

21.13.6 Door interlock or lock protective controls

21.13.6.1 If a door-actuated switch is employed to directly disconnect power to the motor and heating element, it shall comply with the endurance test as specified in Clause [21.13.6.3](#) and:

- a) CSA C22.2 No. 55 and UL 1054;
- b) CAN/CSA-C22.2 No. 61058-1 and UL 61058-1; or
- c) CSA C22.2 No. 14 and UL 508.

For switches complying with C22.2 No. 61058-1 and UL 61058-1, see Clause [21.15.3](#).

21.13.6.2 If a door-actuated switch is employed as a sensor for an electronic control to disconnect power to the motor and heating element, the switch and control shall comply with Clause [21.13.3](#).

21.13.6.3 Endurance testing of a door lock shall be conducted in accordance with Clause [17.7.4](#). Endurance testing of a door interlock shall be conducted for 6 000 cycles.

21.14 Solenoids

21.14.1 A solenoid shall be investigated as part of the appliance and comply with the requirements of this end product Standard. In addition, it shall comply with the following:

- a) A spring shall be protected against abrasion and shall be guided or arranged to reduce binding, buckling, or other interference with its free movement.
- b) Protective devices may be used to interrupt the flow of current to the solenoid coil. If an integral protective device is provided, it shall be located inside the overwrap insulation of the solenoid coil.
- c) Insulation between a crossover lead and the winding to which it is connected is not specified if the coil withstands the induced potential test described in Clause [21.14.2](#).
- d) a slot in a molded bobbin for guiding the crossover or start-lead – unspliced at the windings – of a magnet-coil shall be filled with an insulating material unless:
 - 1) the slot provides a graduated spacing to the winding increasing to the end turns; and
 - 2) the magnet-coil winding withstands the induced potential test described in Clause [21.14.2](#).

Note: A solenoid that complies with one of the following standards need not be subjected to these tests: CSA C22.2 No. 139 and UL 906.

21.14.2 Where required in (c) and/or (d) of Clause [21.14.1](#), each of three separate magnet-coil-winding samples shall withstand without breakdown an induced potential. They shall be operated under conditions representing those attained during the normal temperature test. While still heated, the coil winding shall be subjected to an alternating potential of twice the rated voltage at any suitable frequency – typically 120 Hz or higher – for 7,200 electrical cycles or for 60 s, whichever is less. The required test voltage shall be obtained by starting at one-quarter or less of the full value and increasing to the full value in not more than 15 s. After being held for the time specified, the voltage shall be reduced within 5 s to one-quarter or less of the maximum value, and the circuit shall be opened.

21.14.3 There shall be no emission of flame or molten metal after a solenoid has operated for 7 hours within the appliance while energized at the voltage specified for the Heating Test, Clause [10](#), and with the plunger blocked in the de-energized position at the maximum stroke length specified for the assembly. For

the test, the supply source to the appliance shall include appropriate branch circuit protection and be grounded, if applicable. Following this test, the solenoid shall comply with the requirements in the Electric Strength Test, Clause [14](#).

Note: The winding may open in a shorter period of time, provided that there is no emission of flame or molten metal.

21.15 Switches and controls

21.15.1 Switches shall comply with the following, as applicable:

- a) C22.2 No. 55 and UL 1054;
- b) CAN/CSA-C22.2 No. 61058-1 and UL 61058-1; or
- c) C22.2 No. 111 and UL 20.

21.15.2 Membrane switches shall be evaluated with the appliance control or to the applicable requirements of this Standard. Membrane switches complying with UL 2557 are considered to fulfill the requirements of this Standard. Membrane switches, including those complying with UL 2557, shall be evaluated for use in other than low voltage circuits, when applicable.

21.15.3 Switches that comply with C22.2 No. 61058-1 and UL 61058-1 shall be rated as specified in Clauses [21.15.4](#) – [21.15.6](#).

21.15.4 Power switches shall be rated as follows:

- a) For a voltage not less than the rated voltage of the appliance;
- b) For a current not less than the rated current of the appliance;
- c) For Continuous Duty;
- d) With respect to load
 - 1) Switches for motor-operated appliances: for resistance and motor load if the switch would encounter this load in normal use; or
 - 2) Switches may be regarded as switches for a declared specific load and may be classified based upon the load conditions encountered in the appliance under normal load.
- e) For ac if the appliance is rated for ac;
- f) For dc if the appliance is rated for dc.

21.15.5 Unless otherwise specified in this Standard, switches shall also be rated with respect to endurance as follows:

- a) Power and door-interlock switches: 6000 cycles;
- b) Power switches provided with series electronics shall be subject to an additional 1000 cycles of operation with the electronics bypassed;
- c) Switches other than power switches, such as speed selector switches, that may be switched under electrical load: 1000 cycles;
- d) The following non-power switches are not required to be rated for endurance:

1) Switches not intended for operation with an electrical load, and which can be operated only with the aid of a tool or are interlocked so that they cannot be operated under electrical load; or

2) Switches for 20 mA load as classified in C22.2 No. 61058-1 and UL 61058-1.

21.15.6 Ratings and load classifications for switches other than power switches shall be based on the conditions encountered in the appliance under normal load.

21.16 Overcurrent protection

21.16.1 Fuses shall comply with CSA C22.2 No. 248-1, UL 248-1 and the applicable part of the CSA C22.2 No. 248 and UL 248 series for the specific fuse type.

21.16.2 Fuseholders shall comply with the following:

a) CSA C22.2 No. 39 or CAN/CSA-C22.2 No. 4248-1 and the applicable part of the CSA C22.2 No. 4248 series for the specific fuseholder type; and

b) UL 4248-1 and the applicable part of the UL 4248 series for the specific fuseholder type.

21.16.3 Supplementary protectors shall comply with CSA C22.2 No. 235 and UL 1077.

21.17 Electrically operated valves

21.17.1 Electrically operated valves shall comply with the following:

a) CSA C22.2 No. 139 and UL 429; or

b) CAN/CSA-E60730-2-8 and UL 60730-2-8.

21.18 Terminals and connectors

21.18.1 Terminals and connectors shall comply with the following:

a) CSA C22.2 No. 153 and UL 310 for quick connect terminals;

b) CSA C22.2 No. 182.3 and UL 1977 for single and multipole connectors for use in data, signal, control and power applications;

c) CAN/CSA-C22.2 No. 65 and UL 486A-486B for wire connectors;

d) CSA C22.2 No. 188 and UL 486C splicing wire connectors;

e) CSA C22.2 No. 158 and UL 486E for equipment wiring terminals for use with aluminum and/or copper conductors;

f) CSA C22.2 No. 2459 and UL 2459 for multi-pole splicing wire connectors; or

g) CSA C22.2 No. 158 and UL 1059 for terminal blocks.

21.19 Pumps

21.19.1 Pumps shall be evaluated to this Standard or comply with CSA C22.2 No. 108 and UL 778.

21.20 Insulating devices

21.20.1 The requirements for insulating devices, such as wire positioning devices or insulating bushings, are not specified unless the insulating device is required to comply with this Standard. In such cases, the insulating device shall comply with the applicable requirements of this Standard or shall be evaluated in accordance with the following standards, as applicable:

- a) CSA C22.2 No. 18.5 and UL 1565 for wire positioning devices; or
- b) UL 635 for insulating bushings.

21.20.2 Tests specified in this Standard (e.g, Strain Relief Test) shall be performed to confirm the combination of the insulating bushing and the supporting part are suitable.

21.21 Adhesives used to secure parts

21.21.1 An adhesive relied upon to reduce the risk of fire, electric shock, or injury to persons shall comply with the requirements for adhesives in CSA C22.2 No. 0.15 or UL 746C.

21.21.2 The requirement in Clause [21.21.1](#) also applies to an adhesive used to secure a conductive part that might, if loosened or dislodged:

- a) energize an accessible dead metal part;
- b) make a live part accessible;
- c) reduce spacings below the minimum acceptable values; or
- d) short-circuit live parts.

21.22 Transformers and power supplies

21.22.1 Transformers located in a LOW VOLTAGE CIRCUIT that do not involve a risk of fire or personal injury need not comply with the standards referenced in Clauses [21.22.2](#) through [21.22.5](#).

21.22.2 Class 2 transformers shall comply with CSA C22.2 No. 66.3 and UL 5085-3.

21.22.3 General purpose transformers shall comply with:

- a) CSA C22.2 No. 66.2; and
- b) UL 5085-2.

21.22.4 Class 2 power supplies shall comply with:

- a) CSA C22.2 No. 223 and UL 1310; or
- b) For power supplies with non-linear transformers, CAN/CSA-C22.2 No. 60950-1 and UL 60950-1 or CSA C22.2 No. 62368-1 and UL 62368-1.

21.22.5 Power supplies other than Class 2 power supplies shall comply with:

- a) CSA C22.2 No. 107.1 and UL 1012; or
- b) For power supplies with non-linear transformers, CAN/CSA-C22.2 No. 60950-1 and UL 60950-1 or CSA C22.2 No. 62368-1 and UL 62368-1.

21.23 Button or coin cell batteries of lithium technologies

21.23.1 The battery compartment of an appliance or any accessory, such as a wireless control, incorporating one or more coin cell batteries of lithium technologies, shall comply with UL 4200A, if the appliance or any accessory:

- a) is intended for use with one or more single cell batteries having a diameter of 32 mm (1.25 in) maximum with a diameter greater than its height; and
- b) the appliance is intended for household use.

22 Supply Connection and External Flexible Cords

22.1 General

22.1.1 An appliance shall be provided with wiring terminals or leads for the connection of conductors that will be connected in the field and means for connection of a wiring system.

Note: An appliance other than a wall-insert type may be provided with a flexible cord and an attachment plug for connection to the supply circuit.

22.2 Permanently connected appliances

Note: The CE Code, Part I requires that electric clothes dryers having an input of 30 A or less be cord-connected.

22.2.1 Electrical boxes and the associated bushings and fittings, and raceways, of the types specified in the Canadian Electrical Code for Wiring Methods and the National Electrical Code for Wiring Methods and Materials, that comply with the relevant CSA Group and UL Standards, and Section [22](#), are considered to fulfill the requirements of this Standard.

Note: Examples of relevant standards are CSA C22.2 No. 18.1 and UL 514A, CSA C22.2 No. 18.2 and UL 514C, CSA C22.2 No. 18.3 and UL 514B, and CSA C22.2 No. 42.1 and UL 514D.

22.2.2 An outlet or terminal box in which connections to the supply circuit will be made shall be located so that, after the appliance has been connected as intended, such connections will be readily accessible for inspection.

Note: The appliance may be moved to examine these connections.

22.2.3 The requirement in Clause [22.2.2](#) necessitates that the terminal box of a wall-insert appliance be located so that it will be accessible without the necessity of moving the appliance after installation, unless the appliance is provided with not less than 1.5 m of either:

- a) flexible metallic conduit with conductors; or
- b) armored cable;

to extend the point of supply to an accessible location.

Note: The top or front of the appliance may serve as the inspection cover, provided that the fastening means for the cover is apparent, or indicated, and that the cover can be moved and replaced without damage to the cover or fastening means.

22.2.4 An outlet box, terminal box, wiring compartment, or the like in which connections to the supply circuit will be made in the field shall be free from any sharp edges, including screw threads, a burr, a fin, a moving part, or the like, that could damage the insulation on a conductor.

22.2.5 If it is intended that supply connections be made to the motor of an appliance, the terminal compartment on the motor shall comply with the requirements for terminal compartments in CSA C22.2 No. 100 and UL 1004-1.

22.2.6 Conduit connection shall not be made to covers giving access to supply terminals. Component parts shall not be mounted on removable covers giving access to supply connections.

22.2.7 An opening in a wiring compartment for the connection to the power supply in the field, whether in the form of a knockout or an open hole, shall:

- a) have the minimum width of flat surface surrounding the opening as specified in [Table 5](#); or
- b) be acceptable when the test gauge for flat surfaces surrounding knockout is applied as specified in CSA-C22.2 No. 0.5 and UL 514A.

22.2.8 A household appliance shall be marked in accordance with Clause [6.1.2.32](#) if it:

- a) has a knockout with a diameter of 21.9 mm minimum to 23.0 mm maximum; or
- b) is only intended to be connected to the power supply by means of permanent wiring brought into the appliance.

22.2.9 A household appliance that is intended to be connected to the power supply by means of either permanent wiring brought into the appliance or a power-supply cord kit shall be provided with:

- a) two knockouts (concentric or eccentric);
- b) an opening inside a knockout;
- c) a reducing fitting in an opening; or
- d) a single knockout or opening sized in accordance with [Table 6](#).

The smaller knockout or opening, or the opening in the reducing fitting, shall have a diameter of 21.9 mm minimum to 23.0 mm maximum. The larger knockout, or the opening in which the reducing fitting is mounted, shall be sized in accordance with [Table 6](#).

22.2.10 A knockout shall remain in place when a force of 44.5 N is applied at right angles to the knockout by means of a mandrel with a 6.4 mm diameter flat end. The mandrel shall be applied at the point most likely to result in movement of the knockout.

22.2.11 The removal of a knockout shall not result in deformation that would affect the attachment of a strain relief or fitting, or result in reduction of electrical spacings below the minimum acceptable values.

22.2.12 At a point where the power-supply conductors enter the enclosure, sheet metal shall not be less than 0.81 mm thick if uncoated steel, not less than 0.86 mm if galvanized steel, not less than 1.12 mm if aluminum, and not less than 1.09 mm if copper or brass.

22.2.13 Sheet metal sub-enclosures to which a wiring system shall be connected in the field with the dimensions specified in [Table 18](#) and [Table 19](#) are considered to comply with the intent of Clause [22.2.12](#).

22.3 Cord-connected appliances

22.3.1 A power supply cord shall comply with CSA C22.2 No. 21 and UL 817 and shall be of the non-detachable type that requires a tool to remove.

22.3.2 Flexible cords and cables shall comply with CAN/CSA-C22.2 No. 49 and UL 62. Flexible cords or cables are considered to fulfill this requirement when preassembled into a power supply cord complying with Clause [22.3.1](#).

22.3.3 Attachment plugs and appliance couplers shall comply with CSA C22.2 No. 42 and UL 498. Attachment plugs and appliance couplers are considered to fulfill this requirement when preassembled into a power supply cord complying with Clause [22.3.1](#).

22.3.4 The flexible cord shall have an ampacity not less than the current rating of the appliance.

22.3.5 An attachment plug shall have an ampere rating not less than 125 percent of the rated current of the appliance, and shall have a voltage rating not less than the rated voltage of the appliance, except as stated in Clause [22.3.6](#).

Note: The CE Code, Part I requires that electric clothes dryers have a plug ampere rating not less than 125 percent of the rated current of the appliance in all cases.

22.3.6 A stationary product marked in accordance with Clause [6.1.2.20](#) shall employ an attachment plug rated no less than the current rating of the appliance or the input current under normal load conditions in Clause [9](#), whichever is greater.

22.3.7 Flexible cord shall be Type SJ, SJO, SJT, SJTO, S, SO, ST, STO, SRD, SRDE, SRDT, HSJ, HSJO, DRT, HSJOO, SJOO, SJTOO, SOO, and STOO, or equivalent. Type SP-3 or SPT-3 cord may be used on an appliance not mounted on wheels, casters, or the equivalent.

22.3.8 A power-supply connection opening in the enclosure of an appliance shall be sized in accordance with [Table 6](#).

Note: The opening need not be sized in accordance with [Table 6](#) if the clothes dryer is provided with the instructions described in Clause [6.2.3.7](#).

22.3.9 The cord length shall not be less than:

- a) 1.8 m for an appliance provided with casters; or
- b) 1.5 m for an appliance not provided with casters.

The cord length shall be measured from the face of the attachment plug to the point of entry into the appliance.

22.3.10 A flexible cord shall be provided with strain relief so that stress on the cord will not be transmitted to terminals, splices, or internal wiring.

22.3.11 Except as specified in Clause [22.3.13](#), a strain relief shall be constructed so that the flexible cord, when installed as intended, does not contact the edges of the opening in which the strain relief is mounted.

22.3.12 The flexible cord shall be provided with a means to reduce the likelihood of the cord's being pushed into the appliance through the cord-entry hole if such displacement:

- a) can subject the cord to mechanical damage or to exposure to a temperature higher than that for which the cord is rated; or
- b) can reduce spacings, such as to a metal strain-relief clamp, below the minimum acceptable values.

22.3.13 If a knot in a flexible cord serves as strain relief, a surface against which the knot can bear or with which it can come in contact shall be free from projections, sharp edges, burrs, fins, or the like that can result in abrasion of the insulation of the cord.

22.3.14 When tested as described in Clause [22.3.15](#), a strain-relief device shall withstand for 1 minute, without displacement, a direct pull of 155 N applied to the cord, with the connections within the appliance disconnected.

22.3.15 A 16 kg weight shall be suspended on the cord and supported by the appliance so that the strain-relief device will be stressed from any angle that the construction of the appliance permits. The strain relief is not acceptable if there is movement of the cord, at the point of disconnection of the conductors, to indicate that stress would have resulted on the connections.

22.4 Bushings

22.4.1 The edges of an opening through which flexible cord passes, including the opening in a strain relief or bushing, shall be smooth and free from burrs, fins, projections, sharp edges and the like that can result in abrasion of the insulation of the cord.

22.4.2 If an insulating bushing is provided in an opening through which a power-supply cord passes, and if the bushing is of material other than ceramic, phenolic, or cold-moulded composition, fibre, or other material that has been investigated and found to be acceptable for the application, the opening shall be smooth and free from burrs, fins, projections, sharp edges, and the like that can result in abrasion of the cord.

23 Terminals for External Conductors

23.1 Wiring terminals or leads intended for connection of the conductors of the supply circuit shall be acceptable for the connection of conductors having an ampacity not less than the rating of the branch circuit marked on the appliance. Leads for supply connection are acceptable only for appliances requiring 3.3 mm² or smaller supply conductors.

23.2 A wiring terminal shall be provided with a soldering lug or with a pressure terminal connector securely fastened in place (i.e., firmly bolted or held by a screw). A connection device that depends on solder shall not be used for the connection of an equipment-bonding conductor.

Note: A wire-binding screw can be employed at a wiring terminal intended to accommodate a 5.3 mm² or smaller conductor if upturned lugs or the equivalent are provided to hold the wire in position.

23.3 A wiring terminal shall be provided with means to reduce the likelihood of turning.

23.4 A wire-binding screw shall thread into metal.

23.5 A wire-binding screw at a wiring terminal shall not be smaller than M5. A M4 screw may be used at a terminal intended only for the connection of a 2.1 mm² conductor.

23.6 A terminal plate tapped for a wire-binding screw shall be of metal not less than 1.27 mm thick and shall provide not less than two full threads in the metal.

Note: An alloy plate not less than 0.76 mm thick may be used if the tapped threads have adequate mechanical strength.

23.7 A terminal plate may have the metal extruded at the tapped hole to give the thickness necessary for not less than two full threads, provided the thickness of the unextruded metal is not less than the pitch of the thread.

23.8 Upturned lugs or a cupped washer shall be capable of retaining a conductor of the size mentioned in Clause [23.1](#), but not smaller than 2.1 mm², under the head of the screw or the washer.

23.9 The free length of a lead inside an outlet box or wiring compartment shall be 152 mm or more if the lead is intended for field connection to an external circuit.

23.10 An appliance constructed so that it can be adapted upon installation for either of two different supply voltages, such as 120 V, 2-wire or 120/240 V, 3-wire, shall be provided with a terminal block or board on which the appropriate connections can be made during field installation without the necessity of changing or disrupting internal wiring or connections other than at the terminal block.

23.11 An appliance provided with wiring terminals or leads and rated 125 V or 125/250 V or less and employing:

- a) a lamp- or element-holder of the Edison-screw-shell type;
- b) a single-pole switch; or
- c) a single-pole automatic control;

shall have one terminal or lead identified for connection of the grounded conductor of a supply circuit.

23.12 A terminal for connection of the grounded conductor of a supply circuit shall be of, or plated with, a silver-coloured metal. Such a terminal shall be readily distinguishable from the other terminals, or identification of the terminal shall be clearly shown in some other way, such as on an attached wiring diagram.

23.13 A lead for connection of the grounded conductor of a supply circuit shall have a white or gray colour and shall be readily distinguishable from the other leads.

24 Provision for Grounding

Note: The term "grounding" as used in this Standard relates to "bonding" in Canada.

24.1 General

24.1.1 In an appliance intended to be permanently connected to the power supply, all exposed non-current-carrying metal parts that can become energized and all non-current-carrying metal parts within the enclosure that are exposed to contact during any servicing operation and that can become energized shall be conductively connected to the equipment-grounding terminal or lead (see Clause [24.5](#)).

24.1.2 For an appliance provided with a power-supply cord and an attachment plug for connection to the power supply, the supply cord shall contain a bonding conductor for use in connecting the equipment to ground.

Note: A portable appliance provided with a system of double insulation need not comply with this requirement.

24.1.3 Except as specified in Clause [24.1.4](#), the bonding conductor of a flexible power-supply cord shall be:

- a) bare or provided with insulation having an outer surface that is green with or without one or more yellow stripes;
- b) connected to the grounding blade of an attachment plug of the grounding type; and

c) conductively connected to all exposed non-current-carrying metal parts that can become energized and all non-current-carrying metal parts within the enclosure that are exposed to contact during any servicing operation and that can become energized.

24.1.4 With reference to the requirements of Clause [24.1.3](#), the bonding conductor of the power-supply cord of a nonautomatic appliance may be connected to the motor frame only and not to the enclosure of the appliance, provided that the:

- a) only electrical components of the appliance are the motor and power-supply cord;
- b) power-supply cord enters the motor without being attached to or passing through any other part of the appliance; and
- c) motor is mounted in resilient mounting rings that provide between the frame of the motor and all other non-current-carrying metal parts of the appliance:
 - 1) a spacing of not less than 3.2 mm; and
 - 2) insulation resistance measured as described in Clause [11.2](#) of not less than 50 000 Ω .

24.1.5 A non-current-carrying metal part within the enclosure that is exposed to contact during any servicing operation and that can become energized need not be bonded to ground, provided the appliance is marked in accordance with Clause [6.1.2.15](#).

24.1.6 With reference to the requirements of Clause [24.1.3\(c\)](#), the connection shall be made by a means not likely to be removed during ordinary servicing not involving the power-supply cord. Solder alone shall not be used for making this connection.

24.1.7 With reference to the requirements in Clauses [24.1.1](#) and [24.1.3](#), the following non-current-carrying metal parts are not considered as being likely to become energized:

- a) a small metal part such as an adhesive-attached foil marking, a screw, or a handle that is:
 - 1) on the exterior of the enclosure and separated from all electrical components by grounded metal; or
 - 2) electrically isolated from all electrical components;
- b) a panel, cover, or other metal part that is isolated from all electrical components, including wiring, by a barrier or vulcanized fibre, varnished cloth, phenolic composition, or other moisture-resistant insulating material not less than 0.8 mm thick and secured in place;
- c) a panel, cover, or other metal part that does not enclose uninsulated current-carrying parts and that is electrically isolated from other electrical components; and
- d) a door or the like that can only become energized through a grounded part;

24.1.8 Servicing, as mentioned in Clauses [24.1.1](#) and [24.1.3](#), is considered to include the repair of the appliance by a qualified serviceman as well as by the user.

24.1.9 If an appliance is intended to be grounded and is provided with means for separate connection to more than one power supply, each such connection shall be provided with a means for grounding.

24.1.10 In Canada, bonding of electrical equipment forming part of an appliance shall comply with CAN/CSA-C22.2 No. 0.4.