Continuous (rated output)
Industrial	Representative battery fully discharged in parallel with a variable resistor	Continuous (rated output)
Marine		
(a) Rated 10 A and less	RC* (100 000 μF)	Continuous (rated output)
(b) Rated over 10 A	RC* (200 000 μF)	Continuous (rated output)

**Adjustable resistor in parallel with a capacitor of the value* (μF) *specified.*

Table 8
Minimum Output Voltage
(See Clauses 6.4.2.1, 6.4.3.1, and 6.6.2.)

	Minimum rated load output voltages	
Rated output current, A	6 V battery	12 V battery
0–5	6.24	12.48
5.1–10	6.39	12.78
10.1–15	6.45	12.90
15.1–20	6.51	13.02
20.1–30	6.60	13.20
30.1–40	6.69	13.38
40.1–50	6.81	13.62
50.1–60	6.90	13.80
60.1–70	6.99	13.98
70.1–80	7.11	14.22
80.1–90	7.20	14.40
90.1 and greater	7.29	14.58

Table 9
Maximum Acceptable Temperatures
(See Clauses 6.6.1, 6.6.9, 6.6.11, and 7.5.3.3(a).)

Materials and components	°C
1. A surface upon which a permanently connected product may be mounted in service, and surfaces that may be adjacent to the product when so mounted	95
2. Any point on or within a terminal box or compartment of a permanently connected product on which field-installed conductors to be connected may rest	60
3. Class 105 coil insulation systems of a relay, a solenoid, or the like	
Thermocouple method	90*
Resistance method	110
4. Class 130 coil insulation systems of a relay, a solenoid, or the like	
Thermocouple method	110*
Resistance method	130
5. Class 105 transformer insulation systems	
Thermocouple method	90*
Resistance method	95
6. Class 130 transformer insulation systems	
Thermocouple method	110*
Resistance method	120
7. Class 155 transformer insulation systems	
Thermocouple method	135
Resistance method	140
8. Class 180 transformer insulation systems	
Thermocouple method	150
Resistance method	160

(Continued)

Table 9 (Continued)

	Materials and components	°C
9.	Class A motor coil insulation systems	
	In an open motor	
	Thermocouple method	90*
	Resistance method	100
	In a totally enclosed nonventilated motor or motor having a service factor 1.15 or larger	
	Thermocouple method	95*
	Resistance method	110
10.	Class B motor coil insulation systems	
	In an open motor	
	Thermocouple method	110*
	Resistance method	120
	In a totally enclosed nonventilated motor or motor having a service factor 1.15 or larger	
	Thermocouple method	110*
	Resistance method	130
11.	Varnished-cloth insulation	85
12.	Fibre employed as electrical insulation	90
13.	Phenolic composition employed as electrical insulation or as a part the deterioration of which would result in a risk of fire or electric shock	150†
14.	Wood and other combustible material	90
15.	Insulated wire and cord	recognized temperature rating‡§
16.	Fuse	90**
17.	Capacitor	
	Electrolytic	65††
	Other than electrolytic	90‡‡
18.	Sealing compound	§§
19.	Selenium rectifier	75***†††
20.	Silicon rectifier	100†††
21.	Handle or knob for lifting, carrying, or holding	
	Metallic	75
	Nonmetallic	85‡‡‡
22.	Handle or knob for other than lifting, carrying, or holding, and other surfaces that can be contacted in operation	
	Metallic	85
	Nonmetallic	110‡‡‡
23.	Surface subject to casual contact	
	Metallic	95
	Nonmetallic	120‡‡‡

**At a point on the surface of a coil where the temperature is affected by an external source of heat, the temperature measured by means of a thermocouple may be 5°C higher than that specified, if the temperature of the coil as measured by the resistance method is not more than that specified.*

†*The temperature limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to a compound that has been investigated and found to have acceptable heat-resistant properties.*

‡*The temperature of rubber-insulated conductors within a Class A insulated motor and rubber-insulated motor leads, and a rubber-insulated flexible cord entering a motor, may be more than 60°C, provided that an acceptable braid is employed on the conductors of other than a flexible cord. This does not apply to thermoplastic-insulated wires or cords.*

(Continued)

Table 9 (Concluded)

§*A short length of rubber- or thermoplastic-insulated flexible cord inside the product may be exposed to a temperature of more than* 60°C *if supplementary insulation acceptable for the measured temperature and of acceptable dielectric properties is employed on each individual conductor, except that a flexible cord having a temperature rating greater than* 60°C *may be exposed to a corresponding higher temperature.*
*******A fuse that has been investigated and found acceptable for use at a higher temperature may be used at that temperature.*
††*For an electrolytic capacitor that is integral with or attached to a motor, the temperature on insulating material integral with the capacitor enclosure may be not more than* 90°C.
‡‡*A capacitor that operates at a temperature of more than* 90°C *may judged on the basis of its marked temperature limit.*
§§*Except for a thermosetting compound, the maximum sealing component temperature, when corrected to a* 25°C *ambient temperature, is* 15°C *less than the softening point of the compound, as determined in accordance with ASTM Standard E 28.*
*******A temperature of* 85°C *is acceptable if the stack assembly is insulated with phenolic composition or other insulating materials acceptable for a temperature of* 150°C.
†††*The limitation does not apply to a material that has been investigated and found acceptable for a higher temperature.*
‡‡‡*A material other than metal that is plated or clad with metal having a thickness of* 0.13 mm *or less is to be judged as a nonmetallic part.*

Table 10
Discharge Time
(See Clause 6.6.8.)

Length of discharge recommended by manufacturer, min	Discharge time
2 or less	150% of time recommended by manufacturer
More than 2	125% of time recommended by manufacturer
No recommendation	1.5 min

Table 11
Ampere Ratings of Batteries for Protector Tests
(See Clause 6.21.2.)

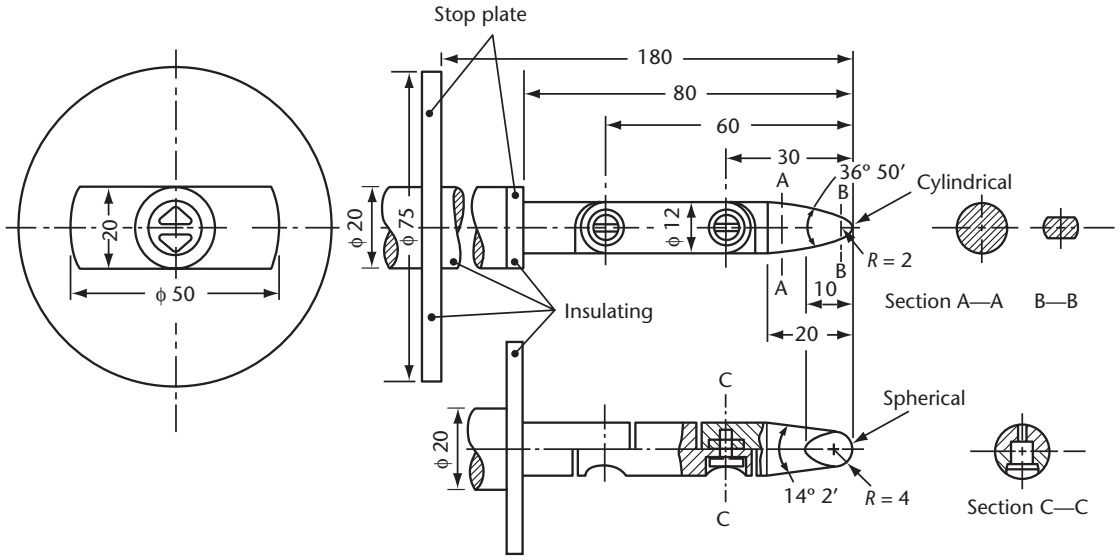
Voltage rating of protector, V dc	Minimum battery reserve capacity, min	Battery open-circuit voltage, V dc
6	220	7 ± 0.2
12	110	14 ± 0.2
24	—	28 ± 0.2

Table 12
Size of Test Leads for Protector Tests
(See Clause 6.21.3.)

Rated current of protector, A dc	Size of test leads, AWG
5 to 10	16
Over 10 to 15	14
Over 15 to 30	12
Over 30 to 40	10
Over 40 to 50	8

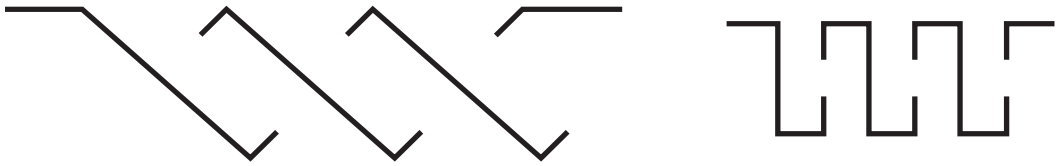
Table 13
Vibration Test Requirements
(See Clauses 8.5.1.1 and 8.5.1.3.)

Location	Duration	Peak-to-peak amplitude, mm	Frequency, Hz
Ignition-protected battery charger	12 h (4 h each in planes x, y, and z)	0.51 ± 0.025	10–60
Battery charger installed above cockpit, deck — not ignition-protected	12 h (4 h each in planes x, y, and z)	0.38 ± 0.025	10–60



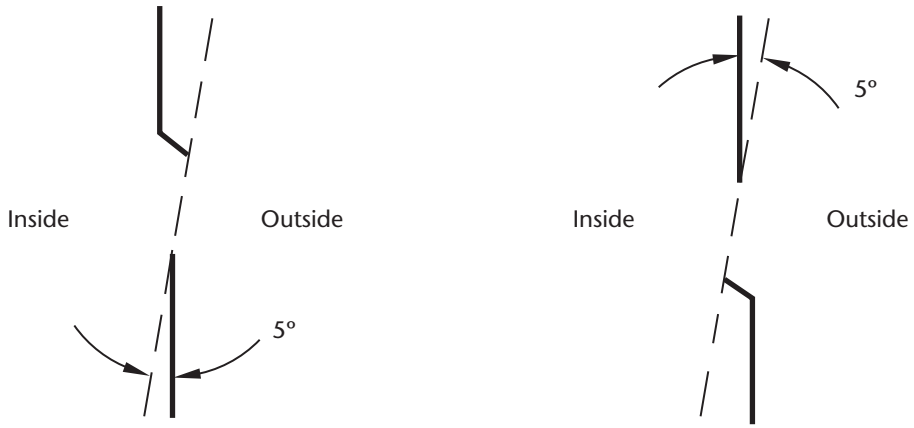
Note: *All dimensions are in millimetres.*

Figure 1
Articulated Probe
(See Clauses 4.2.5.1, 4.2.5.2, 4.2.7.2, 4.13.8, and 6.16.1.2(a).)



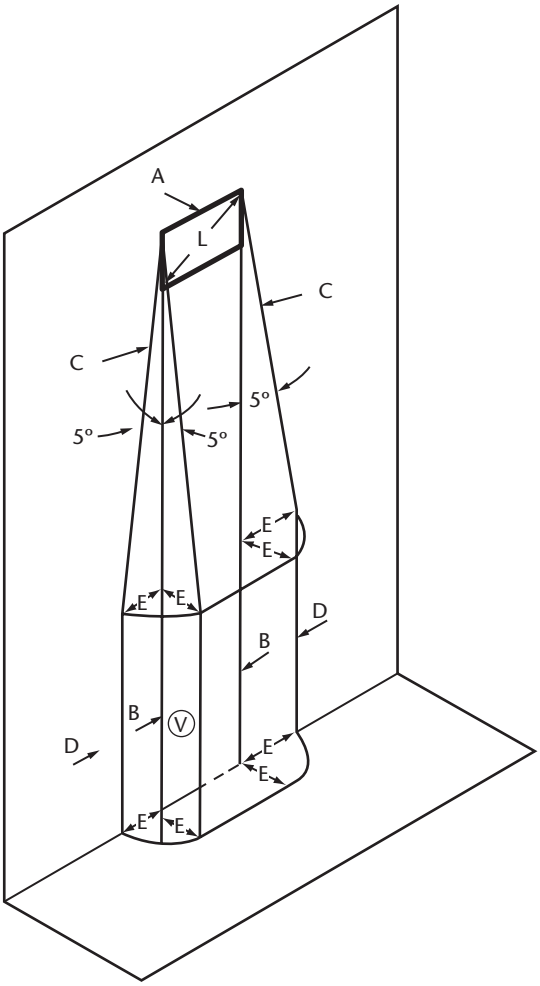
(a) Slanted openings (b) Vertical openings

Figure 2
Top Cover Designs
(See Clause 4.2.5.3.)



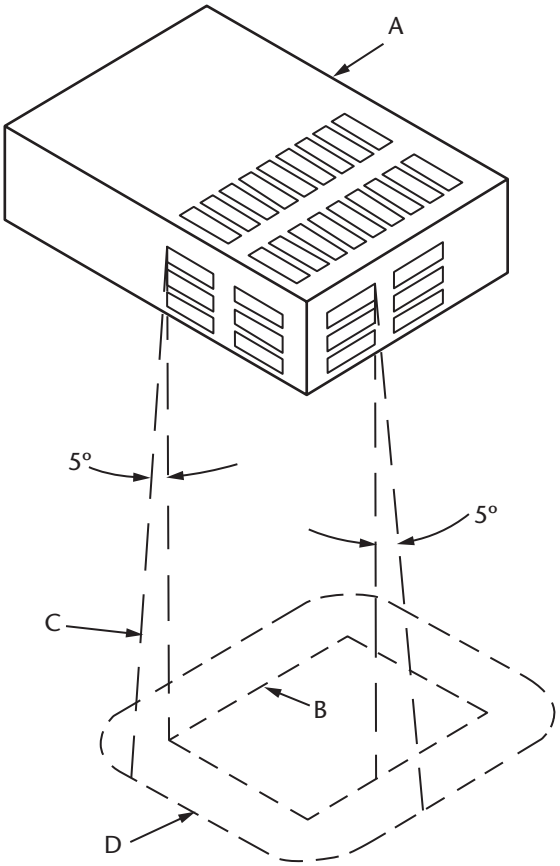
(a) Outward projections (b) Inward projections

Figure 3
Openings in Vertical Sides
(See Clause 4.2.5.4(c).)



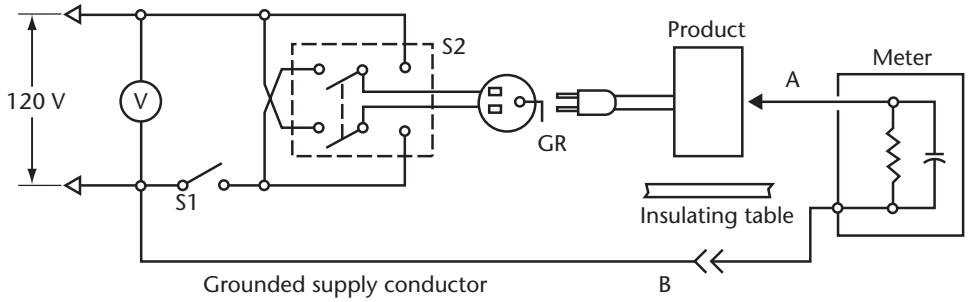
Legend
A — enclosure side opening
B — vertical projection of the outer edges of the side opening
C — inclined lines that project a 5° angle from the edges of the side opening to points located
E distance from B
D — line that is projected straight downward in the same plane of the enclosure sidewall
E — distance between B and C (not to be greater than L)
L — maximum dimension of the enclosure side opening
V — volume in which parts that involve a risk of electric shock or energy hazard shall not be located

Figure 4
Openings in Vertical Sides
(See Clause 4.2.5.4(d).)

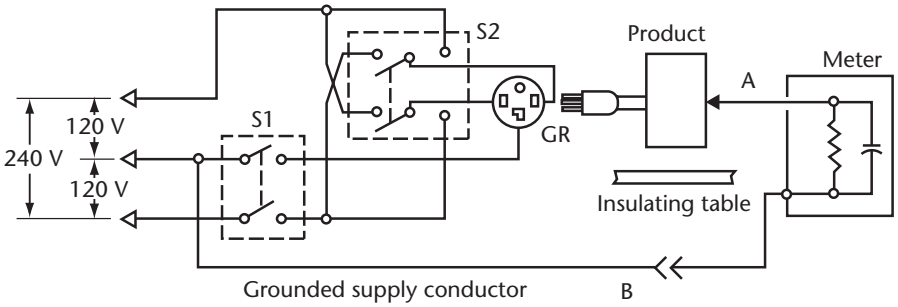


Legend:
A — designates the entire component under which a barrier is required. The barrier may be flat or dished, with or without a lip, or other raised edge. The drawing is of an acceptably enclosed component with ventilating openings in the lower part to show that the protective barrier is required only for those openings from which flaming particles may be emitted. If the component or assembly does not have its own fire enclosure, the area to be protected would be the entire area occupied by the component or assembly
B — projection of outline of the area of A vertically downward onto the horizontal plane of the lowest point of the fire enclosure
C — inclined line that traces an outline D on the same plane as B. Moving around the perimeter of the outline B, this line projects at a 5° angle from the vertical at every point around the perimeter of the openings in A and is oriented to trace the largest possible area
D — minimum outline of the required bottom enclosure. A portion of a vertical enclosure or side panel that is within the area traced out by the 5° angle shall be considered to be part of the required bottom enclosure

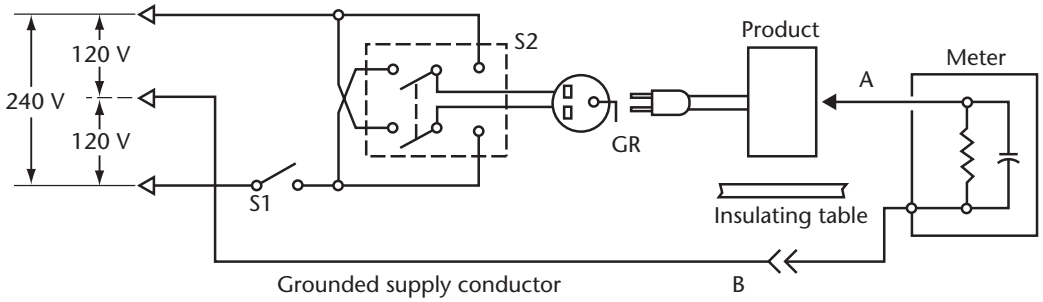
Figure 5
Location and Extent of Barrier
(See Clauses 4.2.5.6 and 4.2.5.7(c).)



Product intended for connection to 120 V power supply.



Product intended for connection to a 3-wire, grounded neutral power supply, as illustrated above.



Product intended for connection to a 3-wire, grounded neutral power supply, as illustrated above.

Legend:
A — probe with shielded lead
B — separated and used as a clip when measuring currents from one part of the device to another

Figure 6
Leakage-Current Measurement Circuits
(See Clause 6.5.7.)

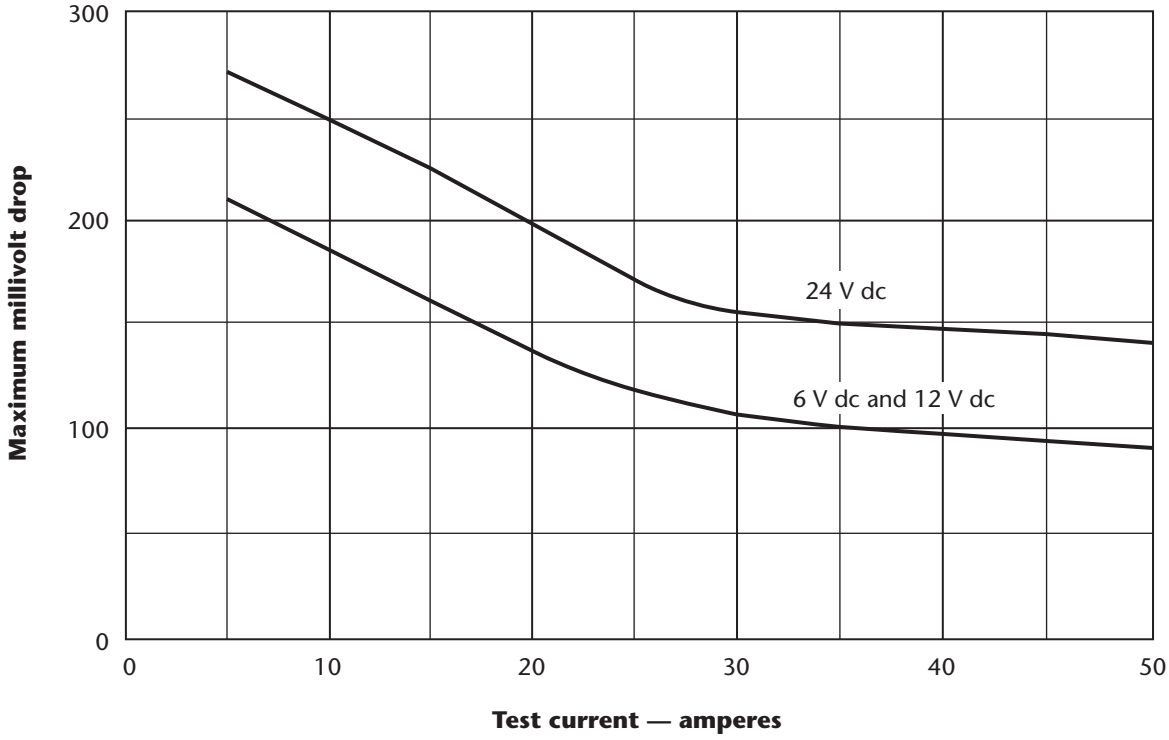


Figure 7
Maximum Millivolt Drop for Protectors
(See Clauses 6.21.5(b) and 6.21.6(b).)

Proposition de modification

N'hésitez pas à nous faire part de vos suggestions et de vos commentaires. Au moment de soumettre des propositions de modification aux normes CSA et autres publications CSA prière de fournir les renseignements demandés ci-dessous et de formuler les propositions sur une feuille volante. Il est recommandé d'inclure

- le numéro de la norme/publication
- le numéro de l'article, du tableau ou de la figure visé
- la formulation proposée
- la raison de cette modification.

Proposal for change

CSA welcomes your suggestions and comments. To submit your proposals for changes to CSA Standards and other CSA publications, please supply the information requested below and attach your proposal for change on a separate page(s). Be sure to include the

- Standard/publication number
- relevant Clause, Table, and/or Figure number(s)
- wording of the proposed change
- rationale for the change.

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