UL 2157

STANDARD FOR SAFETY

Electric Clothes Washing Machines and Extractors

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UL Standard for Safety for Electric Clothes Washing Machines and Extractors, UL 2157

Fourth Edition, Dated May 28, 2018

Summary of Topics

This revision of ANSI/UL 2157 dated September 20, 2019 is being issued to incorporate several miscellaneous corrections.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated June 14, 2019.

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CSA Group
CSA C22.2 No. 169-18
Fifth Edition

Underwriters Laboratories Inc.
UL 2157
Fourth Edition

Electric Clothes Washing Machines and Extractors

May 28, 2018

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ANSI/UL 2157-2019

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This ANSI/UL Standard for Safety consists of the Fourth Edition including revisions through September 20, 2019. The most recent designation of ANSI/UL 2157 as an American National Standard (ANSI) occurred on September 20, 2019. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

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SUPPLEMENT SA - OZONE GENERATING WASHING MACHINES

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PREFACE

This is the harmonized CSA Group and UL Standard for Electric Clothes Washing Machines and Extractors. It is the fifth edition of CSA C22.2 No. 169, and the fourth edition of UL 2157. This edition of CSA C22.2 No. 169 supersedes the previous edition published in 2015. This edition of UL 2157 supersedes the previous edition published in 2015. This harmonized standard has been jointly revised on September 20, 2019. For this purpose, CSA Group and UL are issuing revision pages dated September 20, 2019.

The major differences between this edition and the previous edition include the clarification of the risk of electrical shock and fire definitions and the revision of requirements for instruction manual, operating instructions, protection against accessibility to current-carrying parts, power input and current, heating test, electric strength test, abnormal operation test, polymeric materials. The new edition also incorporates the new requirements for nichrome wire test, glass loading doors and lids, endurance test for pedestral wire flexing, botton or coin cell batteries of lithium techniologies and plumbing requirements for household laundry equipment.

This harmonized standard was prepared by the CSA Group and Underwriters Laboratories Inc. (UL). The efforts and support of the Technical Harmonization Committee for Laundry Standards and Association of Home Appliance Manufacturers (AHAM) are gratefully acknowledged.

This standard is considered suitable for use for conformity assessment within the stated scope of the standard.

This standard was reviewed by the CSA Subcommittee on Clothes Washers - Household and Commercial, under the jurisdiction of the CSA Technical Committee on Consumer and Commercial Products, and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee.

Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is to be considered a minimum quantity.

Note: Although the intended primary application of this standard is stated in its scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.

Level of Harmonization

This standard is published as an identical standard for CSA Group and UL.

An identical standard is a standard that is exactly the same in technical content except for national differences resulting from conflicts in codes and governmental regulations. Presentation is word for word except for editorial changes.

Reasons for Differences From IEC

This standard provides requirements for electric clothes washing machines and extractors for use in accordance with the electrical installation codes of Canada and the United States. This standard does not employ any IEC standard for base requirements

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Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

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1 Scope

1.1 This Standard applies to electric clothes washing machines and extractors intended to be used in nonhazardous locations in accordance with the Canadian Electrical Code, Part I (CE Code), and the (U.S.) National Electrical Code (NEC), on circuits having a nominal voltage not exceeding 600 V.

Note: Wherever practical, for convenience, the term "appliance" has been used in lieu of "clothes washer "or "machine".

1.2 This Standard applies to both cord-connected and permanently connected appliances. The appliances covered by this Standard are intended for use by the general public not specifically trained in the use of the appliance, regardless of the mode by which its operation is initiated. They are for use in household and commercial purposes, including appliances provided with coin-, ticket-, or card-operated mechanisms, wringer washers, tumbler, agitator and spinner machines, combination washer-dryers, and extractors of the centrifugal type.

1.3 This Standard does not apply to industrial and institutional type appliances. Industrial or institutional appliances are covered under the scope of Electric Washing Machines, CSA C22.2 No. 53, or Electric Commercial Clothes-Washing Equipment, UL 1206.

Note: Industrial and institutional type appliances are not intended for use by the general public, but only by trained or supervised personnel.

2 Definitions

Note: For the purpose of this Standard, the following definitions apply.

2.1 APPLIANCE, CORD-CONNECTED – an appliance that is connected to the electrical supply by a cord set or by a power-supply cord terminating in an acceptable attachment plug.

2.2 APPLIANCE, HOUSEHOLD TYPE – an appliance commonly used in, but not restricted to, a single-family dwelling.

2.3 APPLIANCE, PERMANENTLY CONNECTED – an appliance that is connected to the electrical supply by means other than a supply cord and an attachment plug.

2.4 APPLIANCE, RECESSED – an appliance intended to be:

a) supported by the floor; and

b) located immediately adjacent to a wall in the rear or located immediately adjacent to a wall, a cabinet, or another appliance on each side.

If the construction permits, a countertop can cover the appliance and adjacent cabinets and appliances. A recessed appliance is not intended for permanent attachment to the building structure or to adjacent cabinets or appliances.

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2.5 APPLIANCE, STATIONARY – any appliance that is intended to be fastened in place or located in a dedicated space.

2.6 APPLIANCE, WALL-INSERT – an appliance intended to be mounted permanently in a wall or other vertical surface of a building or cabinet.

2.7 AUTOMATIC – an appliance is considered to be automatically controlled if one or more of the following conditions applies:

a) repeated starting of the appliance, beyond one complete predetermined cycle of operation, to the point where some form of limit switch opens the circuit, is independent of any manual control;

b) during any single predetermined cycle of operation, the motor is caused to stop and restart one or more times;

c) upon energizing the appliance, the initial starting of the motor could be intentionally delayed beyond normal, conventional starting; or

d) during any single predetermined cycle of operation, automatic changing of the mechanical load could reduce the motor speed to re-establish starting-winding connections to the supply circuit.

2.8 BARRIER – a partition for the insulation or isolation of electric circuits, for the isolation of electric arcs, or for the isolation of moving parts or hot surfaces. In this respect, a barrier could serve as a portion of an enclosure and as a functional part.

2.9 BUILT-IN APPLIANCE – a stationary appliance that is constructed to be permanently installed in a cabinet or wall.

2.10 CIRCUIT, LINE-VOLTAGE – a circuit having characteristics in excess of those of a low-voltage circuit.

2.11 CIRCUIT, LOW-VOLTAGE – a circuit having limited voltage and energy capacity supplied by:

a) a primary battery having an output voltage of 30 V or less;

b) a Class 2 transformer; or

c) a Class 2 power supply.

Note 1: A circuit that is derived from a circuit that exceeds 30 V by connecting resistance or impedance, or both, in series with the supply circuit to limit the voltage and current is not considered to be a low-voltage circuit.

Note 2: The term "low voltage" as used in this clause relates to "extra low voltage" in Canada.

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2.12 CONTROL, OPERATING – control, the operation of which starts or regulates the appliance during normal operation.

2.13 CONTROL, PROTECTIVE – control, the operation of which is intended to prevent the risk of electric shock, fire, or injury to persons during normal or abnormal operation of the appliance.

Note: During the evaluation of the protective control, the protective functions are verified under normal and single-fault conditions of the control.

2.14 CRITICAL COMPONENT – a component that performs one or more safety related functions whose failure would result in an increased risk of fire, electric shock or injury to persons.

2.15 CURRENT-CARRYING PARTS – parts carrying current during normal or abnormal operation in line-voltage circuits.

Note: With respect to Separation of circuits, Clause 18.3, this term refers to parts in both low-voltage and line-voltage circuits.

2.16 ELECTRICAL CONNECTION – the physical interface between two points in a circuit such as spade terminals, pin terminals, micro switch contacts, relay contacts, timer contacts, crimped connections, and connections that are welded or soldered.

2.17 ENCLOSURE – a material used to:

a) render inaccessible, by itself or in conjunction with acceptable enclosure barriers and supplementary enclosures, any or all uninsulated current-carrying parts, internal wiring, or electrical components not having their own enclosures;

b) reduce the likelihood of propagation of ignition due to electrical disturbances occurring within; or

c) both (a) and (b).

2.18 ENCLOSURE BARRIER – a material used to reduce the size of an opening in an enclosure that:

a) will not permit the entrance of a 19.1 mm diameter rod; and

b) does not comply with Clause 6.2(a)(1) or (2).

A polymeric enclosure barrier is evaluated as a functional polymeric part.

2.19 ENCLOSURE, SUPPLEMENTARY – a material used to reduce the size of an opening in an enclosure that:

a) will permit the entrance of a 19.1 mm diameter rod; and

b) does not comply with Clause 6.2(a)(1) or (2); when enclosure barriers, if provided, are removed.

A polymeric supplementary enclosure is evaluated as an enclosure.

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2.20 FIELD WIRING TERMINAL – a terminal to which a wire may be connected in the field, unless the wire and a means of making the connection, such as:

a) a pressure wire connector;

b) soldering lugs;

c) a soldered loop; or

d) a crimped eyelet;

factory-assembled to the wire, is provided as a part of the appliance.

2.21 FLAME CYLINDER – a projection of a vertical cylinder having a diameter of 20 mm and a height of 50 mm.

2.22 HEATER ASSEMBLY – an assembly of:

a) a heating element;

b) electrical insulation (eg, refractory, mica, magnesium oxide); and

c) a frame or housing (eg, a metal sheath or the like) that holds the assembly together.

2.23 HEATING ELEMENT – the actual electrical conducting medium that is intended to be heated by an electric current.

2.24 MEMBRANE SWITCH – a momentary switching device in which at least one contact is on, or made of a flexible substrate.

2.25 NONCOMBUSTIBLE MATERIAL – for purposes of this Standard a noncombustible material is:

a) metal;

b) a 5VA material; or

c) a material that complies with the requirements for enclosure flammability in accordance with the 127 mm flame test in UL 746C.

2.26 PART, DECORATIVE – a material used for no other function except appearance. A removable polymeric control knob or lever may be considered a decorative part.

2.27 PART, FUNCTIONAL – a material used in such a way that deterioration or breakage of the part would result in a risk of fire, electric shock, or injury to persons.

2.28 PART, NONFUNCTIONAL – a part, such as thermal insulation or decorative material, that does not serve as electrical insulation or to support or enclose electrical components, maintain electrical spacings, or reduce the risk of injury to persons.

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2.29 RISK OF ELECTRIC SHOCK – a risk of electric shock is considered to exist if under normal conditions and single component fault conditions the potential between the part and earth ground or any other simultaneously accessible part is more than the following relevant values (these low-voltage circuits shall be supplied from an isolating source):

a) 30 V rms;

b) 42.4 V peak for sinusoidal or nonsinusoidal AC;

c) 60 V dc continuous, or 60 V peak for interrupted DC outside the range of 10 - 200 Hz; and

d) 24.8 V peak for DC interrupted at a rate of 200 Hz or less

Note 1: A low-voltage circuit and the secondary circuit of a Class 2 circuit do not involve a risk of electric shock.

Note 2: In Canada, the low-voltage circuit in Note 1 is an extra low-voltage power circuit.

2.30 RISK OF FIRE – A risk of fire is considered to exist at any two points in a circuit where a power of more than 15 watts can be delivered into an external variable resistor connected between the two points within 5 seconds under normal conditions and single component fault conditions; see Clause 26.6.3.2 and SD14.

Note: A low power circuit does not involve a risk of fire.

2.31 TEMPERATURE-REGULATING AND -LIMITING DEVICE, COMBINATION – a device that functions to:

a) regulate the temperature under normal conditions of use; and

b) limit abnormal temperatures that might result from conditions of abnormal operation of the appliance.

2.32 TEMPERATURE-LIMITING DEVICE – a device that functions:

a) only under conditions that produce abnormal temperatures; and

b) that is not intended to function during normal operation of the appliance.

2.33 TEMPERATURE-REGULATING DEVICE – a device that:

a) regulates temperature; and

b) functions during normal operation of the appliance.

2.34 VULCANIZED FIBRE – a material that, if 0.8 mm thick minimum and acceptably mounted and secured, may be used as an enclosure barrier, but not as an enclosure or supplementary enclosure.

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2.35 WITHIN 3 MM – falling within the dotted boundary formed by the flame cylinder with hemispherical ends as shown in Figure 9.

2.36 WRINGER WASHER – a clothes washer that performs only washing and wringing operations.

3 General requirements and reference publications

3.1 General requirements

3.1.1 Combination washer-dryers shall comply with this Standard and also with the requirements of CSA C22.2 No. 112 and UL 2158. Where more than one Standard applies, preference shall be given to that Standard considered to require the highest standard of construction or testing.

3.1.2 In Canada, the general requirements applicable to this Standard are provided in CAN/CSA-C22.2 No. 0.

3.2 Reference publications

3.2.1 Where reference is made to other publications, such reference shall be considered to refer to the latest edition and all amendments published to that edition up to the time when this Standard was approved.

CSA Group Standards

B64 Series-11 (R2016)
Backflow Preventers and Vacuum Breakers

C22.1-15
Canadian Electrical Code, Part I

CAN/CSA-C22.2 No. 0-10 (R2015)
General Requirements – Canadian Electrical Code, Part II

C22.2 No. 0.1-M1985 (R2013)
General Requirements for Double-Insulated Equipment

C22.2 No. 0.2-16
Insulation Coordination

C22.2 No. 0.3-09 (R2014)
Test Methods for Electrical Wires and Cables

C22.2 No. 0.4-17
Bonding of Electrical Equipment

C22.2 No. 0.5-16
Threaded Conduit Entries

C22.2 No. 0.8-12 (R2016)
Safety Functions Incorporating Electronic Technology

C22.2 No. 0.15-15
Adhesive Labels

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CAN/CSA-C22.2 No. 0.17-00 (R2013)
Evaluation of Properties of Polymeric Materials

C22.2 No. 8-13
Electromagnetic Interference (EMI) Filters

C22.2 No. 14-13
Industrial Control Equipment

C22.2 No. 18.1-13
Metallic Outlet Boxes

C22.2 No. 18.2-06 (R2016)
Nonmetallic Outlet Boxes

C22.2 No. 18.3-12
Conduit, Tubing, and Cable Fittings

C22.2 No. 18.5-13
Positioning Devices

C22.2 No. 21-14
Cord Sets and Power Supply Cords

C22.2 No. 24-15
Temperature-Indicating and Regulating Equipment

C22.2 No. 38-14
Thermoset-Insulated Wires and Cables

C22.2 No. 39-13
Fuseholder Assemblies

C22.2 No. 42-10 (R2015)
General Use Receptacles, Attachment Plugs, and Similar Wiring Devices

C22.2 No. 42.1-13
Cover Plates for Flush-Mounted Wiring Devices

C22.2 No. 43-08 (R2013)
Lampholders

C22.2 No. 49-14
Flexible Cords and Cables

C22.2 No. 53-1968 (R2014)
Electric Washing Machines

C22.2 No. 55–15
Special Use Switches

C22.2 No. 65-13
Wire Connectors

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C22.2 No. 66.2-06 (R2015)
Low Voltage Transformers – Part 2: General Purpose Transformers

C22.2 No. 66.3-06 (R2015)
Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers

C22.2 No. 72-10 (R2014)
Heater Elements

C22.2 No. 74-16
Equipment for Use with Electric Discharge Lamps

C22.2 No. 75-14
Thermoplastic-Insulated Wires and Cables

C22.2 No. 77-14
Motors with Inherent Overheating Protection

C22.2 No. 100-14
Motors and Generators

C22.2 No. 107.1-16
Power Conversion Equipment

CSA C22.2 No. 108-14
Liquid Pumps

C22.2 No. 111-10 (R2015)
General Use Snap Switches

C22.2 No. 112-17
Electric Clothes Dryers

C22.2 No. 127-15
Equipment and Lead Wires

C22.2 No. 139-13
Electrically Operated Valves

C22.2 No. 153-14
Electrical Quick Connect Terminals

C22.2 No. 156-M1987 (R2013)
Solid-State Speed Controls

C22.2 No. 158-10 (R2014)
Terminal Blocks

C22.2 No. 177-13
Clock Operated Switches

C22.2 No. 182.3-16
Special Use Attachment Plugs, Receptacles, and Connectors

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C22.2 No. 188-13
Splicing Wire Connectors

C22.2 No. 190-14
Capacitors for Power Factor Correction

C22.2 No. 197-M1983 (R2013)
PVC Insulating Tape

CAN/CSA-C22.2 No. 198.1-06 (R2015)
Extruded Insulating Tubing

CAN/CSA-C22.2 No. 198.3-05 (R2014)
Coated Electrical Sleeving

C22.2 No. 209-M1985 (R2013)
Thermal Cut-Offs

C22.2 No. 210-15
Appliance Wiring Material Products

C22.2 No. 223-15
Power Supplies with Extra-Low-Voltage Class 2 Outputs

C22.2 No. 235-04 (R0213)
Supplementary Protectors

C22.2 No. 248.1-11 (R2016)
Low-Voltage Fuses – Part 1: General Requirements

CAN/CSA-C22.2 No. 248.2-00 (R2015)
Low Voltage Fuses – Part 2: Class C Fuses

CAN/CSA-C22.2 No. 248.3-00 (R2015)
Low Voltage Fuses – Part 3: Class CA and CB Fuses

CAN/CSA-C22.2 No. 248.4-00 (R2015)
Low Voltage Fuses – Part 4: Class CC Fuses

CAN/CSA-C22.2 No. 248.5-00 (R2015)
Low Voltage Fuses – Part 5: Class G Fuses

CAN/CSA-C22.2 No. 248.6-00 (R2015)
Low Voltage Fuses – Part 6: Class H Non-Renewable Fuses

CAN/CSA-C22.2 No. 248.7-00 (R2015)
Low Voltage Fuses – Part 7: Class H Renewable Fuses

C22.2 No. 248.8-11 (R2016)
Low Voltage Fuses – Part 8: Class J Fuses

CAN/CSA-C22.2 No. 248.9-00 (R2015)
Low Voltage Fuses – Part 9: Class K Fuses

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C22.2 No. 248.10-11 (R2016)
Low Voltage Fuses – Part 10: Class L Fuses

C22.2 No. 248.11-11 (R2016)
Low Voltage Fuses – Part 11: Plug Fuses

C22.2 No. 248.12-11 (R2016)
Low Voltage Fuses – Part 12: Class R Fuses

CAN/CSA-C22.2 No. 248.14-00 (R2015)
Low Voltage Fuses – Part 14: Supplemental Fuses

CAN/CSA-C22.2 No. 248.15-00 (R2015)
Low Voltage Fuses – Part 15: Class T Fuses

CAN/CSA-C22.2 No. 250.13-14
Light emitting diode (LED) equipment for lighting applications

C22.2 No. 2459-08 (R2013)
Insulated Multi-pole Splicing Wire Connectors

CAN/CSA-C22.2 No. 4248.1-07 (R2016)
Fuseholders – Part 1: General Requirements

CAN/CSA-C22.2 No. 4248.4-07 (R2016)
Fuseholders – Part 4: Class CC

CAN/CSA-C22.2 No. 4248.5-07 (R2016)
Fuseholders – Part 5: Class G

CAN/CSA-C22.2 No. 4248.6-07 (R2016)
Fuseholders – Part 6: Class H

CAN/CSA-C22.2 No. 4248.8-07 (R2016)
Fuseholders – Part 8: Class J

CAN/CSA-C22.2 No. 4248.9-07 (R2016)
Fuseholders – Part 9: Class K

CAN/CSA-C22.2 No. 4248.11-07 (R2016)
Fuseholders – Part 11: Type C (Edison Base)

CAN/CSA-C22.2 No. 4248.12-07 (R2016)
Fuseholders – Part 12: Class R

CAN/CSA-C22.2 No. 4248.15-07 (R2016)
Fuseholders – Part 15: Class T

CAN/CSA-C22.2 No. 60950-1-07 (R2016)
Information Technology Equipment Safety – Part 1: General Requirements

CAN/CSA-C22.2 No. 61058-1-09 (R2014)
Switches for Appliances – Part 1: General Requirements

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CAN/CSA-C360-13
Energy Performance and Drum Volume of Household Electric Clothes Dryers

CAN/CSA-E60384-14:14
Fixed Capacitors for Use in Electronic Equipment Part 14: Sectional specification – Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains

CAN/CSA-E60384-1:14
Fixed Capacitors for use in Electronic Equipment — Part 1: Generic Specification

CAN/CSA-E60691:15
Thermal Links – Requirements and Application Guide

CAN/CSA-E60730-1:15
Automatic Electrical Controls for Household and Similar Use – Part 1: General Requirements

CAN/CSA-E730-2-6-94 (R2013)
Automatic Electrical Controls for Household and Similar Use – Part 2: Particular Requirements for Automatic Electrical Pressure Sensing Controls, Including Mechanical Requirements

CAN/CSA-E730-2-7-94 (R2013)
Automatic Electrical Controls for Household and Similar Use – Part 2: Particular Requirements for Timers and Time Switches

CAN/CSA-E60730-2-8:01 (R2016)
Automatic Electrical Controls for Household and Similar Use – Part 2-8: Particular Requirements for Electrically Operated Water Valves, Including Mechanical Requirements

CAN/CSA-E60730-2-9:15
Automatic Electrical Controls for Household and Similar Use – Part 2-9: Particular Requirements for Temperature Sensing Controls

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UL 61058-1
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ASSE (American Society of Sanitary Engineering) Standards

ASSE 1001-2008
Performance Requirements for Atmospheric Type Vacuum Breakers

ASTM International Standards

ASTM B 344-14
Standard Specification for Drawn or Rolled Nickel-Chromium and Nickel-Chromium-Iron Alloys for Electrical Heating Elements

ASTM D638M-96
Test Method for Tensile Properties of Plastics (Metric)

ASTM D6670-13
Standard Practice for Full-Scale Chamber Determination of Volatile Organic Emissions from Indoor Materials/Products

ASTM E230/E230M-12
Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples

Government of USA

Code of Federal Regulations, Title 10, Part 430, as amended from time to time (referenced as 49 CFR 430).

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IEC (International Electrotechnical Commission) Standards

IEC 60127-1:2015
Miniature Fuses – Part 1: Definitions for Miniature Fuses and General Requirements for Miniature Fuse-links

IEC 60695-2-11:2014
Fire Hazard Testing – Part 2-11: Glowing/Hot-Wire Based Test Methods – Glow-Wire Flammability Test Method for End-Products

IEC 60695-2-12:2010
Fire Hazard Testing – Part 2-12: Glowing/Hot-Wire Based Test Methods – Glow Wire Flammability Test Method for Materials

IEC 60695-2-13:2010
Fire Hazard Testing – Part 2-13: Glowing/Hot-Wire Based Test Methods – Glow Wire Ignitability Test Method for Materials

IEC 60695-11-10:2013
Fire Hazard Testing – Part 11-10: Test Flames – 50 W Horizontal and Vertical Flame Test Methods

ISO (International Organization for Standardization) Standards

ISO 16000-9:2011
Indoor Air – Part 9: Determination of the Emission of Volatile Organic Compounds from Building Products and Furnishing – Emission Test Chamber Method

ISO/IEC 28360:2015
Information Technology – Office Equipment – Determination of Chemical Emission Rates from Electronic Equipment

NFPA (National Fire Protection Association) Standards

NFPA 70
National Electrical Code

4 General Conditions for the Tests

4.1 Voltage and frequency

4.1.1 Unless otherwise specified in the requirements, all tests shall be conducted with the appliance connected to a supply circuit with a rated frequency and a voltage (Vs) of:

a) 120 V for an appliance rated from 110 to 120 V;

b) 240 V for an appliance rated from 220 to 240 V; or

c) the maximum rated voltage of the appliance for an appliance rated other than as mentioned in (a) or (b).

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4.1.2 The test voltage, (Vt), used during the heating tests of Clause 11 and the abnormal operation tests of Clause 19 shall be adjusted so that the calculated (see formula below) heating circuit input (Wt) is achieved. This compensates for heating elements with inputs at Vs (see Clause 4.1.1) that are different than their rated (marked) inputs.

$$W_t = Wm(V_s/V_m)^2$$

where

W_t = the calculated heating circuit input, W

W_m = the heating element rated (marked) input, W

V_s = the supply circuit voltage specified in Clause 4.1.1

V_m = the heating element rated (marked) input, V

4.1.3 If it is necessary to increase the appliance test voltage beyond the voltage as specified in Clause 4.1.1, the motor shall be supplied from a separate circuit not exceeding the nominal system voltage (eg, 120 V, 240 V).

4.2 Test load

4.2.1 Unless otherwise specified, the test load shall:

a) consist of cloths as described in Clause 4.3; and

b) have a dry mass equal to the manufacturer's recommended load or 0.048 kg/L of clothes-drum volume, whichever is greater.

Note: Whenever a referee method is necessary to determine clothes-drum volume, the measurement is made in accordance with the method described in CAN/CSA-C360 or the U.S. Department of Energy (DOE) Energy Conservation Program for Consumer Products – Paragraph 3.1 of Appendix J to Subpart B of 10 CFR 430, Uniform Test Method for Measuring the Energy Consumption of Automatic and Semi-Automatic Clothes Washers.

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4.3 Test fabric

4.3.1 The fabric used for tests shall be bleached, preshrunk cotton suiting, having a warp of 55 ± 2 threads per 25.4 mm and a filling of 48 ± 2 threads per 25.4 mm. Individual cloths shall be 610 × 915 mm, double hemmed to a size of approximately 560 × 865 mm. A small number of smaller cloths, 305 × 305 mm, double hemmed to a size of 255 × 255 mm, may be used if necessary to make the total weight of cloth correct.

4.4 Thermocouples

4.4.1 Thermocouples shall consist of wires not larger than 24 AWG (0.21 mm^2). The thermocouple wire shall conform with the requirements for Special Tolerances thermocouples as listed in the Tolerances on Initial Values of EMF versus Temperature tables in ANSI/ASTM E230/E230M.

Note: When thermocouples are used in the determination of temperatures in connection with the heating of electrical devices, it is common practice to employ thermocouples consisting of 30 AWG (0.05 mm^2) iron and constantan wires and a potentiometer-type indicating instrument; such equipment is used whenever referee temperature measurements by thermocouples are necessary.

4.5 Laundry detergent

4.5.1 Whenever laundry detergent is required for a test in this Standard it shall be AHAM detergent or any other powdered laundry detergent having similar properties.

4.6 Laundry bleach

4.6.1 Whenever laundry bleach is specified in this Standard, commercially available liquid chlorine bleaches for household use shall be acceptable.

4.7 Cheesecloth for heating and abnormal tests

4.7.1 Whenever cheesecloth is required for a test in this Standard, the cloth shall be bleached cheesecloth running approximately 34 g/m^2 with a thread count in the range of 10 – 13 × 9 – 12 threads/cm.

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4.8 Test temperature

4.8.1 The tests shall be conducted in a draught-free location and in general at an ambient temperature in the range of 10–40°C.

5 Marking and Instructions

5.1 Marking

***Advisory Note**: In Canada, there are two official languages. Therefore, it is necessary to have CAUTION, WARNING, and DANGER markings in both English and French. Annex A lists acceptable translations of the markings specified in this Standard. When a product is not intended for use in Canada, cautionary markings may be provided in English only.*

5.1.1 General

5.1.1.1 A marking that is required to be permanent shall be moulded, die-stamped, paint-stencilled, stamped, or etched metal that is permanently secured, or indelibly stamped on a pressure-sensitive label secured by adhesive. Pressure-sensitive labels and adhesive shall comply with CAN/CSA-C22.2 No. 0.15 and UL 969. If a pressure-sensitive label would be exposed to fabric softeners, bleach, or detergent because of its location, the label shall comply with Clauses 5.1.1.2 and 5.1.1.3.

5.1.1.2 After being conditioned as described in Clause 5.1.1.3, a pressure-sensitive label or a label secured by cement or adhesive, immediately following removal from each test medium and after being exposed to room temperature for 24 h following removal from each medium, shall:

a) demonstrate good adhesion and not have curled edges;

b) resist defacement or removal as demonstrated by scraping across the test panel with a flat metal blade 0.8 mm thick held at right angles to the test panel; and

c) be legible and resist defacement when rubbed with thumb or finger pressure.

5.1.1.3 Three samples of the label applied to test surfaces as in the intended application shall be conditioned for 24 h in a controlled atmosphere maintained at 23 ± 2°C with a 50 ± 5% relative humidity. The samples shall then be immersed for 48 h in a solution representative of service use, maintained at the temperature the solution would attain in service, but not less than 23 ± 2°C.

5.1.1.4 A marking required to be permanent shall be located on a part that would require the use of a tool for removal.

5.1.1.5 A cautionary marking intended to instruct the operator shall be legible and visible to the operator during normal operation of the appliance. A marking giving servicing instructions shall be legible and visible when such servicing is being performed.

5.1.1.6 A cautionary marking shall be prefixed by the word “CAUTION”, “WARNING”, or “DANGER” in letters not less than 3.2 mm high. The remaining letters of such marking shall not be less than 1.6 mm high.

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5.1.2 Appliance markings

5.1.2.1 An appliance shall be rated in volts and in amperes. The number of phases shall be included in the ratings if the appliance is intended for connection to a polyphase circuit, and the ratings shall include the frequency expressed in hertz (Hz).

5.1.2.2 An appliance, as mentioned in Clause 7.2, that will not start and operate normally when connected to a circuit protected by a 15 A fuse of other than the time-delay type, but that will start and operate normally when connected to a circuit protected by a 15 A time-delay fuse, shall be plainly and permanently marked with the following or the equivalent:

“If connected to a circuit protected by fuses, use time-delay fuses with this appliance”.

5.1.2.3 If replaceable fuses are provided, the maximum size in amperes of the fuse required shall be permanently marked on the appliance.

5.1.2.4 Appliances having field wiring terminals shall be marked with one of the following:

a) “Use copper conductors only”

if the terminal is acceptable only for connection to copper wire;

b) “Use aluminum conductors only”

if the terminal is acceptable only for connection to aluminum wire;

c) “Use copper or aluminum conductors “or “Use copper, copper-clad aluminum, or aluminum conductors” if the terminal is acceptable only for connection to either copper or aluminum wire; or

d) “Use copper-clad aluminum or copper conductors”

if the terminal is acceptable only for connection to either copper or copper-clad aluminum wire.

5.1.2.5 A heating element rated more than 1 A and intended to be replaceable in the field shall be marked with:

a) its rating in V and A or in V and W;

b) the manufacturer’s part number; or

c) an equivalent means of identification.

The marking shall withstand the environment involved.

Note: An open-wire heating element need not be marked if it is part of an assembly that is marked as required.

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5.1.2.6 An appliance that is intended to comply with Clause 17.5.3 shall be marked, in a location that is visible during installation and inspection with the word: “WARNING”, and the following statement or the equivalent: “To reduce the risk of fire, this appliance must be fastened or otherwise secured to an uncovered concrete floor”.

5.1.2.7 If an appliance employs a non-current-carrying metal part that is not grounded as provided in Clause 22.1.5, the appliance shall be permanently marked with the word “WARNING” and the following or the equivalent: “Certain internal parts are intentionally not grounded and may present a risk of electric shock only during servicing. Service Personnel – Do not contact the following parts while the appliance is energized: (list of ungrounded parts)”. The marking shall be located on the outside of the appliance and it shall be readily visible before any servicing operation. The marking also shall be located close to each ungrounded part and it shall be readily visible before or when the part becomes accessible.

If all approaches to ungrounded parts can be adequately covered by one marking:

a) then only one marking, visible from the outside of the appliance and at the approach to the ungrounded parts, need be employed; or

b) if the marking is located on the ungrounded part, only one marking need be employed.

5.1.2.8 If a manufacturer produces or assembles appliances at more than one factory, each finished appliance shall have a distinctive marking, which may be in code, by which it can be identified as the product of a particular factory.

5.1.2.9 An appliance provided with instructions for any type of user maintenance shall be marked with the word “WARNING” and the following or the equivalent:

“To reduce the risk of electric shock, disconnect this appliance from the power supply before attempting any user maintenance. Turning the controls to the OFF position does not disconnect this appliance from the power supply”.

The marking shall be so located as to be visible before the maintenance is attempted.

5.1.2.10 An appliance shall have a permanent, legible marking that will be readily visible after the appliance has been installed as intended without the necessity of moving the appliance. The markings shall include the:

a) manufacturer’s name, tradename, trademark, or other descriptive marking by which the organization responsible for the product can be identified, hereinafter referred to as the “manufacturer’s name”;

b) catalogue number or the equivalent;

c) electrical rating; and

d) date of manufacture by week, month or quarter, and year, which may be abbreviated or in an established or otherwise acceptable code.

If an appliance employs a single motor as its only energy-consuming component, the electrical ratings on the motor nameplate need not be shown elsewhere on the appliance if this nameplate is readily visible after the motor has been installed in the appliance.

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5.1.2.11 An appliance that is intended to be installed in a closet shall be provided with a permanent marking that specifies the required clearances to all adjacent surfaces and the required ventilation in the door. This marking may be included with other markings on a common label provided it is:

a) separate from the wording of all other markings on the label; and

b) visible during installation.

5.1.2.12 A stationary appliance employing an attachment plug in accordance with Clause 20.3.6 shall be marked in the installation instructions, markings, or by a hang tag or equivalent:

“Connect To Individual Branch-Circuit”.

5.1.2.13 With reference to Clause 8.3, an appliance that is fastened or otherwise secured at a specific location and is intended to be connected to a supply circuit protected by a 15 A or a 20 A overcurrent-protective device and that has a current rating greater than 50% of the supply-circuit-current rating shall be permanently marked to indicate that the appliance shall be connected only to a supply circuit to which no lighting units or general-purpose receptacles are connected. The marking shall be located so that it will be readily visible when the connections to the supply circuit are made.

5.1.2.14 If an appliance employs a dual-voltage motor and if the motor nameplate is employed to give the electrical ratings of the appliance, as mentioned in Clause 5.1.2.10, the appliance shall also be marked to indicate the voltage for which it shall be connected when it is in use.

5.1.2.15 If a cord-connected appliance employs a dual-voltage motor, instructions shall be provided to indicate the type of attachment plug that should be used if the appliance is reconnected for the alternative voltage.

5.1.2.16 A permanently connected appliance having one motor and other loads or more than one motor with or without other loads shall be permanently marked in a location that will be visible when connections to the power-supply circuit are made and inspected. The markings shall include:

a) the minimum supply-circuit conductor ampacity in accordance with Clause 5.1.2.17; and

b) the maximum rating and type of supply-circuit overcurrent-protective device, such as a non-time-delay fuse or a dual-element time-delay fuse, in accordance with Clause 5.1.2.18.

5.1.2.17 With reference to the requirement in Clause 5.1.2.16(a), the minimum supply-circuit conductor ampacity shall be based on the maximum input in accordance with Clause 8.

5.1.2.18 With reference to the requirement in Clause 5.1.2.16(b), the rating of the supply-circuit overcurrent-protective device shall not exceed the rating of the fuse employed in the short-circuit test of the motor overload-protective device employed in the appliance as specified in Clause 19.8.2.

5.1.2.19 An appliance provided with double insulation shall be permanently marked with the words:

“DOUBLE INSULATION – When servicing, use only identical replacement parts”.

The words “DOUBLE-INSULATED” may be used instead of “DOUBLE INSULATION”.

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5.1.2.20 An appliance shall not be marked with a double insulation symbol (a square within a square), the words “DOUBLE INSULATION”, or the equivalent unless it complies with the requirements for double-insulated appliances in accordance with CSA C22.2 No. 0.1 and UL 1097.

5.1.2.21 A marking shall state the weight of clothes (in lb and kg) that the appliance is intended to wash at one time. The weight of clothes need not be included in the marking on a washing machine if this information or its equivalent is given in the instructions for operation that the manufacturer provides with the appliance.

5.1.2.22 A pressure wire connector intended for connection of an equipment-grounding conductor shall be identified by being marked “G”, “GR”, “GND”, “Ground”, “Grounding”, with the grounding symbol illustrated in Figure 8, a similar marking; or by a marking on the wiring diagram provided on the appliance.

5.1.2.23 A dedicated receptacle shall have a marking immediately adjacent to it identifying its use. The marking shall include the statement:

″Not a general-use receptacle – For use with _____ only″.

A description of the pedestal or drawer-type washing machine to be connected to the receptacle, including the model number, catalog number, or other identification determined to be equivalent, and the electrical rating in volts and amperes, shall be inserted in the blank space.

5.1.3 Wringer washers

5.1.3.1 A wringer washer provided with a release, as described in Clause 15.7.4, shall be plainly marked on the operating member to indicate its function and method of operation.

5.1.3.2 Unless it incorporates a device or system as described in Clause 15.7.2(a), a wringer washing machine shall be plainly and permanently marked with the word “CAUTION” and the following statement or the equivalent:

“Disengage wringer mechanism when not attended – See instruction book”.

This marking shall be on the wringer assembly at such a location that it will be readily visible with the wringer in any normal operating position.

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5.1.4 Wall-mounting kits and stands

5.1.4.1 A wall-mounting kit or an appliance stand packaged and marketed separately for the basic appliance or recommended by the appliance manufacturer for use with the basic appliance shall be permanently and legibly marked with a catalogue number or the equivalent. Information packaged with the appliance shall identify, by catalogue number:

a) the wall-mounting kits;

b) the appliance stands that have been investigated and found acceptable for use with the appliance; or

c) the appliance with which the wall-mounting kit or appliance stand is intended to be used.

5.1.4.2 The catalogue number mentioned in Clause 5.1.4.1 shall appear in at least one of the following locations:

a) on the wall-mounting kit or appliance stand;

b) on the package containing the wall-mounting kit or appliance stand; or

c) in the information furnished with the wall-mounting kit or appliance stand.

5.2 Instruction manual

5.2.1 General

5.2.1.1 A household appliance shall be provided with:

a) instructions pertaining to a risk of fire, electric shock, or injury to persons associated with the use of the appliance;

b) installation instructions;

c) operating instructions; and

d) if applicable, user-maintenance instructions.

5.2.1.2 The instructions required by Clause 5.2.1.1 shall be:

a) in separate manuals; or

b) combined in one or more manuals, provided the instructions pertaining to a risk of fire, electric shock, or injury to persons are emphasized and in a separate format to distinguish them from the rest of the text.

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5.2.1.3 The following material shall be provided as printed material:

a) the instructions pertaining to a risk of fire, electric shock, or injury to persons as required by Clause 5.2.1.1(a) and Clause 5.2.2; and

b) a minimum set of installation and operating instructions, such as a quick start guide, that includes the required warning instructions required by Clauses 5.3 and 5.4.

5.2.1.4 All other instructions may be provided in electronic read-only media format only, such as a DVD, website, flash drive or CD-ROM. If any electronic media instructions are provided, the instructions and warning statements required by Clause 5.2.1.1 shall also be included within the electronic media instructions.

5.2.1.5 The printed instructions material referenced in 5.2.1.3 shall contain detailed instructions of how to obtain a printed copy of the material contained in electronic format.

5.2.1.6 Instructions for user repair that are provided with an appliance, or that are specifically referenced by other literature or markings provided with the appliance, shall be considered with respect to the risks that might be present during the repair and after the repair has been completed.

5.2.1.7 Any heading or statement requiring the cautionary prefix “WARNING” shall be entirely in upper case letters or otherwise emphasized to distinguish it from the rest of the text.

5.2.1.8 Unless otherwise indicated, the text of all instructions shall be in the words specified or words that are equivalent, clear, and understandable. However, there shall be no substitute for the word “WARNING”.

Note: If the appliance is such that the specific wording is unnecessary or conflicting, the wording may be omitted or modified as applicable.

5.2.2 Instructions pertaining to a risk of fire, electric shock, or injury to persons

5.2.2.1 The instructions pertaining to a risk of fire, electric shock, or injury to persons shall warn the user of reasonably foreseeable risks and state the precautions that should be taken to reduce such risks.

5.2.2.2 The heading “IMPORTANT SAFETY INSTRUCTIONS” or the equivalent shall precede the list of instructions required in Clause 5.2.2.4, and the statement “SAVE THESE INSTRUCTIONS” or the equivalent shall either precede or follow the list (see Clause 5.2.1.7).

5.2.2.3 The instructions shall include the appropriate instructions from Clauses 5.2.2.4 and 5.2.2.5.

5.2.2.4 The instructions required by Clause 5.2.2.1 shall include the items in the following list, as applicable, as well as any other instructions a manufacturer considers to be necessary for the appliance. The items in the list may be numbered (see Clause 5.2.1.7).

IMPORTANT SAFETY INSTRUCTIONS

WARNING – To reduce the risk of fire, electric shock, or injury to persons when using your appliance, follow basic precautions, including the following:

1) Read all instructions before using the appliance.

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2) Do not wash articles that have been previously cleaned in, washed in, soaked in, or spotted with gasoline, dry-cleaning solvents, or other flammable or explosive substances, as they give off vapours that could ignite or explode.

3) Do not add gasoline, dry-cleaning solvents, or other flammable or explosive substances to the wash water. These substances give off vapours that could ignite or explode.

4) Under certain conditions, hydrogen gas may be produced in a hot-water system that has not been used for 2 weeks or more. HYDROGEN GAS IS EXPLOSIVE. If the hot-water system has not been used for such a period, before using a washing machine, turn on all hot-water faucets and let the water flow from each for several minutes. This will release any accumulated hydrogen gas. As the gas is flammable, do not smoke or use an open flame during this time.

5) Do not allow children to play on or in the appliance. Close supervision of children is necessary when the appliance is used near children.

6) Before the appliance is removed from service or discarded, remove the door.

7) Do not reach into the appliance if the tub or agitator is moving.

8) Do not install or store this appliance where it will be exposed to the weather.

9) Do not tamper with controls.

10) Do not repair or replace any part of the appliance or attempt any servicing unless specifically recommended in the user-maintenance instructions or in published user-repair instructions that you understand and have the skills to carry out.

11) **Wringer washing machines**

Moving parts are a risk of injury to persons, and the following safety precautions should be followed:

a) Never leave the washer unattended unless the wringer rolls are stopped. Move wringer shift handle or lever to neutral position to stop rolls.

b) Do not allow children to play with or operate the wringer or the washer at any time.

c) Use extreme caution when feeding laundry into the wringer to reduce the likelihood that the operator's hands or clothing will enter the wringer.

d) Disengage wringer and disconnect power before cleaning or before performing any recommended user maintenance on the wringer assembly. See maintenance instructions for details.

e) If material gets caught in the wringer rolls or wraps around a roll, IMMEDIATELY release the CONTROL DEVICE, push the PUSH TO RELEASE bar, and disconnect power. Releasing the control device will stop the wringer rolls, and pushing the release bar will relieve roll tension and open the rolls.

Note: This statement is employed with appliances that employ the construction described in Clause 15.7.2(a).

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f) If material gets caught in the wringer rolls or wraps around a roll, IMMEDIATELY push the PUSH TO RELEASE bar, and disconnect power. This will release roll tension and stop and open the rolls. A pull or jerk on material caught in the wringer, or on the wringer, will also stop the rolls and open them.

Note: This statement is employed with appliances that employ the construction described in Clause 15.7.2(b).

SAVE THESE INSTRUCTIONS

5.2.2.5 The instructions pertaining to a risk of fire, electric shock, or injury to persons shall include (a) (b), or (c) below, as applicable. As an alternative, (a) or (b) may be included in the installation instructions, and (c) may be included in the user-maintenance instructions. If the instructions in (a) and (b) are included in the installation instructions, and if (c) is included in the user-maintenance instructions, a reference to these instructions shall be included as a separate item in the list required by Clause 5.2.2.4 (see Clause 5.2.1.7).

a) For a grounded, cord-connected appliance:

GROUNDING INSTRUCTIONS

This appliance must be grounded. In the event of malfunction or breakdown, grounding will reduce the risk of electric shock by providing a path of least resistance for electric current. This appliance is equipped with a cord having an equipment-grounding conductor and a grounding plug. The plug must be plugged into an appropriate outlet that is properly installed and grounded in accordance with all local codes and ordinances.

WARNING – Improper connection of the equipment-grounding conductor can result in a risk of electric shock. Check with a qualified electrician or serviceman if you are in doubt as to whether the appliance is properly grounded.

Do not modify the plug provided with the appliance – if it will not fit the outlet, have a proper outlet installed by a qualified electrician.

b) For a permanently connected appliance:

GROUNDING INSTRUCTIONS

This appliance must be connected to a grounded metal, permanent wiring system, or an equipment-grounding conductor must be run with the circuit conductors and connected to the equipment-grounding terminal or lead on the appliance.

c) For a double-insulated, cord-connected appliance:

SERVICING A DOUBLE-INSULATED APPLIANCE

In a double-insulated appliance, two systems of insulation are provided instead of grounding. No grounding means is provided on a double-insulated appliance, nor should a means for grounding be added to the appliance. Servicing requires extreme care and knowledge of the system, and should be done only by qualified service personnel. Replacement parts for a

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double-insulated appliance must be identical to those parts being replaced. A double-insulated appliance is marked with the words “DOUBLE INSULATION” or “DOUBLE INSULATED”. The double-insulation symbol (a square within a square) may also be marked on the appliance.

5.3 Installation instructions

5.3.1 The installation instructions shall include all the information needed to install the appliance for use as intended, and shall be preceded by the heading “INSTALLATION INSTRUCTIONS” or the equivalent.

5.3.2 The installation instructions of an appliance that is intended to comply with Clause 17.5.3 shall also include the warning marking required by Clause 5.1.2.6.

5.3.3 The installation instructions of an appliance that is intended to be installed in a closet shall specify the required clearances to all adjacent surfaces and the required ventilation in the door.

5.3.4 The installation instructions of an appliance that employs non-current-carrying metal parts within the enclosure that are accessible during installation and not grounded in accordance with Clause 22.1.5 shall include the warning marking required by Clause 5.1.2.7.

5.4 Operating instructions

5.4.1 The operating instructions shall include all the information needed to operate an appliance as intended, and shall be preceded by the heading “OPERATING INSTRUCTIONS” or the equivalent (see Clause 5.2.1.7).

5.4.2 The operating instruction shall:

a) explain and describe the location, function, and operation of each user-operated control of the appliance;

b) for a wringer washing machine, specify the correct use and operation of the wringer; and

c) include the statement:

“WARNING – To reduce the risk of fire, electric shock, or injury to persons, read the IMPORTANT SAFETY INSTRUCTIONS before operating this appliance”.

Note: This statement may be omitted if the IMPORTANT SAFETY INSTRUCTIONS required by Clauses5.2.2.1 to 5.2.2.5 are included in the operating instruction manual immediately prior to the operating instructions.

5.4.3 For vertical axis machines, the operating instructions shall be provided with instructions to the user on how to properly wash water-resistant and water-repellant type clothing, or not to wash water-resistant or water repellant-type clothing. These instructions shall include the following or equivalent:

“WARNING: Failure to closely follow these instructions may result in an abnormal vibrating and out-of-balance condition that could result in physical injury, property damage, and/or appliance damage.”

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5.5 User-maintenance instructions

5.5.1 The user-maintenance instructions shall include explicit instructions for all cleaning and servicing that is intended to be performed by the user, such as lubrication, adjustments, or removal of lint, dust, or dirt.

5.5.2 The user-maintenance instructions shall be preceded by the heading “USER-MAINTENANCE INSTRUCTIONS” or the equivalent (see Clause 5.2.1.7).

5.5.3 The user maintenance instructions of an appliance that employs non-current-carrying metal parts within the enclosure that are accessible during user servicing and not grounded in accordance with Clause 22.1.5 shall include the warning marking required by Clause 5.1.2.7.

5.6 Appliance stand and wall-mounting kit instructions

5.6.1 Installation instructions for an appliance stand or wall-mounting kit shall include a complete list and description of all parts that are included with the kit or stand, and a complete and detailed description of any additional readily available part, such as a nail, a screw, or a piece of lumber, that is needed but not included with the kit or stand. The instructions shall be included with the wall-mounting kit or appliance stand, and shall contain sufficient detail so that the kit or stand can be installed as intended.

5.6.2 The appliance stand and wall-mounting kit instructions shall be preceded by the heading “APPLIANCE STAND AND WALL-MOUNTING KIT INSTRUCTIONS” or the equivalent (see Clause 5.2.1.7).

6 Protection against accessibility to current-carrying parts

6.1 Where an opening in an enclosure has a minor dimension (see Clause 6.5:

a) less than 25.4 mm, an uninsulated current-carrying part or film-coated wire shall not be contacted by the probe illustrated in Figure 1; or

b) of 25.4 mm or more, an uninsulated current-carrying part or film-coated wire shall be positioned from the opening as specified in Table 1, to reduce the likelihood of electric shock resulting from unintentional contact with such a part or wire.

6.2 A motor with an integral enclosure that has an opening with a minor dimension (see Clause 6.5):

a) less than 19.1 mm is acceptable, if:

1) film-coated wire cannot be contacted by the probe illustrated in Figure 2;

2) in a directly accessible motor (see Clause 6.6), an uninsulated current-carrying part cannot be contacted by the probe illustrated in Figure 3; and

3) in an indirectly accessible motor (see Clause 6.6), an uninsulated current-carrying part cannot be contacted by the probe illustrated in Figure 4; and

b) of 19.1 mm or more is acceptable, if an uninsulated current-carrying part or film-coated wire is spaced from the opening as specified in Table 1.

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6.3 The probes referenced in Clauses 6.1 and 6.2 and illustrated in Figures 1, 2, 3, and 4 shall be applied to any depth that the opening will permit and shall be rotated or angled before, during, and after insertion through the opening to any position that is necessary to examine the enclosure. The probes illustrated in Figures 1 and 4 shall be applied in any possible configuration and, if necessary, the configuration shall be changed after insertion through the opening.

6.4 The probes referenced in Clauses 6.1 and 6.2 shall be used as measuring instruments to determine the accessibility provided by an opening, and not as instruments to measure the strength of a material. They shall be applied with the minimum force necessary to determine accessibility.

6.5 With reference to the requirements in Clauses 6.1 and 6.2, the minor dimension of an opening is the diameter of the largest cylindrical probe having a hemispherical tip that can be inserted through the opening.

6.6 With reference to the requirements in Clause 6.2:

a) an indirectly accessible motor is a motor that is:

1) accessible only by opening or removing a part of the outer enclosure, such as a guard or panel, that can be opened or removed without using a tool; or

2) located at such a height or is otherwise guarded or enclosed so that it is unlikely to be contacted; and

b) a directly accessible motor is a motor that:

1) can be contacted without opening or removing any part; or

2) is located so as to be accessible to contact.

6.7 Terminals, wires, or other current-carrying parts shall not be exposed by the removal of covers:

a) that open for cleaning and do not require the use of a tool (eg, screwdriver) for opening or removal; or

b) for coin or ticket collection on coin-, ticket-, or card-operated appliances.

6.8 With reference to the requirements in Clauses 6.1 and 6.2, insulated brush caps are not required to be additionally enclosed.

6.9 The requirements in Clauses 6.1 and 6.2 apply to the back of a freestanding appliance and to the back and sides of a recessed appliance. For the bottom of a freestanding or recessed appliance if the front, sides, and back of the appliance can be positioned no more than 38.1 mm (1.5 in) above the surface upon which the appliance rests, the tip of the probe, illustrated in Figure 1, shall be inserted up to 150 mm inside the plane of the opening created between the bottom edge of the appliance and the supporting surface. If the distance between the bottom edge of the appliance and supporting surface is greater than 38.1 mm, accessibility through the opening created between the bottom of the appliance and the supporting surface shall be evaluated in accordance with Table 1.

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6.10 The accessibility of protective devices shall be determined by the following requirements.

6.11 A protective device, such as a fuse, the functioning of which requires renewal or replacement, shall be in a readily accessible location.

6.12 A protective device shall be wholly inaccessible from outside the appliance without opening a door or cover.

Note: The operating handle of a circuit breaker, the operating button of a manually operable motor protector, and similar parts may project outside the appliance enclosure.

6.13 A door or cover of an enclosure shall be hinged or otherwise attached in an equivalent manner if it gives access to any overload-protective device, the functioning of which requires renewal, or if it is necessary to open the cover in connection with the operation of the protective device.

6.14 Means shall be provided for holding the door or cover over a fuseholder in a closed position, and the door or cover shall be tight fitting.

6.15 The construction and installation of a fuseholder shall be such that an uninsulated current-carrying part other than the screw shell or clips will not be exposed to contact by persons removing or replacing fuses.

7 Starting of Motor-Operated Appliances

7.1 An appliance shall start and operate normally on a circuit protected by an ordinary (not a time-delay) fuse.

7.2 For the test in Clause 7.1, a time-delay fuse shall be employed if the appliance.

a) will start and operate normally on a circuit protected by a time-delay fuse; and

b) is marked in accordance with Clause 5.1.2.2.

7.3 To determine whether an appliance complies with the requirements in Clause 7.1, the appliance shall be connected to a supply circuit of the rated test voltage and rated frequency. The appliance shall be started three times with the control(s) set to that part of the cycle resulting in the highest starting current. Wringer washers shall be tested in accordance with Clause 9.6 in the wringing mode of operation with the wringer test board described in Clause 15.7.9 passing through the wringer rolls. The appliance shall be allowed to come to full speed after each start, and to come to rest between successive starts. The performance is unacceptable if the fuse opens or an overload protector provided as part of the appliance trips.

8 Power input and current

8.1 The current input shall not be more than 110% of the marked rating with the appliance connected to a supply circuit of rated voltage and frequency. Only the steady-state current input during any condition of normal operation shall be measured (eg, washing, wringing, or idling); the input during a period of acceleration shall not be measured.

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8.2 An appliance provided with a dedicated receptacle shall be tested with the receptacle loaded with the intended ampere load. A pedestal or drawer-type clothes washer may be used for this load, or a simulated load may be used.

8.3 Unless marked in accordance with Clause 5.1.2.13, the rating of an appliance that is fastened or otherwise secured at a specific location and intended to be connected to a supply circuit protected by a 15 A or a 20 A overcurrent-protective device shall not exceed 50% of the supply-circuit-current rating.

9 Heating

9.1 General

9.1.1 An appliance shall be tested as described in Clauses 9.2 to 9.11, and shall not:

a) reach a temperature, at any point, high enough to result in a risk of fire or to damage any material used in the appliance; or

b) exceed the temperature rises specified in Table 2.

9.1.2 A motor-protective, thermal, or overcurrent-protective device shall neither operate nor open the circuit during the heating test.

9.1.3 All temperature rises in Table 2 are based on an assumed ambient temperature of 25°C. An observed temperature shall be corrected by addition (if the ambient temperature is lower than 25°C) or by subtraction (if the ambient temperature is higher than 25°C) of the difference between 25°C and the ambient temperature.

9.1.4 A temperature shall be considered to be constant when three successive readings taken at intervals of 10% of the previously elapsed duration of the test, but not less than 5 min intervals, indicate no change.

9.1.5 Ordinarily, coil or winding temperatures shall be measured by thermocouples unless the:

a) coil is inaccessible because of mounting, such as a coil immersed in sealing compound; or

b) coil-wrap includes thermal insulation of more than two layers, up to a 0.8 mm maximum, of cotton, paper, rayon, or the like.

For a thermocouple-measured temperature of a coil of an ac motor other than a universal motor (refer to Table 2, Items 11 and 14) having a frame diameter of 178 mm or less (see Note c in Table 2), the thermocouple shall be mounted on the integrally applied insulation of the conductor.

9.1.6 For a motor employing Class A or Class B insulation systems, the conditions under which the analysis mentioned in Note b in Table 2 may be undertaken are when:

a) the appliance normally follows a predetermined duty cycle automatically scheduled by the appliance control. It is not intended that the user govern the behaviour of the appliance, other than to de-energize it, after the normal cycle of operation has been initiated;

b) no temperature rise is more than 115°C for Class A insulation systems or 140°C for Class B insulation systems, regardless of the duration of such temperature; and

c) the properties of the insulation used are known over a wide range of temperatures.

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9.1.7 With reference to Note b to Table 2, for a motor employing Class A or Class B insulation systems, the analysis to determine whether insulation systems will be adversely affected by higher temperatures shall be conducted as follows:

a) the values of motor winding temperatures obtained during one complete cycle of operation shall be plotted using the temperatures as abscissas (X-axis) and the times as ordinates (Y-axis), and the curve shall be drawn;

b) the axis of ordinates shall be divided into intervals by erecting abscissas at equally spaced points. The number of such points shall be adequate to represent clearly all significant variations represented by the curve;

c) from the curve, the maximum value of temperature for each interval shall be determined, and from each maximum-temperature value, the maximum-temperature rise for each interval shall be determined by subtracting the ambient temperature;

d) for each maximum-temperature rise, the value of the expected percentage of normal life shall be determined from Figure 5;

e) each value of the expected percentage of normal life shall be divided by 100, and the reciprocal of this quotient shall be taken; and

f) the sum of the reciprocals shall be divided by the number of intervals obtained in item (b) above. If the result is less than unity, the insulation systems can be expected to have a life greater than normal, and are not considered to be adversely affected by the higher temperature. If the result is more than unity, the insulation systems are considered to be adversely affected by the higher temperature.

9.1.8 An appliance provided with a dedicated receptacle shall be tested as described in Clauses 9.2 to 9.11 with the receptacle loaded with the intended ampere load during the heating test. A pedestal or drawer-type clothes washer may be used for this load, or a simulated load may be used.

9.2 Appliances intended for closet installation

9.2.1 An appliance that is:

a) intended to be installed in a closet per Clause 5.3.3; and

b) marked in accordance with Clause 5.1.2.11;

shall be tested in an enclosure that is constructed of nominal 9.5 mm thick flat-black-painted plywood and consists of a bottom, a back, two sides, a top, and a door. The spacings to each enclosure surface and the door ventilation, shall be as specified by the manufacturer.

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9.3 Wall-insert or recessed appliances

9.3.1 A wall-insert or recessed appliance shall be mounted in an enclosure constructed of nominal 9.5 mm thick plywood painted black. The enclosure shall consist of a bottom, a back, two sides, and a top. The top shall be omitted for the test on a recessed appliance if its construction is such that a countertop could not be used. Each of these areas shall be brought into as intimate contact with the corresponding surface of the appliance as the configuration of the appliance will permit. Temperatures shall be measured at points on each of these enclosing surfaces.

9.4 Other appliances

9.4.1 An appliance that is not intended to be installed in a:

a) closet (Clause 9.2); or

b) wall or recess (Clause 9.3);

shall be placed on a horizontal surface and located within an enclosure formed by three flat-black-painted, vertical surfaces of nominal 9.5 mm thick plywood. The enclosure surfaces shall be located as close to the back and both sides of the appliance as possible and shall extend not less than 610 mm beyond the physical limits of the front and the top of the appliance.

9.5 Cord reels

9.5.1 Supply-cord reels shall be tested with the supply cord unreeled to 1/3 of its full extension, and the cord insulation temperatures shall be determined at the center of the cord reel, the terminal end, and between the outer two layers on the reel.

9.6 Nonautomatic washing machine

9.6.1 A nonautomatic washing machine shall be operated for 2 h, through four complete cycles, each consisting of 18 min of washing, 8 min of wringing, and 4 min of OFF time. The tank shall be filled, to the level indicated on the appliance, with water that, at the beginning of the first cycle and the beginning of the fourth cycle, has a temperature of 65°C. With the concurrence of those concerned, 120 cm^3 (4 ounces) or less of powdered laundry detergent may be added to each fresh tank of water.

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9.7 Household automatic washing machine

9.7.1 A household automatic washing machine shall be operated for four successive operations of the appliance through the complete program cycle(s) that gives the highest temperature rises. A 4 min interval shall be allowed between successive cycles to permit rearrangement of the clothes load. Hot water shall be supplied to the hot water inlet valve of the appliance at a temperature of 60 ± 2°C, and cold water shall be supplied to the cold water inlet valve of the appliance at a temperature of 15 ± 5°C, with both supplied at a minimum pressure of 150 kPa. The outlet of the hose from the drain pump shall be 900 mm above the floor on which the appliance rests. With the concurrence of those concerned, 120 cm^3 (4 ounces) or less of powdered laundry detergent may be added to the appliance at the beginning of each cycle.

9.7.2 For appliances provided with one water inlet valve, water shall be supplied in accordance with the installation instructions. If the manufacturer recommends connection to cold water, the water supply shall be 15 ± 5°C at a minimum pressure of 150 kPa. If the manufacturer recommends connection to hot water, the water supply shall be 60 ± 2°C at a minimum pressure of 150 kPa.

9.8 Commercial washing machines

9.8.1 A commercial appliance shall be operated continuously through the cycles as outlined in Clause 9.6 or 9.7, as applicable, until maximum temperatures have been obtained.

9.9 Water heating feature

9.9.1 If the appliance employs a heater assembly for the purposes of heating water, the test shall also be conducted with the cold water inlet valve and the hot water inlet valve connected to cold water at 15 ± 5°C.

9.9.2 For appliances provided with one water inlet valve, the test shall be conducted with the water inlet valve connected to a 15 ± 5°C water supply and then to a 60 ± 5°C water supply.

9.9.3 If the appliance is provided with warm-water spray function that is accessible to users when the top lid is open, and the warm-water spray is derived from the water-heating feature in the appliance, the temperature of this water shall not exceed 60°C.

9.10 Household extractors

9.10.1 Extractors shall be tested with the rated load, except the load shall be dripping wet with water before loading the appliance. Extractors intended for household duty shall be operated through a maximum of four duty cycles, the duration of each cycle to be as recommended by the manufacturer in the operating instructions or, if not so specified, the minimum normal cycle as estimated by the testing agency. A 4 min interval shall be allowed between cycles for reloading.

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9.11 Coin-, ticket-, or card-operated commercial extractors

9.11.1 Coin-, ticket-, or card-operated extractors for commercial use shall be tested with rated load as specified in Clause 9.10.1, except operated continuously at a duty cycle representing normal use.

10 Leakage current

10.1 When tested as described in Clauses 10.2 to 10.6, the leakage current of an appliance rated 240 V or less, single phase, that is:

a) moved, or can be moved easily from one place to another in normal use, shall not be more than 0.5 mA; or

b) not moved easily from one place to another in normal use, or fastened or otherwise secured at a specific location, shall not be more than 0.75 mA.

Appliances having sheathed heating elements may exceed the leakage current specified in items (a) or (b) above for a period not exceeding 5 min, but shall not exceed 2.5 mA. The 5 min period shall be measured during the warmup period and again during the cool down period from the first excursion above the value specified in (a) or (b) until the value is less than and remains less than the value in (a) or (b).

Note: "Leakage current" refers to all currents, including capacitively coupled currents, that could be conveyed between exposed conductive surfaces of an appliance and ground or other exposed surfaces of the appliance.

10.2 All exposed conductive surfaces shall be tested for leakage currents. The leakage currents shall be measured from the accessible surface or parts individually as well as collectively where simultaneously accessible to the grounded supply conductor and from one surface or part to another where both are simultaneously accessible.

Parts shall be considered to be exposed surfaces unless guarded by an enclosure that has been investigated and found to be acceptable to reduce the risk of electric shock (see Clauses 6 and 16).

Surfaces are considered to be simultaneously accessible if they can be readily contacted by one or both hands of a person at the same time.

These measurements do not apply to terminals operating at voltages that are not considered to involve a risk of electric shock. If all accessible surfaces are bonded together and connected to the bonding conductor of the power-supply cord, the leakage current shall be measured between the bonding conductor and the grounded supply conductor.

10.3 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 100 × 200 mm in contact with the surface. If the surface is less than 100 × 200 mm, 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 appliance.

10.4 The measurement circuit for leakage current shall be as illustrated in Figure 6. The meter that is actually used for a measurement need only indicate the same numerical value for a particular measurement as would the defined instrument. The meter used need not have all the attributes of the defined instrument. The measurement instrument is defined as:

a) a meter that has an input impedance of 1 500 Ω shunted by a capacitance of 0.15 μf;

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b) a meter that indicates 1.11 times the average of the full-wave rectified composite waveform of the voltage across the resistor or current through the resistor; and

c) an instrument in which the measurement circuitry has a frequency response ratio (over a range of 0-100 kHz) of indicated to actual value of current that is equal to the ratio of the impedance of a 1 500 Ω shunted by a 0.15 µf capacitor to 1 500 Ω. At an indication of 0.5 or 0.75 mA, the measurement may have an error of not more than 5% at 60 Hz.

10.5 Unless the meter is used to measure leakage from one part of an appliance to another, it shall be connected between accessible parts and the grounded supply conductor.

10.6 A sample of the appliance shall be tested for leakage current starting with the as-received condition. ″As-received″ is defined as not having previously been energized except as may occur as part of the production-line testing. The bonding conductor of the appliance, if any, shall also be open at the grounding terminal or attachment plug. The supply voltage shall be adjusted to the voltage specified in Clause 4.1. The test sequence, with reference to the measuring circuit (Figure 6) shall be as follows:

a) with switch S1 open, the appliance shall be connected to the measuring circuit. The leakage current shall be measured using both positions of switch S2, and with the appliance switching devices in all their normal operating positions;

b) switch S1 shall then be closed, energizing the appliance, and within 5 s, the leakage current shall be measured using both positions of switch S2 and with the appliance switching devices in all their normal operating positions; and

c) the leakage current shall be monitored until temperatures become constant. Both positions of switch S2 shall be used in determining this measurement. The appliance shall be operated as described in Clause 9.

10.7 The test sample shall be installed in a manner so that all parallel ground paths, such as through the fill and drain lines, will be eliminated.

11 Moisture resistance

11.1 A cord-connected appliance rated 240 V or less, single phase, shall comply with the requirements for leakage current in Clause 10.1 following exposure in air for 48 h at a temperature of 32 ± 2°C and 88 ± 2% relative humidity.

11.2 To determine whether an appliance complies with the requirement in Clause 11.1, a sample of the appliance shall be heated to a temperature just above 34°C, to reduce the likelihood of condensation of moisture during conditioning. The heated sample shall be placed in the humidity chamber and conditioned for 48 h under the conditions specified in Clause 11.1. Following the conditioning, the sample shall be tested unenergized, as described in Clause 10.6(a). The sample shall then be energized and tested as described in Clauses 10.6(b) and (c). The test shall be discontinued when the leakage current stabilizes or decreases.

12 Insulation resistance

12.1 An appliance employing insulating material that might be adversely affected by moisture under conditions of normal use and intended to be permanently connected to the power source shall be conditioned in moist air for 24 h at a temperature of 32 ± 2°C and 85 ± 5% relative humidity. After the conditioning the appliance shall have an insulation resistance of not less than 50 000 Ω between current-carrying parts and interconnected non-current-carrying metal parts.

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13 Electric strength

13.1 An appliance shall withstand for 1 min without breakdown the application of a DC potential or an AC 60 Hz essentially sinusoidal potential between current-carrying parts and non-current-carrying metal parts. This potential shall be:

a) 1 000 V AC or 1400 V DC for an appliance of any rated voltage up to 250 V; or

b) 1 000 V AC plus twice rated voltage or 1400 V DC plus 2.8 times rated voltage for an appliance of any rated voltage from 251 to 600 V.

Note: Solid-state control circuits that normally have a bond connection to ground may have the bond connection disconnected during the electric strength test.

13.2 If a transformer or an autotransformer is employed in the appliance, the test potential for the secondary circuit shall be:

a) 500 V if the secondary operates at 50 V or less, except that this does not apply if the secondary circuit is supplied from a Class 2 transformer;

b) 1 000 V if the secondary operates from 51 to 250 V; or

c) 1 000 V plus twice the rated voltage of the appliance if the secondary operates from 251 to 600 V.

13.3 To determine whether an appliance complies with the requirements in Clause 13.1, the appliance shall be tested by means of a 500 VA or larger-capacity transformer, the output voltage of which is DC or essentially sinusoidal and can be varied. The applied potential shall be increased from zero until the required test level is reached and shall be held at that level for 1 min. The increase in the applied potential shall be at a uniform rate and as rapid as is consistent with its value being correctly indicated by a voltmeter. The appliance shall be at the maximum operating temperature reached in normal use and all controls shall be in the ON position.

14 Abnormal operation

14.1 Stalled motor and open solenoid test

14.1.1 To determine if a risk of fire exists, separate abnormal tests shall be conducted with the appliance operating continuously in one mode until the ultimate result has been determined. The timer shall be stopped at any position while conducting this test. The appliance shall be supported on a surface of soft wood covered with four thicknesses (two layers) of cheesecloth. Temperature controls such as thermostats shall be set at the maximum heat position, and single-pole switching devices connected in the identified (grounded) conductor shall be short-circuited.

The supply circuit shall be protected by fuses rated not less than four times the motor full-load current, but in no case less than 30 A. If an appliance has a cord reel it shall have the cord fully reeled on the take-up reel during these tests.

The ultimate result shall be determined by constant temperatures, opening of the circuit by a fuse or the operation of a thermal protector, or the opening of a winding, without resulting in a risk of fire or the like.

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1) For appliances equipped with solid-state controls, continuous operation for 7 h, or more, could be necessary to make sure that the ultimate result has been observed.

2) For abnormal operation tests on polymeric enclosures and functional polymeric parts, refer to Clause 26.

14.1.2 To determine compliance with Clause 14.1.1, appliances shall be tested with:

a) any motor(s) stalled; and

b) solenoid armatures blocked open.

14.2 Cord reels

14.2.1 An appliance having a cord reel shall withstand an abnormal test at the rated voltage, applied through the highest-rated fuse that can be installed in the branch-circuit fuseholder, with the motor or highest-rated (if more than one) motor stalled and while the cord is as fully reeled on the take-up reel as the construction will permit. A 3 A fuse shall be connected between the accessible non-current-carrying conductive parts of the appliance and ground, and the power shall be left connected until the branch-circuit fuse opens the circuit, or until temperatures stabilize. The 3 A fuse shall not rupture.

There shall be no resulting risk of electric shock, fire, or serious deterioration of the insulation on the supply cord and cord reel as demonstrated by visual inspection and a repeated electric strength test.

14.3 Wetting of electrical components

14.3.1 The malfunction of a timer switch, of a float or pressure-operated switch, or other control, or a boot, diaphragm, or the like of rubber or similar material, when tested as described in Clause 14.3.3, shall not result in:

a) a leakage current greater than 5.0 mA for cord-connected appliances;

b) an insulation resistance of not less than 50 000 Ω for permanently connected appliances;

c) insulation breakdown as determined by repeating the electric strength test; or

d) the obvious wetting of current-carrying materials; see Clause 14.3.2.

14.3.2 Obvious wetting shall be considered to be wetting by a stream, spray, or dripping of water on the component. Obvious wetting shall be repeated during each test. Wetting by random drops of water that may wet the component by chance shall not be considered obvious wetting.

14.3.3 To determine whether or not a clothes washing machine complies with the requirements in Clause 14.3.1 with respect to the malfunction of a boot or diaphragm, the appliance shall be levelled prior to the test, and operated through one complete cycle of normal operation, after which the boot, diaphragm, or the like shall be removed. A solution of 5 g of a low-sudsing detergent per litre of water shall be placed in the vessel described in Clause 14.3.4, and maintained at the maximum at-rest level of the water and clothes load in the appliance during operation. The free end of the flexible tube, pointed in any direction, shall be held at points within the body enclosed by the outer surface of the boot, diaphragm, or the like when in position.

Note: A boot or diaphragm that is acceptable when tested in accordance with the requirements of Clause 19.10 is considered to comply with this requirement.

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14.3.4 The vessel mentioned in Clause 14.3.3 shall be flat-bottomed, be of any convenient dimensions, and have a 1.6 mm diameter hole in the bottom. A tube of rubber or similar flexible material shall be attached to the bottom of the vessel beneath the hole. The tube shall have an inside diameter of 9.5 mm, and shall be of whatever length is necessary for conditioning as described.

14.3.5 To determine whether the appliance complies with the requirements in Clause 14.3.1 with respect to the malfunction of the timer switch or a float or a pressure-operated switch or other devices, the appliance shall be operated through one complete cycle of normal operation. The timer switch shall then be defeated and 5 g of a low-sudsing-type detergent shall be added per litre of water in the appliance at the highest level of fill during normal operation. The appliance shall be operated in the intended manner. If a means is not provided to preclude overfilling of the appliance, the fill shall be continued for an additional 15 min following the first evidence of overflow from the tub. If a second device is provided to preclude overfilling, the actuation of this device shall terminate the test. If both a timer and fill switch are provided, a second test shall be conducted as described above, with the timer operating normally and with the fill switch defeated.

14.3.6 For vertical axis spin extractors, the water outlet shall be obstructed and the container loaded with a saturated normal load. A quantity of 0.25 L of water shall then be added and the motor switched ON for 1 min.

14.3.7 Spin extractors intended for rinsing shall be tested with an additional 10 L of water poured into the clothes container within 20 s while the container is spinning, and a further 10 L while the extractor is standing still.

14.4 Oversudsing

14.4.1 To determine whether an appliance complies with the requirements in Clause 14.3.1, the appliance shall be levelled prior to the test and shall be operated through one complete cycle of normal operation. This shall be followed by an additional cycle, with the selector switches set to give the maximum flow of water at the maximum temperature. A high-sudsing detergent shall be gradually added during the fill portion of the cycle, or during the first 3 min of agitation, in whatever amount is required to result in oversudsing. Oversudsing is considered to occur when the suds overflow the stationary tub, if possible, or come up and out of the loading opening or any other opening.

14.5 Auxiliary reservoirs

14.5.1 Liquid overflowing from an auxiliary reservoir (such as a reservoir for bleach, rinse additive, or cleaning agent) shall not wet uninsulated current-carrying parts or film-coated wire, and shall not wet electrical insulation that might be adversely affected by the liquid normally used in the reservoir.

14.5.2 To determine whether an appliance complies with the requirement in Clause 14.5.1, water shall be poured into the reservoir through an orifice 9.5 mm in diameter. The reservoir shall be filled to the level recommended by the manufacturer, if such level is plainly marked; otherwise, the reservoir shall be filled to maximum capacity. Additional water, equal to 50% of the volume just mentioned, but not more than 0.47 L, shall then be poured into the reservoir. Ordinarily, determination of whether uninsulated current-carrying parts have become wet as a result of the overflow shall be by means of visual inspection, but this may be supplemented by an insulation-resistance test, an electric strength test, or both, if necessary.

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14.6 Liquid spillage test

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14.6.1 Appliances subject to spillage of liquid in normal use shall comply with the requirements of Clause 14.6.4 using a solution comprising water containing approximately 1% NaCl and 0.6% rinsing agent. Any commercially available rinsing agent may be used.

14.6.2 The appliance shall be leveled and 0.5 liter of the solution specified in Clause 14.6.1 shall be poured steadily over the appliance.

The solution shall be poured equally at each of the eight location and in the direction shown in Figure 12. The solution shall be poured from a height of approximately 1 inch (25.4 mm).

14.6.3 The appliance shall then be operated through one complete cycle of normal operation during which the controls shall be adjusted to energize as many circuits as possible without affecting the normal function of the unit.

14.6.4 The tests in 14.6.2 – 14.6.3, shall not result in:

a) a leakage current greater than 5.0 mA for cord-connected appliances;

b) an insulation resistance of not less than 50, 000 Ω for permanently connected appliances;

c) insulation breakdown as determined by repeating the electric strength test; or

d) the obvious wetting of current-carrying materials; see Clause 14.3.2.

14.7 Nichrome wire test

14.7.1 If specified by Clause 26.6.3.2(b), an electrical connection shall be tested as specified in Clauses 14.7.2 to 14.7.10. Each connection shall be evaluated using one connector sample. Multiple connections may be independently evaluated within the same appliance if they are located such that they do not influence the outcome or evaluation of the test. As a result of the test, there shall be no evidence of ignition of the cheesecloth referenced in Clause 14.7.4 as indicated by broken threads of the cheesecloth. Browning of the cheesecloth is acceptable provided that all individual threads are unbroken.

Note: Cheesecloth fibres may become brittle after exposed to heat. Care should be taken to prevent breakage of fibres during inspection. Fibres broken during inspection are not considered as a non-compliance.

14.7.2 The test shall be considered inconclusive and then repeated if there is evidence of:

a) fracture or shorting of the nichrome wire prior to completion of the test; or

b) a shift in the position of the nichrome wire sufficient to alter the severity of the test.

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14.7.3 This test intentionally attempts to cause a fire. Appropriate safety precautions to prevent the spread of fire should be taken. The test location shall have sufficient fresh air to sustain the flame. This test shall be conducted at an elevation of less than 609.6 m above sea level.

14.7.4 The appliance shall be supported on a non-conductive surface. The top, two sides, front and back of appliance shall be completely covered by single-layer cheesecloth panels. A mechanical means, such as small pieces of metal foil adhesive tape, shall be used to secure the cheesecloth panels so there are no gaps between the panels. A single layer of cheesecloth, slightly larger than the appliance bottom surface, shall cover the supporting surface. If agreeable to those concerned, cheesecloth may be placed only in the area of the anticipated breach.

14.7.5 All labels that are applied by the manufacturer shall be applied to the intended surfaces of the test appliance. Printing on the labels is not required. The manufacturer shall place the wiring diagram in the test appliance as intended.

14.7.6 The appliance shall be de-energized during the test unless equipped with a protective control or device. The connection under evaluation shall be electrically isolated from the appliance circuitry during the test. If the appliance is energized during the test, a duplicate connection that is electrically isolated from live parts shall be evaluated. Thermocouples shall be placed around the part (but not in direct contact) such that when ignition occurs, an increase in temperature can be detected. When appropriate, windows made of glass, or other clear non-combustible material may be used in the product to allow viewing of the component being tested. Windows must be ″sealed″ to prevent extraneous drafts or air leaks. Windows shall be located in areas not likely to be involved in or influence flame propagation. Video cameras may be employed to assist in verification of ignition. A constant current power supply shall be used and current shall be monitored for evidence of shorting or resistance wire breaks during testing.

14.7.7 An appliance control or device employed to provide protection from risk of fire shall be evaluated as protective control and may be used to de-energize the nichrome wire if found to actuate during the test.

14.7.8 Nichrome wire [80 % Nickel, 20 % Chrome, 22 AWG, in accordance with ASTM B344] shall be applied to a connector or switching contact such that the adjacent non-metallic combustible materials will be ignited during the test.

14.7.9 In the application of the nichrome wire to the part under test, the nichrome wire may be inserted into the part, or the wire may be externally wrapped around the part under test. The intent is to achieve complete combustion of the part under test and/or adjacent materials:

a) When inserting the coil into the part under test, a single strand of nichrome wire with a minimum length of 100 mm shall be formed into a coil with a diameter and length that approximates the connection under evaluation. The coil shall be inserted in place of the connection under evaluation. In the case of a multi-pin connector, a single terminal pin shall be removed from the connector such that the coil can be inserted in the worst case location (typically the lowest position). If the worst case position is not obvious, then multiple positions shall be evaluated.

b) When externally wrapping a connector or uninsulated terminal, use minimum 50 mm of nichrome wire to achieve a minimum of three evenly spaced wraps along the length of the connector or uninsulated terminal.

c) Uninsulated terminals shall be wrapped with a non-flammable tape or sleeve prior to wrapping with nichrome wire to prevent shorting out portions of the nichrome wire.

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d) In the case of switching devices, a coil of nichrome wire shall be placed inside the device in the position of the contacts and appropriately supported to prevent movement during the test. See Clause 26.6.3.3.

Insulated wire leads shall be used to supply power to the nichrome wire and shall be supported and strain-relieved to prevent the nichrome wire from shifting during testing.

Note: With reference to (a) and (d), the preferred method of wrapping a coil is wrapping nichrome wire around the threads of a No. 6-18 wood screw with a root diameter of 2.4 mm and a thread per 25.4 mm count of 18.

14.7.10 The nichrome wire shall be energized such that current in the circuit is immediately increased to 11 A and held constant for the duration of the test. If no ignition is detected within 20 min, the current shall be removed from the nichrome wire. If ignition is detected, current shall be held constant until burning of the non-metallic combustible material ceases naturally or there is ignition of the cheesecloth. If ignition of the cheesecloth occurs, the fire shall be extinguished as soon as possible. If the nichrome wire fractures prematurely, the test shall be repeated.

14.8 Dry operation

14.8.1 In accordance with Clause 19.5.5 an appliance provided with a heating element to raise the temperature of the wash water shall be tested as described in Clauses 14.8.2 and 14.8.3. As a result of the tests, there shall not be:

a) emission of flame or molten metal;

Note: Drops of melted solder are not considered to be molten metal.

b) glowing or flaming of combustible material upon which the appliance is placed or that could be in proximity to the appliance as installed; or

c) indication of flame or glowing embers in the load of cloths, either before or after the loading door or lid is opened.

14.8.2 Water connections to the appliance shall be turned off. The appliance shall be loaded with dry cloths having the weight specified in Clause 4.2. After the cloth load is added, a normal wash cycle shall be initiated. Any control which might operate during this test to de-energize the heating element shall be defeated, unless it has been evaluated as a protective control in accordance with Clause 19.12.3.

Note: For the purposes of this test, the normal wash cycle is considered to be the cycle that energizes the heating element for the longest period of time and results in the hottest temperatures when compared to other wash cycles.

14.8.3 The test shall be continued until ultimate results are observed or, for an appliance controlled by a timer, the duration of the test shall be the maximum interval permitted by the timer.

15 Stability and mechanical hazards

15.1 Automatic restarting of motor

15.1.1 If an automatically reset protective device is employed in an appliance, automatic restarting of the motor shall not result in a risk of injury to persons.

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15.1.2 The requirement in Clause 15.1.1 necessitates the use of an interlock in the appliance if moving parts or the like can result in a risk of injury to persons upon automatic restarting of the motor.

15.2 Stability (freestanding appliances)

15.2.1 An appliance shall not accidentally overturn in normal use, which includes the moving of appliances having casters or wheels. Appliances shall have any casters, wheels, or other supporting means placed in the most unfavourable position. If adjustable feet are provided, all of them shall be adjusted to the same height. The appliance shall not overturn when tested in accordance with Clause 15.2.2.

Appliances that are intended to tilt in normal operation shall be investigated.

15.2.2 The empty appliance shall be placed on a flat surface inclined at an angle of 10° from the horizontal. The loading door or lid of the appliance shall be placed in the most unfavourable position. Initially, the wringer assembly on a wringer washer shall be positioned over the center of the tub. The appliance shall be blocked to reduce the likelihood of sliding during the test, and it shall be rotated so that all positions are evaluated.

15.2.3 Wringer washers also shall be tested on a flat level surface, with the wringer assembly turned away from the tub while the tub is empty. The appliance shall not overturn when tested in accordance with this clause.

15.2.4 Front-loading appliances having a mass of more than 11.5 kg when empty, and having any hinged door, shelf, or other projection that is hung with a horizontal hinge and that opens beyond the enclosure, shall not overturn when a mass of 16 kg is supported from any position along the outside edge of such projection while the appliance is empty, on a level surface, and with any casters turned to the most unfavourable position.

The test weight shall be 9 kg for a front-loading appliance that has a projection hung with a vertical hinge.

15.3 Wall-mounted appliances

15.3.1 A wall-mounting kit shall contain all of the hardware needed to assemble and mount the kit and to install the appliance.

Note: A readily available part, such as a nail, a screw, or a piece of lumber, need not be provided if the instructions accompanying the kit include a description of the part and specify how the part is to be used.

15.3.2 The mounting means shall be constructed so that the appliance, when hung from the wall in the intended manner, cannot be removed without the use of a tool.

15.3.3 A wall-mounted appliance shall be subjected to the test described in Clauses 15.3.4 to 15.3.7. There shall be no damage to the wall, the appliance, or the mounting means, and the appliance shall not become dislodged.

Note: Damage to the loading door is acceptable.

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15.3.4 The appliance shall be mounted on a wall in accordance with the installation instructions, using the hardware provided in the mounting kit and the hardware and construction materials described in the instructions. The hardware shall be used as specified in the instructions, and if not otherwise indicated, securing screws shall be positioned between the studs and secured in the plasterboard.

15.3.5 If no wall constructions are specified in the instructions, a wall construction of nominal 9.5 mm thick plasterboard on nominal 38 by 88 mm wood studs spaced on 406 mm centers shall be used as the support.

15.3.6 An adjustable mounting means shall be adjusted to the position that results in the maximum projection from the wall.

15.3.7 A 45.4 kg weight shall be suspended from the front of the appliance or the loading door. The weight and the door shall be positioned so as to produce the most severe test condition. The weight shall remain in place until the ultimate results have been observed, but not longer than 5 min.

15.4 Appliance stands

15.4.1 An appliance stand shall contain all of the hardware needed to assemble the stand and to install the appliance on it.

Note: A readily available part, such as a nail, a screw, or a piece of lumber, need not be provided if the instructions accompanying the kit include a description of the part and specify how the part is to be used.

15.4.2 When installed as intended on the appliance stand, the appliance shall be reliably attached to the stand assembly, and shall not overturn on an inclined surface when tested in accordance with Clauses 15.4.3 to 15.4.5 or on a flat level surface when tested in accordance with Clauses 15.4.6 to 15.4.10.

15.4.3 An appliance and stand assembly that has been assembled as specified in the instructions shall be placed on a flat surface inclined at an angle of 10° from the horizontal. The loading door of the appliance shall be placed in the most unfavourable position.

15.4.4 If the stand permits stacking of appliances, the test shall be conducted both with and without the bottom appliance installed and with the loading door of the bottom appliance placed in the most unfavourable position. The appliance stand assembly shall be blocked to preclude sliding during the test, and it shall be rotated on the inclined surface so that all positions are evaluated.

15.4.5 The appliances in the stand shall be either loaded, as described in Clause 4.2, or unloaded, whichever results in the most unfavourable test condition.

15.4.6 An appliance and stand assembly shall be assembled in accordance with the instructions. A fastener provided for anchoring the stand to a wall shall not be used if a tool is required to attach the:

a) appliance or stand to the fastener; or

b) fastener to the wall.

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15.4.7 The assembly shall be tested in accordance with Clauses 15.4.8 to 15.4.10. If the stand permits stacking of appliances, the tests shall be conducted both with and without the bottom appliance installed.

15.4.8 The appliances in the stand shall be either loaded, as described in Clause 4.2, or unloaded, whichever results in the most unfavourable result.

15.4.9 A 22.6 kg weight shall be suspended from the front of the upper appliance or the front edge of the loading door. The weight and the door shall be placed in the most unfavourable position and the weight shall remain suspended for 1 min.

15.4.10 A hollow rubber ball, 240 to 250 mm in diameter, shall be filled with sand to a total weight of 9.1 kg. The weight shall fall from the rest position as a pendulum through the distance necessary to strike with an impact of 40.7 J. The ball shall strike the appliance and stand assembly 1.5 m above floor level or at the top of the upper appliance, whichever is less. All four sides of the appliance-stand assembly shall be subjected to the impact.

15.5 Sharp edges, projections, and moving parts

15.5.1 An enclosure, opening, frame, guard, knob, handle, or the like shall not result in a risk of injury to persons during normal maintenance or use.

15.5.2 A moving part, such as the rotor of a motor, a pulley, belt, or gear, shall be acceptably enclosed or guarded to reduce the likelihood of unintentional contact by persons.

15.6 Entrapment

15.6.1 If a household front-loading appliance has an opening into the clothes drum that will permit the entrance of a 203 mm diameter sphere and a clothes drum with a volume of 60 L or more, then the appliance shall:

a) have a clothes loading-and-unloading door that, when tested as described in Clauses 15.6.4 and 15.6.5, opens with a force of 67 N or less;

b) be investigated with respect to the ventilation it provides; or

c) be constructed so that the clothes loading-and-unloading door can be latched only by holding the door closed and simultaneously performing a second operation near the rear of the top of the appliance.

15.6.2 The secondary-function control specified in Clause 15.6.1(c) may be located on the front of the appliance if:

a) the appliance is intended to be installed in a recess, stacked on top of another appliance, or mounted on a wall;

b) there are no user-operable controls on the top surface of the appliance; and

c) the secondary-function control:

1) is located as far from the clothes loading-and-unloading door as practical; and

2) requires a minimum of two distinct operations to function.

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15.6.3 A rotary switch having a push-and-turn or a pull-and-turn operating sequence is generally considered to comply with the intent of the requirement in Clause 15.6.2(c)(2).

15.6.4 The force mentioned in Clause 15.6.1(a) shall be applied through a point corresponding to, and representative of, any point:

a) accessible from the inside of the clothes drum with the door closed; and

b) accessible to contact by a person's hand.

15.6.5 The force mentioned in Clause 15.6.1(a) shall be applied to the door:

a) in a manner representative of a push from inside the clothes drum, and applied on the inside surface of the door at a location no further from the door hinge than the opposite side of the drum opening;

b) in a direction perpendicular to the plane of the opening into the clothes drum; and

c) at a rate of 13 to 18 N/s.

Note: The test force can be applied to the outside of the door, using a pull force that is aligned with the location on the door where someone could actually push from inside the clothes drum.

15.6.6 An appliance that complies with the requirements of Clause 15.6.1(c) shall withstand the operation described in Clause 15.6.7 without malfunction.

15.6.7 With reference to the requirement in Clause 15.6.6, an appliance shall be subjected to 6 000 cycles of operation, with each cycle consisting of opening, closing, and latching the clothes loading-and-unloading door. The test shall be conducted at a rate of 12 cycles per hour. However, with the concurrence of those concerned, the test may be conducted at a rate other than 12 cycles per hour, provided the test will not be less severe than if conducted at the specified rate. The door shall be operated in the intended manner under the conditions that will result in maximum wear on all parts.

15.7 Wringer washers

15.7.1 In a roller-type washing-machine wringer, the:

a) peripheral speed of the rolls shall not be more than 6.1 m/min; and

b) roll force shall not be more than 2 225 N with no load between the rolls.

15.7.2 Power to the wringer rolls shall be controlled by a device or system that:

a) must be continuously actuated by the operator; or

b) will stop the rolls when any force greater than or equal to 89 N is applied opposite to the direction of infeed to an object in the rolls.

The device or system shall operate automatically and the rolls shall remain stopped without further effort by the user. The wringer assembly shall not rotate under power about the drive column.

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15.7.3 The wringer and automatic stopping mechanism mentioned in Clause 15.7.2 shall be tested by inserting the test board described in Clause 15.7.9 and a flexible strap or webbing (located between the test board and the lower roll) between the rolls at any point, including points as close as possible to the inner edge of the wringer assembly, at the center, and at the outer edge. With the rolls operating, the force shall be measured in a direction opposite to the direction of motion of the board, against the infeed to the rolls both horizontally and in a downward direction, at the maximum angle permitted by the wringer drain board.

15.7.4 Unless the roll pressure is automatically released when the rolls are stopped, the wringer shall be provided with a release having an operating member plainly marked as required in Clause 5.1.3.1. The release bar shall be readily accessible and operable from the infeed side of the wringer frame for a nonreversible-type wringer having only one release, or from both sides in the same manner for any other wringer.

15.7.5 Release of roll pressure shall:

a) not result in any parts being thrown violently out of the assembly;

b) release the tension of the rolls immediately; and

c) permit separation of the rolls for not less than 50.8 mm throughout their entire length. This separation need not be maintained, but the rolls shall be free to assume this clearance.

15.7.6 The means of manually actuating the release mechanism shall be a bar, the length of which, parallel to the major axis of the rollers, is not less than 75% of the exposed length of the rollers. The distance between each end of the release bar and the adjacent end of the exposed wringer shall not be more than 38 mm. The bar shall project in front of the fixed portion of the wringer frame by such distance that release of the load pressure will occur before the bar, upon application of the actuating force, becomes flush with the wringer frame.

15.7.7 A steadily applied 67 N force on the release bar mentioned in Clause 15.7.4 shall operate the release mechanism when applied horizontally and perpendicular to the axis of the wringer rolls. For a reversible- or a nonreversible-type wringer with a release bar on both sides, the force shall be applied in each direction of infeed to the rolls. For a nonreversible-type wringer with a release bar on the infeed side only, the force shall be applied both in the direction of infeed to the rolls and in the direction opposite to the infeed to the rolls.

15.7.8 When the release mechanism is tested as described in Clause 15.7.9, the force necessary to cause the release mechanism to function for the fiftieth operation shall not be more than the force required to cause such action for the fifth operation, and shall not be more than 67 N at any time.

15.7.9 In a test to determine whether the release mechanism complies with the requirements in Clause 15.7.8, the wringer and the release mechanism shall be operated as intended, with the maximum force applied to the rolls. The release mechanism shall be actuated for 50 operations. For the first five operations, and for the fiftieth operation, the pressure necessary to actuate the release mechanism shall be measured with a board between the rolls. The board shall be 203 mm wide and 305-381 mm long, tapered in thickness at each end. The board shall be 19.1 mm thick and shall be inserted between the rolls, with the wringer stopped and with the rolls engaging the board near its center. Beginning with the sixth operation and continuing through the forty-ninth operation, the board shall not be inserted, but the rollers shall be first driven in one direction and then in the other, the wringer then shall be stopped, and the force shall then be applied to actuate the release mechanism.

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Note: For a compact wringer in which insertion of the 19.1 mm thick board would stall the rolls, the test may be conducted with a tapered board of lesser thickness inserted into the rolls until stalling occurs.

15.7.10 A wringer washer provided with casters or the like as a means of providing mobility shall also be provided with a means of making the appliance stationary during the operation and storage of the appliance.

15.8 Washing machines and extraction-type appliances

15.8.1 An appliance shall be provided with:

a) a means to prevent opening of the clothes loading-and-unloading door or lid to allow access to moving parts during operation; or

b) an interlock that, when the clothes loading-and-unloading door or lid is opened more than 50.8 mm during operation will:

1) remove the driving force from moving parts; and

2) stop the movement of all accessible moving parts within 7 s with the appliance loaded as described in Clause 4.2.1.

15.8.2 An appliance shall be considered to comply with the requirements in Clause 15.8.1 if a deliberate action is required to defeat the lid-locking mechanism or braking means. A deliberate action includes disconnecting the power-supply cord, manually advancing the timer to the end of the complete cycle, pulling the timer knob out, or manually rotating a rotary switch. In addition to defeating the lid-locking mechanism or braking means, the deliberate action must also remove the driving force from moving parts. Other than as specified in Clause 15.8.3, pushing the timer knob in, actuating a toggle switch, or actuating any type of push-to-operate switch is not considered a deliberate action.

15.8.3 For a front-loading appliance with the controls in a console located at the rear of the top surface of the appliance, pushing the timer knob in, actuating a toggle switch, or actuating any type of push-to-operate switch shall be considered a deliberate action.

15.8.4 An interlock shall be recessed or guarded to reduce the likelihood of inadvertent operation when the door or lid is opened. An interlock shall not be actuated when the articulated probe shown in Figure 1 is inserted into an external interlock actuator opening.

15.8.5 With reference to Clause 15.8.1(b), accessible parts shall not move until the clothes loading-and-unloading door or lid is closed to less than 50.8 mm of opening. A front-loading appliance shall not operate until a secondary function control, manually operated from outside the appliance, is actuated.

15.8.6 With reference to Clause 15.8.1(b), a brake mechanism or other means that is employed to stop the rotation of the basket shall be subjected to a 6 000 cycle endurance test consisting of starting and stopping the basket after it has reached its maximum speed of rotation. The test shall be conducted at the rate of three times per hour; however, with the concurrence of those concerned, a faster rate may be employed. A mechanical load twice that of the maximum dry-weight load specified by the manufacturer shall be equally distributed around the periphery of the basket. The construction complies with the requirements if, after 6 000 cycles of operation, the stopping time is not more than 10 s.

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15.8.7 The failure of an interlock switch used to satisfy the requirements of Clause 15.8.1(b) shall not result in a risk of injury due to access to moving parts.

15.8.8 To determine whether an appliance complies with Clause 15.8.7, the interlock switch shall be intentionally defeated and the washer operated through 3 complete cycles. After 3 cycles, the washer shall be started again with the door or lid open, and it shall not advance to spin. If more than one interlock switch is used, each interlock switch shall be tested independently. If an electronic circuit or control is relied upon for compliance with Clause 15.8.7, it shall be evaluated as a protective control and comply with Clause 19.12.3.

15.8.9 In a clothes washer, means shall be provided to reduce the likelihood of a risk of injury to persons due to exposure to hot water or detergent/bleach solutions due to spillage through the door or lid opening. With a clothes load as prescribed in Clause 4.2.1, a means shall be provided:

a) to prevent the water level reaching above the lower rim of the door or lid opening during filling unless the door or lid is closed; and

b) for latching the door or lid in the closed position unless the water level has been drained to the lower rim of the door or lid opening.

15.8.10 A solenoid or similar component that is employed to hold the lid or door latched in the closed position shall be subjected to a 6 000 cycle endurance test consisting of energizing and de-energizing the component. There shall be no malfunction of the component as a result of this test.

16 Mechanical strength

16.1 Frame and enclosure

16.1.1 The frame and enclosure of an appliance shall have the necessary strength and rigidity to resist the abuses likely to be encountered during normal service. The degree of resistance inherent in the unit shall preclude total or partial collapse with the attendant reduction of spacings, loosening or displacement of parts, and other defects that alone or in combination would result in a risk of fire, electric shock, or injury to persons.

Note: For nonmetallic materials, refer to Clause 26.

16.1.2 For an unreinforced, flat surface, cast metal shall not be less than 3.2 mm thick, malleable iron shall not be less than 2.4 mm thick, and die-cast metal shall not be less than 2.0 mm thick.

Note: Metal of lesser thickness, but not less than 2.4, 1.6, and 1.2 mm, respectively, may be acceptable, provided the surface under consideration is curved, ribbed, or otherwise reinforced or sized to provide mechanical strength equivalent to that required.

16.1.3 An enclosure of sheet metal shall be investigated with respect to size, shape, thickness of metal, and acceptability for the application considering the intended use of the appliance.

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16.1.4 For an enclosure of sheet metal, steel shall be not less than 0.66 mm thick, aluminum shall not be less than 0.91 mm thick, and copper or brass shall not be less than 0.84 mm thick.

Note: This requirement does not apply to an area that is relatively small or to a surface that is curved or otherwise reinforced in a manner that provides equivalent strength.

16.2 Back covers

16.2.1 The back cover may be of thinner material if the enclosure complies with the requirements of Clause 16.2.2.

16.2.2 The back cover shall be able to withstand a continuous force of 110 N applied through a 51 mm steel ball for a period of 1 minute at any location, without resulting in a risk of electric shock or reducing spacings below those required by Clause 24.

16.3 Glass loading doors and lids

16.3.1 A glass loading door or lid shall be made from glass that has the mechanical strength to reduce the risk of injury to persons.

16.3.2 With respect to Clause 16.3.1, samples of the glass loading door or lid shall be subjected to the following tests:

a) for all surfaces, 6.8 J Impact of Clause 26.7; and

b) for horizontal top surfaces:

1) the static load of Clause 26.8; and

2) the 56.7 J impact of Clause 26.9.

16.3.3 The location of the impacts and test loads on the glass surfaces shall be upon the weakest portion of the glass that is exposed to the consumer, including any edges and the transition area between the ceramic ink/paint and clear glass. This could necessitate the test being repeated on several different areas of the surface to completely evaluate the glass part.

Note: A new sample may be utilized for each impact impacted in accordance with Clause 26.7.

16.3.4 In addition to the compliance criteria specified in Clauses 26.7, 26.8, and 26.9, the testing specified in Clause 16.3.2 shall not result in a risk of injury due to cracking or breaking of the glass breaking, or by allowing accessibility to moving parts.

Note: This clause is deemed as being met if cracking or breaking of the glass occurs, and the pieces are not released or dropped from their normal position.

17 Construction

17.1 Current-carrying parts

17.1.1 A current-carrying material shall be silver, copper, a copper alloy, or other material that has been investigated and found to be acceptable for the purpose. Current-carrying materials shall have acceptable mechanical strength and current-carrying capacity.

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17.1.2 Plated iron may be used for a current-carrying material, if the material:

a) has a temperature during normal operation of more than 100°C;

b) is within a motor or associated governor; or

c) is acceptable in accordance with Clause 19.1.1.

Unplated iron or unplated steel shall not be used. Stainless steel, other corrosion-resistant alloys, and plated steel may be used for a current-carrying part regardless of temperature.

17.2 Electrical insulation

17.2.1 The requirements for supplemental insulation (eg, tape, sleeving or tubing) are not specified unless the insulation or device is required to comply with this Standard. In such cases:

a) Insulating tape shall comply with CSA C22.2 No. 197 and UL 510.

b) Sleeving shall comply with CAN/CSA-C22.2 No. 198.3 and UL 1441.

c) Tubing shall comply with CAN/CSA-C22.2 No. 198.1 and UL 224.

17.2.2 An insulating washer, bushing, and the like and the base or support for the mounting of a current-carrying part shall be of a heat- and moisture-resistant material that will not be damaged by the temperatures to which it will be subjected under conditions of actual use such as porcelain, phenolic, cold-moulded composition or other materials that have been investigated and found to be acceptable for the application.

17.2.3 Insulating material employed in an appliance shall be investigated with respect to the application. Materials such as mica, some moulded compounds, and certain refractory materials may be used as the sole support of a current-carrying part. Materials that are not acceptable for general use, such as magnesium oxide, may be acceptable if used in conjunction with other acceptable insulating materials or if located and protected so as to reduce the likelihood of mechanical damage and the absorption of moisture.

17.2.4 If an investigation is necessary to determine whether a material is acceptable, consideration shall be given to its mechanical strength, electric strength characteristics, insulation resistance, heat- and moisture-resistance properties, the degree to which it is enclosed or protected, and any other features that could have a bearing on the risk of fire, electric shock, and injury to persons, in conjunction with the conditions of actual use.

17.2.5 Ordinary vulcanized fibre may be used for an insulating bushing, a washer, a separator, and a barrier, but not as the sole support for an uninsulated current-carrying part if shrinkage, current leakage, or warpage could introduce a risk of fire or electric shock.

17.2.6 Coils and windings shall incorporate moisture absorption-resistant insulating materials or shall be acceptably treated to render them absorption resistant.

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17.3 Thermal insulation

17.3.1 Combustible or electrically conductive heat-insulating material shall not be located so that it contacts an uninsulated current-carrying part.

17.3.2 With reference to Clause 17.3.1, some types of mineral-wool thermal insulation contain conductive impurities in the form of slag that could present a risk of fire or electric shock if in contact with an uninsulated current-carrying part.

17.4 Overflow pipes

17.4.1 An overflow pipe or the like shall be secured if the flow of liquid from the pipe can be misdirected so as to wet an uninsulated current-carrying part, a film-coated current-carrying part, or electrical insulation.

17.4.2 Compliance with Clause 17.4.1 of the means of securing an overflow pipe or the like shall be determined with respect to its reliability, acceptability, and likelihood of being defeated.

17.5 Bottom openings

17.5.1 Means shall be provided to reduce the likelihood of molten metal, burning insulation, or the like falling upon combustible materials, including the surface on which the appliance is supported.

17.5.2 With reference to Clause 17.5.1, a barrier of noncombustible material shall be used to reduce the likelihood that molten metal, burning material, or the like will fall to the supporting surface:

a) under a motor unless:

1) the structural parts of the motor or the appliance provide the equivalent of such a barrier;

2) the protection provided with the motor is such that no burning insulation or molten material falls to the surface that supports the appliance when the motor is energized under each of the following fault conditions:

i) open main winding;

ii) open starting winding;

iii) starting switch short-circuited; or

iv) capacitor of permanent-split capacitor motor short-circuited. The short-circuit shall be applied before the motor is energized, and the rotor shall be locked; or

3) the motor is provided with a thermal motor protector (a protective device that is sensitive to temperature and current), or the motor is provided with electronic protection, that will reduce the likelihood that the temperature of the motor windings will exceed 125°C under the maximum load under which the motor will run without causing the protector to cycle and that the temperature will exceed 150°C with the rotor of the motor locked.

b) under wiring, unless there is no evidence of a risk of fire as a result of the tests conducted in this Standard; and

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c) under the grounded sheath of a heater assembly.

17.5.3 The requirement of Clause 17.5.2 does not apply to the supporting surface of an appliance that is:

a) intended to be permanently bolted to an uncovered concrete floor;

b) marked in accordance with Clause 5.1.2.6; and

c) provided with installation instructions that include a warning statement in accordance with Clause 5.3.2.

17.5.4 The requirement in Clause 17.5.2 will also necessitate that a component such as a switch, relay, or solenoid be individually and completely enclosed.

A component need not be enclosed if:

a) malfunction of the component would not result in a risk of fire; or

b) there are no openings in the bottom of the appliance enclosure.

The terminals of a component need not be enclosed.

17.5.5 The barrier mentioned in Clause 17.5.2 shall:

a) be horizontal or at such an angle so that falling metal hitting the barrier would not rebound and fall on the supporting surface;

b) be located as illustrated in Figure 7; and

c) have an area in accordance with Figure 7.

17.5.6 With reference to the barrier mentioned in Clause 17.5.2, openings for drainage, ventilation, and the like may be employed in the barrier if such openings would not permit molten metal, burning insulation, or the like to fall on combustible material.

17.5.7 The bottom of the enclosure of a wall-insert appliance shall be complete and without openings.

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17.6 Plumbing requirements

17.6.1 An appliance shall comply with the plumbing requirements specified in Supplement SC of this Standard.

17.6.2 If a vacuum breaker is installed, it shall comply with the requirements of CAN/CSA-B64 Series or ANSI/ASSE 1001. It shall be installed downstream from the last valve (including any solenoid) in the water supply system.

18 Internal wiring

18.1 General

18.1.1 The internal wiring of an appliance shall be considered to be all the interconnecting wiring beyond the point where the power-supply cord of a cord-connected appliance enters the enclosure, or beyond the wiring terminals or leads for power-supply connection of a permanently connected appliance, even though some of such wiring may not be completely enclosed and even though some of it may be in the form of flexible cord.

18.1.2 The internal wiring and connections between parts of an appliance shall be protected or enclosed. A length of flexible cord complying with Clause 20.3.2 may be employed for an external (unenclosed) connection between such parts if flexibility is necessary.

18.1.3 The protection of insulated wiring required by Clause 18.2 shall be considered to exist if, when evaluated as though it were film-coated wire, the wiring is acceptable in accordance with Clause 6.1. Internal wiring not so protected may be accepted if it is secured within the enclosure so that it is unlikely to be subjected to stress or mechanical damage.

18.1.4 A conductor shall not be smaller than 20 AWG (0.52 mm^2). Integral leads not more than 150 mm long of a small electrical component, such as a relay coil or a timer motor, may be smaller than 20 AWG (0.52 mm^2), but shall not be smaller than 24 AWG (0.21 mm^2).

Note: This requirement does not apply to solid-state controls and associated circuits.

18.1.5 Unless it is to be investigated as an uninsulated current-carrying part or located in a low-voltage circuit not involving a risk of personal injury, insulated internal wiring of an appliance, including a bonding conductor, shall consist of wire complying with:

a) CSA C22.2 No. 127 or CSA C22.2 No. 210 and UL 758;

b) CSA C22.2 No. 38 and UL 44;

c) CSA C22.2 No. 75 and UL 83;

d) CSA C22.2 No. 49 and UL 66; or

e) the appropriate CSA and UL standard(s) for other insulated conductor types specified in the Canadian Electrical Code, Part 1 (CE Code) for Wiring Methods and the National Electrical Code (NEC) for Wiring Methods and Materials.

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18.1.6 Insulated internal wiring shall be acceptable for the application, when considered with respect to:

a) the temperature and voltage to which the wiring may be subjected;

b) exposure to oil, grease, or other substances that might have a deleterious effect on the insulation;

c) exposure to moisture; and

d) other conditions to which it may be subjected during normal use.

18.1.7 Wiring shall be protected from sharp edges, including screw threads, burrs, fins, moving parts, and the like, that could result in abrasion of the insulation on conductors.

18.1.8 Wiring shall not be supported by bare-metal-wire type wire-routing clips. Such clips may be used to position wiring that:

a) runs vertically; or

b) is supported by a flat, horizontal surface.

18.1.9 A hole through which insulated wires pass in a sheet-metal wall within the overall enclosure of an appliance shall be provided with a smooth, rounded bushing of one of the materials mentioned in Clause 20.4.2 or shall have smooth surfaces, upon which the wires may bear, free of burrs, fins, sharp edges, and the like, which could result in abrasion of the insulation.

18.1.10 Insulated wires may be bunched and passed through a single opening in a metal wall within the enclosure of the appliance.

18.2 Splices and connections

18.2.1 Splices and connections shall be mechanically secure and shall provide adequate and reliable electrical contact. Soldered connections shall be made mechanically secure before being soldered, if breaking or loosening of the connection could result in a risk of fire, electric shock, or injury to persons. Splices shall be provided with insulation equivalent to that of the wires involved if permanency of spacing between splices and other metal parts is maintained.

18.2.2 A wire-binding screw or nut shall be provided with a lock washer under the head of the screw or under the nut to reduce the likelihood of it's becoming loosened due to vibration, if such loosening could result in a risk of fire, electric shock, or injury to persons.

18.2.3 An open-end spade lug shall not be used unless additional means are provided to hold the lug in place should the wire-binding screw or nut become loosened.

18.2.4 Splices shall be provided with insulation equivalent to that of the wires involved if the spacing between the splice and other metal parts are found not likely to be permanently maintained.

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18.2.5 Insulation consisting of two layers of friction tape, two layers of thermoplastic tape, or one layer of friction tape on top of one layer of rubber tape, shall be acceptable on a splice if the voltage involved is less than 250 V. In determining if splice insulation consisting of coated fabric, thermoplastic, or other type of tubing is acceptable, consideration shall be given to such factors as its electric strength properties, resistance to heat, resistance to moisture, and the like. Thermoplastic tape wrapped over a sharp edge shall not be acceptable.

18.2.6 The means of connecting stranded internal wiring to a wire-binding screw shall be such that loose strands of wire will not contact other current-carrying parts not always of the same polarity as the wire and will not contact non-current-carrying metal parts. This may be accomplished by use of a pressure terminal connector, a soldering lug, a crimped eyelet, soldering all strands of the wire together, or other equivalent means.

18.2.7 An aluminum conductor, insulated or uninsulated, used as internal wiring, such as for interconnection between current-carrying parts or as motor windings, shall be terminated at each end by a method that has been investigated and found to be acceptable for the combination of metals involved at the connection point.

18.2.8 With reference to Clause 18.2.7, a wire-binding screw construction or a pressure terminal connector used as a terminating device shall be acceptable for use with aluminum under the conditions involved, such as temperature, heat cycling, or vibration.

18.3 Separation of circuits

18.3.1 Conductors of circuits operating at different potentials shall be reliably separated from each other unless they are provided with insulation acceptable for the highest potential involved.

18.3.2 An insulated conductor shall be reliably retained so that it cannot contact an uninsulated current-carrying part of a circuit operating at a different potential.

18.3.3 In a compartment that is intended for the field installation of conductors, and that contains provision for the connection of Class 1 power, or lighting circuit conductors, and low-voltage, Class 2, circuit conductors, a barrier shall be provided to separate the conductors of the different circuits, or the arrangement of the compartment shall be such that a minimum spacing of 6.4 mm can be maintained between the conductors of the different circuits including the conductors to be field installed.

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18.4 Overcurrent protection

18.4.1 In an appliance that is intended to be connected to a branch circuit rated at more than 30 A, overcurrent protection shall be provided for the control circuits.

18.5 Endurance test for pedestal wire flexing

18.5.1 For pedestal or drawer-type washing machines, where the operation of a movable part of an appliance can mechanically affect the wiring or other insulated parts, the part shall be operated as specified in Clauses 18.5.2 and 18.5.3. As a result of the operation, there shall be no malfunction of the movable parts that increase the risk of electrical shock, fire, or injury to person. After operation, the appliance shall comply with the electric strength requirements in Clause 13.

18.5.2 The movable part shall be subjected to 30,000 cycles of operation. For the first 20,000 cycles, any wiring or insulated current-carrying part that is flexed shall be de-energized. For the remaining 10,000 cycles, such parts shall be energized so as to represent the maximum load encountered during intended operation of the appliance.

18.5.3 The test shall be conducted at the rate of 12 cycles/min. The part shall be operated in the intended manner so that it will reach the actual limits of travel in both directions during each cycle and under the conditions that will result in maximum wear on all parts.

Note: The test may be conducted at a rate other than 12 cycles/min if it is not less severe than if conducted at the specified rate.

19 Components

19.1 General requirements for components

19.1.1 Except as indicated in Clause 19.1.2, a component of an appliance covered by this Standard shall:

a) comply with the requirements for that component. A component shall comply with both the Canadian Standards Association and Underwriters Laboratories Inc. standards;

b) be used in accordance with its rating established for the intended conditions of use;

c) be used within its established use limitations or conditions of acceptability; and

d) additionally comply with the applicable requirements of this end product standard.

Note: Specific components are considered as being incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and can only be used under those specific conditions for which they have been investigated.

19.1.2 A component of a product covered by this Standard is not required to comply with a specific component requirement that:

a) involves a feature or characteristic not required in the application of the component in the product;

b) is superseded by a requirement in this Standard; or

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c) is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

19.1.3 A component complying with a CSA or UL component standard other than those specified in this Standard is acceptable if:

a) the component also complies with the applicable component standard specified in this Standard; or

b) the component standard:

1) is compatible with the ampacity and overcurrent protection requirements of the Canadian Electrical Code, Part 1 (CE Code) and National Electrical Code (NEC), where appropriate;

2) considers long-term thermal properties of polymeric insulating materials in accordance with UL 746B; and

3) ensures that any use limitations of the other component standard is identified and appropriately accommodated in the end use application.

Note: For example, a component used in a household application, but intended for industrial use and complying with the relevant component standard can assume user expertise not common in household applications.

19.1.4 A component that is also intended to perform other functions, such as overcurrent protection, ground-fault circuit-interruption, surge suppression, any other similar functions, or any combination thereof, shall comply additionally with the requirements of the applicable CSA and UL standard(s) that cover devices that provide those functions unless those other functions are:

a) not required for the application, and

b) not identified as part of markings, instructions, or packaging for the appliance.

19.1.5 A component not anticipated by the requirements of this Standard, not specifically covered by the component standards specified in this Standard, and that involves a potential risk of electric shock, fire, or personal injury, shall be additionally investigated in accordance with the applicable CSA and UL standards, and shall comply with Clause 19.1.1(b) – (d).

19.1.6 With respect to Clause 19.1.5, reference to construction and performance requirements in another CSA and UL end-product standard is appropriate where that standard anticipates normal and abnormal use conditions consistent with the application of washing machines.

19.1.7 Components located in a low-voltage circuit that are not relied upon to reduce the risk of electric shock, fire, or injury shall not require additional investigation.

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19.2 Mechanical assembly

19.2.1 An appliance shall be assembled so that it will not be adversely affected by the vibration of normal operation. Brush caps shall be tightly threaded or otherwise constructed to reduce the likelihood of loosening. The operating mechanism of switches or controls shall not subject electrical parts to undue strain.

19.2.2 A switch, a lampholder, an attachment-plug receptacle, a motor-attachment plug, or a similar component shall be mounted securely and rigidly to maintain the required clearances.

Note: A lampholder of the type in which the lamp cannot be replaced, such as a neon pilot or indicator light in which the lamp is sealed in by a nonremovable lens, need not be prevented from turning if rotation cannot reduce spacings below the minimum acceptable values.

19.2.3 Means to reduce the likelihood of the turning of a switch need not be provided if:

a) the switch is of a plunger or other type that does not tend to rotate when operated. A toggle switch is considered to be subject to forces that tend to rotate the switch during normal operation of the switch;

b) means for mounting the switch make it unlikely that operation of the switch will loosen it;

c) spacings are not reduced below the minimum acceptable values if the switch rotates; and

d) normal operation of the switch is by mechanical means rather than by direct contact by persons.

19.2.4 Means of reducing the likelihood of the rotation shall consist of more than friction between surfaces. For example, a lock washer, properly applied, may be used to reduce the likelihood of turning of a small stem-mounted switch or other device having a single-hole mounting means.

19.3 Capacitors

19.3.1 The component requirements for capacitors are not specified, except:

a) capacitors connected across the line or from line to ground shall comply with:

1) CSA C22.2 No. 8, CAN/CSA-E60384-1, or CAN/CSA-E60384-14; and

2) UL 1283 or UL 60384-14; and

b) motor starting or running capacitors shall comply with the applicable requirements of CSA C22.2 No. 190 and UL 810.

19.3.2 Capacitors with integral enclosures complying with the standards specified in Clause 19.3.1 are considered to fulfill the requirements of Clause 19.3.3.

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19.3.3 A capacitor provided as a part of a capacitor motor and a capacitor connected across the line, such as a capacitor for the elimination of radio-frequency interference, shall be housed within an enclosure or container that is intended to protect the plates against mechanical damage and that will reduce the likelihood of the emission of flame or molten material resulting from malfunction of the capacitor. The construction shall comply with one of the following:

a) the capacitor container or enclosure shall be of sheet steel not less than 0.51 mm thick, or shall be constructed to afford equivalent protection; or

b) a capacitor having a sheet-steel container or enclosure thinner than 0.51 mm or of other material shall be mounted in an enclosure that houses other parts of the appliance and that is acceptable for the enclosure of current-carrying parts.

19.3.4 If a capacitor that is not part of a permanent-split-capacitor motor or a part of a capacitor-start motor is connected in an automatic appliance so that capacitor malfunction would result in a risk of fire, electric shock, or injury to persons, thermal or overcurrent protection shall be provided in the appliance.

19.3.5 The voltage rating of a capacitor, other than a motor-starting capacitor, shall not be less than the maximum steady-state potential to which the capacitor is subjected during operation of the appliance.

19.4 Field-installed devices and accessories

19.4.1 Field-installed devices

19.4.1.1 Field-installed devices that are necessary for the operation of the appliance, such as complete coin-, ticket-, or card-operated assemblies and the like, and that are to be attached mechanically and electrically to the appliance in the field, shall comply with the following:

a) electrical conductors and connections shall comply with Clauses 18 and 23;

b) the wiring within the appliance shall not be disturbed;

c) the wires and terminals shall be acceptably tagged or otherwise coded, and a wiring diagram shall be affixed to the appliance where it is readily visible during assembly, or shall be included in the assembly instructions; and

d) if the wiring between the coin-, ticket-, or card-operated timer assembly and the appliance is external to the appliance, it shall be enclosed in flexible conduit, armored cable, or the equivalent.

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19.4.2 Field-attached or optional accessories

19.4.2.1 Clauses 19.4.2.2 to 19.4.2.6 apply to accessories intended for installation on or connection to an appliance for the purpose of modifying or supplementing the functions of the appliance.

19.4.2.2 An appliance having provision for the use of an accessory to be attached in the field shall be constructed so that the use of the accessory will not introduce a risk of fire, electric shock, or injury to persons.

19.4.2.3 The installation of an electrical component of an accessory by the operator shall be restricted to an arrangement that can be accomplished by means of receptacles and plug-in connectors.

19.4.2.4 The installation of an electrical component of an accessory by qualified personnel shall be acceptable if connections are made to existing terminals by use of wire connectors.

19.4.2.5 An installation that requires field rearrangement of components or wiring, cutting or splicing of wiring, or soldering of connections is not acceptable.

19.4.2.6 As part of the investigation, an accessory shall be tested and trial-installed to determine that installation is feasible, that the instructions are detailed and correct, and that the use of the accessory will not introduce a risk of fire, electric shock, or injury to persons.

19.5 Heating elements

19.5.1 Sheath-type heating elements shall comply with CSA C22.2 No. 72 and UL 1030.

19.5.2 The voltage rating of a heating element employed in an appliance shall be not less than:

a) 110 V if connected in a circuit in which the potential across the heating element is a nominal 120 V;

b) 191 V if connected in a circuit in which the potential across the heating element is a nominal 208 V;

c) 220 V if connected in a circuit in which the potential across the heating element is a nominal 240 V;

d) 254 V if connected in a circuit in which the potential across the heating element is a nominal 277 V;

e) 440 V if connected in a circuit in which the potential across the heating element is a nominal 480 V; or

f) the voltage rating of the circuit if connected in a circuit in which the potential across the heating element is more than 480 V.

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19.5.3 A heating element shall be supported in a substantial and reliable manner, and provided with means to reduce the likelihood of mechanical damage and contact with outside objects.

19.5.4 An appliance shall be constructed so that the clothes load will be reliably confined to the drum or basket, and shall be provided with a means to reduce the likelihood of contact between clothes and heating elements and other parts operating at temperatures that could result in the ignition of fabric.

19.5.5 An appliance provided with a heating element to raise the temperature of the wash water shall not present a risk of fire if the heating element is operated without water. Compliance is determined by subjecting the appliance to the test of Clause 14.7.

19.6 Lampholders

19.6.1 Lampholders and indicating lamps shall comply with CSA C22.2 No. 43 and UL 496.

19.6.2 Lighting ballasts shall comply with CSA C22.2 No. 74 and UL 935 or UL 1029, unless the ballast forms a part of a luminaire complying with the appropriate CSA and UL standards.

19.6.3 Light emitting diode (LED) light sources shall comply with CSA C22.2 No. 250.13 and UL 8750, unless the LED light source forms a part of a luminaire complying with the appropriate CSA and UL standards. Individual light emitting diodes mounted on the printed wiring board of a control and intended for indicating purposes shall be evaluated with the control.

19.6.4 An Edison-base lampholder of:

a) a permanently connected appliance; or

b) an appliance equipped with a polarized attachment plug;

shall be wired so that the screw shell will be connected to the terminal or lead that is intended for the connection of the grounded conductor of a supply circuit.

19.6.5 A lampholder shall be constructed or installed so that uninsulated current-carrying parts other than a screw shell will not be exposed to contact by persons removing or replacing lamps in normal service.

Note: If it is necessary to dismantle the appliance or remove a cover plate or other part by means of a tool in order to remove or replace a lamp, uninsulated current-carrying parts may be accessible to contact during the relamping process only.

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19.7 Motors

19.7.1 Motors shall comply with CSA C22.2 No. 100 and UL 1004-1 and shall have inherent overheating protection in accordance with the requirements of CSA C22.2 No. 77 and UL 1004-3, except for:

a) appliances having a device, which may be integral with the control of the appliance, responsive to motor current, as required by the Canadian Electrical Code, Part 1 (CE Code) and the National Electrical Code (NEC), for overload and overheating, and which is sized in accordance with Clauses 19.7.9 and 19.7.10;

b) motors rated at less than 1 hp, manually controlled, continuously attended and not automatically started by a timer, float, or time-delay switch, or not having an automatic changing of the mechanical load that could reduce the motor speed sufficiently to re-establish starting winding connections to the supply circuit;

c) motors for automatic washing machines protected from overheating under locked-rotor conditions only, as specified under Clauses 19.7.3 – 19.7.8;

d) motors employing impedance protection complying with the locked-rotor requirements specified in CSA C22.2 No. 77 and UL 1004-2; or

e) motors employing electronic protection complying with CSA C22.2 No. 77 and UL 1004-7.

19.7.2 Devices employed for motor-overload protection, other than those that are inherent in a motor, shall be located in an ungrounded conductor of each phase.

19.7.3 With reference to the requirement in Clause 19.7.1(c), if, when tested as described in Clause 19.7.6, the fuse in the supply circuit, as specified in Clause 19.7.5, opens before the motor reaches any of the temperatures specified in Table 3, the appliance shall be considered as not requiring overload protection.

19.7.4 The average temperatures specified in Table 3 and Clause 19.7.6 shall be determined by taking the arithmetic mean of the maximum temperatures and the minimum temperatures.

19.7.5 To determine whether a washing machine complies with the requirement in Clause 19.7.6, the appliance shall be connected to a circuit protected by a time-delay fuse having a current rating of at least 30 A. If the appliance is rated 125 V or less, and if a 30 A fuse is used, it shall be a plug fuse.

19.7.6 The motor shall be tested under locked-rotor conditions, with the applied voltage as specified in Clause 4.1. The test shall be conducted with the appliance at room temperature or at its normal operating temperature, whichever results in higher motor temperatures. During the test the motor winding shall not open or exceed the temperatures specified in Table 3.

19.7.7 The duration of the test of a washing machine shall be in accordance with the normal operation of timer switches and other limiting devices with which the appliance is equipped.

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19.7.8 If a control operates during the test of Clause 19.7.6 to end the test before completion of the normal operating cycle or to limit the motor temperatures, the test of Clause 19.7.6 shall be repeated with the control defeated, unless the control has been evaluated as a protective control specified in Clause 19.12.3.

19.7.9 A separate protective device incorporated in an appliance in accordance with Clause 19.7.1(a), shall be responsive to the motor current, and shall be rated or set in accordance with Table 14.

19.7.10 With reference to the requirements in Clause 19.7.9, each winding connection of a multispeed motor shall be considered separately.

19.8 Motor overload-protective devices

19.8.1 Overload-protective devices for motors shall comply with Clauses 19.8.2 to 19.8.4. Three samples of the device shall be subjected to the tests, and in one of the three tests the protector shall close the short circuit.

19.8.2 Protective devices for motors rated 1/2 hp (373 W) or less and 250 V or less shall be connected in turn to a circuit limited to 200 A at a power factor between 0.9 and 1.0, in series with a nonrenewable cartridge fuse rated four times the full-load current of the motor for which the device is intended, but in no case less than 15 A for devices rated 125 V or less, or less than 10 A for devices rated more than 125 V and less than 250 V.

19.8.3 Protective devices for motors rated more than 1/2 hp (373 W) or more than 250 V shall be tested as in Clause 19.8.2, except that the short-circuit current shall be limited to 1 000 A.

19.8.4 The outer enclosure of the device under test, or the enclosure of the motor to be protected in the case of inherent protective devices, shall be surrounded by cotton. There shall be no ignition of such cotton during the test.

19.9 Receptacles

19.9.1 An appliance shall not be provided with a general-use receptacle.

Note 1: Clothes washers intended to be stacked on a pedestal or drawer-type clothes washer may be provided with a dedicated receptacle for the connection of the pedestal or drawer-type clothes washer.

Note 2: General-use receptacles are intended for the connection of non-specific appliances, service and repair equipment, and the like. Dedicated receptacles are intended and designed for connection of a specific appliance.

19.9.2 A clothes washer intended to be stacked on a pedestal or draw type clothes washer and provided with a dedicated receptacle shall comply with the requirements in Clauses 19.9.3 – 19.9.5.

19.9.3 Only one receptacle shall be provided; it shall be located on the back of the appliance, and it shall be a 3-wire grounding-type receptacle, rated 15 or 20 A, 125 V.

Note: A NEMA-type receptacle with the above ampere ratings is not required if the manufacturer provides a receptacle that is specifically designed for connection to their pedestal or drawer-type clothes washer.

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19.9.4 The circuit supplying the dedicated receptacle shall have the circuit protected by supplementary overcurrent protection, such as a fuse, circuit breaker, or similar device, having a current rating not exceeding the applicable value specified in Table 17.

19.9.5 A marking identifying the pedestal or draw type clothes washer to be used with the dedicated receptacle shall be provided adjacent to the dedicated receptacle; see Clause 5.1.2.23.

19.10 Seals and diaphragms

19.10.1 If the deterioration or breakage of a liquid seal or the like could increase the risk of electric shock, the seal or the like shall be investigated.

19.10.2 The test procedure for determining whether a component complies with the requirement in Clause 19.10.1 depends upon the material of which it is composed, its size and shape, the mode of application in the appliance, and other factors. The test procedure may include visual inspection for determination of cracks, deformation, and the like, after artificial ageing, as well as comparison of hardness, tensile strength, and elongation before and after artificial ageing.

19.10.3 With reference to Clauses 19.10.1 and 19.10.2, a noncomposite material, when tested to compare its tensile strength and elongation before and after artificial ageing, is acceptable if these properties are found to be not less than the minimum corresponding values specified in UL 157. The maximum service temperature specified in UL 157 corresponds to the temperature of the component during the heating test.

19.10.4 Materials exposed to powdered laundry detergents and bleach shall be subjected to the exposure test conditions of UL 157.

19.11 Switches

19.11.1 Switches shall comply with the following, as applicable:

a) CSA 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.

19.11.2 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.

19.11.3 Switches shall be acceptable for the application, and shall have a current and voltage rating not less than that of the maximum load they control in the appliance.

Note: Refer to Clause 19.13 for requirements relating to controls with a switching function.

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19.11.4 For a centrifugal-type switch that controls a motor-start winding, the basis for the current and voltage rating of auxiliary contacts provided for the direct or indirect control of a heating element shall include the endurance test in Clause 19.11.10.

19.11.5 Switches shall be so located or protected that they are not subjected to mechanical damage, excessive moisture, or excessive collection of lint.

19.11.6 Switches, excluding thermally operated switches for heater elements, shall disconnect all ungrounded conductors of the circuit controlled when in the OFF position, except that one ungrounded conductor only may be disconnected if the other ungrounded conductor is thereby automatically disconnected by a second switch (eg, motor centrifugal switch).

19.11.7 A switch or other device that controls a motor shall have a horsepower rating not less than that of the motor that it controls. This requirement does not apply to a centrifugal-type switch or other device that is necessary for a motor to change from the start winding to the main winding so that the motor will attain running speed.

19.11.8 A switch or other device that controls a solenoid, relay coil, or the like, and that has not been investigated for the purpose for which it is used, shall be tested as described in Clause 19.11.9. As a result of the test, there shall be no electrical or mechanical malfunction or breakdown of the switch or other device nor welding or undue pitting or burning of the contacts. A 3 A fuse placed in the grounding connection shall not open.

19.11.9 In a test to determine whether a switch or other control device complies with the requirement in Clause 19.11.8, the appliance shall be connected to a supply circuit of rated frequency and 110% of maximum rated voltage. The load on the device under test shall be the same as that which it is intended to control in normal service. The device shall be operated for 50 cycles at a rate of not more than 10 cycles/min. However, with the concurrence of those concerned, a faster rate of operation may be employed.

19.11.10 For a centrifugal-type switch that controls a motor-start winding, auxiliary contacts provided for the direct or indirect control of a heating element shall be subjected to an endurance test consisting of at least 30 000 cycles of operation conducted in accordance with the requirements of CSA C22.2 No. 55 and UL 1054.

19.11.11 If a cord-connected appliance employs a motor rated more than 1/3 hp (249 W), a motor control switch shall be provided in the appliance. The control switch shall not be located in the grounded conductor unless its operation also results in the opening of all ungrounded supply conductors to the motor.

19.11.12 The operating mechanism of switches shall not subject electrical parts to undue strain.

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19.12 Controls

19.12.1 General

19.12.1.1 Components, wiring, printed wiring assemblies, insulating material, potting materials, and the like, and associated circuitry employed in controls, shall be investigated and found acceptable for the application in accordance with the specified component standards with respect to a risk of fire, electric shock, and injury to persons.

19.12.1.2 Except as specified in Clause 19.12.4 through Clause 19.12.7, controls shall comply with the standards specified in Clause 19.12.2 for operating controls or Clause 19.12.3 for protective controls.

19.12.1.3 Controls shall be so located or protected that they are not subjected to mechanical damage, excessive moisture, or excessive collection of lint.

19.12.1.4 The operating mechanism of controls shall not subject electrical parts to undue strain.

19.12.2 Operating controls

19.12.2.1 An operating control shall comply with:

a) CSA C22.2 No. 156, CSA C22.2 No. 24, or CAN/CSA E60730-1 and any applicable Part 2, and

b) UL 244A, UL 873, or UL 60730-1, and any applicable Part 2.

19.12.2.2 The cycle selection control, water level detection (Clause 14.3.5), out of balance detection (Clause 26.2.3), temperature-regulating devices and any control not relied upon to provide a required safety function are considered and shall be tested and evaluated as operating controls.

19.12.2.3 The minimum test parameters for the evaluation of an operating control to CAN/CSA E60730-1 and UL 60730-1 and any applicable Part 2 of the CAN/CSA E60730-1 and UL 60730-1 series are specified in Table 15.

19.12.3 Protective controls

19.12.3.1 A control that performs a safety-related (protective) function shall comply with the protective control requirements of:

a) CSA C22.2 No. 24, CSA C22.2 No. 209, CAN/CSA-E60691, or CAN/CSA E60730-1 and any applicable Part 2; and

b) UL 244A, UL 873, UL 60691, or UL 60730-1 and any applicable Part 2.

19.12.3.2 Electronic protective controls shall also be evaluated for reliability in accordance with:

a) CSA C22.2 No. 0.8 or CAN/CSA E60730-1 and any applicable Part 2, and

b) UL 991, UL 1998, or UL 60730-1 and any applicable Part 2.

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19.12.3.3 Electronic motor protection shall be evaluated in accordance with Clause 19.7.1(e).

19.12.3.4 Electronic protective controls not relying on software as a protective component shall comply with the standards specified in Clause 19.12.3.2 except for UL 1998 and Clause H.11.12 of CAN/CSA E60730-1 and UL 60730-1. If software is relied upon to perform the protective control function, it shall be considered Software Class B as indicated in Table 16.

19.12.3.5 The secondary function control (Clause 15.6.2), wringer washer controls (15.7), door or lid interlock (Clauses 15.1 and 15.8.1(b)), door or lid lock (Clauses 15.8.1(a) and 15.8.10), electronic braking means (Clause 15.8.1(b)), water level detection (Clauses 14.7 and 15.8.9), motor overload protection (Clause 19.7), temperature-limiting devices, combination temperature-regulating and -limiting devices, and any control relied upon for compliance with the Abnormal Operation testing of Clauses 14, 26.15, or 26.16 are considered and shall be tested and evaluated as protective controls.

19.12.3.6 The test parameters and conditions used in the investigation of the electronic protective control as specified by Clause 19.12.3.2 shall be as stated in UL 991, except that exposure Class H5 shall be used for the humidity test, and there shall be no critical components.

Note: a critical component is a component that performs one or more safety related functions whose failure would result in an increased risk of fire electric shock or injury to persons.

19.12.3.7 The minimum test parameters for the evaluation of a protective control to CAN/CSA E60730-1 and any applicable Part 2 and UL 60730-1 and any applicable Part 2 are specified in Table 16.

19.12.4 Temperature-regulating and temperature-limiting devices

19.12.4.1 A temperature sensing device, such as a positive temperature coefficient (PTC) thermistor or a negative temperature coefficient (NTC) thermistor, that performs the same function as a thermostat shall comply with:

a) CAN/CSA E60730-2-9, and

b) UL 60730-2-9 or UL 1434.

19.12.5 Cycle selection controls

19.12.5.1 Clock-operated switches incorporating mechanical clockwork, such as gears, springs, and motors, shall comply with:

a) CSA C22.2 No. 177 and UL 917; or

b) CAN/CSA-E730-2-7 and UL 60730-2-7.

19.12.5.2 A cycle selection control incorporating electronic timing or switching circuits, shall comply with the standards specified in Clause 19.12.2.1.

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19.12.5.3 If the cycle selection control incorporates electronic secondary function controls for compliance with Clause 15.6.2, the control shall be evaluated as specified in Clause 19.12.3. The Endurance test shall be conducted in accordance with Clause 15.6.7.

19.12.6 Door/lid interlock or lock protective controls

19.12.6.1 If a door-actuated or lid-actuated switch is employed to directly disconnect power to the motor, it shall comply with the Endurance Test as specified in Clause 19.12.6.4 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.

19.12.6.2 If a door-actuated or lid-actuated switch is employed as a sensor for an electronic control to disconnect power to the motor, the switch and control shall comply with Clause 19.12.3.

19.12.6.3 If a solenoid is employed as a part of a door or lid locking mechanism, it shall comply with CSA C22.2 No. 139 and UL 906.

19.12.6.4 Endurance testing of a door or lid lock shall be conducted in accordance with Clause 15.8.10. Endurance testing of a door or lid interlock and the associated braking means shall be conducted in accordance with Clause 15.8.6.

19.12.7 Water level detection controls

19.12.7.1 If a switch is employed as part of a water level detection mechanism, it shall comply with:

a) CSA C22.2 No. 55 and UL 1054;

b) CAN/CSA-C22.2 No. 61058-1 and UL 61058-1; or

c) CAN/CSA-E60730-2-15 and UL 60730-2-15.

19.12.7.2 If a pressure or flow switch is employed as part of a water level detection mechanism, it shall comply with Clause 19.10 for gaskets or seals in contact with laundry detergent or bleach, Clause 26.3 for polymeric materials in contact with laundry detergent or bleach, and:

a) CSA C22.2 No. 14 and UL 508;

b) CAN/CSA-E730-2-6 or CSA C22.2 No. 24, and UL 60730-2-6; or

c) CAN/CSA-E60730-2-15 and UL 60730-2-15.

19.12.7.3 A water level detection control required for compliance with Clause 14.3.5, but not for compliance with Clause 15.8.9, shall be evaluated as an operating control. A water level detection control required for compliance with Clause 15.8.9 shall be evaluated as a protective control.

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19.12.7.4 The number of cycles required for Endurance testing specified in Table 15 for a water level detection control required for compliance with Clause 14.3.5 or Table 16 for a water level detection control required for compliance with Clause 15.8.9 shall be 6000 cycles.

19.13 Overcurrent protection

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

19.13.2 Fuseholders shall comply with:

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.

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

19.14 Electrically operated valves

19.14.1 Electrically operated valves shall comply with:

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

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

19.15 Terminals and connectors

19.15.1 Terminals and connectors shall comply with:

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

d) CSA C22.2 No.188 and UL 486C for 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.

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19.16 Pumps

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

19.16.2 Polymeric parts of pumps subjected to wash water, detergent, or rinse agent shall also be subjected to the immersion test in Clause 26.3.

19.17 Insulating devices

19.17.1 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.

19.17.2 Tests specified in this Standard (eg, strain relief test) shall be performed to confirm the combination of the insulating bushing and the supporting part are suitable.

19.18 Adhesives used to secure parts

19.18.1 An adhesive relied upon to reduce the risk of fire, electric shock, or injury to persons shall comply with the requirements for adhesives in UL 746C.

19.18.2 The requirement in Clause 19.18.1 also applies to an adhesive used to secure a conductive part, that if loosened or dislodged:

a) energizes an accessible dead metal part;

b) makes a live part accessible;

c) reduces spacings below the minimum acceptable values; or

d) short-circuits live parts.

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19.19 Transformers and power supplies

19.19.1 Transformers located in a low-voltage circuit that does not involve a risk of fire or personal injury need not comply with the standards referenced in Clauses 19.19.2 – 19.19.5.

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

19.19.3 General purpose transformers shall comply with:

a) CSA C22.2 No. 66.2; and

b) UL 5085-2.

19.19.4 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, CSA C22.2 No. 60950-1 and UL 60950-1.

19.19.5 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, CSA C22.2 No. 60950-1 and UL 60950-1.

19.20 Button or coin cell batteries of lithium technologies

19.20.1 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.

20 Supply connection and external flexible cords

20.1 General

20.1.1 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.

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20.2 Permanently connected appliances

20.2.1 Electrical boxes and the associated bushings and fittings, and raceways, of the types specified in the Canadian Electrical Code, Part 1 (CE Code) for Wiring Methods and the National Electrical Code (NEC) for Wiring Methods and Materials, that comply with the relevant CSA and UL Standards, and Clause 19.1, 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.

20.2.2 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.

20.2.3 The requirement in Clause 20.2.2 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.

20.2.4 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.

20.2.5 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.

20.2.6 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.

20.2.7 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 4; or

b) be acceptable when the test gauge for flat surfaces surrounding a knockout is applied as specified in CSA C22.2 No. 0.5 and UL 514A.

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20.2.8 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.

20.2.9 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.

20.2.10 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 1.09 mm if copper or brass, and not less than 1.12 mm if aluminum.

20.3 Cord-connected appliances

20.3.1 A power-supply cord shall comply with CSA C22.2 No. 21 and UL 817.

20.3.2 Flexible cords and cables shall comply with 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 20.3.1.

20.3.3 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 20.3.1.

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

20.3.5 An attachment plug shall have an ampere rating not less than 125% 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 20.3.6.

20.3.6 A stationary product marked in accordance with Clause 5.1.2.12 shall employ an attachment plug rated at no less than the current rating of the appliance or the input current under normal load conditions in Clause 8, whichever is greater.

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

20.3.8 The cord length shall be not 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.

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20.3.9 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.

20.3.10 Except as specified in Clause 20.3.12, 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.

20.3.11 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) could subject the cord to mechanical damage or to exposure to a temperature higher than that for which the cord is rated; or

b) could reduce spacings, such as to a metal strain-relief clamp, below the minimum acceptable values.

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

20.3.13 When tested as described in Clause 20.3.14, a strain-relief device shall withstand for 1 min, without displacement, a direct pull of 155 N applied to the cord, with the connections within the appliance disconnected.

20.3.14 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.

20.4 Bushings

20.4.1 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 could result in abrasion of the insulation of the cord.

20.4.2 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 could result in abrasion of the cord.

21 Terminals for external conductors

21.1 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 12 AWG (3.3 mm^2) or smaller supply conductors.

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21.2 A wiring terminal shall be provided with a soldering lug or with a pressure terminal connector securely fastened in place (ie, 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. A wire-binding screw may be employed at a wiring terminal intended to accommodate a 10 AWG (5.3 mm^2) or smaller conductor if upturned lugs or the equivalent are provided to hold the wire in position.

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

21.4 A wire-binding screw shall thread into metal.

21.5 A wire-binding screw at a wiring terminal shall not be smaller than No. 10 (M5). A No. 8 (M4) screw may be used at a terminal intended only for the connection of a 14 AWG (2.1 mm^2) conductor.

21.6 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.

21.7 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.

21.8 Upturned lugs or a cupped washer shall be capable of retaining a conductor of the size mentioned in Clause 21.1, but not smaller than 14 AWG (2.1 mm^2), under the head of the screw or the washer.

21.9 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.

21.10 An appliance constructed so that it could 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.

21.11 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.

The terminal or lead intended to be connected to a grounded conductor of a supply circuit shall be the one that is connected to the screw shells of lamp- or element-holders. The terminal or lead intended to be connected to an ungrounded conductor of a supply circuit shall be the one that is connected to single-pole switches or single-pole automatic controls.

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21.12 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.

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

22 Provision for grounding

Note: The term ″grounding″ as used in this clause relates to ″bonding″ in Canada.

22.1 General

22.1.1 In an appliance intended to be permanently connected to the power supply, all exposed non-current-carrying metal parts that could become energized and all non-current-carrying metal parts within the enclosure that are exposed to contact during any servicing operation and that could become energized shall be conductively connected to the equipment-bonding terminal or lead (see Clauses 22.4.1 to 22.4.5).

22.1.2 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 connecting the equipment to ground.

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

22.1.3 Except as specified in Clause 22.1.4, 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 could become energized and all non-current-carrying metal parts within the enclosure that are exposed to contact during any servicing operation and that may become energized.

22.1.4 With reference to Clause 22.1.3, 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 of not less than 50 000 Ω.

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22.1.5 A non-current-carrying metal part within the enclosure need not be bonded to ground, provided the appliance is marked in accordance with Clause 5.1.2.7.

22.1.6 With reference to the requirements of Clause 22.1.3(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.

22.1.7 With reference to the requirements in Clauses 22.1.1 and 22.1.3, 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 could only become energized through a grounded part.

22.1.8 Servicing, as mentioned in Clauses 22.1.1 and 22.1.3, is considered to include the repair of the appliance by a qualified service personnel as well as by the user.

22.1.9 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.

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

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22.2 Bonding means

22.2.1 A bonding conductor shall be copper, copper alloy, or other material that has been investigated and found to be acceptable for use as an electrical conductor. A ferrous metal part in the grounding path shall be protected against corrosion by enamelling, galvanizing, plating, or other equivalent means.

22.2.2 A bonding conductor shall:

a) be protected from mechanical damage or be located within the enclosure; and

b) not be secured by a removable fastener used for any purpose other than bonding for grounding unless the bonding conductor is not likely to be omitted after removal and replacement of the fastener.

22.2.3 Bonding shall be by a positive means, such as by clamping, riveting, bolted or screwed connection, or by welding or soldering and brazing for materials having a softening or melting point more than 454°C.

22.2.4 The bonding connection shall penetrate nonconductive coatings such as paint or vitreous enamel.

22.2.5 Among the factors to be taken into consideration when judging the acceptability of a clamping device are the:

a) effect of assembling and disassembling the appliance for servicing; and

b) likelihood that the device will not be reassembled in its intended manner.

22.2.6 If the adequacy of a bonding connection cannot be determined by examination, it shall comply with the requirement in Clause 22.2.11.

22.2.7 A bonding conductor shall have a cross-sectional area not less than that of the bonding conductor of the power-supply cord.

22.2.8 A bonding conductor:

a) may be smaller than specified in Clause 22.2.7 if it complies with the requirements in Clause 22.2.12; or

b) for a component or separate electrical enclosure, may be smaller than specified in Clause 22.2.7, but shall not be smaller than the conductors supplying power to the component or components within the separate enclosure.

22.2.9 A bonding conductor intended to be permanently connected to the power supply shall not be smaller than the size specified in Table 5, except as provided in Clause 22.2.8.

22.2.10 If more than one rating of the branch-circuit overcurrent-protective device is involved, the size of the bonding conductor shall be based on the rating of the overcurrent device intended to provide protection against ground-fault for the component bonded by the conductor. For example, if a motor is individually protected by a branch-circuit overcurrent device of lesser rating than other overcurrent devices used with the appliance, a bonding conductor for that motor shall be sized on the basis of the overcurrent device intended for protection of the motor under ground-fault conditions.

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22.2.11 If a test is needed to determine the adequacy of a bonding connection, the connection shall not open when carrying a current equal to twice the rating of the branch-circuit overcurrent device for the time specified in Table 6.

22.2.12 A bonding conductor having a cross-sectional area less than that of the bonding conductor of the power-supply cord and the bonding connections may be used if the connection does not open when carrying a current of 200% of the rating of the appropriate branch-circuit protective device for the time specified in Table 6.

22.3 Continuity of grounding circuit

22.3.1 The resistance between the point of connection of the equipment-bonding means, at or within the appliance, and any point in the grounding circuit shall not be more than 0.1 Ω.

22.3.2 With reference to Clause 22.3.1, the resistance may be determined by any convenient method. However, if unacceptable results are obtained, an alternating current of at least 20 A from a source of supply of not more than 12 V shall be passed from the point of connection of the equipment-bonding means to a metal part in the grounding circuit, and the resulting drop in potential shall be measured between these two points. The resistance shall be determined by dividing the drop in potential in volts by the current in amperes passing between the two points. The bonding conductor of a power-supply cord shall not be included in this measurement.

22.4 Grounding terminals and leads

22.4.1 A wiring terminal or lead for attaching an equipment-bonding conductor shall be provided and shall comply with the requirements in Clause 21.

22.4.2 A terminal for attaching an equipment-bonding conductor shall be such that the equipment-bonding conductor can be connected either inside or outside the appliance.

Note: A terminal that is placed in close proximity to the terminal box or wiring compartment so as not to expose the equipment-bonding conductor to damage may be such that the conductor can be connected only inside the appliance, or only outside the appliance.

22.4.3 A wire-binding screw intended for the connection of an equipment-bonding conductor shall have a green-coloured head that is hexagonal, slotted, or both. A pressure terminal connector intended solely for the connection of such a conductor shall be marked in accordance with Clause 5.1.2.22. The wire-binding screw or pressure terminal connector shall be located so that it does not require removal during normal servicing of the appliance. A sheet-metal screw shall not be used for connection of an equipment-grounding conductor.

Note: The ground screw may be provided with a secondary means of rotation.

22.4.4 A lead intended for attaching an equipment-bonding conductor shall not be smaller than the wire to which it is intended to be connected.

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22.4.5 The surface of an insulated lead intended solely for the connection of an equipment-bonding conductor shall be green with or without one or more yellow stripes, and no other lead shall be so identified.

23 Screws and connections

23.1 Screws or other fastenings of fragile insulating parts shall not be so tight as to result in cracking or breaking of such parts due to expansion and contraction, unless the insulating material is completely retained. Generally, such parts shall be slightly loose or shall be provided with cushioning material.

24 Creepage distances, clearances, and distances through insulation

24.1 General

24.1.1 Spacings between uninsulated current-carrying parts of opposite polarity, between uninsulated parts of low-voltage and line voltage circuits, and between an uninsulated current-carrying part and a non-current-carrying metal part, shall not be less than the values specified in Table 7. If an uninsulated current-carrying part is not rigidly fixed in position, by means other than friction between surfaces, or if a movable non-current-carrying metal part is in proximity to an uninsulated live part, the construction shall be such that the acceptable minimum spacing is maintained.

24.1.2 The spacing between parts of different circuits shall not be less than the largest spacings required for parts of opposite polarity for the circuits involved.

24.1.3 The spacing requirements specified in Clause 24.1.1 do not necessarily apply to the inherent spacings of a component of the appliance, such as a snap switch, lampholder, motor, or other device. Such spacings shall comply with the requirements for the component in question if they are smaller than the values specified in Table 7.

24.1.4 Film-coated wire shall be regarded as an uninsulated current-carrying part when spacings are being considered.

24.1.5 At terminal screws and studs to which connection could be made in the field by means of wire connectors, eyelets, or the like, the spacings shall not be less than those specified in Table 7 when the connectors, eyelets, or the like are in such position that minimum spacings exist between:

a) current-carrying parts;

b) current-carrying parts of opposite polarity; or

c) current-carrying parts and non-current-carrying metal parts.

24.1.6 An insulating liner or barrier of vulcanized fibre or similar material employed in lieu of spacings shall:

a) not be less than 0.8 mm thick; and

b) be located so, or of such material that, it will not be adversely affected by arcing.

Fibre not less than 0.4 mm thick may be used in conjunction with an air spacing of not less than 50% of the spacing required for air alone.

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24.2 Alternate spacings - clearances and creepage distances

24.2.1 As an alternative to the specified spacing requirements of Clause 24.1.1, the spacing requirements shall be in accordance with the requirements of CSA C22.2 No. 0.2 and UL 840, except for spacings between:

a) field wiring terminals; or

b) uninsulated current-carrying parts and a metal enclosure.

24.2.2 Appliances shall be considered overvoltage category 2 as specified in CSA C22.2 No. 0.2 and UL 840.

24.2.3 Printed wiring boards constructed of Types XXXP, XXXPC, G-10, FR-2, FR-3, FR-4, FR-5, CEM-1, CEM-3, GPO-2, or GPO-3 industrial laminates in accordance with UL 746E shall be considered to have a minimum comparative tracking index of 100 as specified in accordance with CAN/CSA-C22.2 No. 0.17 and UL 746A.

24.2.4 The internal microenvironment of the enclosure shall be considered pollution degree 2 as specified in CSA C22.2 No. 0.2 and UL 840, unless steps have been taken to achieve pollution degree 1 at a creepage distance by encapsulation or hermetic sealing. For printed wiring boards, coatings may be used to achieve pollution degree 1 provided that the coating satisfies the performance criteria specified in CSA C22.2 No. 0.2 and UL 840, and is used within the approved thickness.

Note 1: Pollution degree 2 is considered an environment where normally only nonconductive pollution occurs except occasionally a temporary conductivity caused by condensation is to be expected.

Note 2: Pollution degree 1 is considered an environment where no pollution or only dry, nonconductive pollution occurs. The pollution has no influence.

24.2.5 In order to evaluate clearances where the levels of overvoltage are controlled, control of overvoltage shall be achieved by providing an overvoltage device or system as an integral part of the appliance. The appliance shall be evaluated for the rated impulse withstand voltage specified in CSA C22.2 No. 0.2 and UL 840.

24.2.6 A device having exposed Class 2 outputs that:

a) could be contacted during normal operation or user servicing; and

b) has clearances between the Class 2 circuit and an overvoltage as specified in CSA C22.2 No. 0.2 and protected line-voltage circuits that have been evaluated in accordance with Clearance B requirements as specified in CSA C22.2 No. 0.2 and UL 840;

shall be provided with a mechanism to indicate the malfunction of the overvoltage protective device or system.

25 Resistance to rusting

25.1 Iron and steel parts shall be provided with means to reduce the likelihood of corrosion, such as enamelling, galvanizing, plating, or other equivalent means, if the corrosion of such unprotected parts would be likely to result in a risk of fire, electric shock, or injury to persons.

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Note 1: In certain instances in which the oxidation of iron or steel resulting from the exposure of the metal to air and moisture is not likely to be appreciable and the thickness of metal and temperature are also factors, surfaces of sheet-steel and cast-iron parts within an enclosure, there could be instances where protection against corrosion is not required.

Note 2: Bearings, laminations, or minor parts of iron or steel, such as washers, screws, or the like, need not be protected against corrosion.

25.2 If deterioration or breakage of a liquid container provided as a part of an appliance would result in a risk of fire, electric shock, or injury to persons, the container shall be of a material that is resistant to corrosion by the liquid intended to be contained.

26 Polymeric materials

26.1 General

26.1.1 The requirements of Clause 26 apply to polymeric materials, including thermoset materials, used as enclosures, functional polymeric parts, decorative parts, nonfunctional polymeric parts, or liquid containers.

26.1.2 Some tests may be eliminated or modified if specimen testing as part of a previous test program indicates that the polymeric material is acceptable for the properties being investigated.

26.1.3 The tests that may be conducted are identified in Table 8. Table 9 specifies the tests applicable to the polymeric part being evaluated. Table 10 specifies the tests applicable to a polymeric part that is subjected to a solution or solution vapour.

26.1.4 Polymeric material employed to support a live part, in direct contact with a live part, or in the vicinity of a live part, as noted below, shall be rated for use at the operating temperature involved and shall have the following material properties determined in accordance with CAN/CSA C22.2 No. 0.17 and UL 746C:

a) volume resistivity of at least 50×10^6 ohm-cm:

Note 1: This volume resistivity requirement is applicable to polymeric materials that serve as insulation between uninsulated live parts of opposite polarity, or between uninsulated live parts and (1) dead metal parts that may be grounded in service or (2) any surface exposed to user contact.

Note 2: In lieu of volume resistivity requirement the leakage current test of Clause 10 may be conducted to determine compliance.

b) comparative tracking index (CTI) of at least 175 volts (PLC 3 – see note (a) of Table 13) for a moderately contaminate environment; and

Note 1: This CTI requirement is applicable when the polymeric material surface is:

1) in contact with uninsulated live parts of opposite polarity that are spaced less than 12.7 mm (over surface), or in contact with an uninsulated live part that is spaced less than 12.7 mm (over surface) from either a dead metal part that may be grounded in service or any surface exposed to user contact;

2) located less than 0.8 mm (through air) from an uninsulated live part; or

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3) located less than 0.8 mm (through air) from uninsulated live parts of opposite polarity that are spaced less than 12.7 mm (over surface) or an uninsulated live part that is spaced less than 12.7 mm (over surface), from either a dead metal part that may be grounded in service or any surface exposed to user contact.

Note 2: See C22.2 No.0.17 Clause 6.5 or UL 746C, Figure 6.1, examples 2, 3, and 4, if additional clarification is needed.

c) a high current arc ignition (HAI) and hot-wire ignition (HWI) as specified in Table 13.

Note 1: The HAI requirement is applicable for a polymeric material that is in contact with uninsulated live parts; or within 0.8 mm from a non-arcing uninsulated live part, or within 12.7 mm from an arcing uninsulated live part).

Note 2: The HWI requirement is applicable to a polymeric material that is in contact with, or within 0.8 mm from an uninsulated live part.

26.1.5 In reference to Clause 26.1.4, the high current arc ignition of a material need not be evaluated as specified in Clause 26.1.4(c) when:

a) the spacing over the surface of the material is at least 12.7 mm between:

i) live parts of opposite polarity; and

ii) live parts and grounded noncurrent-carrying metal;

b) the material is evaluated by conducting the end-product arc resistance test of UL 746C using the power (current, voltage and power factor) of the circuit in the washer; or

c) the live parts are part of a low power circuit, where the maximum power available does not exceed 15 W.

26.1.6 In reference to Clause 26.1.4, the hot wire ignition of a material need not be evaluated as specified in Clause 26.1.4(c) when:

a) the material is evaluated by conducting the abnormal overload test or end-product glow-wire test of UL 746C; or

b) the live parts are part of a low power circuit, where the maximum power available does not exceed 15 W.

26.1.7 In reference to Clause 26.1.4, foamed thermoplastic material employed for sound reduction that is in direct contact with an uninsulated live part or is within 0.8 mm of an uninsulated live part shall be rated HF-1 and is not required to be evaluated for CTI, HWI, and HAI.

26.1.8 With respect to Clause 26.1.4(b), if suitable measures are taken to protect the environment from contamination, the material shall have a comparative tracking index of at least 100 V (PLC 4) for a relatively clean environment.

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26.2 Long-term exposure

26.2.1 A polymeric material, the deterioration of which could result in a risk of fire, electric shock, or injury to persons, shall be resistant to solutions to which it is exposed during normal use of the appliance. The material shall be evaluated by one of the following methods:

a) an endurance test conducted on samples of the complete appliance as prescribed in Clauses 26.2.2 and 26.2.3; or

b) tensile strength and tensile impact energy tests conducted on specimens of the material used in the part as prescribed in Clauses 26.2.4 and 26.2.8.

26.2.2 With reference to Clause 26.2.1(a), samples of an appliance shall be tested in accordance with Clause 26.2.3. A polymeric part shall show no cracking, leakage, or deterioration that would result in a risk of fire, electric shock, or injury to persons.

26.2.3 Three complete appliances shall be subjected to 5 000 cycles of operation. The length of each cycle shall be the maximum length of time permitted by the timer. The tub shall be loaded with the manufacturer's maximum recommended clothes load or mechanically loaded to simulate the recommended clothes load. During the wash period, one cup of non-concentrated, powdered laundry detergent shall be added during each cycle, one cup of laundry bleach shall be added each third cycle, and 30 g of sand shall be added at equally spaced intervals throughout the test until a total of 15 000 g has been added. If the appliance has a means of extracting water by spinning the clothes, each appliance shall be operated for 500 cycles, with a maximum out-of-balance condition created after the samples have completed the first 2 500 cycles. The maximum out-of-balance condition is one that is produced when the tub makes its maximum excursion from the at-rest position without striking against the side of the outer tub or enclosure and without causing the out-of-balance switch (if so equipped) to function. A cycle of operation shall be as follows:

a) Programmed Cycle (Automatic Wash and Rinse Appliance)

Each cycle shall consist of the maximum duration for wash and rinse cycles, maximum water level, hot 60°C wash, cold rinse.

b) Unprogrammed, Nonwringer Appliance

Each cycle shall consist of 60°C water fill, wash, drain, cold-water fill, rinse, drain and, spin, or the cycle shall be as recommended by the manufacturer if it results in a cycle of greater duration. On twin-tub appliances, washing and spinning shall occur simultaneously after the first cycle.

c) Wringer Appliance

Each cycle shall consist of 60°C water fill, 18 min wash, drain, cold-water fill, 5 min rinse and, drain.

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26.2.4 With reference to Clause 26.2.1(b), specimens as described in Clauses 26.2.5 or 26.2.6 shall be tested for tensile strength and tensile impact energy. The average tensile strength and tensile impact energy of the conditioned specimens shall be at least 50% of that of the as-received specimens for each condition.

26.2.5 With reference to Clause 26.2.4, each specimen shall be approximately 203 mm by 76 mm, having a thickness equal to the minimum thickness of the polymeric material as used in the part. The average tensile strength of five as-received specimens shall be determined as described in Clause 26.2.7, and the average tensile impact energy of five as-received specimens shall be determined as described in Clause 26.2.8. Additional specimens shall be subjected to the following conditioning:

a) for a part subjected to wash water, 30 specimens (10 for each period) shall be immersed for 30, 60, and 138 days at 82°C in 2.5% (by weight), aqueous laundry detergent solution;

b) for a part subjected to laundry bleach, 10 specimens shall be immersed for 1 000 h at 100°C in 100% bleach; and

c) 40 specimens measuring approximately 203 mm by 76 mm, having a thickness equal to the minimum thickness of the polymeric material as used in the part, shall be used. Twenty of these specimens shall be cross-hatched with parallel lines scribed 1.6 mm apart using a razor blade with an applied force of 0.45 kg. Three groups of ten specimens, each group consisting of five cross-hatched and five plain specimens, shall be immersed in laundry detergent and bleach solution at 82°C for periods of 30, 60, and 138 days. The laundry detergent and bleach solution shall consist of 50 g of non-concentrated powdered laundry detergent and 100 ml of bleach per litre of water.

26.2.6 With reference to Clause 26.2.4, the polymeric material under test shall be moulded to form the test specimens indicated in Clauses 26.2.7 and 26.2.8 having a thickness equal to the minimum thickness of the polymeric material as used in the part. These test specimens shall be tested as indicated in Clauses 26.2.5 and 26.2.7 through 26.2.8.

Note: The results of tensile impact testing of standard specimens in the nominal 4 mm thickness can be considered representative of the testing of a reduced thickness provided the non-impact testing at the minimum thickness of the polymeric material as used in the part complies with the applicable requirements of Clause 26.

26.2.7 After conditioning the materials as specified in Clause 26.2.5(a), (b), or (c), the tensile strength shall be determined in accordance with ASTM D 638, using Type I specimens.

26.2.8 After conditioning the materials as specified in Clause 26.2.5(a) or (b), the tensile impact energy shall be determined in accordance with ASTM D 1822, using Type S specimens.

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26.3 Immersion

26.3.1 A polymeric part shall show no cracking, leakage, or deterioration that would result in a risk of fire, electric shock, or injury to persons when subjected to one of the following exposures in accordance with Table 10:

a) **Test No. 1**

Three samples of the complete assembly shall be immersed in a solution for 1 000 h at a temperature 10°C above that temperature to which the part is subjected, but not less than 70°C. The solution shall consist of 25 g of powdered laundry detergent (not soap) and 50 ml of laundry bleach per litre of water.

b) **Test No. 2**

Three samples of the complete assembly shall be immersed in a solution for 1 000 h at a temperature 10°C above that temperature to which the part is subjected, but not less than 70°C. The bleach solution shall be 100% laundry bleach. The powdered laundry detergent (not soap) solution shall be a saturated aqueous solution at the test temperature and at atmospheric pressure. If other solutions are to be investigated, they shall be 100% concentration of the agent.

c) **Test No. 3**

Three samples of the complete assembly shall be immersed in a solution for 168 h at a temperature 10°C above that temperature to which the part is subjected, but not less than 70°C. The solution shall be 25 g of powdered laundry detergent (not soap) and 50 ml of laundry bleach per litre of water.

Note: The immersion test may be waived for moulded polymeric parts of the same material having different shapes and sizes if all of the following conditions are met:

a) the candidate polymeric part uses the same material as the originally tested polymeric part;

b) the candidate polymeric part has a minimum thickness not less than the originally tested polymeric part; and

c) the candidate polymeric part is subjected to an operating temperature not more than the originally tested polymeric part.

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26.4 Mould stress relief

26.4.1 A polymeric part shall be tested as specified in the mould stress relief test in UL 746C. As a result of this test:

a) spacings shall not be reduced to less than those specified in Table 7;

b) current-carrying parts or internal wiring shall not be exposed, as determined in accordance with Clause 8;

c) there shall be no damage that would increase the risk of fire, electric shock, or injury to persons; and

d) a part exposed to liquid shall not crack or leak.

Note: This test may be waived if the part is required to be subjected to the thermal ageing test, Clause 26.13.

26.5 Horizontal burning rate

26.5.1 The burning rate of a polymeric part shall have a flammability rating complying with HB. The test specimens may be flat stock of the thickness of the end-use part or cut from the part.

Note: Materials not classified HB may be tested in accordance with the needle flame test of CAN/CSA-C22.2 No. 0.17 or the 12 mm or 20 mm flame test described in UL 746C, using parts moulded from the polymeric material.

26.6 Flammability

26.6.1 Cord-connected appliances

26.6.1.1 Specimens of a polymeric part shall be subjected to the tests specified in CAN/CSA-C22.2 No. 0.17 and UL 94, and shall be classed V-1 minimum.

26.6.1.2 In reference to Clause 26.6.1.1, materials not classed V-1 minimum may be tested in accordance with CAN/CSA-C22.2 No. 0.17 and the 20 mm flammability test described in UL 746C using parts moulded from the polymeric material.

26.6.1.3 If a metal or V-0 polymeric material sub-enclosure houses all insulated or uninsulated live parts that involve a risk of fire, the overall polymeric outer enclosure may be classed 5VA, 5VB, V-0, V-1, V-2, or HB. To determine if live parts presenting a risk of fire are adequately housed within the sub-enclosure, no insulated or uninsulated live parts shall be contacted as determined by application of the probe as shown in Figure 1 to the sub-enclosure. (See also Clause 26.6.1.5.)

26.6.1.4 In addition to complying with the relevant requirements of Clause 26.6.1.3, the use of HB rated materials as the enclosure is acceptable if all electrical connections, other than welded connections, presenting a risk of fire within the polymeric enclosure comply with Clauses 26.6.3 including connections to the components specified in Clause 26.6.1.6.

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26.6.1.5 In reference to Clauses 26.6.1.3 and 26.6.1.4, live parts and electrical connections within a low-power circuit, where the maximum power available does not exceed 15 W, are not considered to present a risk of fire.

26.6.1.6 In reference to Clause 26.6.1.4, this requirement is not applicable to connections within snap switches, lampholders with switching mechanisms, appliance inlets and outlets, receptacles, and special-use switches that comply with the applicable standard (C22.2 No. 111 and UL 20; C22.2 No. 43 and UL 496; C22.2 No. 42 and UL 498; or C22.2 No. 55 and UL 1054) with respect to resistance to ignition, resistance to arcing, or overload and endurance testing.

26.6.2 Permanently connected appliances

26.6.2.1 Specimens of a polymeric part shall be subjected to the tests specified in CAN/CSA-C22.2 No. 0.17 and UL 94, and shall be classed 5VA.

26.6.2.2 In reference to Clause 26.6.2.1, materials not classified 5VA may be tested in accordance with CAN/CSA-C22.2 No. 0.17 and the 127 mm flammability test described in UL 746C using parts moulded from the polymeric material.

26.6.3 Electrical connections for cord connected and permanently connected appliances

Note: See Figure 11 for guidance in the application of Clause 26.6.3.

26.6.3.1 These requirements shall not apply to welded or soldered connections.

26.6.3.2 All electrical connections where the total circuit load is greater than 60 watts during normal operation shall:

a) comply with Clauses 26.6.3.4, 26.6.3.5, and 26.6.3.6; or

b) be evaluated as specified in Clause 14.7.

Note: A risk of fire is considered to exist at any two points in a circuit where a power of more than 15 watts can be delivered into an external resistor connected between the two points within 5 seconds. To deliver 15 watts at a connector, the circuit must have a nominal load of 60 watts or more. This is based on the maximum power transfer theorem that shows an electrical connection can only dissipate 1/4 of the power of the load when the resistance of the connection is equal to the resistance of the load.

26.6.3.3 Electrical connections are not required to comply with Clause 26.6.3.2 when all mating parts of the electrical connection are provided with a component (eg, contacts within a switch or relay, connections within a motor, etc.) that complies with the relevant component standard. Electrical connections that are mated to the component from the appliance are required to comply with Clause 26.6.3.2.

26.6.3.4 With reference to Clause 26.6.3.2, components such as wire, tubing, sleeving, or tape that are located within 3 mm of an electrical connection, as shown in Figure 9, shall have a flammability classification as follows:

a) VW-1 for wire evaluated in accordance with UL 1581 and FT1 for wire evaluated in accordance with CSA C22.2 No. 2556;

b) VW-1 for tubing and sleeving evaluated in accordance with CAN/CSA-C22.2 No. 198.1 and UL 224 or UL 1441; or

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c) as evaluated in accordance with CSA C22.2 No. 197 and UL 510 for flame-retardant insulating tape.

26.6.3.5 With reference to Clause 26.6.3.2, polymeric materials located within 3 mm of an electrical connection, as shown in Figure 9, shall have a flammability classification as follows:

a) a minimum V-0 or VTM-0, in accordance with CSA C22.2 No. 0.17 and UL 94;

b) a minimum SC-0 or SCTC-0, in accordance with CSA C22.2 No. 0.17 and UL 1694;

c) a minimum glow wire ignition temperature (GWIT) of 775°C according to IEC 60695-2-13; or

d) withstands glow-wire test (GWT) according to IEC 60695-2-11 with a minimum test severity of 750°C and during the test flames persist for no longer than 2 s.

26.6.3.6 With reference to Clause 26.6.3.2, all nonmetallic combustible materials located within the envelope of a vertical flame cylinder having a diameter of 20 mm and a height of 50 mm, placed above the center of the connection zone and on top of the nonmetallic parts that are supporting current-carrying electrical connections, as shown in Figure 10, shall have a flammability classification as follows:

a) a minimum of V-0, VTM-0, or HF-1, in accordance with CSA C22.2 No. 0.17 and UL 94 and IEC 60695-11-10;

b) a minimum of SC-0 or SCTC-0, in accordance with CSA C22.2 No. 0.17 and UL 1694; or

c) a minimum VW-1 for wire, tubing, sleeving and tape in accordance with Clause 26.6.3.4(a), (b), and (c).

26.6.3.7 With reference to Clause 26.6.3.6 and Figure 10, the flame cylinder shall be placed above the center of each connection zone and on top of any non-metallic parts that are supporting current-carrying connections as shown in Examples 1-3 of Figure 10. In the case of uninsulated connections, the flame cylinder shall be placed above the center of each connection zone and directly on top of current-carrying conductors as shown in Examples 4-6 of Figure 10. The flame cylinder shall project through all metallic and polymeric material. If “C” is intended to act as a barrier to “D”, or if the flame cylinder extends beyond the outer enclosure of the appliance, then the adequacy of the barrier shall be demonstrated by testing as described in Clause 14.7.

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26.7 6.8 J impact (ambient and low temperature)

26.7.1 A polymeric part shall be subjected to the impact test specified in Clause 26.7.2. As a result of the impacts:

a) spacings shall not be reduced to less than those specified in Table 7;

b) current-carrying parts or internal wiring shall not be exposed, as determined in accordance with Clause 8; and

c) there shall be no damage that would increase the risk of fire, electric shock, or injury to persons.

26.7.2 Samples of the polymeric part shall be subjected to the impact test described in Clause 26.7.3. Counter-supported, floor-supported, fixed, and stationary appliances shall be subjected to 6.8 J impacts.

Samples shall be tested from each group as follows:

a) Group A shall be tested in as-received condition; and

b) for Group B, the tests shall be performed on samples that have been conditioned as follows: three samples of indoor equipment shall be cooled to a temperature of 0.0 ±2.0°C and maintained at this temperature for 3 hours. While the samples are still cold, the samples shall be subjected to the impact test.

26.7.3 Each of three samples of the appliance shall be subjected to a single impact on any surface that can be exposed to a blow during intended use. The impacts shall be produced by a 50.8 mm diameter, 0.54 kg steel ball, dropped through a vertical distance of 1.29 m. The ball may be swung through an arc as a pendulum or allowed to fall freely to produce the required impact force; see Figure 13. Each sample shall be mounted in its intended position and shall be subjected to a single impact directed at a different location.

Note: Fewer samples may be used, in accordance with Figure 14. The overall performance is acceptable upon completion of any one of the sequences represented in Figure 14.

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26.8 Static load

26.8.1 A polymeric part on which a person could stand shall be subjected to the loading described in Clauses 26.8.2 and 26.8.3. As a result of the loading:

a) spacings shall not be reduced to less than those specified in Table 7;

b) current-carrying parts or internal wiring shall not be exposed, as determined in accordance with Clause 8; and

c) a condition shall not be produced that would increase the risk of fire, electric shock, or injury to persons.

26.8.2 The test shall be conducted on as-received samples and then repeated on samples that have been subjected to the mould stress-relief test, Clause 26.4.

26.8.3 Two hardwood or equivalent material boards having rounded edges and corners, each 25.4 mm thick by 102 mm wide by 254 mm long, and separated by a distance of 25.4 mm along the 254 mm edge, shall be placed on the surface under investigation. A 890 N force shall be applied simultaneously to each board for 3 min. The test shall be repeated, as necessary, on several different areas to completely evaluate the polymeric part. A different sample shall be used for each subsequent test if the preceding test damages or reduces the integrity of the part.

26.9 56.7 J impact

26.9.1 A polymeric part on which a person could jump shall be subjected to the impact described in Clause 26.9.2 and 26.9.3. As a result of the impact:

a) spacings shall not be reduced to less than those specified in Table 7;

b) current-carrying parts or internal wiring shall not be exposed, as determined in accordance with Clause 8; and

c) there shall be no damage that would increase the risk of fire, electric shock, or injury to persons.

26.9.2 The test shall be conducted on as-received samples.

26.9.3 A hardwood or equivalent material board having rounded edges and corners, 25.4 mm thick by 86.5 mm wide by 127 mm long, shall be placed in the area under investigation. A 45.4 kg weight shall be dropped from a height of 127 mm to impact evenly over the surface of the board. The test shall be repeated on different areas, as necessary. A different sample shall be used for each subsequent test if the preceding test damages or reduces the integrity of the part.

Note: Alternatively, this test may be conducted at different height and weight combinations that result in an impact of 56.7 J, provided they are not less severe than if conducted as specified.

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26.10 Thermal cycling

26.10.1 A polymeric part shall be tested as described in Clause 26.10.2. The part shall show no cracking, leakage, or deterioration that would increase the risk of fire, electric shock, or injury to persons.

26.10.2 Three samples of the polymeric part shall each be subjected to 50 cycles of thermal cycling, with each cycle consisting of 1 h in a circulating-air oven at a temperature 10°C above that temperature to which the part is subjected, but not less than 70°C, followed by 1 h in a room ambient of 25°C.

26.11 Hot-wire ignition

26.11.1 A polymeric material shall be tested as described in Clause 26.11.2. The part shall not ignite for at least 15 s.

Note: A polymeric material that does not ignite when tested as specified in the abnormal current tests described in UL 746C is acceptable.

26.11.2 Bar specimens shall be subjected to the hot-wire-ignition test specified in CAN/CSA-C22.2 No. 0.17 and UL 746A.

26.12 Thermal ageing

26.12.1 A polymeric part shall be tested as described in Clause 26.12.2. As a result of the test:

a) spacings shall not be reduced to less than those specified in Table 7;

b) current-carrying parts or internal wiring shall not be exposed, as determined in accordance with Clause 8;

c) a condition shall not be produced that would increase the risk of fire, electric shock, or injury to persons; and

d) a part exposed to liquids shall not crack or leak.

26.12.2 Three complete samples of the polymeric part shall be placed in an oven for 1 000 h at the temperature specified in Table 11. The parts shall be removed from the oven, cooled to room temperature, and examined for compliance with the requirements of Clause 26.12.1.

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26.13 Volume resistivity

26.13.1 The resistance per unit volume (volume resistivity) of the polymeric material shall not be less than the values specified in CAN/CSA-C22.2 No. 0.17 and UL 746C. The volume resistivity shall be determined in accordance with CAN/CSA-C22.2 No. 0.17 and UL 746A.

26.14 Enclosure flammability - large mass consideration

26.14.1 A polymeric part shall be composed of the material that is to be tested as described in UL 723 or UL 94. The flame-spread rating of the part shall not exceed 200.

26.15 Abnormal operation test on enclosures

26.15.1 A polymeric enclosure shall be tested as described in Clause 26.15.2. There shall be no:

a) ignition of the enclosure material;

b) exposure of current-carrying parts, as determined in accordance with Clause 6; or

c) deformation or damage that would increase the risk of fire, electric shock, or injury to persons.

26.15.2 A polymeric enclosure that contains a motor, solenoid, relay, transformer, or solid-state component shall be evaluated by operating the appliance with the motor armature locked, relay or solenoid plunger blocked open, transformer secondary shorted, and solid-state component opened or shorted. If other electrical components are employed, consideration shall be given to operating them within the enclosure under an abnormal operating condition. The abnormal operation test shall be continued until ultimate results occur, but no longer than 7 h. If the appliance is provided with a timer or the equivalent that will terminate operation in less than 7 h, the test need not be continued longer than the maximum interval permitted by the timer.

26.16 Abnormal operation test on functional polymeric parts

26.16.1 A functional polymeric part shall be tested as described in Clause 26.16.2. There shall be no:

a) ignition of the polymeric part; or

b) damage or deformation of the part that would increase the risk of fire, electric shock, or injury to persons.

26.16.2 A functional polymeric part located below a motor, solenoid, relay component, transformer, or solid-state component, or within 100 mm of any of these components, shall be evaluated by operating the appliance with the motor armature locked, relay or solenoid plunger blocked open, transformer secondary shorted, and solid-state component opened or shorted. If other electrical components are located within 100 mm of the functional polymeric part or above the part, consideration shall be given to operating them under an abnormal condition. The abnormal operation test shall be continued until ultimate results occur, but no longer than 7 h. If the appliance is provided with a timer or the equivalent that will terminate operation in less than 7 h, the test need not be continued longer than the maximum interval permitted by the timer.

Note: This test need not be conducted if the component is provided with acceptable protection against overload.

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26.17 Abnormal operation test on parts wetted only during an abnormal condition

26.17.1 If a polymeric part is wetted only during an abnormal condition, the appliance shall be subjected to the abnormal condition that results in wetting of the part, six times in succession. The part shall not crack or show other signs of deterioration that would reduce its ability to perform its intended function.

26.18 High-current arc ignition

26.18.1 Bar specimens of a polymeric material shall be subjected to a minimum of 30 high-current arcs in accordance with the high-current arc-ignition test specified in CAN/CSA-C22.2 No. 0.17 and UL 746A. The specimens shall not ignite.

Note: Polymeric materials that comply with the end-use product tests under normal current conditions as specified in UL 746C are acceptable.

27 Manufacturing and production tests

27.1 Plumbing system leakage test

27.1.1 The manufacturer shall determine that the plumbing system of each appliance produced does not leak. The test shall consist of filling the appliance with a sufficient amount of water and operating the appliance in a manner that will permit any leakage from the plumbing system to be observed.

27.2 Grounding continuity test

Note: The term ″grounding″ as used in this clause relates to ″bonding″ in Canada.

27.2.1 Each appliance that has a power-supply cord having a bonding conductor for connecting the appliance to ground shall be tested to determine that grounding continuity exists between the grounding blade of the attachment plug and the accessible non-current-carrying metal parts of the appliance that could become energized.

27.2.2 Any acceptable indicating device, such as an ohmmeter, a battery and buzzer combination, or the like, may be used to determine compliance with the requirement in Clause 27.2.1.

27.2.3 Only a single test need be conducted if the accessible metal selected is conductively connected by design to all other accessible metal.

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27.3 Electric strength test

27.3.1 Each appliance shall withstand without electrical breakdown the application of a DC potential or an AC potential at a frequency within the range of 40 to 70 Hz:

a) between the primary wiring, including connected components, and accessible non-current-carrying metal parts that are likely to become energized; and

b) between primary wiring and accessible low-voltage (42.4 V peak or less) metal parts, including terminals.

27.3.2 The test shall be in accordance with either condition A or condition B of Table 12.

27.3.3 The appliance may be in a heated or an unheated condition for the test.

27.3.4 The test shall be conducted when the appliance is complete and fully assembled. It is not intended that the appliance be unwired, modified, or disassembled for the test.

Notes:

1) A part, such as a snap cover or a friction-fit knob, that would interfere with conducting the test need not be in place.

2) The test may be conducted before final assembly if the test represents that for the completed appliance.

27.3.5 An appliance employing a solid-state component that is not relied upon to reduce the risk of electric shock and that could be damaged by the electric strength potential may be tested before the component is electrically connected, provided a random sampling of each day's production is tested at the potential specified in Table 12. The circuitry may be rearranged for the purpose of the test to reduce the likelihood of solid-state-component damage while retaining the representative electric strength stress of the circuit.

27.3.6 The test equipment shall include a transformer having a DC or an AC essentially sinusoidal output, a means of indicating the test potential, an audible or visual indicator of electrical breakdown, and either a manually reset device to restore the equipment after electrical breakdown or an automatic reject feature of any unacceptable unit.

27.3.7 If the output of the test equipment transformer is less than 500 V·A, the equipment shall include a voltmeter in the output circuit to directly indicate the test potential.

27.3.8 If the output of the test equipment transformer is 500 V·A or larger, the test potential may be indicated:

a) by a voltmeter in the primary circuit or in a tertiary-winding circuit;

b) by a selector switch marked to indicate the test potential; or

c) for equipment having a single test-potential output, by a marking in a readily visible location to indicate the test potential. If marking is used without an indicating voltmeter, the equipment shall include a positive means, such as an indicator lamp, to indicate that the manually reset switch has been reset following an electric strength breakdown.

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27.3.9 Test equipment other than that described in Clauses 27.3.6 to 27.3.8 may be used if found acceptable to accomplish the intended factory control.

27.3.10 During the test, the primary switch shall be in the ON position, both sides of the primary circuit of the appliance shall be connected together and to one terminal of the test equipment, and the second test-equipment terminal shall be connected to accessible non-current-carrying metal.

Notes:

1) An appliance - resistive, high-impedance winding, and the like - having circuitry not subject to excessive secondary-voltage buildup in case of electrical breakdown during the test may be tested:

a) with a single-pole primary switch in the OFF position; or

b) with only one side of the primary circuit connected to the test equipment when the primary switch is in the ON position, or when a primary switch is not used.

2) The primary switch is not required to be in the ON position if the testing means applies full test potential between primary wiring and non-current-carrying metal parts with the switch not in the ON position.

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Table 1
Minimum acceptable distance from an opening to a part that may involve a risk of electric shock

(See Clauses 6.1 and 6.2.)

Minor dimensions of opening,[a] mm	Minimum distance from opening to part, mm
≤19.1	114.0
25.4	165.0
31.8	190.0
38.1	318.0
47.6	394.0
54.0	444.0
>54.0 ≤ 152.0	762.0

[a] See Clause 6.5

Notes:

1) Between 19.1 mm and 54.0 mm, interpolation is used to determine a value between values specified in the table.

2) Any dimension less than 25.4 mm applies to a motor only.

Table 2
Maximum acceptable temperature rises

(See Clauses 9.1.1, 9.1.3, 9.1.5, 9.1.6 and 9.1.7.)

Location		°C
1	Varnished-cloth insulation	60
2	Fuses	
	a) Class J, L, T and CC	
	1) tube	100
	2) ferrule or blade	85
	b) Others	65[a]
3	Fibre employed as electrical insulation	65
4	Wood or other combustible material, including the inside surfaces of the test enclosure and the surface supporting the appliance	65
5	Class A insulation systems on coil windings of an ac motor having a frame diameter of more than 178 mm, a dc motor, and a universal motor in	[b, c, d]
	a) an open motor	
	1) thermocouple method	
	2) resistance method	65
	b) a totally enclosed motor	75
	1) thermocouple method	70
	2) resistance method	80
6	Phenolic composition employed as electrical insulation or as a part, the malfunction of which could result in a risk of injury to persons	125[e]
7	Insulated wires and cords	35[e,f]
8	At any point within a terminal box or wiring compartment of a permanently connected appliance	35
9	Sealing compound	40 less than melting point
10	Capacitors	
	a) electrolytic	40[g]
	b) other types	65[h]

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Table 2 Continued on Next Page

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Table 2 Continued

Location		°C
11	Class A insulation systems on coil windings of an ac motor having a frame diameter of 178 mm or less, not including a universal motor in	b, c, d
	a) an open motor; thermocouple or resistance method	75
	b) a totally enclosed motor; thermocouple or resistance method	80
12	Class 130 insulation systems, other than as specified in 13 and 14(a); thermocouple method	80
13	Class B insulation systems on coil windings of an ac motor having a frame diameter of more than 178 mm, of a dc motor, and of a universal motor in	b, c, d
	a) an open motor	
	1) thermocouple method	85
	2) resistance method	95
	b) a totally enclosed motor	
	1) thermocouple method	90
	2) resistance method	100
14	Class B insulation systems on coil windings of an ac motor having a frame diameter of 178 mm or less, not including a universal motor in	b, c, d
	a) an open motor and on vibrator coils; thermocouple or resistance method	95
	b) a totally enclosed motor; thermocouple or resistance method	100
15	Class F insulation systems on coil windings of an ac motor having a frame diameter of more than 178 mm, of a dc motor, and of a universal motor in	d
	a) an open motor	
	1) thermocouple method	110
	2) resistance method	120
	b) a totally enclosed motor	
	1) thermocouple method	115
	2) resistance method	125
15A	Class F insulation systems on coil windings of an ac motor having a frame diameter of 178 mm or less, not including a universal motor,	d
	a) an open motor thermocouple or resistance method	120
	b) a totally enclosed motor thermocouple or resistance method	125
16	Transformer windings	
	a) Class 105 insulation systems	
	1) thermocouple method	65
	2) resistance method	75
	b) Class 130 insulation systems	
	1) thermocouple method	85
	2) resistance method	95
17	Windings of relays, coils, buzzers, and the like	
	a) Class 105 insulation systems	
	1) thermocouple method	65
	2) resistance method	85
	b) Class 130 insulation systems	
	1) thermocouple method	85
	2) resistance method	105

[a] These limitations do not apply to classes of fuses that have been investigated and found to be acceptable for use at higher temperatures.

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Table 2 Continued on Next Page

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Table 2 Continued

Location	°C

[b] For an automatic washing machine or an automatic combination washer-dryer, the maximum acceptable temperature rises may be more than the values specified in this table for short intervals during the cycle, provided analysis indicates that the insulation systems will not be adversely affected by the higher temperature (see Clauses 9.6 and 9.7).

[c] 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 more than the maximum acceptable temperature specified in this table, provided the temperature as measured by the resistance method is not more than that specified. The temperature measured by means of a thermocouple may be more than the specified value by

Reference item	Temperature rise, °C - thermocouple method
5(a)	15
11(a)	5
13(a)	20
14(a)	10

[d] This is the diameter measured in the plane of the lamination of the circle circumscribing the stator frame, excluding lugs, fins, boxes, and the like, used solely for motor mounting, cooling, assembly, or connection.

[e] Phenolic composition, rubber, and thermoplastic insulation that has been investigated and found acceptable for use at higher temperatures may be used at those temperatures.

[f] A rubber-insulated conductor within a motor, a rubber-insulated motor lead, and a rubber-insulated conductor of a flexible cord entering a motor may be subjected to a higher temperature if the conductor is provided with sleeving or a braid that has been investigated and found acceptable for use at the higher temperature. This does not apply to thermoplastic-insulated wires or cords.

[g] For an electrolytic capacitor that is physically integral with or attached to a motor, the maximum acceptable temperature rise on insulating material integral with the capacitor enclosure shall be not more than 65°C.

[h] A capacitor that operates at a temperature rise of more than 65°C may be evaluated on the basis of its marked temperature limit.

Table 3
Winding temperatures for motors in washing machines

(See Clauses 19.7.3, 19.7.4 and 19.7.6.)

Insulation system	Maximum temperature		Average temperature after first hour
	During first hour, °C	After first hour, °C	
Class A	200	175	150
Class B or F	225	200	175

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Table 4
Sizes of flat surfaces surrounding connection openings

(See Clause 20.2.7.)

Nominal diameter of opening, mm	Corresponding conduit trade size, in	Minimum width of surrounding flat surface, mm
22.23	1/2	3.38
28.17	3/4	3.96
34.93	1	5.03

Table 5
Minimum acceptable size of bonding conductor on an appliance intended to be permanently connected to the power supply

(See Clause 22.2.9.)

Rating of branch-circuit overcurrent device to which appliance will be connected, A	Size of bonding conductor, AWG (mm^2)[a]	
	Copper wire	Aluminum wire
15	14 (2.1)	12 (3.3)
20	12 (3.3)	10 (5.3)
30	10 (5.3)	8 (8.4)
40	10 (5.3)	8 (8.4)
60	10 (5.3)	8 (8.4)

[a] Or equivalent cross-sectional area.

Table 6
Duration of overcurrent test

(See Clauses 22.2.11 and 22.2.12.)

Rating or setting of branch-circuit overcurrent-protective device, A	Test time, min
≤ 30	4
> 30 ≤ 60	6
> 60 ≤ 100	8
> 100 ≤ 200	10

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Table 7
Minimum spacings

(See Clauses 24.1.1, 24.1.3, 24.1.5, 26.4.1, 26.7.1, 26.8.1, 26.9.1, and 26.13.1.)

Spacing involved	Spacings, mm			
	≤ 300 V		> 300 ≤ 600 V	
	Through air	Over surface	Through air	Over surface
a) At field wiring terminals[a] between current-carrying parts				
1) of opposite polarity and between current-carrying parts and non-current-carrying metal parts other than the enclosure	6.3	9.5	9.5	12.5
2) and the enclosure	12.5	12.5	12.5	12.5
b) At points other than field wiring terminals and closed-in points between current-carrying parts				
1) of opposite polarity and between current-carrying parts and non-current-carrying metal parts other than enclosures	1.6	1.6	6.3	6.3
2) and the enclosure	6.3	6.3	12.5	12.5
c) At closed-in points, such as screw-and- washer construction of an insulated terminal mounted in metal between current-carrying parts and non-current-carrying metal parts	1.6	1.6	2.4	2.4

[a] These spacings do not apply to connecting straps or buses extending away from wiring terminals. Such spacings are investigated under the requirements of (b) of this Table.

Table 8
Polymeric materials test summary

(See Clause 26.1.3.)

Test No.	Test
1	Long-term exposure tests, Clause 26.2.
2	Immersion test No. 1 (1 000 h, dilute solution), Clause 26.3.
3	Immersion test No. 2 (1 000 h, 100% solution), Clause 26.3.
4	Immersion test No. 3 (168 h, dilute solution), Clause 26.3.
5	Mould stress-relief test (7 h), Clause 26.4.
6	Horizontal burning rate test, Clause 26.5.
7	Flammability test, Clause 26.6.
8	6.8 J impact test (ambient and low temperature), Clause 26.7.
9	Static load test (890 N), Clause 26.8.
10	56.7 J impact test, Clause 26.9.
11	Thermal cycling test, Clause 26.10.
12	Hot-wire-ignition test, Clause 26.11.
13	Thermal ageing test, Clause 26.12.
14	Volume resistivity test, Clause 26.13.
15	Enclosure flammability - large mass consideration, Clause 26.14.
16	Abnormal operation test on enclosures, Clause 26.15.
17	Abnormal operation test on functional polymeric parts, Clause 26.16.
18	Abnormal operation test on parts wetted only during an abnormal condition, Clause 26.17.
19	High-current arc-ignition test, Clause 26.18.

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Table 9
Tests on a polymeric part

(See Clause 26.1.3.)

Group[a]	Description	Applicable test number[b]
1	A decorative or nonfunctional part	6, 15[c]
2	A functional polymeric part subjected to a temperature of not more than 65°C and not subjected to impact	5, 6, 15[c], 17
3	A functional polymeric part subjected to a temperature of not more than 65°C and subjected to impact	5, 6, 8, 9[e], 10[e], 15[c], 17
4	A functional polymeric part subjected to a temperature of more than 65°C and not subjected to impact	5, 6, 13[i], 15[c], 17
5	A functional polymeric part subjected to a temperature of more than 65°C and subjected to impact	5, 6, 8, 9[e], 10[e], 13[i], 15[c], 17
6	A part serving as an enclosure or supplementary enclosure and subjected to a temperature of not more than 65°C	5, 7[f,h], 8, 9[e], 10[e], 12, 15[c], 16
7	A part serving as an enclosure or supplementary enclosure and subjected to a temperature of more than 65°C	5, 7[f,h], 8, 9[e], 10[e], 12, 13[i], 15[c]
8	A part spaced less than the distances specified in Clause 26.1.4 (b and c) [j]	14, 19[g]

[a] If a polymeric part falls into more than one test group, separate samples shall be subjected to the tests required for each group.

[b] These requirements do not fully cover a plated plastic part if loss of bond strength between the plastic substrate and the metal coating could result in a reduction of electrical spacings, reduction in mechanical strength, or reduction in resistance to flammability. A plated plastic part shall be the subject of a separate investigation.

[c] These tests do not apply to an appliance readily movable from one place to another.

[d] This test shall be conducted only on an external part having a dimension greater than 1.83 m or a projected surface area greater than 0.93 m^2

[e] This test may be waived for a console.

[f] An enclosure provided with a liner of vulcanized fibre, metal foil, or other material intended to reduce the flammability of the enclosure shall be tested with the liner in place, and the flame shall be applied to the liner.

[g] Additional consideration shall be given to an appliance protected by an overcurrent device rated more than 30 A.

[h] Wash-water tubs need only comply with Test No. 6 if the material for the lid complies with Test No. 7. A lid need only comply with Test No. 6 if the material of the wash-water tub complies with Test No. 7.

[i] Material used within its temperature index based on historical data or a long-term thermal ageing programme need not be subjected to Test No. 13.

[j] See also 26.1.4.

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Table 10
Additional tests on a polymeric part subjected to wash-water, wash-water vapour, concentrated detergent, or other solutions

(See Clauses 26.1.3 and 26.3.1.)

Group[a]	Description	Applicable test number[b,c]
A	A part that serves as a wash-water tub	1
B[d]	A part that serves as a wash-water carrier, hose fitting, sump, pump drain valve, diverter valve, or the like	2, 11
C	A part, such as a dispenser, subjected to concentrated detergents or other solutions	3, 11
D	A part subjected to casual splashing of water or vapour or a part subjected to wash water or vapour during intended operating conditions	4
E	A part subjected to wetting only during an abnormal condition, such as flooding or oversudsing	19

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Table 10 Continued

Group[a]	Description	Applicable test number[b,c]
[a] If a polymeric part falls into more than one test group, a separate sample shall be subjected to the test required for each group. [b] These requirements do not fully cover a plated plastic part if loss of bond strength between the plastic substrate and the metal coating may result in a reduction of electrical spacings, reduction in mechanical strength, or reduction in resistance to flammability. A plated plastic part shall be the subject of a separate investigation. [c] A complete assembly, consisting of the part to be evaluated and associated fittings, could be required to be tested to evaluate resistance to liquid leakage. [d] Tests for this group may be omitted if the long-term exposure test, Clause 26.2, is conducted.		

Table 11
Temperatures for oven conditioning

(See Clause 26.12.2.)

Maximum operating temperature of polymeric enclosure part, °C	Oven temperature, °C
> 65 ≤ 75	85
> 75 ≤ 85	95
> 85 ≤ 95	105
> 95	[a]
[a] A polymeric part subjected to a temperature higher than 95°C shall have a temperature index, based on historical data or a long-term thermal ageing program, that indicates its acceptability for use at the temperature involved. This part shall be the subject of a separate investigation.	

Table 12
Production line test conditions

(See Clauses 27.3.2 and 27.3.5.)

Appliance rating, V	Condition A			Condition B		
	Potential, V		Time, s	Potential, V		Time, s
	AC	DC		AC	DC	
≤ 250	1 000	1400	60	1200	1700	1
> 250 ≤ 600	1 000 + 2V	1400 + 2.8V	60	1200 + 2.4V	1700 + 3.4V	1
V = maximum marked voltage.						

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Table 13
Material property

(See Clause 26.1.4.)

Material property (units)	Flame rating of material			
	V-0	V-1	V-2	HB
HAI (arcs)	≥15	≥30	≥30	≥60
(PLC)[a]	(3)	(2)	(2)	(1)
HWI (seconds)	≥7	≥15	≥30	≥30
(PLC)[a]	(4)	(3)	(2)	2
[a]PLC is the performance level category in accordance with UL 746A.				

Table 14
Maximum rating or setting of overcurrent-protective device

(See Clause 19.7.9.)

Type of motor	Maximum ampere rating of device as a percentage of motor full-load current rating
Motor with marked service factor of 1.15 or more, or with marked temperature rise of 40°C or less[a]	125
Any other motor	115
[a]Motor manufacturer's applied marking	

Table 15
Operating control correlation table

(See Clauses 19.12.2.3 and 19.12.7.4.)

Information	Operating control requirement
FMEA	Conduct a failure-mode and effect analysis (FMEA) to identify components the failure of which may result in a risk of fire or electric shock.
Operating ambient	Determined via heating test, Clause 9, of the appliance
Endurance testing	Except as indicated in Clause 19.12.7.4: a) 100 000 cycles for automatic, self-resetting operating controls, and b) 6 000 cycles for manual, non-self-resetting operating controls
Overvoltage Category	Overvoltage Category II
Pollution degree	See Clause 24.2.4

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Table 16
Protective control correlation table

(See Clauses 19.12.3.4, 19.12.3.7 and 19.12.7.4.)

Information	Protective control requirement
FMEA	Conduct a failure-mode and effect analysis (FMEA) identifying component failures which may result in a risk of fire, electric shock, or injury and confirming the protective function continues to operate as intended.
Operating ambient	Determined via heating test, Clause 9, of the appliance
Endurance testing (for electromechanical devices)	a) 6 000 cycles for controls as indicated in Clauses 19.12.5.3, 15.7.9, 19.12.6.4, 19.12.7.4 and b) 100 000 cycles, for temperature controls and other protective controls
Overvoltage category	Overvoltage Category II
Pollution degree	See Clause 24.2.4
Radio-frequency electromagnetic field immunity to conducted disturbances	Test Level 3
Radio-frequency electromagnetic field immunity to radiated electromagnetic fields	Field strength of 3 V/m
Fast transient bursts	Test Level 3 applied for 1 minute in each polarity
Surge immunity	Installation Class 3
Electrostatic discharge	Severity Level 3
Thermal cycling (for electronic devices)	14 days, Assumed temperature range: 10.0 +2 °C to the operating ambient
Software class	Software Class B (See Clause 19.12.3.4)

Table 17
Supplementary overcurrent protective device current rating

(See Clause 19.9.4.)

Maximum supplementary overcurrent protective device rating	Minimum cord conductor size rating		Minimum internal conductor size	
A	AWG	(mm2)	AWG	(mm2)
10	18	(0.82)	18[a]	(0.82)
13	16	(1.3)	18[a]	(0.82)
15	14	(2.1)	14	(2.1)
18	14	(2.1)	12	(3.3)
20	12	(3.3)	12	(3.3)

[a] Rated 90°C or 6 A maximum.

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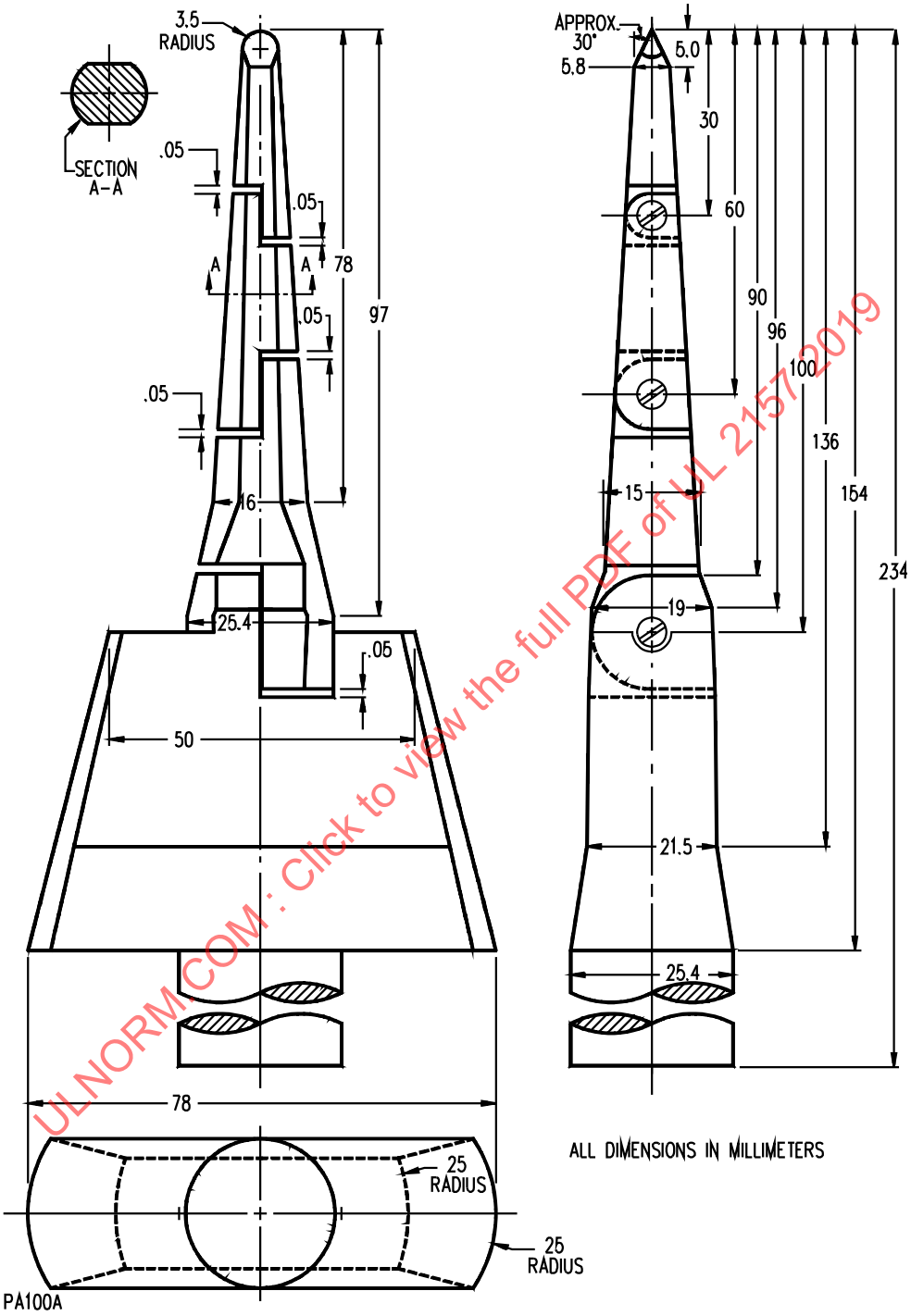
Figure 1
Articulated probe with web stop

(See Clauses 6.1, 6.3, 15.8.4 and 26.6.1.3.)



Dimensions in mm

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Figure 2
Probe for film-coated wire

(See Clauses 6.2 and 6.3.)

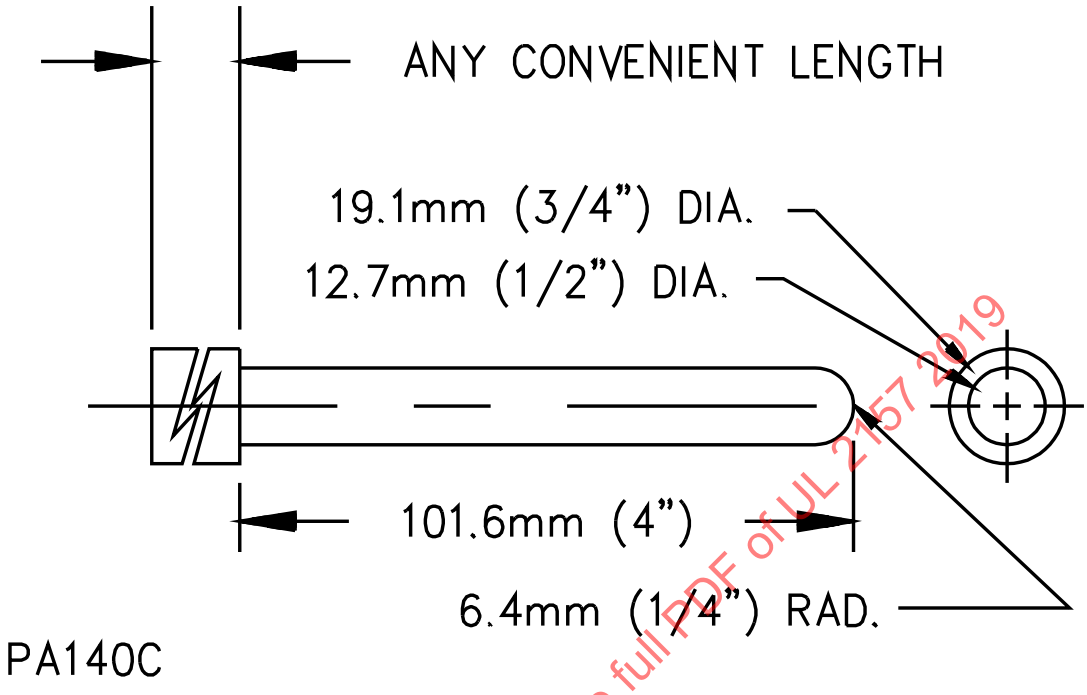

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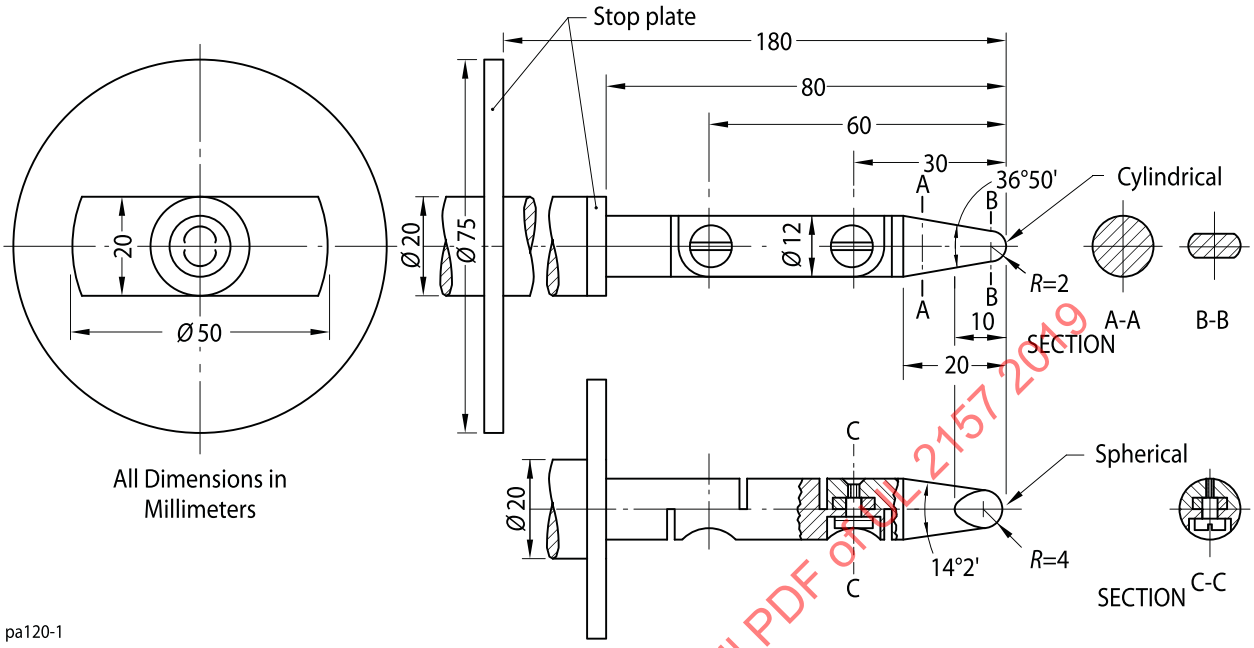
Figure 3
IEC accessibility probe with stop plate

(See Clauses 6.2 and 6.3.)



Dimensions in mm

Material: metal, except where otherwise specified

Linear: dimensions in mm

Tolerances on dimensions without specific tolerance:

on angles: 0/-10'

on linear dimensions:

up to 25 mm: 0/0,05

over 25 mm: ± 0,2

Both joints shall permit movement in the same plane and the same direction through an angle of 90° with a 0 to + 10° tolerance.

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Figure 4
Probe for uninsulated current-carrying parts

(See Clauses 6.2 and 6.3.)

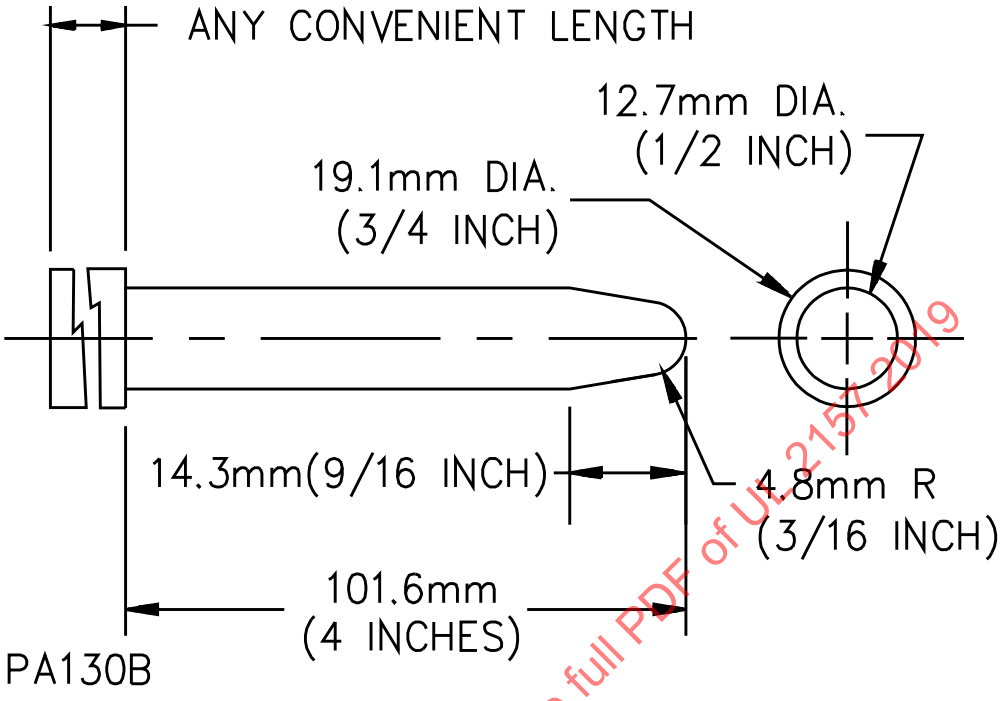

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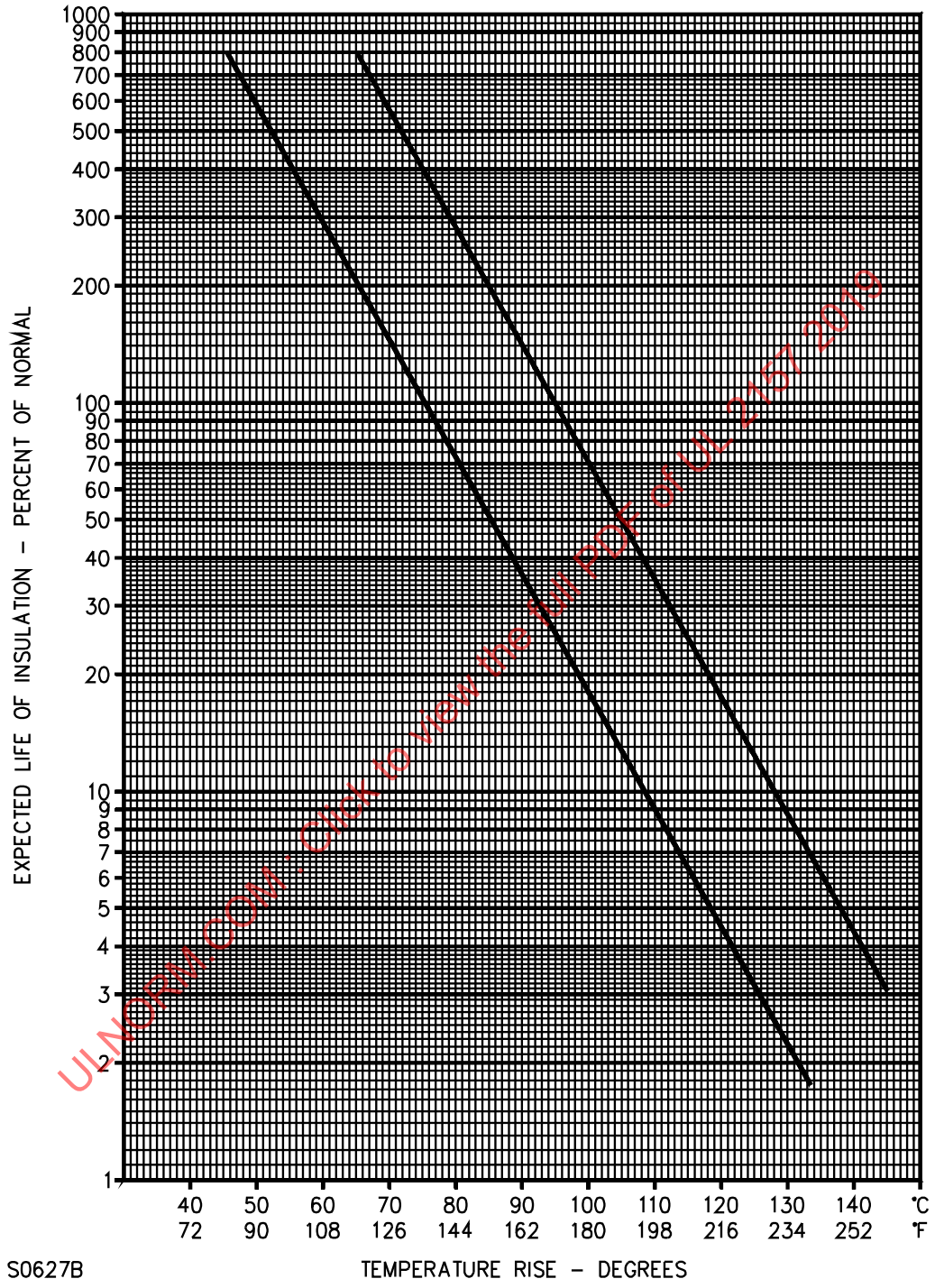
Figure 5
Expected life of insulation vs temperature rise

(See Clause 9.1.7.)



Note: The line on the left represents Class A insulation systems. The line on the right represents Class B insulation systems.

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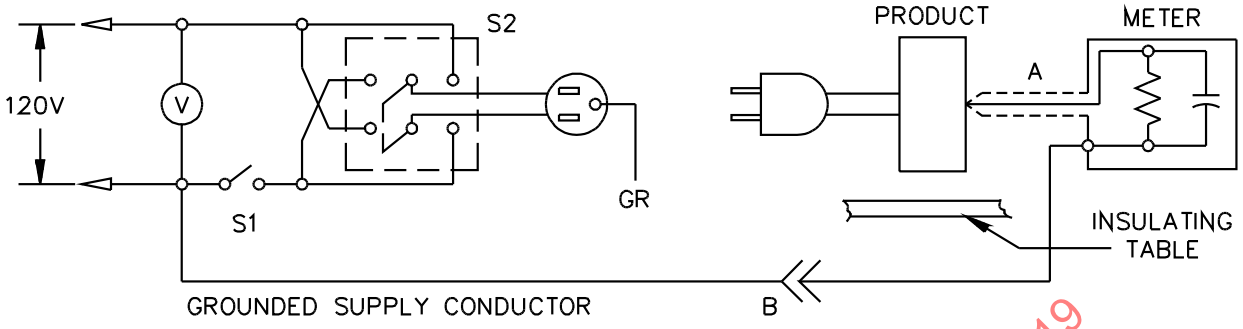
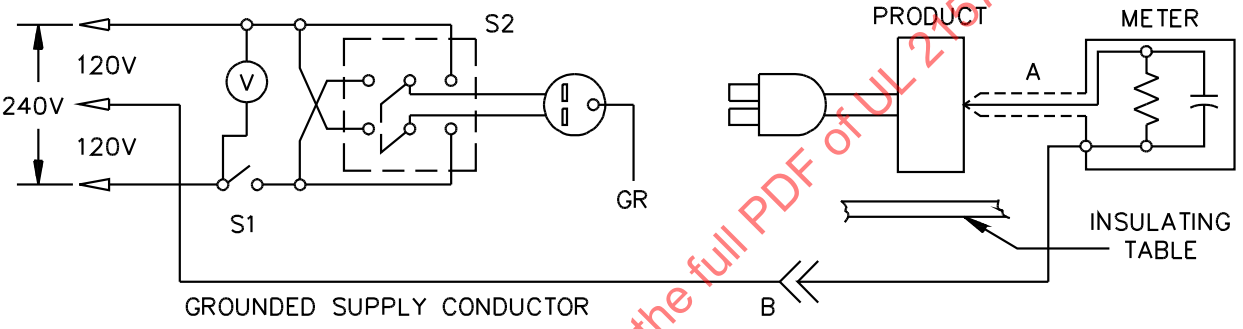
Figure 6
Leakage current measurement circuits

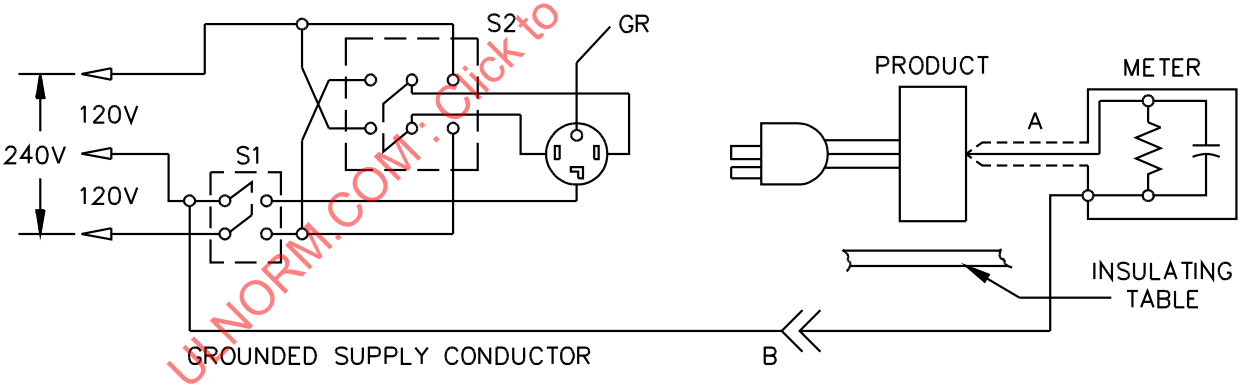
(See Clauses 10.4 and 10.6.)



Product intended for connection to a 120–volt power supply, as illustrated above.



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.

LC300J

A Probe with shielded lead.

B Separated and used as clip when measuring currents from one part of appliance to another.

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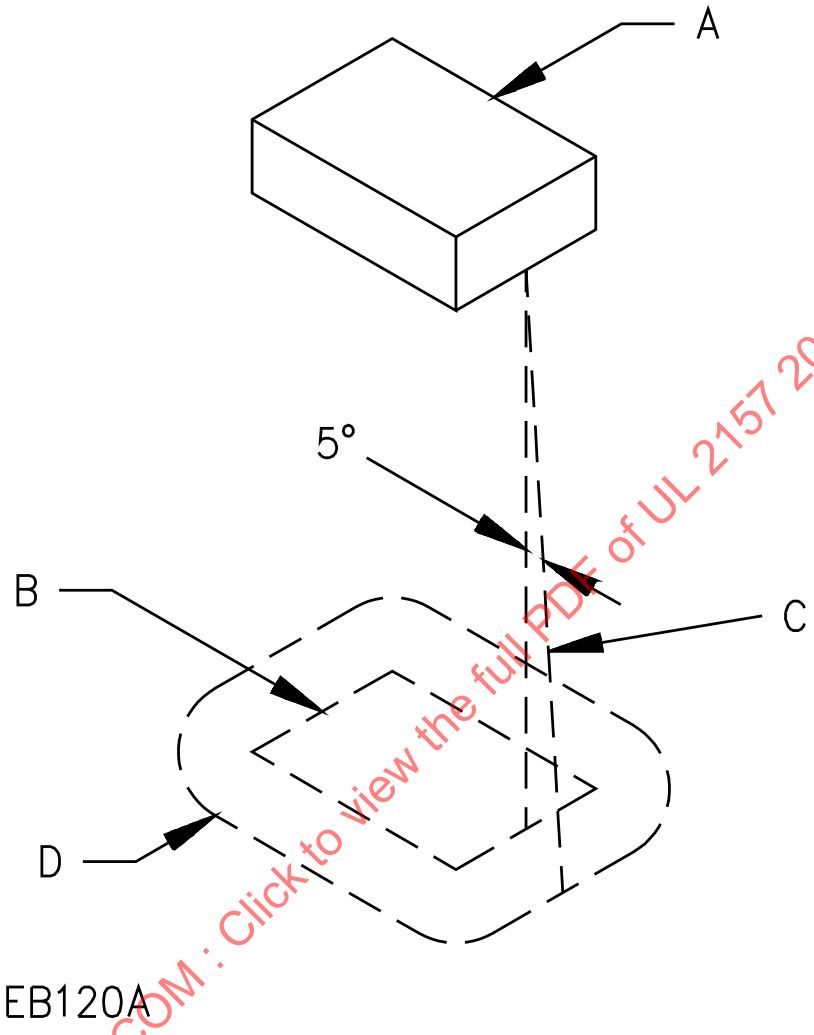
Figure 7
Location and extent of barrier

(See Clause 17.5.5.)



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A Region to be shielded by barrier. This will consist of the entire component if it is not otherwise shielded, and will consist of the unshielded portion of a component that is partially shielded by the component enclosure or equivalent.

B Projection of outline of component on horizontal plane.

C Inclined line that traces out minimum area of barrier. When moving, the line is always

1) tangent to the component;

2) 5° from the vertical; and

3) so oriented that the area traced out on a horizontal plane is maximum.

D Location (horizontal) and minimum area for barrier. The area is that included inside the line of intersection traced out by the inclined line C and the horizontal plane of the barrier.

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Figure 8
Grounding symbol
(See Clause 5.1.2.22.)

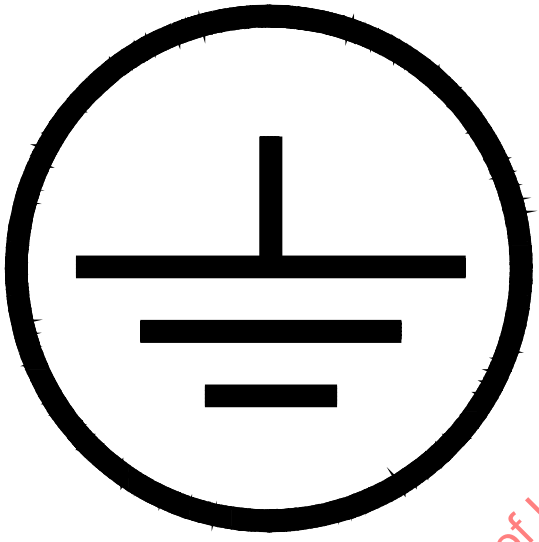

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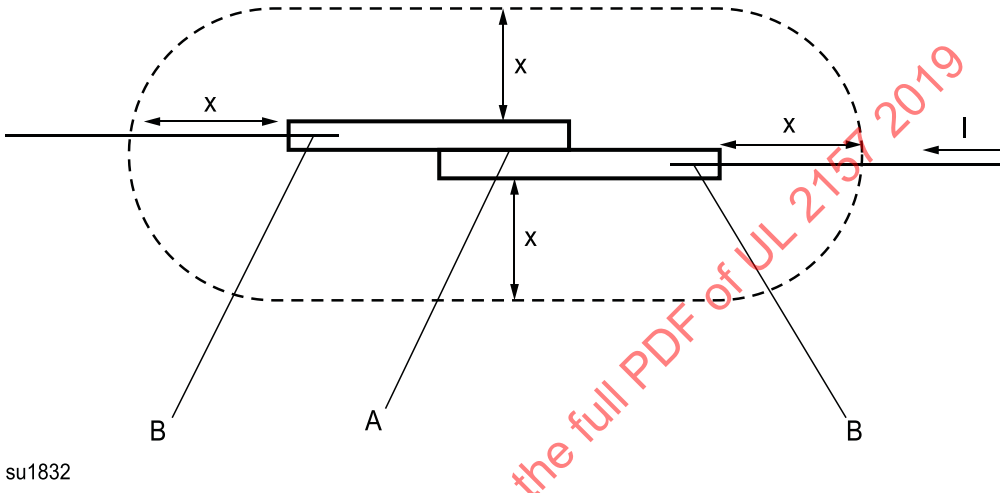
Figure 9
Definition of within 3 mm of an electrical connection
(See Clauses 26.6.3.4, 26.6.3.5 and Figure 11.)



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Note: Within 3 mm of an electrical connection means falling within the dotted boundary formed by the flame cylinder with hemispherical ends, as shown in the above drawing.

A Terminal connection zone

B Wire crimp connection zone

I Current through the connection

X Distance from the connection

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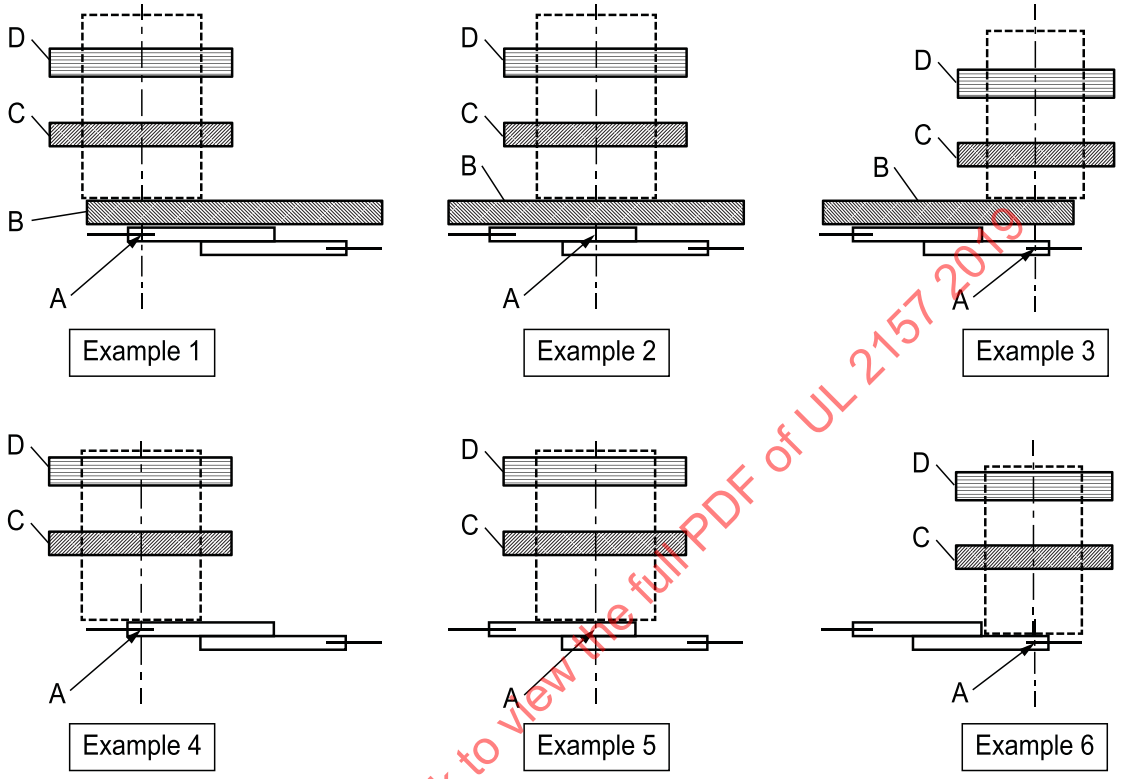
Figure 10
Placement of flame cylinder

(See Clauses 26.6.3.6 and 26.6.3.7.)



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A Center of connection zone

B Non-metallic material supporting current carrying connection

C Metallic or non-metallic material

D Metallic or non-metallic material

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Figure 11
Flammability of polymeric materials in connectors

(See Clause 26.6.3.)

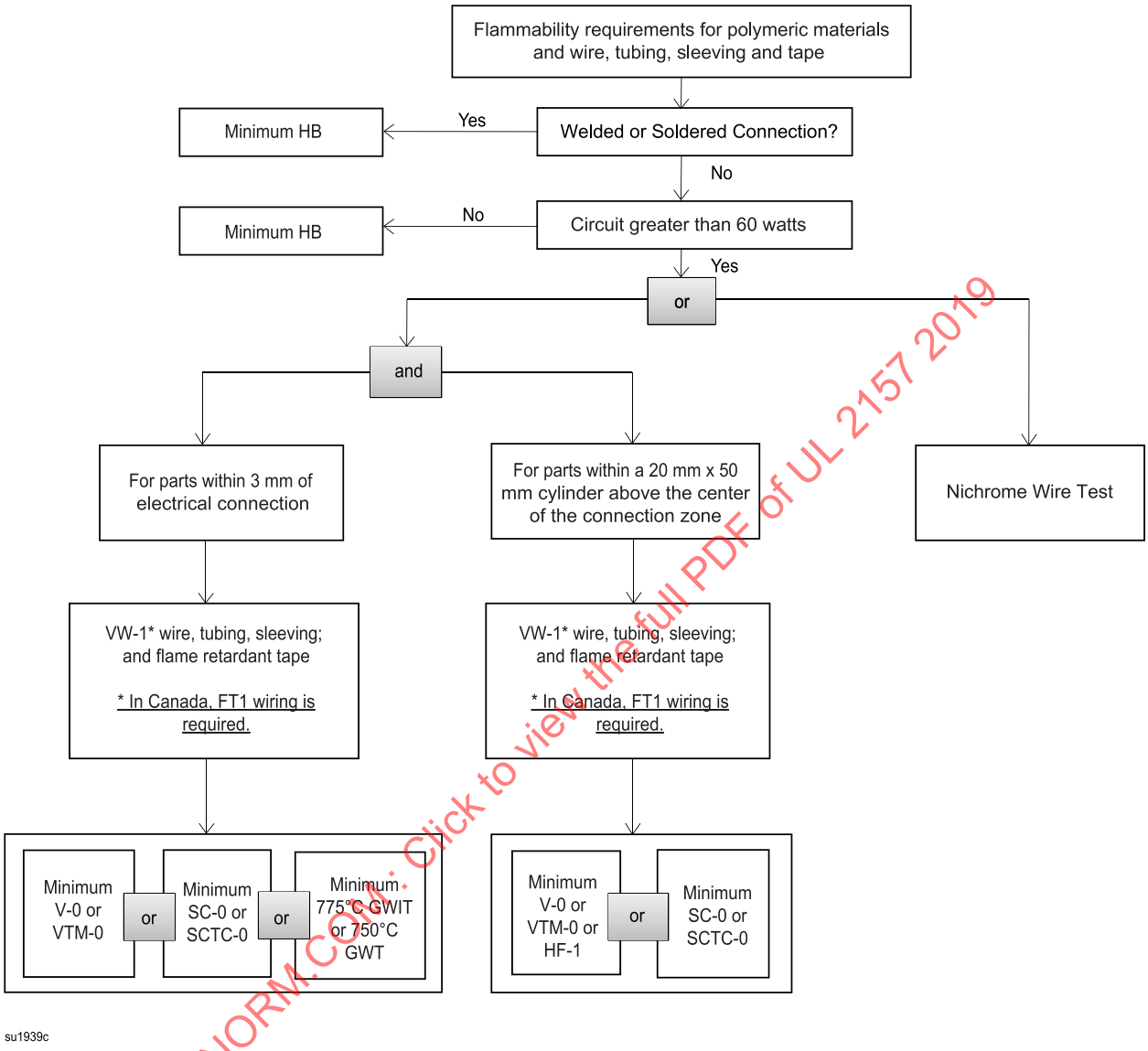

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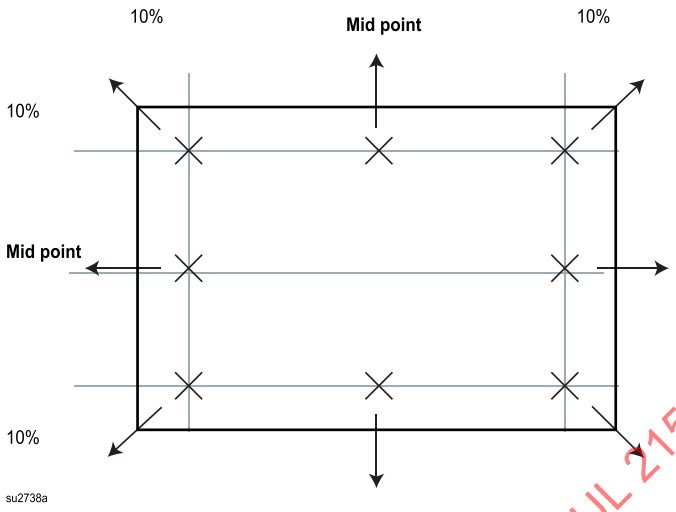
Figure 12
View of appliance top (Spill locations and direction of spills)

(See Clause 14.6.2.)

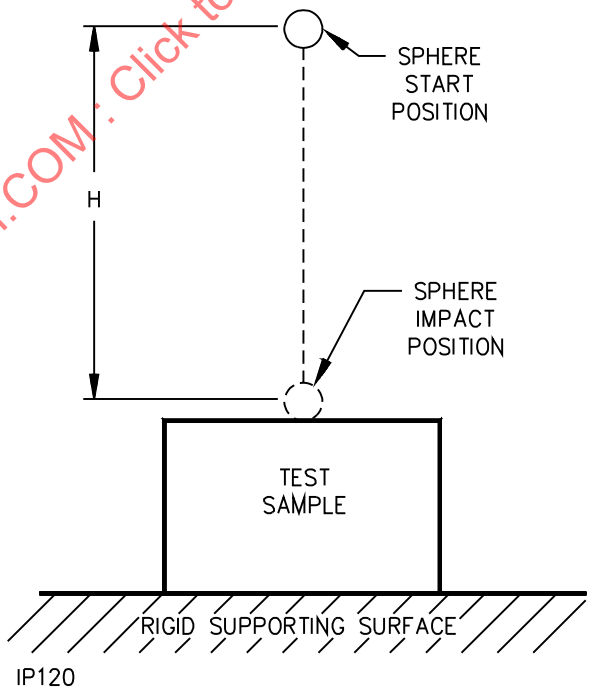


X denotes spill location.

Arrows denote spill direction.

Figure 13
Ball impact test

(See Clause 26.7.3.)



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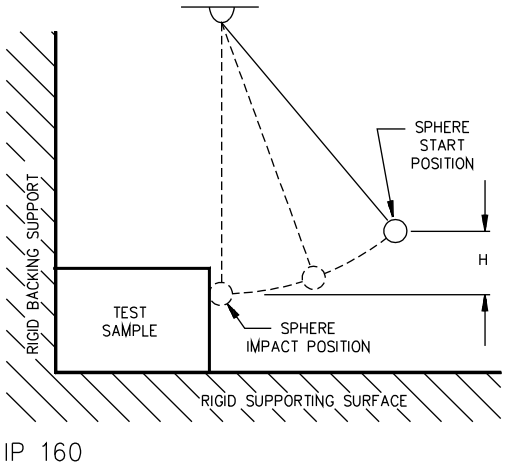

Note 1: H in Figure 13 indicates the vertical distance the sphere must travel to produce the desired impact.

Note 2: For the ball-pendulum impact test the sphere shall contact the test sample when the string is in the vertical position as shown.

Note 3: The backing surface shall consist of 19 mm plywood over a rigid surface of concrete. An equivalent non-resilient backing surface may be used.

Figure 14
Procedures for impact tests (Each series consists of one ball impact on each sample as applicable)

(See Clause 26.7.3.)

Series Number	Sample Number											
	1	2	3	1	2	3	1	2	3	1	2	3
1	A	N	N	A	N	N	A	N	N	A	N	N
2	A	N	N	A	N	N	U	A	N	U	A	N
3	A	N	N	U	A	N		A	N		U	A

Arrows indicate sequence of test procedure

A – Acceptable results from drop

U – Unacceptable results from drop

N – No test necessary

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SUPPLEMENT SA - OZONE GENERATING WASHING MACHINES

SA1 Scope

SA1.1 The requirements outlined in this Supplement shall be applied to washing machines generating ozone during normal operation. These requirements are applied in addition to the requirements specified in this Standard.

SA1.2 An appliance shall not produce a concentration of ozone exceeding 0.050 parts per million by volume when tested as described in this Supplement. A transitory concentration in excess of 0.050 ppm but less than 0.100 ppm is acceptable if the average of any five consecutive 1 min average measurements is less than 0.050 parts per million.

SA2 Ozone Test

SA2.1 Chamber specifications

SA2.1.1 The test shall be performed in a room having a volume of 26.9 - 31.1 m^3 with a minimum side dimension of 2.4 m and a maximum height dimension of 3.0 m without openings. The test chamber walls, ceiling, and floor shall be surface treated (polished) stainless steel or other nonporous and non-reactive material equivalent to stainless steel.

SA2.1.2 The air tightness of the chamber shall be evaluated using ASTM D6670 at 10 Pa static conditions. To be considered air tight the chamber shall have an air exchange rate of 0.03 ACH as determined using either the fan pressurization or tracer gas methods.

SA2.1.3 During the test, the test room shall be maintained at a temperature of 25 ± 2°C and a relative humidity of 50 ± 5 percent. Prior to the start of this test, the ozone background level shall be measured with the appliance off. The background level shall be subtracted from the maximum measurement during the test.

SA2.1.4 The appliance shall be located in the center of the test room floor.

SA2.1.5 The ozone concentration shall be measured using a single ozone monitor sampling tube positioned with the sample tube opening located 50 mm from where the detergent drawer is inserted, or where the detergent lid is opened. The detergent drawer shall be removed or the detergent compartment lid shall be open during this test.

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SA2.2 Equipment specifications

SA2.2.1 The ozone analyzer shall be able to record and/or report data on 0.001 ppmv increments, and shall have an accuracy of ±0.010 ppmv or better.

SA2.3 Test conditions

SA2.3.1 A new appliance shall be loaded with test cloths as specified in Clause 4.3 to the minimum load (1.36 kg) in accordance with the 10 CFR 430, Appendix J2 to Subpart B Uniform Test Method for Measuring the Energy Consumption of Automatic and Semi-Automatic Clothes Washers, Table 5.1, Test Load Sizes.

SA2.3.2 A household automatic washing machine and commercial washing machine shall be operated without detergent for four successive operations of the appliance through the complete washing cycle(s) that gives the highest ozone output.

SA2.3.3 A 4 min interval shall be allowed between successive cycles to represent unloading and reloading of the clothes load. During this off period, the test cloth load shall not be changed, but the door or lid shall be opened within 10 s of the completion of the cycle to the maximum extent allowed by the construction and closed immediately before starting the next cycle. If the appliance is provided with a door or lid lock in accordance with Clause SA6, the door or lid shall be opened immediately after the lock is disengaged.

SA2.3.4 Water shall be supplied to the appliance in accordance with Clause 9.7 or 9.9.

SA2.3.5 The outlet of the hose from the drain pump shall be 900 mm above the floor on which the appliance rests and shall be routed out of the test chamber.

SA2.3.6 If the washing machine is operable with the detergent dispenser removed or opened, the test shall be repeated with the detergent dispenser opened or removed as permitted by the construction of the washing machine.

SA2.3.7 If the maximum ozone concentration in the test chamber is dependent upon the functioning of a control, the washer will be subjected to the ozone emission test with and without this control function defeated, unless this control function has been evaluated as a protective control as specified in Clause 19.12.3.

Note: For example, if the ozone generator operation time is limited by the control, the test will be repeated with this control function defeated to cause continuous operation of the ozone generator.

SA2.3.8 If the ozone generating device is provided with a filter which is replaceable or removable without the use of a tool, the test shall be repeated with the filter removed.

SA3 Markings and Instructions

SA3.1 The Important Safety Instructions outlined in Clause 5.2.2 shall include the following, or equivalent:

″This appliance produces ozone within the washing compartment during normal operation. Long-term exposure to ozone or exposure at elevated levels may result in respiratory problems, especially for the infirmed, elderly, and children.″

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