UL 2158

STANDARD FOR SAFETY

Electric Clothes Dryers

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UL Standard for Safety for Electric Clothes Dryers, UL 2158

Sixth Edition, Dated July 30, 2021

Summary of Topics

This Sixth Edition of ANSI/UL 2158, Standard for Electric Clothes Dryers dated July 30, 2021 includes the addition of requirements for entrapment, stability test and anti-tip devices, heating test and surface temperature, dryers provided with a water inlet valve, UL 510A insulting tape, acoustic insulation and heat pump clothes dryers and motor controls for commercial appliances. This edition also includes the clarifications and revisions to risk of fire definition, thermocouples, mean value of input current, change-of-resistance method, leakage current, cool down period, base fire containment test, nichrome wire test, protective controls, metal enclosure thickness, cord-connected appliance requirements, airflow for base fire containment and endurance cycles for control devices.

The requirements are substantially in accordance with Proposal(s) on this subject dated October 16, 2020 and April 16, 2021.

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CSA Group
CSA C22.2 No. 112:21
Twelfth Edition

Underwriters Laboratories Inc.
UL 2158
Sixth Edition

Electric Clothes Dryers

July 30, 2021

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Approved American National Standard

ANSI/UL 2158-2021

Commitment for Amendments

This standard is issued jointly by the Canadian Standards Association (operating as "CSA Group") and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to CSA Group or UL at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of CSA Group and UL. CSA Group and UL will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue.

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This ANSI/UL Standard for Safety consists of the Sixth Edition.

The most recent designation of ANSI/UL 2158 as an American National Standard (ANSI) occurred on July 30, 2021. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

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

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PREFACE

This is the harmonized CSA Group and UL Standard for Electric Clothes Dryers. It is the twelfth edition of CSA C22.2 No. 112 and the sixth edition of UL 2158. This edition of CSA C22.2 No. 112 supersedes the previous edition published in 2018. This edition of UL 2158 supersedes the previous edition published in 2018.

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

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

This Standard was reviewed by the CSA Subcommittee on Clothes-Drying Machines, 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.

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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 dryers 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.

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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Electric Clothes Dryers

1 Scope

1.1 This Standard applies to electric clothes dryers intended to be used in nonhazardous locations in accordance with CSA C22.1, *Canadian Electrical Code, Part I* (CE Code, Part I) 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 dryer" 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 households and for commercial purposes, including appliances provided with coin-, ticket-, or card-operated mechanisms, laundry centers and combination washer-dryers.

1.3 This Standard applies to tumbling clothes dryers and non-tumbling clothes dryers, such as drying cabinets, as well as both vented clothes dryers and non-vented clothes dryers, such as condensation-type and heat pump clothes dryers. Additional requirements for heat pump clothes dryers are given in Supplement SD.

1.4 This Standard does not apply to industrial and institutional type appliances. Industrial or institutional appliances are covered under the scope of *Electric Commercial Clothes-Drying Equipment,* UL 1240.

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

2 Normative References

2.1 Products covered by this Standard shall comply with the referenced installation codes and standards noted in this clause.

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

CSA Group Standards

C22.1-21
Canadian Electrical Code, Part I

C22.2 No. 0:20
General Requirements – Canadian Electrical Code, Part II

C22.2 No. 0.1:19
General Requirements for Double-Insulated Equipment

C22.2 No. 0.2:16
Insulation Coordination

CAN/CSA-C22.2 No. 0.4-17
Bonding of Electrical Equipment

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C22.2 No. 0.5-16
Threaded Conduit Entries

C22.2 No. 0.8:19
Safety Functions Incorporating Electronic Technology

C22.2 No. 0.15-15 (R2020)
Adhesive Labels

CAN/CSA-C22.2 No. 0.17-00 (R2018)
Evaluation of Properties of Polymeric Materials

C22.2 No. 8-13 (R2018)
Electromagnetic Interference (EMI) Filters

C22.2 No. 250.4:20
Portable Luminiares

C22.2 No. 14-18
Industrial Control Equipment

C22.2 No. 18.1-13 (R2018)
Metallic Outlet Boxes

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

C22.2 No. 18.3-12 (R2017)
Conduit, Tubing, and Cable Fittings

C22.2 No. 18.5-13 (R2018)
Positioning Devices

C22.2 No. 21-18
Cord Sets and Power-Supply Cords

C22.2 No. 24-15 (R2019)
Temperature-Indicating and -Regulating Equipment

C22.2 No. 38-18
Thermoset-Insulated Wires and Cables

C22.2 No. 39-13 (R2017)
Fuseholder Assemblies

C22.2 No. 42-10 (R2020)
General Use Receptacles, Attachment Plugs, and Similar Wiring Devices

C22.2 No. 42.1-13 (R2017)
Cover Plates for Flush-Mounted Wiring Devices

C22.2 No. 43-17
Lampholders

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CAN/CSA-C22.2 No. 49-18
Flexible Cords and Cables

C22.2 No. 55-15 (R2020)
Special Use Switches

CAN/C22.2 No. 65-18
Wire Connectors

C22.2 No. 66.1-06 (R2015)
Low-voltage Transformers – Part 1: General Requirements

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 (R2019)
Heater Elements

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

C22.2 No. 75-17
Thermoplastic Insulated Wires and Cables

C22.2 No. 77-14 (R2019)
Motors with Inherent Overheating Protection

C22.2 No. 94.1-15
Enclosures for Electrical Equipment, Non-Environmental Considerations

C22.2 No. 100-14 (R2019)
Motors and Generators

C22.2 No. 108-14 (R2019)
Liquid Pumps

C22.2 No. 111-18
General-Use Snap Switches

C22.2 No. 127-18
Equipment and Lead Wires

C22.2 No. 139:19
Electrically Operated Valves

C22.2 No. 140.2-96 (R2016)
Hermetic Refrigerant Motor-Compressors

C22.2 No. 153-14 (R2019)
Electrical Quick-Connect Terminals

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C22.2 No. 156-M1987 (R2018)
Solid-State Speed Controls

C22.2 No. 158-10 (R2019)
Terminal Blocks

C22.2 No. 169-18
Electric Clothes Washing Machines and Extractors

C22.2 No. 177-13 (R2018)
Clock-Operated Switches

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

C22.2 No. 188-18
Splicing Wire Connectors

C22.2 No. 190-14 (R2019)
Capacitors for Power Factor Correction

C22.2 No. 197-M1983 (R2018)
PVC Insulating Tape

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

CAN/CSA-C22.2 No. 198.3-05 (R2019)
Coated Electrical Sleeving

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 (R2017)
Supplementary Protectors

C22.2 No. 236-15
Heating and Cooling Equipment

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

C22.2 No. 250.13:20
Light Emitting Diode (LED) Equipment for Lighting Applications

C22.2 No. 2459-08 (R2017)
Insulated Multi-Pole Splicing Wire Connectors

C22.2 No. 2556-15
Wire and Cable Test Methods

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CAN/CSA-C22.2 No. 4248.1-17
Fuseholders – Part 1: General Requirements

CAN/CSA-C22.2 No. 60335-1:16
Safety of Household and Similar Appliances – Part 1: General Requirements

CAN/CSA-C22.2 No. 60335-2-34:17
Safety of Household and Similar Electrical Appliances – Part 2-34: Particular Requirements for Motor-compressors

CAN/CSA-C22.2 No. 60065:16
Audio, Video and Similar Electronic Apparatus – Safety Requirements

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

CAN/CSA-C22.2 No. 61058-1:17
Switches for appliances – Part 1: General requirements

CAN/CSA-C361-16
Energy Performance and Drum Volume of Household Electric Clothes Dryers

CAN/CSA-E60384-14:14 (R2018)
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 (R2018)
Fixed Capacitors for Use in Electronic Equipment – Part 1: Generic Specification

CAN/CSA-E60730-1:15
Automatic Electrical Controls – Part 1: General Requirements

CAN/CSA-E730-2-7-94 (R2018)
Automatic Electrical Controls for Household and Similar Use – Part 2: Particular Requirements for Timers and Time Switches

CAN/CSA-E60730-2-8:17
Automatic Electrical Controls for Household and Similar Use – Part 2-8: Particular Requirements for Electrically Operated Water Valves, Including Mechanical Requirements

CAN/CSA-E60730-2-9:18
Automatic Electrical Controls for Household and Similar Use – Part 2-9: Particular Requirements for Temperature Sensing Controls

CSA Component Acceptance Notice 5A
Announcement of Extension of the Component Acceptance Service for Optocouplers and Related Devices

CSA C22.2 No. 62368-1:19
Audio/video, information and communication technology equipment – Part 1: Safety requirements – Third Edition

B64.1.1-11 (R2016)
Atmospheric Vacuum Breakers (AVB)

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UL Standards

UL 20
General-Use Snap Switches

UL 44
Thermoset-Insulated Wires and Cables

UL 62
Flexible Cords and Cables

UL 66
Fixture Wire

UL 83
Thermoplastic-Insulated Wires and Cables

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UL 510
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UL 758
Standard for Appliance Wiring Material

UL 778
Standard for Motor-Operated Water Pumps

UL 810
Capacitors

UL 817
Standard for Cord Sets and Power-Supply Cords

UL 840
Insulation Coordination Including Clearances and Creepages Distances for Electrical Equipment

UL 873
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Standard for Power Units Other Than Class 2

UL 1029
Standard for High-Intensity-Discharge Lamp Ballasts

UL 1030
Standard for Sheathed Heating Elements

UL 1054
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UL 1059
Standard for Terminal Blocks

UL 1077
Standard for Supplementary Protectors for Use in Electrical Equipment

UL 1097
Double Insulation Systems for Use in Electrical Equipment

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Class 2 Power Units

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Thermistor-Type Devices

UL 1411

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Standard for Transformers and Motor Transformers for Use in Audio-, Radio-, and Television-Type Appliances

UL 1441
Coated Electrical Sleeving

UL 1446
Standard for Systems of Insulating Materials – General

UL 1565
Positioning Devices

UL 1577
Optical Isolators

UL 1581
Reference Standard for Electrical Wires, Cables, and Flexible Cords

UL 1694
Tests for Flammability of Small Polymeric Component Materials

UL 1977
Standard for Component Connectors for Use in Data, Signal, Control and Power Applications

UL 1995
Heating and Cooling Equipment

UL 1998
Software in Programmable Components

UL 2157
Electric Clothes Washing Machines and Extractors

UL 2158A
Clothes Dryer Transition Duct

UL 2353
Standard for Safety for Single- and Multi-Layer Insulated Winding Wire

UL 2459
Insulated Multi-Pole Splicing Wire Connectors

UL 4200A
Standard for Safety for Products Incorporating Button or Coin Cell Batteries of Lithium Technologies

UL 4248-1
Fuseholders – Part 1: General Requirements

UL 5085-1
Low-Voltage Transformers – Part 1: General Requirements

UL 5085-2
Low-Voltage Transformers – Part 2: General Purpose Transformers

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UL 5085-3
Low-Voltage Transformers – Part 3: Class 2 and Class 3 Transformers

UL 8750
Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products

UL 60065
Audio, Video and Similar Electronic Apparatus – Safety Requirements

UL 60335-1
Safety of Household and Similar Appliances – Part 1: General Requirements

UL 60335-2-34
Safety of Household and Similar Electrical Appliances, Part 2-34: Particular Requirements for Motor-Compressors

UL 60384-14
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UL 60691
Thermal-Links – Requirements and Application Guide

UL 60730-1
Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements

UL 60730-2-7
Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches

UL 60730-2-8
Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Electrically Operated Water Valves, Including Mechanical Requirements

UL 60730-2-9
Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Temperature Sensing Controls

UL 60950-1
Information Technology Equipment – Safety – Part 1: General Requirements

UL 60939-1
Passive Filter Units for Electomagnetic Interference Suppression – Part 3: Passive Filter Units for Which Safety Tests are Appropriate

UL 61058-1
Switches for Appliances – Part 1: General Requirements

UL 61800-5-1
Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy

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UL 62368-1
Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements

ASSE (American Society of Sanitary Engineering) Standards

ASSE 1001
Performance Requirements for Atmospheric Type Vacuum Breakers

ASTM International Standards

ASTM B344
Standard Specification for Drawn or Rolled Nickel-Chromium and Nickel-Chromium-Iron Alloys for Electrical Heating Elements

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

ASTM B603
Standard Specification for Drawn or Rolled Iron-Chromium-Aluminum Alloys for Electrical Heating Elements

ASTM D5025
Standard Specification for Laboratory Burner Used for Small-Scale Burning Tests on Plastic Materials

Government of USA

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

Appendix D to Subpart B of Part 430, Uniform Test Method for Measuring the Energy Consumption of Clothes Dryers

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

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

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

IEC 61000-4-2-08
Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test

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IEC 61000-4-3-10
Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test

IEC 61000-4-4-12
Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test

IEC 61000-4-5-14
Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test

IEC 61000-4-6-15
Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields

IEC 61000-4-11-10
Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests

IEC 61000-4-13-09
Electromagnetic compatibility (EMC) – Part 4-13: Testing and measurement techniques – Harmonics and interharmonics including mains signalling at a.c. power port, low frequency immunity tests

NFPA (National Fire Protection Association) Standards

NFPA 70
National Electrical Code

ULC (Underwriters Laboratories of Canada) Standards

CAN/ULC-S102-10
Test for Surface Burning Characteristics of Building Materials and Assemblies

3 Definitions

3.1 For the purpose of this Standard, the following definitions apply.

3.2 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.

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

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

3.5 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.

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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.

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

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

3.8 AUTOMATIC – an appliance is considered to be automatically controlled if one or more of the following condition 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 can be intentionally delayed beyond normal, conventional starting; or

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

3.9 BAFFLE – a paddle inside the drum that lifts and tumbles clothes.

3.10 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 can serve as a portion of an enclosure and as a functional part.

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

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

a) a primary battery having an output 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.

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

3.14 COMBINATION WASHER-DRYER – A machine utilized to wash and dry clothes within the same compartment.

3.15 CONTROL, OPERATING – Control, the operation of which starts or regulates the appliance during normal operation.

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3.16 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.

3.17 COOL DOWN PERIOD – Final part of the tumble dryer cycle where the drum is continuously rotated with reduced power to the heating element and with air circulation in order to reduce the possibility of spontaneous combustion of the clothes load.

Note: Continuous rotation does not mean rotation in same direction if the intended operation is to reverse direction in normal use.

3.18 CURRENT CARRYING PARTS – Parts carrying current during normal or abnormal operation in line voltage circuits.

Note: With respect to separation of circuits, Clause 20.3, this term refers to parts in both low-voltage and line-voltage circuits.

3.19 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.

3.20 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).

3.21 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 7.2(a)(1) or (2).

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

3.22 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 7.2(a)(1) or (2);

when enclosure barriers, if provided, are removed.

A polymeric supplementary enclosure shall be evaluated as an enclosure.

3.23 FIELD WIRING TERMINAL – A terminal to which a wire can 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;

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c) a soldered loop; or

d) a crimped eyelet;

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

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

3.25 HEATER ASSEMBLY – An assembly of

a) a heating element;

b) electrical insulation (e.g., refractory, mica, magnesium oxide); and

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

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

3.27 LAUNDRY CENTER – A machine utilized to wash and dry clothes in separate compartments.

3.28 LIVE PART – Conductor or conductive part intended to be energized in normal use, including a neutral conductor.

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

3.30 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 5V flame test in CAN/CSA-C22.2 No. 0.17 and the 127 mm flame test in UL 746C.

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

3.32 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.

3.33 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.

3.34 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 are supplied from an isolating source:

a) 30 V rms;

b) 42.4 V peak for sinusoidal or nonsinusoidal AC;

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

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

Note: A LOW-VOLTAGE CIRCUIT and the secondary circuit of a Class 2 circuit do not involve a risk of electric shock.

3.35 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 W can be delivered into an external variable resistor connected between the two points at the end of 5 seconds under normal conditions and single component fault conditions; see Clauses 28.4.7 and SB14.

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

3.36 COMBINATION TEMPERATURE-REGULATING AND LIMITING DEVICE – 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.

3.37 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.

3.38 TEMPERATURE-REGULATING DEVICE – A device that:

a) regulates temperature; and

b) functions during normal operation of the appliance.

3.39 TUMBLE DRYER – An appliance in which textile material is dried by tumbling in a rotating drum through which heated air is blown or drawn.

3.40 TUMBLE DRYER, VENTED TYPE – A tumble dryer in which the heated air is then exhausted from the appliance.

3.41 TUMBLE DRYER, CONDENSATION TYPE – A tumble dryer in which the air used for the drying process is dehumidified by cooling.

3.42 WITHIN 3 MM – Falling within the dotted boundary formed by the flame cylinder with hemispherical ends, as shown in Figure 10.

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

4 General Requirements

4.1 Combination washer-dryers and laundry centers shall comply with this Standard and also with the requirements of the Binational Standard CSA C22.2 No. 169 and UL 2157. Where more than one Standard applies, preference shall be given to that Standard considered to require the highest standard of construction or testing.

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

4.3 In Canada, the general requirements applicable to this Standard are given in the latest version of CSA C22.2 No. 0.

5 General Conditions for the Tests

5.1 Voltage and frequency

5.1.1 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 (V_s) 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).

5.1.2 The test voltage (V_t) used during the heating tests of Clause 10 and the abnormal operation tests of Clause 16 shall be adjusted so that the calculated (see formula below) heating circuit input (W_t) is achieved. This compensates for heating elements with inputs at V_s (see Clause 5.1.1) that are different than their rated (marked) inputs.

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

in which:

W_t is the calculated heating circuit input in, *W*;

W_m is the heating element rated (marked) input in, *W*;

V_s is the supply circuit voltage specified in Clause 5.1.1; and

V_m is the heating element rated (marked) input in, *V*.

5.1.3 If it is necessary to increase the appliance test voltage beyond the voltage as specified in Clause 5.1.1, the motor shall be supplied from a separate circuit not exceeding the nominal system voltage (e.g., 120 V, 240 V).

5.2 Test load

5.2.1 Unless otherwise specified, the test load shall consist of cloths as described in Clause 5.3 and shall:

a) be soaked in water, which shall be extracted as it would be in normal use just before the cloths are placed in the appliance; or

b) be wet until they have absorbed a mass of water equal to the dry mass of the cloths.

5.2.2 The dry mass of the test cloths shall be the greater of:

a) the maximum load recommended by the manufacturer; or

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b) 0.032 kg/L of clothes-drum volume. The clothes-drum volume shall be determined by a measurement or calculation method. Whenever a referee method is necessary to determine clothes-drum volume, the measurement shall be made in accordance with the method described in CAN/CSA-C361 or Paragraph 3.1 of Appendix D to Subpart B of 10 CFR 430.

5.3 Test fabric

5.3.1 The fabric used for tests shall be bleached, preshrunk cotton suiting, having a warp of 21 – 23 threads per cm and a filling of 18 – 20 threads per cm. 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.

5.4 Thermocouples

5.4.1 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 the ANSI/ASTM E230/E230M.

5.5 Laundry detergent

5.5.1 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.

5.6 Cheesecloth for heating and abnormal tests

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

5.7 Test temperature

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

6 Marking and Instructions

6.1 Marking

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 French 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.*

6.1.1 General

6.1.1.1 A marking that is required to be permanent shall be moulded, die-stamped, paint-stenciled, 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 CSA-C22.2 No. 0.15 and UL 969.

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

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6.1.1.3 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.

6.1.1.4 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.

6.1.2 Appliance markings

6.1.2.1 An appliance shall be rated in volts and in amperes or watts. 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).

6.1.2.2 An appliance shall be provided with a schematic circuit diagram, attached or secured to the appliance in a location that is easily accessible for servicing, such as the back panel, the toe panel, the location of the wiring terminals, the console, or the control housing.

6.1.2.3 An appliance, as mentioned in Clause 8.2, 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".

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

6.1.2.5 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.

6.1.2.6 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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6.1.2.7 Clothes dryers employing supply terminals intended for use with supply conductors rated above 60°C shall be marked on the exterior adjacent to the supply entry with the following or equivalent wording:

"USE SUPPLY CONDUCTORS RATED___°C (___°F)."

The marking shall include both °C and °F. The temperature rating of the conductors used in the heating test (Clause 10) shall be placed in the marking.

6.1.2.8 An appliance shall be clearly and permanently marked with a warning that the appliance is intended for use only with fabrics that have been washed with water as a cleaning agent.

6.1.2.9 A warning consisting of the following shall be included in the permanent marking on an appliance:

a) for an appliance that includes a no-heat setting in its controls:

"WARNING – To reduce the risk of fire, do not use heat when drying articles containing foam rubber or similarly textured rubber-like materials";

or the marking given in (b).

b) for any other appliance:

"WARNING – To reduce the risk of fire, do not dry articles containing foam rubber or similarly textured rubber-like materials."

6.1.2.10 An appliance that provides means for collection of dust and lint accumulation shall be plainly and permanently marked to indicate the necessity of keeping the lint trap cleaned out.

6.1.2.11 The markings mentioned in Clauses 6.1.2.8 to 6.1.2.10 shall be separated from other markings to reduce the likelihood of their being overlooked.

6.1.2.12 An appliance shall be permanently marked:

a) at or near the exhaust opening of the appliance with the word "CAUTION" and the following statement or the equivalent: "Risk of Fire. A clothes dryer produces combustible lint. The dryer must be connected to an exhaust to the outdoors. See Installation Instructions"; and

b) on a surface readily visible to the user after installation of the appliance with the word "CAUTION" and the following statement or the equivalent: "Risk of Fire. A clothes dryer produces combustible lint. The dryer must be connected to an exhaust to the outdoors. Regularly inspect the outdoor exhaust opening and remove any accumulation of lint around the outdoor exhaust opening and in the surrounding area."

6.1.2.13 The requirements in Clause 6.1.2.12 do not apply to condensation type tumble dryers.

6.1.2.14 For a vented laundry center or vented combination washer-dryer, the words "A clothes dryer," where used in Clause 6.1.2.12, shall be changed to "The dryer operation of a laundry center (or combination washer-dryer)."

In the markings, where the words "clothes dryer" appear more than once, the word "appliance" may be substituted for the subsequent use of the words "clothes dryer."

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6.1.2.15 If an appliance employs a non-current-carrying metal part that is not grounded as provided in Clause 24.1.5, 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: _____." (A list of ungrounded parts shall be inserted.)

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.

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

6.1.2.17 An appliance provided with instructions for any type of user maintenance other than cleaning a lint trap 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 other than cleaning the lint trap. 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.

Note: An appliance not equipped with a lint trap may omit the reference to a lint trap in the required marking.

6.1.2.18 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, trade name, 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.

6.1.2.19 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.

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6.1.2.20 A stationary appliance employing an attachment plug in accordance with Clause 22.3.6 shall be marked in the installation instructions, markings, or by a hang tag or equivalent: "Connect to Individual Branch Circuit."

6.1.2.21 A cord-connected appliance shall be clearly and permanently marked in a location that will be visible after the appliance has been installed as intended. The marking shall include a statement indicating the size of the branch circuit to which the appliance is intended to be connected and the maximum ampere rating of the overcurrent-protective device to be used in that branch circuit. (See Clause 9.)

Note: A marking on the back of the appliance is acceptable.

6.1.2.22 With reference to Clause 9.3, 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 percent 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.

6.1.2.23 An appliance that does not comply with Clause 19.5.7 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."

6.1.2.24 The following marking shall appear on all 120/208 V household clothes dryers:

"WARNING: DO NOT USE ON 120/240 V SUPPLY."

The marking shall be located adjacent to the supply entry and shall be in contrasting letters not less than 6 mm high.

6.1.2.25 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.

6.1.2.26 If an appliance can be readily adapted, upon installation, for connection to a supply circuit of either of two different voltages, complete instructions, including identification of terminals, for making the connections for the different voltages shall be included in the permanent marking of the appliance.

6.1.2.27 If an appliance is for use either on a 120 V, 2-wire circuit or on a 120/240 V, 3-wire circuit, depending on the connections to be made when the appliance is installed, there shall be a warning marking on the appliance stating that non-current-carrying metal parts are not to be connected to the grounded terminal when the appliance is used on the lower-voltage circuit.

6.1.2.28 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 6.1.2.29; 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 6.1.2.30.

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6.1.2.29 With reference to the requirement in Clause 6.1.2.28(a), the minimum supply-circuit conductor ampacity shall be based on the maximum input in accordance with Clause 9.

6.1.2.30 With reference to the requirement in Clause 6.1.2.28(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 21.8.2.

6.1.2.31 An appliance intended for permanent connection shall be marked to indicate the wiring system or systems for which it is acceptable. The marking shall be located so that it will be visible when power-supply connections to the appliance are being made.

Note: An appliance intended for permanent connection to a rigid metal conduit or armoured cable wiring system need not be marked.

6.1.2.32 An appliance constructed in accordance with Clause 22.2.8 shall be marked, in a location visible during connection to the supply circuit, with the word "WARNING" and the following statement:

"To reduce the risk of electric shock or fire, do not use a flexible power-supply cord with this appliance."

6.1.2.33 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".

6.1.2.34 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.

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

6.1.2.36 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 clothes washer 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.

6.1.2.37 An appliance provided with a securing means or requires a leveling adjustment that is used to comply with Clause 17.2.3 shall be provided with a marking located where visible during installation stating that the installation is not complete until the appliance is secured to the structure with the securing means provided or adjusted as required, and that the installation instructions are to be referred to for proper installation.

6.1.3 Dryers with neutral-link grounding

Note: The CE Code, Part I, does not permit the use of neutral-link grounding on products intended to be installed in Canada.

6.1.3.1 If a neutral-grounding link as described in Clause 24.2 is provided, instructions for the proper use of the link, which may be in the form of a circuit diagram, shall be provided on the appliance. If an appliance is for use either on a 120 V, 2-wire circuit or on a 120/240 V, 3-wire circuit, depending on the connections to be made when the appliance is installed, there shall be a warning marking on the appliance

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stating that non-current-carrying metal parts are not to be connected to the grounded terminal when the appliance is used on the lower voltage circuit.

6.1.3.2 An appliance intended for permanent connection to the power supply, and for which the connection between the grounding link and the grounded terminal is made at the factory in accordance with the requirements in Clause 24.2, shall be legibly marked at a location visible during installation of the appliance with the word "WARNING" and the following statement or the equivalent:

"Risk of Electric Shock: Appliance grounded to neutral conductor through a link. Grounding through the neutral conductor is prohibited for (1) new branch-circuit installations, (2) mobile homes, (3) recreational vehicles, and (4) areas where local codes prohibit grounding through the neutral conductor. For installations where grounding through the neutral conductor is prohibited: (1) disconnect the link from the neutral, (2) use grounding terminal or lead to ground appliance, and (3) connect neutral terminal or lead to branch-circuit neutral in usual manner (where the appliance is to be connected by means of a cord kit use 4-conductor cord for this purpose)."

6.1.3.3 An appliance intended to be connected to the power supply by a flexible cord and attachment plug, and for which the connection between the grounding link and the grounding terminal is made at the factory in accordance with the requirements of Clause 24.2, shall be legibly marked at a location visible during installation of the appliance with the word "WARNING" and the following or equivalent:

"Risk of Electric Shock: Appliance grounded to neutral conductor through a link. Grounding through the neutral conductor is prohibited for (1) new branch-circuit installations, (2) mobile homes, (3) recreational vehicles, and (4) areas where local codes prohibit grounding through the neutral conductor. For installations where grounding through the neutral conductor is prohibited, the 3-conductor cord or cable assembly must be replaced by a 4-conductor cord or cable assembly. See manufacturer's instructions."

(See also Clause 6.2.3.6.)

6.1.4 Wall-mounting kits and stands

6.1.4.1 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.

6.1.4.2 The catalogue number mentioned in Clause 6.1.4.1 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.

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6.1.5 Heat pump clothes dryers

6.1.5.1 For condensation-type and heat pump clothes dryers where the sharp edges of the condenser or evaporator coil fins are accessible during normal user maintenance in accordance with Clause 17.5.2, shall be legibly marked at a location visible before accessing the sharp edges with the word "WARNING" and the following statement or the equivalent:

“Sharp Edges – To reduce the risk of injury, use care when cleaning the condenser or evaporator coil fins.”

6.2 Instruction manual

6.2.1 General

6.2.1.1 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 in accordance with Clause 6.2.2;

b) installation instructions in accordance with Clause 6.2.3;

c) operating instructions in accordance with Clause 6.2.4; and, if applicable

d) user-maintenance instructions in accordance with Clause 6.2.5.

6.2.1.2 The instructions required by Clause 6.2.1.1 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.

6.2.1.3 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 6.2.1.1(a) and Clause 6.2.2; 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 6.2.3 and 6.2.4.

6.2.1.4 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 6.2.1.1 shall also be included within the electronic media instructions.

6.2.1.5 The printed instructions material referenced in Clause 6.2.1.3 shall contain detailed instructions of how to obtain a printed copy of the material contained in electronic format.

6.2.1.6 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 can be present during the repair and after the repair has been completed.

6.2.1.7 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.

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6.2.1.8 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 appropriate.

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

6.2.2.1 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.

6.2.2.2 The heading "IMPORTANT SAFETY INSTRUCTIONS" or the equivalent shall precede the list of instructions required in Clause 6.2.2.4, and the statement "SAVE THESE INSTRUCTIONS" or the equivalent shall either precede or follow the list (see Clause 6.2.1.7).

6.2.2.3 The instructions shall include the appropriate instructions from Clauses 6.2.2.4 and 6.2.2.5.

6.2.2.4 The instructions required by Clause 6.2.2.1 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 6.2.1.7).

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.

2) Do not dry 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) Risk of Suffocation and Injury from Entrapment: Do not allow children to play on or in the appliance. Close supervision of children is necessary when the appliance is used near children.

4) Before the appliance is removed from service or discarded, remove the door to the drying compartment.

5) Do not reach into the appliance if the drum is moving.

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

7) Do not tamper with controls.

8) 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.

9) Do not use fabric softeners or products to eliminate static unless recommended by the manufacturer of the fabric softener or product.

10) Do not use heat to dry articles containing foam rubber or similarly textured rubber-like materials.

11) Clean lint screen before or after each load.

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12) Keep area around the exhaust opening and adjacent surrounding areas free from the accumulation of lint, dust, and dirt.

13) The interior of the appliance and exhaust duct should be cleaned periodically by qualified service personnel.

14) Do not place items exposed to cooking oils in your dryer. Items contaminated with cooking oils may contribute to a chemical reaction that could cause a load to catch fire. To reduce the risk of fire due to contaminated loads, the final part of a tumble dryer cycle occurs without heat (cool down period). Avoid stopping a tumble dryer before the end of the drying cycle unless all items are quickly removed and spread out so that the heat is dissipated.

15) Do not use replacement parts that have not been recommended by the manufacturer (e.g. parts made at home using a 3D printer).

SAVE THESE INSTRUCTIONS

6.2.2.5 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 6.2.2.4. (See Clause 6.2.1.7.)

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 service representative or personnel 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 double-insulated appliance must be identical to those parts being replaced. A double-insulated appliance is marked

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with the words "DOUBLE INSULATION" or "DOUBLE INSULATED". The double-insulation symbol (a square within a square) may also be marked on the appliance.

6.2.2.6 For a heat pump clothes dryer where sharp edges of the condenser or evaporator coil fins are accessible during normal user maintenance in accordance with Clause 17.5.2, the instructions pertaining to a risk of fire, electric shock, or injury to persons shall include the following or details shall be provided in the user maintenance instructions and a reference to those instructions shall be included as a separate item in the list required by Clause 6.2.2.4.

“Sharp Edges – To reduce the risk of injury, use care when cleaning the condenser or evaporator coil fins.”

6.2.3 Installation instructions

6.2.3.1 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 (see Clause 6.2.1.7).

6.2.3.2 The cover or first page of the installation instructions shall include the following wording or the equivalent:

"Install the clothes dryer according to the manufacturer's instructions and local codes."

6.2.3.3 The cover or first page of the installation instructions, for vented type tumble dryers, shall include:

a) the safety alert symbol (triangle with exclamation mark);

b) the word "WARNING" in black letters not less than 6.4 mm high on an orange or white background; and

c) the following wording or equivalent:

"WARNING – Risk of Fire"

"Clothes dryer installation must be performed by a qualified installer."

"Do not install a clothes dryer with flexible plastic venting materials. If flexible metal (foil type) duct is installed, it must be of a specific type identified by the appliance manufacturer as suitable for use with clothes dryers. Flexible venting materials are known to collapse, be easily crushed, and trap lint. These conditions will obstruct clothes dryer airflow and increase the risk of fire."

"To reduce the risk of severe injury or death, follow all installation instructions."

"Save these instructions."

6.2.3.4 The installation instructions for vented type tumble dryers shall also include statements concerning how the appliance is to be exhausted. The instructions shall state:

a) that the appliance shall not be exhausted into a chimney, a wall, a ceiling, an attic, a crawl space, or a concealed space of a building;

b) that only rigid or flexible metal duct shall be used for exhausting;

c) in Canada, that only those foil-type flexible ducts, if any, specifically identified for use with the appliance by the manufacturer shall be used. In the United States, that only those foil-type flexible ducts, if any, specifically identified for use with the appliance by the manufacturer and that comply with the UL 2158A, shall be used;

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d) in Canada, that the exhaust duct shall be 102 mm in diameter. In the United States, the required exhaust duct diameter;

e) the maximum duct length and number of bends;

f) that the total length of flexible metal duct shall not exceed 2.4 m; and

g) that the duct shall not be assembled with screws or other fastening means that extend into the duct and catch lint.

Note: Exhausting refers to removal of moist air from the drying compartment to the environment through an opening in the appliance housing.

6.2.3.5 Where the appliance installation instructions indicate that the appliance is not restricted from being connected by means of a power-supply cord kit, the instructions shall indicate that only a power-supply cord kit rated _____ V min, _____ A, and marked for use with clothes dryers shall be used. The specified ampere rating for the cord shall be 30, 40, or 50 A as applicable. The instructions shall also specify:

a) the number of conductors (3 or 4);

b) the type of terminations (tinned leads, closed-loop terminals, open-end spade lugs with upturned ends, or the like) that the cord kit is to employ; and

c) that only a 4-conductor cord shall be used when the appliance is installed in a location where grounding through the neutral conductor is prohibited. Grounding through the neutral conductor is prohibited for (1) new branch-circuit installations, (2) mobile homes, (3) recreational vehicles, and (4) areas where local codes prohibit grounding through the neutral conductors.

6.2.3.6 The installation instructions for an appliance that is marked with the warning specified in Clause 6.1.3.3 shall include explicit instructions for changing from a 3-conductor cord or cable assembly to a 4-conductor cord or cable assembly when the appliance is to be used in a location where grounding through the neutral conductor is prohibited. Grounding through the neutral conductor is prohibited for (1) new branch-circuit installations, (2) mobile homes, and (3) recreational vehicles, and (4) areas where local codes prohibit grounding through the neutral conductor. The instructions shall specify the:

a) size of the conductors and the type of cord or cable to be used;

b) size and the configuration of attachment plug to be used; and

c) means of strain relief to be used.

With regard to cord replacement, and except as specified in Clause 6.2.3.7, the instructions shall:

1) indicate that only a 4-conductor power-supply cord kit rated _____ V min, _____ A, and marked for use with clothes dryers shall be used; and

2) specify the type of terminations (tinned leads, closed-loop terminals, open-end spade lugs with upturned ends, or similar terminations) that the cord kit is to employ.

The specified ampere rating for the cord shall be 30, 40, or 50 A as applicable.

6.2.3.7 For an appliance equipped with a factory-connected flexible cord that leaves the appliance enclosure through an opening that is not sized in accordance with Clause 22.3.8, the cord replacement instructions specified in Clause 6.2.3.5 shall identify the specific cord kit that is to be used. The identification shall include a part number or the name of the cord-kit manufacturer and a distinctive catalogue number.

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6.2.3.8 The installation instruction for 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.

6.2.3.9 The installation instructions for a Clothes Dryer that is intended to be connected to an individual exhaust duct system and to be exhausted outdoors shall include the following statements or equivalent:

"WARNING: Risk of Fire. Do not install a booster fan in the exhaust duct.

Note: The booster fan warning does not apply to clothes dryers intended to be installed in a multiple clothes dryer system, with an engineered exhaust duct system that is installed per the clothes dryer manufacturer's guidelines."

6.2.3.10 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 24.1.4 shall include the following or 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: ____." A list of ungrounded parts shall be inserted.

6.2.3.11 The installation instructions of an appliance that does not comply with Clause 19.5.7 shall include the following or equivalent:

"To reduce the risk of fire, this appliance must be fastened or otherwise secured to an uncovered concrete floor."

6.2.3.12 The installation instructions shall include the following or equivalent: "This appliance shall be secured to the structure or adjusted, using the methods for installation and securing means provided with the appliance."

Note: This applies only to dryers requiring securing means to comply with Clause 17.2.3.

6.2.4 Operating instructions

6.2.4.1 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 6.2.1.7).

6.2.4.2 The operating instructions shall:

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

b) 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: The statement in (b) may be omitted if the IMPORTANT SAFETY INSTRUCTIONS required by Clauses 6.2.2.1 through 6.2.2.5 are included in the operating instruction manual immediately prior to the operating instructions.

6.2.5 User-maintenance instructions

6.2.5.1 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.

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6.2.5.2 The user-maintenance instructions shall be preceded by the heading "USER-MAINTENANCE INSTRUCTIONS" or the equivalent (see Clause 6.2.1.7).

6.2.5.3 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 24.1.4 shall include the following or 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: ___."(A list of ungrounded parts shall be inserted.)

6.2.6 Appliance stand and wall-mounting kit instructions

6.2.6.1 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 information so that the kit or stand can be installed as intended.

6.2.6.2 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 6.2.1.7).

7 Protection Against Accessibility to Current-Carrying Parts

7.1 Where an opening in an enclosure has a minor dimension (see Clause 7.5):

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.

7.2 A motor with an integral enclosure that has an opening with a minor dimension (see Clause 7.5):

a) less than 19.1 mm shall be acceptable, if:

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

2) in a directly accessible motor (see Clause 7.6), an uninsulated current-carrying part cannot be contacted by the probe illustrated in Figure 3; and

3) in an indirectly accessible motor (see Clause 7.6), 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.

7.3 The probes referenced in Clauses 7.1 and 7.2 and illustrated in Figure 1, Figure 2, Figure 3, and Figure 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 Figure 1 and Figure 3 shall be applied in any possible configuration and, if necessary, the configuration shall be changed after insertion through the opening.

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7.4 The probes referenced in Clauses 7.1 and 7.2 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.

7.5 With reference to the requirements in Clauses 7.1 and 7.2, 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.

7.6 With reference to the requirements in Clause 7.2:

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.

7.7 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 (e.g., screwdriver) for opening or removal; or

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

7.8 With reference to the requirements in Clauses 7.1 and 7.2, insulated brush caps are not required to be additionally enclosed.

7.9 The requirements in Clauses 7.1 and 7.2 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 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.

7.10 Wire screens, expanded metal mesh, or the like, together with methods of fastening them, shall be the subject of investigation.

8 Starting of Motor-Operated Appliances

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

8.2 For the test in Clause 8.1, 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 6.1.2.3.

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8.3 To determine whether an appliance complies with the requirements in Clause 8.1, the appliance shall be connected to a supply circuit of the rated test voltage and rated frequency through a fuse, of other than the time-delay type, which has a rating equal to the minimum rating of a branch circuit to which the appliance can be properly connected in accordance with the CE Code, Part I and the NEC. If the manufacturer recommends that the appliance be used on a larger branch circuit, the current rating of the fuse or fuses shall be the same as that of the recommended branch circuit.

8.4 The appliance shall be started three times with the control(s) set to that part of the cycle resulting in the highest starting current. 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.

9 Power Input and Current

9.1 The current input shall not be more than 105 percent or less than 90 percent of the marked rating with the appliance connected to a supply circuit of rated voltage and frequency. The appliance shall be loaded with its rated load and the power input measured with the appliance at normal operating temperatures.

Note: If the current varies throughout the operating cycle and the maximum value of the current exceeds, by a factor greater than two, the arithmetic mean value of the current occurring during a cycle, then the current is the maximum value that is exceeded for more than 10 percent of the cycle. Otherwise the current is taken as the arithmetic mean value.

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

9.3 Unless marked in accordance with Clause 6.12.22, 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 percent of the supply-circuit-current rating.

10 Heating

10.1 General

10.1.1 An appliance shall be tested as described in Clauses 10.2.1 to 10.9.5, 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.

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

10.1.3 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.

10.1.4 A temperature is considered to be constant when three successive readings taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 5 minute intervals, indicate no change.

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

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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.

10.1.6 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.

10.1.6.1 When the temperature of a coil or winding is not obtainable using the thermocouple measurement method, (e.g. encapsulated coils) the change-of-resistance method shall be used.

10.1.6.2 When using the change-of-resistance method, a winding shall be at room temperature at the start of the test, and the temperature of a winding shall be calculated using the formula:

$$\Delta t = \frac{R_2 - R_1}{R_1}(k + t_1) - (t_2 - t_2)$$

where

Δt is the temperature rise of the winding;

R_1 is the resistance at the beginning of the test;

R_2 is the resistance at the end of the test;

k is equal to

- 225 for aluminum windings and copper/aluminum windings with an aluminum content ≥ 85 %,
- 229,75 for copper/aluminum windings with an copper content > 15 % to < 85 %,
- 234,5 for copper windings and copper/aluminum windings with an copper content ≥ 85 %;

t_1 is the room temperature at the beginning of the test;

t_2 is the room temperature at the end of the test.

NOTE It is recommended that the resistance of windings at the end of the test be determined by taking resistance measurements as soon as possible after switching off and then at short intervals so that a curve of resistance against time can be plotted for ascertaining the resistance at the instant of switching off.

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10.1.7 An appliance provided with a dedicated receptacle shall be tested as described in Clauses 10.2.1 – 10.9.5 with the receptacle loaded with the intended ampere load during the heating test. A clothes washer may be used for this load, or a simulated load may be used.

10.2 Cord reels

10.2.1 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 centre of the cord reel, the terminal end, and between the outer two layers on the reel.

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10.3 Appliances intended for closet installation

10.3.1 An appliance that is:

a) intended to be installed in a closet; and

b) marked in accordance with Clause 6.1.2.19;

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.

10.4 Wall-insert or recessed appliances

10.4.1 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.

10.5 Appliances other than closet, wall-insert or recessed

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

a) closet (Clause 10.3); or

b) wall or recess (Clause 10.4);

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.

10.6 Household clothes dryer

10.6.1 A household appliance shall be operated through the complete program cycle(s) that give the highest temperature rises. The test shall be conducted for 3 cycles. For the heating test, the drum shall be normally loaded with damp cloths, as described in Clause 5.2, at the beginning of each drying cycle, and operation shall be continued until temperatures have become constant. The interval between cycles shall not be longer than that necessary for removing the dried cloths from the drum and reloading it with damp cloths. If the appliance is provided with a heat-control switch or thermostat-adjustment means, the control shall be adjusted to give maximum temperatures. The lint screen shall have 25 percent of its surface area blocked, in the area representing lint build-up, and the accumulated lint during testing shall be removed between cycles.

10.6.2 A combination washer and clothes dryer shall be tested as specified in Clause 10.6.1, except the test cycles shall be as follows:

a) The number of cycles shall be four cycles for the clothes washer function, and three cycles for the clothes dryer function.

b) The appliance shall be tested beginning with the washing function, then the drying function, and repeated until seven cycles of washing and drying have been completed (e.g. wash, dry, wash, dry, wash, dry, wash) . Test load shall be rearranged after each drying cycle.

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c) If the combination appliance is intended for closet installation, the requirements of Clause 10.3 are applicable.

Note: If agreeable to all parties concerned, the clothes load does not need to be changed to complete the seven cycles of washing and drying.

10.6.3 For appliances provided with a water inlet valve (e.g. condensation-type dryers and clothes dryers provide with a steam option), 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.

10.7 Commercial clothes dryer

10.7.1 A commercial appliance shall be operated continuously through the cycles as specified in Clause 10.6.1 until maximum temperatures have been obtained.

10.8 Drum light

10.8.1 If the appliance employs a drum light that is ON only at the end of a cycle after the door is opened, the test shall be continued after the last cycle with the door open until temperatures affected by the drum light have become constant but for no more than 1 hour. The door shall be opened to the position when the drum light first turns ON.

10.9 Exhaust duct system

10.9.1 Clause 10.9 does not apply to non-vented clothes dryers.

10.9.2 During the heating test, the appliance shall be connected to an exhaust duct system.

10.9.3 The exhaust duct shall be metal and of the same size as the exhaust duct connection on the appliance. The exhaust duct system shall consist of a centre section approximately 3.35 m long, a 90 degree elbow connected to each end of the centre section, and an additional straight section approximately 460 mm long connected to each elbow. These dimensions are not specified, but the total length of the exhaust duct system, not including elbows, shall be the maximum length recommended by the manufacturer or 4.27 m, whichever is longer. One end of the exhaust duct system shall be long enough to pass through the test enclosure and to be connected to the appliance.

10.9.4 A 7.6 mm water column (w.c.) static pressure shall be applied at the outlet of the exhaust duct system during the test. The 7.6 mm w.c. static pressure shall be adjusted at the start of the test to ±0.51 mm w.c.. The w.c. static pressure shall be determined by averaging the measurements taken from four static pressure taps spaced at 90 degree intervals around the circumference of the exhaust duct and located 305 mm from the outlet end of the exhaust duct system.

10.9.5 If the application of a 7.6 mm w.c. static pressure results in abnormal operation of the appliance, such as the functioning of a temperature-limiting control, the test shall be conducted at the maximum w.c. static pressure against which the appliance will continue to operate normally.

10.10 Surface temperatures

10.10.1 An appliance shall be tested as described below and shall not exceed the temperature rises specified in Table 3. A combination clothes washer and clothes dryer shall meet the temperature rise limits while tested in the drying mode.

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10.10.2 All temperature rises in Table 3 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.

10.10.3 The test probe described in Figure 13 shall be applied for 10 seconds to all accessible external surfaces that are relatively flat and that allow access of the tip of the test probe, and shall be used to measure the temperature rises of the surfaces specified in Table 3. The probe shall be applied with a force of 4 N ±1 N to the surface in such a way that the best possible contact between the probe and the surface is ensured.

Note 1: Accessible surfaces includes the front, top, side, and back surfaces; see Note “d” of Table 3.

Note 2: In the case of a portable clothes dryer, the limits apply to all surfaces shown based on the height above the floor.

10.10.4 This test shall be conducted as follows:

a) The test shall be first conducted with the clothes dryer installed per Clause 10.5 for all installations. The front and top surface temperatures shall be measured during this test.

b) A second test with same cycle setting shall then be conducted with the appliance free-standing. The back and side surface temperatures shall be measured during this test.

Note 1: If the installation instructions indicate that the back of the appliance should be placed against a wall, the temperatures on the back surface are not to be measured.

Note 2: When measuring the surface temperatures, surfaces in close proximity to the heating element are likely to be the highest. A thermal indicator method (e.g. thermal imaging, IR thermometer, heat sensitive paper, etc.) may be used as a referee method to identify the hottest surfaces to reduce the number of thermocouple locations and temperature measurements.

10.11 Laundry centers and stacked appliances

10.11.1 An appliance shall be tested to the relevant requirements of Clauses 10.2.1 – 10.9.5. The appliance shall be tested while the other appliance is operating to simulate worse case conditions. For example, a laundry center shall be operated with both the clothes washing and clothes drying function operating simultaneously, unless the design of the laundry center does not allow for simultaneous operation.

Note: As cycle times differ between washers and dryers, the cycles and options of the appliance not under test (the one operating as a heat source) should be selected to generate the highest temperatures and operate for the maximum amount of time. If the heat source appliance stops, before the appliance being tested, it does not have to be restarted.

11 Leakage Current and Insulation Resistance

11.1 Leakage current

11.1.1 An appliance shall comply with leakage current requirements in UL 101 and Clauses 11.1.2 – 11.1.3.

11.1.2 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 can 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 5.1. The test sequence, with reference to the measuring circuit, in Figure 5 and in UL 101, shall be as follows:

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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 10.

11.1.3 For condensate-type clothes dryers, the test sample shall be installed so that all parallel ground paths, such as through the fill and drain lines, will be eliminated.

11.2 Insulation resistance

11.2.1 Following the tests of Clauses 13.3 and 16.3, for an appliance intended for permanent installation, the insulation resistance between current-carrying parts and non-current-carrying parts shall be measured as specified in Clause 11.2.2. In addition, when evaluating the resilient motor mounting as specified in Clause 24.1.4, the insulation resistance shall be measured as specified in Clause 11.2.2.

11.2.2 Insulation resistance shall be measured by applying a direct-current potential of 250 volts between live parts and the enclosure and other exposed dead metal parts, using two voltmeters – one voltmeter being connected across the supply line and the other connected in series with one of the leads to the pump being tested. See Figure 6. The insulation resistance shall be calculated by the formula:

$$Insulation\ \ Resistance = [(V_1 - V_s)R_s / V_s]$$

in which:

V_1 is the reading of the line voltage;

V_s is the reading of the other voltmeter; and

R_s is the resistance of the latter.

Note: Self-contained laboratory grade instrumentation that produces equivalent results, such as a megohmmeter with an open circuit output of 500 volts DC, may be used in place of the two-voltmeter circuit shown in Figure 5.

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12 Cool Down Period

12.1 In order to reduce the risk of spontaneous ignition of the clothes load, drying cycles shall have a cool down period to reduce the temperature of the clothes load to a suitable value before the user is alerted the drying cycle has ended. This requirement is not applicable to appliances having a drying cycle air temperature not exceeding 55°C, as measured at the first lint filter.

12.2 To determine whether an appliance complies with requirements for Clause 12.1, the appliance shall be operated under the same conditions as the Heating Test (Clause 10). Exhaust temperature of the air from the drum, measured at the first lint filter, shall not exceed 55°C at the end of the cycle.

Note 1: The end of the cycle is considered to be when the drum has stopped rotating unless otherwise noted in the instruction manual.

Note 2: The test should be conducted using the drying cycle and options of the appliance that generates the highest temperatures at the measurement point.

13 Moisture Resistance

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

13.2 To determine whether an appliance complies with the requirement in Clause 13.1, 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 hours under the conditions specified in Clause 13.1. Following the conditioning, the sample shall be tested unenergized, as described in Clause 11.1.2(a). The sample shall then be energized and tested as described in Clauses 11.1.2 (b) and (c). The test shall be discontinued when the leakage current stabilizes or decreases.

13.3 An appliance employing insulating material that can 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 measured as described in Clause 11.2 of not less than 50 000 Ω between current-carrying parts and interconnected non-current-carrying metal parts.

14 Electric Strength

14.1 An appliance shall withstand for 1 minute 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, which normally have a connection to ground, may have the ground connection disconnected during the electric strength test.

14.2 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; and

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

14.3 To determine whether an appliance complies with the requirements in Clause 14.1, the appliance shall be tested by means of a 500 V·A 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 minute. 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.

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15 Overload Protection of Transformers and Associated Circuits

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

15.2 Class 2 power supplies shall comply with CSA C22.2 No. 223 and UL 1310.

15.3 General purpose transformers shall comply with CSA C22.2 No. 66.2 and UL 5085-2.

15.4 Transformers intended for supplying power to low-voltage, Class 2 circuits shall not be of the conductively coupled (e.g., autotransformer) type.

16 Abnormal Operation

16.1 Heating element – ground fault condition

16.1.1 When an appliance is operated under the conditions specified in Clause 16.1.2, there shall be no:

a) emission of flame or molten metal;

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

c) glowing or flaming of the cheesecloth; or

d) indication of flame or glowing embers in the load of clothes either before or after the access door is opened.

16.1.2 An appliance shall be operated under all of the following conditions:

a) the test load shall be 100 percent of the rated load;

b) the test cloths shall be dry and tumbled for 5 minutes;

c) the temperature-regulating thermostats shall be shunted out of the circuit;

d) temperature controls shall be set to the position resulting in maximum temperatures in the dryer;

e) the timer shall be set to the longest drying time duration and the drum shall be held in a stationary position;

f) the heating element shall have one of its terminals open circuited and the element grounded at a point which will result in a current of 110 percent of the rating of the intended branch-circuit over-current protection flowing through the heater. If the current at 110 percent results in opening the heating element then the test shall be conducted at the maximum current that will result without the heating element opening; and

g) the appliance shall be supported on a surface of soft wood covered with four thicknesses of cheesecloth.

16.1.3 The test shall be continued until the ultimate result is obtained or for 7 hours, whichever is less.

16.2 Cord reels

16.2.1 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

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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 resultant 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.

16.3 Wetting of electrical components

16.3.1 Wetting test

16.3.1.1 The malfunction of a boot, diaphragm, or the like of rubber or similar material, when tested as described in Clause 16.3.1.2, shall not result in:

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

b) an insulation resistance measured as described in Clause 11.2 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 wetting of current-carrying materials.

Note: Wetting of current-carrying materials is determined by a stream, a spray, or the dripping of water on a component that will likely happen during each flooding or overfill test, as a result of oversudsing, or as a result of a malfunction of the boot or diaphragm and not as a random occurrence.

16.3.1.2 To determine whether or not an appliance complies with the requirements in Clause 16.3.1.1 with respect to the malfunction of a boot or diaphragm, the appliance shall be leveled 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 L of water shall be placed in the vessel described in Clause 16.3.1.3, 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 21.11 is considered to comply with this requirement.

16.3.1.3 The vessel mentioned in Clause 16.3.1.2 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.

16.3.2 Flood test

16.3.2.1 An appliance shall be tested as specified in Clause 16.3.2.2 to determine if failure of a water valve, water pump, or control of the valve or pump results in:

a) a leakage current greater than 5 MIU for cord connected appliances;

b) insulation resistance measured as described in Clause 11.2 less than 50 000 Ω between current-carrying parts and interconnected non-current-carrying parts for permanently connected appliances;

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

d) obvious wetting of any electric component.

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Note: Obvious wetting is considered to be wetting by a stream, spray, or dripping of water on the component that is observed during each test. Wetting by random drops of water that occur by chance and are not replicated are not considered obvious wetting.

16.3.2.2 The appliance shall be leveled prior to the test. The appliance shall be connected to the water supply or the water tank shall be filled with water as applicable. The water supply shall be 861.9 kPa and 60 ±2°C if intended for hot water connection and 15 ±5°C if intended for cold water connection. The appliance shall be operated for 15 minutes after first evidence of overflow from the drum with the water valve locked open or the water pump locked on.

16.4 Breakdown of belts or parts and the interruption of water supply

16.4.1 An appliance shall be tested as described in Clauses 16.4.2 and 16.4.4, and there shall be no:

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 can be placed or that can be in proximity to the appliance as installed;

c) glowing or flaming of the cheesecloth; or

d) indication of flame or glowing embers in the load of cloths, either before or after the access door is opened.

16.4.2 With consideration given to the design of the appliance, the appliance shall be operated under abnormal conditions representing those likely to be encountered in actual service, such as the breakdown of drive belts or other parts, or interruption of the water supply to an appliance of the condensing type. Ordinarily, only one such condition shall be assumed at one time.

16.4.3 The appliance shall be operated as described in Clause 16.4.4 under each of the following conditions, in turn:

a) total effective area of exhaust blocked 0%;

b) total effective area of exhaust blocked 25%;

c) total effective area of exhaust blocked 50%;

d) total effective area of exhaust blocked 75%; and

e) total effective area of exhaust blocked 100%.

Exhaust blockage shall be at the point where the air exits the dryer prior to connection of external exhaust ducts that are to be put in place when the dryer is installed.

16.4.4 In each abnormal-operation test, all temperature-regulating devices shall be defeated and the drum shall be loaded with dry cloths having the weight specified in Clause 5.2. The cloths shall be stacked by hand, without propping by means of other objects, in the position that will result in maximum temperatures on the cloths in the stationary drum. Before the start of the test, the appliance shall be thoroughly heated by being operated through one complete cycle of normal operation.

16.4.5 The test shall be continued until ultimate results are observed, but no longer than 7 hours (see Clause 16.1). For an appliance controlled by a timing device, the duration of the test shall be the maximum interval permitted by the timer. The appliance shall be installed as described in Clauses 10.9.3, 10.9.4, or 10.9.5 whichever is applicable.

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16.5 Blockage of lint screen, exhaust, and condenser

16.5.1 A household appliance shall be tested as described in Clauses 16.5.2 to 16.5.8, and there shall be no:

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 can be placed or that can be in proximity to the appliance as installed;

c) glowing or flaming of the cheesecloth; or

d) indication of flame or glowing embers in the load of cloths, either before or after the access door is opened.

16.5.2 An appliance shall be operated as described in Clause 16.5.7 under each of the following conditions, in turn:

a) lint screen blocked 75%;

b) lint screen blocked 100%;

c) exhaust blocked 75%;

d) exhaust blocked 100%;

e) air flow of condenser blocked 75%; and

f) air flow of condenser blocked 100%.

16.5.3 The requirements of Clause 16.5.2 (c) and (d) do not apply to condensation type tumble dryers.

16.5.4 The requirements of Clause 16.5.2(e) and (f) do not apply to vented type tumble dryers.

16.5.5 Each blockage shall be stated as a percentage of the total effective area of the opening as follows:

a) lint screen blockage shall be in the area representing lint build-up;

b) exhaust blockage shall be at the point where the air exits the dryer prior to connection of external exhaust ducts that are to be put in place when the dryer is installed; and

c) condenser blockage can be at the inlet or the outlet of the condenser unit, and shall be in the cross sectional area representing drying air flow.

16.5.6 The appliance shall be installed as described in Clauses 10.3 to 10.5, inclusive, as applicable, and exhausted as described in Clause 10.9. The appliance shall be supported on a surface of soft wood covered with four thicknesses of cheesecloth. The drum shall be loaded with test cloths that have:

a) a dry weight as specified in Clause 5.2; and

b) been soaked in water, which shall be extracted as it would be in normal use, immediately prior to the test.

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The appliance shall be operated through one conditioning cycle of maximum length as dictated by the timer. All temperature-regulating and -limiting devices shall then be defeated and the appliance operated under this condition, with the timer modified so as to result in continuous operation, until ultimate results are obtained or for 7 hours, whichever is less.

16.5.7 For the tests in Clauses 16.5.2 to 16.5.6, a temperature-limiting device that complies with the requirements in Clause 21.13.4 may remain in the circuit. A device that is provided by a motor manufacturer as an integral part of a motor, and that operates during the tests, shall be defeated.

16.5.8 At the discretion of the manufacturer, the temperatures in the appliance base, as defined by Clause 16.7.16, which are monitored during the tests of Clause 10, may be monitored during the tests of Clauses 16.5.2 – 16.5.7 for the purpose of confirming the validity of excluding the design under test from the Base fire containment tests of Clause 16.7.

16.6 Load fire containment

16.6.1 Appliances having a rotating drum or basket shall be tested as described in Clauses 16.6.2 to 16.6.21, and there shall be no ignition of the cheesecloth located on the outside of the appliance.

16.6.2 Tests shall be conducted in a closed, draft-free room. When mechanical ventilation is employed during the test, an air stream shall not be directed across the appliance, unless agreed upon by those concerned. The test room shall have:

a) vents for the discharge of the combustion products; and

b) provisions for fresh air intake so that no oxygen-deficient air is introduced into the test configuration during the test (e.g. the test room is not sealed, and the test room air is not recirculated back into the test room).

16.6.3 The supporting surface for the appliance shall be calcium silicate board, fibre cement board, or other material that is noncombustible. Metal shall not be used. With the concurrence of those concerned, metal drains or a similar device may be located in the supporting surface. The supporting surface shall be cleaned between tests.

16.6.4 Appliances that can be operated on a supporting surface shall be tested with the machine on the floor. Appliances intended to operate only when stacked, shall be tested with the appliance on top of the machine in accordance with the installation manual.

16.6.5 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 for this test. The manufacturer shall provide the wiring diagram on the test appliance as intended.

16.6.6 Accessories provided with the appliance, such as dryer racks, shall not be included in the test.

16.6.7 The appliance shall be connected to a source of power for all test conditions in accordance with the installation instructions. The supply circuit for the appliance shall be provided with time-delay fuses of the maximum rating for the branch circuit to which the appliance can properly be connected.

16.6.8 The appliance shall be operated in a timed dry cycle. For any appliance that does not employ a timed dry cycle, any moisture-sensing devices shall be defeated. When the software associated with a moisture-sensing device does not allow operation of the appliance by defeating the moisture sensor, the software will, in some cases, need to be modified to allow heated operation of the appliance.

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16.6.9 The appliance shall be leveled, starting with any adjustable feet at the maximum distance from the bottom of the appliance to the supporting surface.

16.6.10 The top, two sides, front, and back external surfaces of the appliance shall be completely covered by cheesecloth panels. The cheesecloth panels shall be of one thickness and held in close contact with the external surfaces of the appliance. A mechanical means, such as small pieces of metal foil adhesive tape, shall be employed to secure the cheesecloth panels to each other, so that there are no gaps between the cheesecloth panels. The tape shall not cover openings or enclosure seams in the construction of the appliance. One thickness of cheesecloth that is slightly larger than the appliance bottom surface shall cover the supporting surface. The side, front, and back panels of cheesecloth shall be of sufficient length to touch the bottom panel of cheesecloth.

16.6.11 For vented type tumble dryers, the appliance shall be installed freestanding and exhausted with clean rigid metal duct of the same size as the exhaust duct connection on the appliance. The interior of the metal duct shall be cleaned so there is no excessive soot build-up before each test, or new duct shall be used for each test. The duct shall consist of a total length of 4.27 m with two 90 degree bends. A sample configuration is shown in Figure 9. The exhaust duct shall consist of a 1 m straight section connected to the dryer exhaust outlet and terminating perpendicularly in a tee. The tee shall have blast gates/dampers at its outlets. The blast gates/dampers shall be connected to 0.5 m straight sections. One branch shall connect to a 90 degree bend with 2.27 m of straight duct downstream from the bend. The other branch shall connect to the suction of an exhaust blower complying with Clause 16.6.12. The discharge of the blower shall connect to a 2.27 m length of straight duct. With the concurrence of those concerned, less than 4.27 m total length and less than two 90 degree bends may be used for testing. Condensation type tumble dryers are not exhausted.

Note 1: The orientation of the ducting is not specified.

Note 2: For dryer configurations where the duct needs to be elevated based on the location of the dryer exhaust, additional ducting may be added to the test set-up.

16.6.12 An external blower shall be connected to the exhaust duct of a vented appliance as described in Clause 16.6.11. The airflow direction shall be out of the appliance and shall be adjusted to produce 3.3 ±0.5 L/s (7 ±1.0 CFM) through the exhaust duct when the appliance is not operating. The airflow measurement shall be taken at the center of the duct where the airflow is laminar (e.g. at the longest and straightest portion of the ducting). The external blower shall be operating for the duration of the test. For the conditions described in Clause 16.6.14(b), the blast gate/damper to the external blower shall be closed at the start of the test and the blast gate/damper to the unrestricted duct shall be open. If the appliance internal blower ceases to function, the positions of the blast gates/damper shall be switched to open for the external blower and closed for the unrestricted exhaust duct.

16.6.13 A laundry center or combination washer/dryer shall be connected to a water supply and to a drain, but shall not be operated in a wash cycle for this test.

16.6.14 Each of the fire containment tests shall be conducted on two samples under each of the following test conditions:

a) For each of the two samples, the appliance is not started (no drum or basket motion).

b) For each of the two samples, the appliance timer shall be set for the maximum time at the highest heat setting, and the appliance shall be started resulting in the drum or basket rotating.

A separate test appliance shall be used for each test condition.

16.6.15 The appliance shall be loaded with dry cloths, as described in Clause 5.3, that have a dry weight of 0.016 kg/L of clothes-drum volume. The test cloths shall be preconditioned by exposing the cloths to 5

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wash and dry cycles, with the first two wash cycles using both hot water and detergent (using any commercially available detergent). The appliance shall be operated through one conditioning cycle of 15 minutes at the highest heat setting with the dry test load. The lint screen shall be cleaned after the conditioning cycle.

16.6.16 The test load shall be placed in the most severe position in the rotating tumbler in relation to plastic or other flammable materials. When possible, such positioning shall include locating the maximum amount of combustible materials, such as the maximum number of polymeric tumbler baffles, above the drum centerline. When possible, starting and stopping the appliance shall be used to position the combustible materials.

16.6.17 If the test load completely covers the clothes-loading opening after the 15 minutes conditioning cycle, the load shall be patted down to provide enough clearance for the propane torch flame to reach the back surface of the test load.

16.6.18 A propane torch shall be used to ignite the test load.

16.6.19 The front panel of cheesecloth shall be positioned on top of the appliance while igniting the test cloths. To protect the panels of cheesecloth surrounding the clothes-loading door from ignition while igniting the test load, a metal foil dam may be taped to the appliance to shield the cheesecloth. Metal foil may also be used to protect any plastic component edges that might ignite during the load-lighting process.

16.6.20 The flame of the torch shall be applied to the surface of the load, starting from the back and moving the torch forward while sweeping the flame across the surface from left to right. The load shall be manipulated so that edges of the test cloth are available to light. The aim is to ignite most of the top surface of the load. A total lighting time of 45 to 50 s to the top surface of test cloths is likely to be needed. If substantial ignition is achieved in less time, then the lighting time shall be reduced. After igniting as much of the top surface of the test cloths as possible in not more than 45 to 50 s of the sweeping motion, the flames shall be observed for no more than 20 s to verify that the test cloths are continuing to burn. Metal foil protecting plastic edges shall be removed, and the clothes-loading door shall be closed. The aluminum foil dam shall be removed after the clothes-loading door is closed, and the front panel of cheesecloth shall be placed over the front surface of the appliance.

16.6.21 Each test shall be continued until the external cheesecloth ignites or for 7 hours, whichever is less. Two consecutive samples of each appliance construction shall be tested.

16.7 Base fire containment

16.7.1 The requirements in Clause 16.7 do not apply to:

a) Condensation type and heat pump tumble dryers that are not intended to be connected to an external exhaust duct and not to be vented to the outside whose:

1) Maximum temperature rises do not exceed 150°C under blocked air flow conditions. Refer to Clause 16.5.8;
2) Maximum temperature rises comply with the requirements of Clause 10.1 under blocked air flow conditions. An additional 15°C over the maximum temperature rises specified in Table 2 is acceptable. Refer to Clause 16.5.8;

3) Components, such as switches, relays, or solenoids, with a current load exceeding 0.2 A and located as defined by Clause 16.7.16, are individually and completely enclosed. The terminals of a component need not be enclosed; and

b) Combination washer-dryers of the water condensing type.

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16.7.2 Appliances having a rotating drum or basket shall be tested as described in Clauses 16.7.3 to 16.7.20, and there shall be no:

a) ignition of the cheesecloth located on the outside of the appliance; nor

b) indication of flaming or glowing embers in the load of cloth, either before or after the dryer access door is opened.

Note: Browning of the test load is acceptable provided that all individual threads are unbroken.

16.7.3 Tests shall be conducted in a closed, draft-free room. When mechanical ventilation is employed during the test, an air stream shall not be directed across the appliance, unless agreed upon by those concerned. The test room shall have:

a) vents for the discharge of the combustion products; and

b) provisions for fresh air intake so that no oxygen-deficient air is introduced into the test configuration during the test (e.g. the test room is not sealed, and the test room air is not recirculated back into the test room).

16.7.4 The supporting surface for the appliance shall be calcium silicate board, fibre cement board, or other material that is noncombustible. Metal shall not be used. With the concurrence of those concerned, metal drains or a similar device may be located in the supporting surface. The supporting surface shall be cleaned between tests.

16.7.5 Appliances that can be operated on a supporting surface shall be tested with the machine on the floor. Appliances intended to operate only when stacked shall be tested with the appliance on top of the machine in accordance with the installation manual.

16.7.6 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 for this test. The manufacturer shall provide the wiring diagram on the test appliance as intended.

16.7.7 Accessories provided with the appliance, such as dryer racks, shall not be included in the test.

16.7.8 The appliance shall be connected to a source of power for all test conditions in accordance with the installation instructions. The supply circuit for the appliance shall be provided with time-delay fuses of the maximum rating for the branch circuit to which the appliance can properly be connected.

16.7.9 The appliance shall be operated in a timed dry cycle. For any appliance that does not employ a timed dry cycle, any moisture-sensing devices shall be defeated.

16.7.10 The appliance shall be leveled, starting with any adjustable feet at the maximum distance from the bottom of the appliance to the supporting surface.

16.7.11 The top, two sides, front, and back external surfaces of the appliance shall be completely covered by cheesecloth panels. The cheesecloth panels shall be of one thickness and held in close contact with the external surfaces of the appliance. A mechanical means, such as small pieces of metal foil adhesive tape, shall be employed to secure the cheesecloth panels to each other, so that there are no gaps between the cheesecloth panels. The tape shall not cover openings or enclosure seams in the construction of the appliance. One thickness of cheesecloth that is slightly larger than the appliance bottom surface shall cover the supporting surface. The side, front, and back panels of cheesecloth shall be of sufficient length to touch the bottom panel of cheesecloth.

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16.7.12 For vent type tumble dryers, the appliance shall be installed freestanding and exhausted with clean rigid metal duct of the same size as the exhaust duct connection on the appliance. The interior of the metal duct shall be cleaned so there is no excessive soot build-up before each test, or new duct shall be used for each test. The duct shall consist of a total length of 4.27 m with two 90 degree bends. A sample configuration is shown in Figure 9. The exhaust duct shall consist of a 1 m straight section connected to the dryer exhaust outlet and terminating perpendicularly in a tee. The tee shall have blast gates/dampers at its outlets. The blast gates/dampers shall be connected to 0.5 m straight sections. One branch shall connect to a 90 degree bend with 2.27 m of straight duct downstream from the bend. The other branch shall connect to the suction of an exhaust blower complying with Clause 16.7.13. The discharge of the blower shall connect to a 2.27 m length of straight duct. With the concurrence of those concerned, less than 4.27 m total length and less than two 90 degree bends may be used for testing. Condensation type tumble dryers are not exhausted.

Note 1: The orientation of the ducting is not specified.

Note 2: For dyer configurations where the duct needs to be elevated based on the location of the dryer exhaust, additional ducting may be added to the test set-up.

16.7.13 An external blower shall be connected to the exhaust duct of a vented appliance as described in Clause 16.7.12. The airflow direction shall be out of the appliance and shall be adjusted to produce 3.3 ±0.5 L/s (7CFM) through the exhaust duct when the appliance is not operating. The airflow measurement shall be taken at the center of the duct where the airflow is laminar (e.g. at the longest and straightest portion of the ducting). The external blower shall be operating for the duration of the test. For the conditions described in Clause 16.7.15(b), the blast gate/damper to the external blower shall be closed at the start of the test and the blast gate/damper to the unrestricted duct shall be open. If the appliance internal blower ceases to function, the positions of the blast gates/damper shall be switched to open for the external blower and closed for the unrestricted exhaust duct.

16.7.14 A laundry center or combination washer-dryer of other than the water condensing type shall be connected to a water supply and to a drain, but shall not be operated in a wash cycle for this test.

16.7.15 The fire containment tests shall be conducted under each of the following test conditions:

a) the appliance is not started (no drum or basket motion).

b) the appliance timer shall be set for the maximum time at the highest heat setting, and the appliance shall be started resulting in the drum or basket rotating.

A separate test appliance shall be used for each test condition.

16.7.16 All base surfaces, electrical components, internal wiring, and connections that are located in:

a) the air inlet path to the drum heat source; and

b) an area where lint is likely to accumulate;

shall be covered by eight thicknesses of cheesecloth. The cheesecloth shall be draped to completely cover the base, electrical components excluding heating elements, electrical connections, internal wiring, heater enclosure and bearings that are located within 150 mm of the bottom of the appliance so that they are continuously covered. Cheesecloth strips consisting of eight thicknesses approximately 25 mm wide that are of sufficient length to contact surfaces of cheesecloth in the areas being tested shall be used to provide a path for the fire to be transferred from one section of cheesecloth to another and from the base to the cheesecloth on components located above the base of the appliance. The cheesecloth shall be closely placed around components to conform to their shape. The cheesecloth shall be spaced so that it does not contact moving parts such as fan blades. Cheesecloth shall not cover openings to moving parts

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of components or ventilation openings of motors. If small pieces of metal foil tape are used to secure the cheesecloth, they should be located so that the propagation of flame is not impeded.

16.7.17 An opening shall be made in a front or side enclosure to allow access for the purpose of igniting the internal cheesecloth. The access panel shall be of the same type of material as the enclosure material or heat-resistant glass. The access panel shall overlap the opening a minimum of 25 mm and be mechanically secured. Gaps created by the access panel shall be sealed by metal foil adhesive tape.

16.7.18 The appliance shall be loaded with dry cloths, as described in Clause 5.3, that have a dry weight of 0.016 kg/L of clothes-drum volume. The test cloths shall be preconditioned by exposing the cloths to 5 wash and dry cycles, with the first two wash cycles using both hot water and detergent (using any commercially available detergent). The appliance shall be operated through one conditioning cycle of 15 minutes at the highest heat setting with the dry test load. The lint screen shall be cleaned after the conditioning cycle.

16.7.19 The cheesecloth shall be ignited using an electrically operated match, butane lighter, or other suitable means. The internal cheesecloth shall be ignited at the lowest point near bearings or components and away from the appliance air ventilation openings. The cheesecloth shall be relit, as necessary, to burn the internal cheesecloth. If necessary, a total of 5 attempts, each in different areas, shall be made to achieve burning of the internal cheesecloth. An observation window or camera may be installed in the appliance enclosure to determine that the cheesecloth burns.

16.7.20 The test shall be continued until the external cheesecloth ignites or for 7 hours, whichever is less. If it is determined through the use of observation windows or cameras that the cheesecloth inside the appliance cabinet has ceased burning, the test may be terminated.

16.8 Hot coil ignition test

16.8.1 If specified by Clause 28.4.7(b), an electrical connection shall be tested as specified in Clauses 16.8.3 to 16.8.10. 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 16.8.4 as indicated by broken threads of the cheesecloth. Browning of the cheesecloth is acceptable provided that all individual threads are unbroken.

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

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

a) fracture or shorting of the hot coil prior to completion of the test; or

b) a shift in the position of the hot coil sufficient to alter the severity of the test.

16.8.3 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.

16.8.4 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.

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16.8.5 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.

16.8.6 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 shall 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. An AC or DC power supply shall be used, and the test current shall be monitored for evidence of shorting or resistance wire breaks during testing.

16.8.7 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 hot coil if found to actuate during the test.

16.8.8 The coil shall be:

a) Nichrome wire [80% Nickel, 20% Chrome, 20 AWG, in accordance with ASTM B344]; or

b) FeCrAl alloy wire [72.2% Iron, 22% Chromium, 5.8% Aluminum; 20 AWG, in accordance with ASTM B603]

and shall be applied to a connector or switching contact such that the adjacent non-metallic combustible materials will be ignited during the test.

16.8.9 In the application of the hot coil to the part under test, the hot coil 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 hot coil 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.

Note: A 3.5 mm (0.138 in) diameter (max) solid ceramic-rod support may be used to support the hot wire coil during the test. The ceramic-rod may be either smooth (non-threaded) or threaded 8 wraps / 25.4 mm (8 wraps/Inch) to accommodate the wire.

b) When externally wrapping a connector or uninsulated terminal, a minimum 50 mm (2 in) of wire specified in 16.8.8 shall be used 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 the coil to prevent shorting out portions of the coil.

d) In the case of switching devices, a coil of wire shall be placed inside the device in the position of the contacts and appropriately supported to prevent movement during the test. See Clause 28.4.8.

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

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Note: With reference to (a) and (d), the preferred method of wrapping a coil is wrapping the wire specified in Clause 16.8.8 around the threads of a No. 6-8 screw with a nominal root diameter of 2.4 mm (0.1 in) and a thread per 25.4 mm (1 in) count of 8.

16.8.10 The coil shall be energized such that current in the circuit is immediately increased to 13.9 A for the nichrome wire specified in Clause 16.8.8(a), or 12.5 amps if using the FeCrAl alloy specified in Clause 16.8.8(b) and held constant for the duration of the test. If no ignition is detected within 20 minutes, the current shall be removed from the coil. 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 hot coil fractures prematurely, the test shall be repeated.

17 Stability and Mechanical Hazards

17.1 Automatic restarting of motor

17.1.1 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.

17.1.2 The requirement in Clause 17.1.1 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.

17.2 Stability (freestanding appliances)

17.2.1 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 17.2.2.

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

17.2.2 The empty appliance shall be placed on a flat surface inclined at an angle of 10 degrees from the horizontal. The loading door of the appliance shall be placed in the most unfavourable position. 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.

17.2.3 Front-loading appliances having a mass of more than 11.5 kg when empty, and having any hinged door, shelf, or other projection and that opens beyond the enclosure, shall be tested in accordance with (a) and (b) if applicable:

a) The appliance, that has a projection hung with a horizontal hinge, shall not overturn when a weight 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.

b) An appliance provided with a means to permanently secure it to the structure, can be secured for the test specified in 17.2.3(a) using the means provided with the appliance, as long as:

1) the appliance is provided with a marking indicating it shall be secured to the structure at the time of installation (see Clause 6.1.2.37);

2) the installation instructions provided with the appliance specify that the securing means shall be used (see Clause 6.2.3.12); and

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3) the securing means is intended to be installed from the front of the appliance.

17.3 Wall-mounted appliances

17.3.1 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.

17.3.2 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.

17.3.3 A wall-mounted appliance shall be subjected to the test described in Clauses 17.3.4 to 17.3.7. 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.

17.3.4 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.

17.3.5 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 centres shall be used as the support.

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

17.3.7 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 minutes.

17.4 Appliance stands

17.4.1 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.

17.4.2 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 17.4.3 to 17.4.5 or on a flat level surface when tested in accordance with Clauses 17.4.6 to 17.4.10.

17.4.3 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 degrees from the horizontal. The loading door of the appliance shall be placed in the most unfavourable position.

17.4.4 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

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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.

17.4.5 The appliances in the stand either shall be loaded as described in Clause 5.2 or unloaded, whichever results in the most unfavourable test condition.

17.4.6 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.

17.4.7 The assembly shall be tested in accordance with Clauses 17.4.8 to 17.4.10. If the stand permits stacking of appliances, the tests shall be conducted both with and without the bottom appliance installed.

17.4.8 The appliances in the stand shall be either loaded, as described in Clause 5.2, or unloaded, whichever results in the most unfavourable test condition.

17.4.9 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 minute.

17.4.10 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.

17.5 Sharp edges, projections, and moving parts

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

17.5.2 With respect to Clause 17.5.1, for condensation-type and heat pump clothes dryers, the opening in the enclosure that provides access to the sharp edges of the condenser or evaporator coil fins during normal user maintenance shall require two separate and independent actions by the user (such as pushing and turning) to access this portion of the appliance.

17.5.3 In addition, the marking of Clause 6.1.5.1 and instructions of Clause 6.2.2.6 shall be provided.

17.5.4 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.

17.6 Entrapment

17.6.1 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 Clause 17.6.5, opens with a force of 67 N or less;

b) be investigated with respect to the ventilation it provides in accordance with Clause 17.8; or

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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.

17.6.2 The secondary-function control specified in Clause 17.6.1(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.

17.6.3 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 17.6.2(c)(2).

17.6.4 The force mentioned in Clause 17.6.1(a) shall be applied as per Clauses 17.6.5 and 17.6.6.

17.6.5 The force 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.

17.6.6 The force 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.

17.6.7 An appliance that complies with the requirements of Clause 17.6.2(c) shall withstand the operation described in Clause 17.6.8 without malfunction.

17.6.8 With reference to the requirement in Clause 17.6.7, 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.

17.7 Contact with rotating tumbler

17.7.1 An appliance shall be provided with:

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a) a means to reduce the likelihood of the opening of the clothes loading-and-unloading door during the operating cycle; or

b) an interlock that, when the clothes loading-and-unloading door is opened 76 mm or more during the operating cycle, will:

1) remove the driving force from the clothes basket; and

2) de-energize the heat source within 10 s.

17.7.2 The interlock mentioned in Clause 17.7.1(b) shall be such that the basket will not rotate and the heat source will not be energized until:

a) the door is closed to less than 76 mm of opening; and

b) a secondary-function control, manually operated from outside the appliance, is actuated. The requirement for a secondary-function control does not apply to an appliance having an opening into the clothes drum with a dimension of less than 203 mm or a clothes drum with a volume less than 60 L.

17.7.3 To determine whether a clothes dryer, laundry center, or combination washer-dryer complies with the requirements in Clauses 17.7.1 and 17.7.2, tests shall be conducted with the appliance operating with its rated clothes load.

17.7.4 With reference to Clause 17.7.1(a), a solenoid or similar component that is employed to hold the 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 locking means or component as a result of this test.

17.7.5 If opening and closing the door affects mechanical operation of the component, the test shall be conducted in the normal manner. The test shall be conducted at the rate of six times per minute unless a slower rate is dictated by the construction of the appliance.

17.8 Ventilation

17.8.1 With reference to Clause 17.6.1(b), the appliance shall be tested in accordance with Clauses 17.8.2 – 17.8.13. As a result of the testing:

a) O_2 concentration shall not be less than 16 percent;

b) CO_2 concentration shall not exceed 3 percent; and

c) The burner flame shall not be extinguished.

17.8.2 Figure 14 shows the overall test schematic to conduct this ventilation test. The equipment needed for this test is as follows:

a) Oxygen Analyzer, with a range of 0 – 25% and a flowrate capable of 1000 mL/min;

b) CO_2 Analyzer, with a range of 0 – 10 % and a flowrate capable of 2500 mL/min;

c) Air sampling pump, rated at least 0.75 ft^3/min, capable of extracting gas samples at a rate of 3500 mL/min;

d) Methane supply and regulator with a regulated pressure set to match the requirements of the methane mass flow controller;

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e) CO_2 supply and regulator, with a regulated pressure set to match the requirements of the CO_2 mass flow controller;

f) Mass flow controller for methane flow, with a range of at least 0 – 400 mL/min and accuracy of ±2 % of full scale;

g) Mass flow controller for CO_2 flow, with a range of at least 0 – 360 mL/min and accuracy of ±2 % of full scale;

h) Three or four nominal 6.4 mm diameter tubes;

i) 1 ft^3 of gypsum board to mimic the displaced volume of a child in the drum;

j) Bunsen burner, rated at least 0 – 3.85 ft^3/hr (0 – 1820 mL/min) which conforms to ASTM D5025;

k) Thermocouple, used to determine if flame is ignited throughout the test, and to determine if the flame has extinguished;

l) Data acquisition system to monitor O_2 and CO_2 levels during the test;

m) Portable electric fan.

17.8.3 The appliance shall be installed as required by the relevant requirements in Clause 10 with the exhaust duct system required in Clause 10.9.

Note: The room where the test is to be conducted should be well-ventilated to minimize the risk of accidental release of either methane or carbon dioxide.

17.8.4 One cubic foot of gypsum board shall be placed in the drum to simulate the displaced volume of a child in the drum.

17.8.5 The Bunsen burner shall be placed in the drum, on top center of gypsum board. A thermocouple or camera shall be located near enough to the burner flame to serve as an indicator whether the flame is ignited or extinguished.

17.8.6 The gas tubes shall be routed from the test equipment through the appliance into the drum. The method of routing these tubes will vary based on the design of the appliance. Pre-existing openings in the appliance may be used if available. If pre-existing openings are not available or cannot be used, then holes shall be drilled into the drum, and bulkhead-type fittings used to make an air-tight seal in the area where the tubes are routed through the appliance.

17.8.7 One gas tube shall be used to allow methane flow from the methane supply through the mass flow meter to the Bunsen burner inside the drum. The second tube shall be used to extract gas samples from the drum to the O_2 and CO_2 analyzers. The third tube shall be used as the gas sample return back into the drum, as well as to allow CO_2 flow from the CO_2 supply through the CO_2 mass flow meter into the drum.

Note: Four gas tubes may be used, where one tube is used only for the gas sample return back into the drum, and another tube is used to allow CO_2 flow into the drum.

The gas tube to extract the gas samples to the O_2 and CO_2 analyzers shall be located near the top of the drum. The gas sample return tube shall be placed close to the bottom of the drum. The gas tube providing methane to the Bunsen burner in the drum shall be located in any convenient location. If four gas tubes are used, the tube for the separate CO_2 flow back into the drum shall be located close to the bottom of the drum.

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17.8.8 The mass flow meter measuring methane flow to the Bunsen burner shall be set at 200 mL/min.

The mass flow meter measuring CO_2 flow into the drum shall be set at 160 mL/min.

17.8.9 The data acquisition system shall be started with an approximate 60 second countdown before the start of each test.

17.8.10 At time zero, the mass flow meters shall be turned on, the Bunsen burner ignited, and the appliance door closed and latched as intended in normal use.

17.8.11 The test shall be continued until the O_2 and CO_2 concentrations peak, or until the burner flame is extinguished. After the concentration levels peak, O_2 and CO_2 concentrations shall be measured for an additional five minutes to confirm the peak values. The concentration levels shall be recorded at a maximum of 5 second intervals, and averaged in 30 second time periods. If the O_2 level is less than 16 percent, or the CO_2 level exceeds the 3 percent level, over an averaged 30 second time period, this is considered non-compliant.

If the flame extinguishes, the concentration levels of O_2 and CO_2 and the time at the point when the flame can no longer be sustained is to be recorded.

Note: The test may be terminated after one of the O_2 and CO_2 levels are determined to be non-compliant.

17.8.12 This test is to be conducted under the following two conditions:

a) 0 percent blocked exhaust and 50 percent blocked lint filter; and

b) 25 percent blocked exhaust and 50 percent blocked lint filter.

17.8.13 Before the start of each test condition, a portable electric fan, or the like, is to be placed in front of the appliance with the door open to return the drum to room temperature and the gases in the drum to ambient conditions.

18 Mechanical Strength

18.1 Frame and enclosure

18.1.1 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, see Clause 28.

18.1.2 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, can be acceptable, provided the surface under consideration is curved, ribbed, or otherwise reinforced or sized to provide mechanical strength equivalent to that required.

18.1.3 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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18.1.4 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.

18.2 Back covers

18.2.1 The back cover may be of thinner material if the enclosure complies with the requirements of Clause 18.2.2.

18.2.2 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 26.

19 Construction

19.1 Current-carrying parts

19.1.1 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.

19.1.2 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 21.1.1.

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

19.2 Electrical insulation

19.2.1 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.

19.2.2 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.

19.2.3 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 may have a bearing on the risk of fire, electric shock, and injury to persons, in conjunction with the conditions of actual use. See Clause 28.1.4 for polymeric materials.

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19.2.4 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 can introduce a risk of fire or electric shock.

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

19.2.6 The requirements for supplemental insulation (e.g, 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 or UL 510A;

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

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

Note: UL 510 covers tape rated up to 80 C, and UL 510A covers tape rated greater than 80 C.

19.3 Sound and thermal insulation

19.3.1 Combustible or electrically conductive sound (acoustic) or heat-insulating material shall not be located so that it contacts an uninsulated current-carrying part.

19.3.2 With reference to Clause 19.3.1, some types of mineral-wool thermal insulation contain conductive impurities in the form of slag that can present a risk of fire or electric shock if in contact with an uninsulated current-carrying part.

19.3.3 A polymeric sound or thermal insulating material suitable for use in direct contact with live parts as specified in Clause 28.1.4 shall be considered suitable for use in contact with uninsulated current-carrying parts.

19.3.4 Batting formed of an insulating material, such as fiberglass or polyester, shall be considered suitable for use in contact with uninsulated current-carrying parts if the appliance complies with the Leakage Current Test of Clause 11, the Moisture Resistance Tests of Clauses 13 and 16.3, and the Electric Strength Test of Clause 14 with the insulation installed in contact with the uninsulated current-carrying parts.

19.4 Overflow pipes

19.4.1 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.

19.4.2 Compliance with Clause 19.4.1 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.

19.5 Bottom openings

19.5.1 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.

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

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19.5.3 Except as mentioned in Clause 19.5.4, a complete bottom enclosure shall be provided for a freestanding or recessed appliance beneath all wiring and other electrical components not having an individual housing or enclosure.

19.5.4 A complete bottom enclosure is not required for an appliance that complies with Clause 19.5.7 and is intended:

a) to condense the lint-bearing moisture vapour and discharge the condensate into a plumbing system and/or reservoir (i.e., condensation type tumble dryers); or

b) to have all blowers discharge into an exhaust duct and all joints in the duct within the appliance are permanently airtight (i.e., all connections are welded or, in the case of plastics, permanently sealed by adhesives or solvent bonding the parts).

19.5.5 With reference to the requirements in Clause 19.5.3, a bottom enclosure is considered to be complete if:

a) no unused opening has an area of more than 160 mm^2; and

b) the total area of all such openings is no more than 1290 mm^2.

19.5.6 In an appliance other than as mentioned in Clause 19.5.4, arcing parts of a component, such as a switch or thermostat, shall be totally enclosed. However, arcing parts of a component need not be totally enclosed if:

a) the component is located in a separate enclosure, such as a console or other enclosure located outside the enclosure surrounding the drum; and

b) the unused portion of any opening into the enclosure housing the component is not more than 480 mm^2, and the total of all unused openings into that enclosure is not more than 1940 mm^2.

19.5.7 With reference to Clause 19.5.1, a barrier of noncombustible material shall be used to reduce the likelihood that molten metal, burning material, and 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 resulting in the protector cycling and that the temperature will exceed 150°C with the rotor of the motor locked;

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

c) under the grounded sheath of a heater assembly.

19.5.8 The requirement in Clause 19.5.7 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.

19.5.9 The barrier mentioned in Clause 19.5.7 shall:

a) be horizontal;

b) be located as illustrated in Figure 7; and

c) have an area in accordance with Figure 7.

19.5.10 With reference to the barrier mentioned in Clause 19.5.7, openings for drainage, ventilation, and the like may be employed in the barrier if such openings will not permit molten metal, burning insulation, or the like to fall on combustible material.

19.6 Plumbing requirements

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

19.6.2 If a vacuum breaker is installed, it shall comply with the requirements of CSA-B64.1.1 or ANSI/ASSE 1001. It shall be installed downstream from the last valve (including any solenoid) in the water supply system.

19.7 Condensation type dryers

19.7.1 In a clothes dryer provided with a means for condensing the moisture vapour, electrical components shall be located so that there will be no collection of moisture on or flooding of such parts by condensed vapour dripping from pipes, tanks, or the like, or by malfunction of parts of the water system.

19.7.2 The following overflow test shall be conducted if it is not evident that the equipment complies with the requirements of Clause 19.7.1:

a) The appliance equipment shall be positioned as intended in use and investigated for:

1) Overflow of a pan, trough, or the like, at a rate of 30 mL/s for a maximum period of 30 seconds; and

2) Overflow of a blocked drain at a rate of 30 mL/s for a maximum of 30 seconds.

b) As a result of the testing, compliance with Clause 19.7.1 shall be determined by visual examination. Where visual examination is not practical, following each overflow test, the appliance

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shall comply with the leakage current test in Clause 11.1, except the leakage current shall not exceed 5 MIU, and with the electric strength test specified in Clause 14.

19.7.3 The requirements for heat pump clothes dryers are located in Supplement SD.

19.8 Ventilation openings

19.8.1 A ventilation opening in the enclosure, other than in the bottom, that can allow the expulsion of burning insulation, molten metal, or the like shall be provided with a barrier or louvre. Such an opening shall not permit the entrance of a 9.5 mm diameter rod.

20 Internal Wiring

20.1 General

20.1.1 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 cannot be completely enclosed and even though some of it may be in the form of flexible cord.

20.1.2 The internal wiring and connections between parts of an appliance shall be protected or enclosed. A length of flexible cord complying with Clause 22.3.2 may be employed for an external (unenclosed) connection between such parts if flexibility is necessary.

20.1.3 The protection of insulated wiring required by Clause 20.1.2 shall be considered to exist if, when evaluated as though it were film-coated wire, the wiring is acceptable in accordance with Clause 7.2. 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.

20.1.4 A conductor shall not be smaller than 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 0.52 mm^2, but shall not be smaller than 0.21 mm^2.

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

20.1.5 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 the following:

a) CSA C22.2 No. 127 or 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) CAN/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 for Wiring Methods and the National Electrical Cord for Wiring Methods and Materials.

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

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

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

c) Exposure to moisture; and

d) Other conditions to which the wire may be subjected during normal use.

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

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

a) runs vertically; or

b) is supported by a flat, horizontal surface.

20.1.9 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 22.4.2 or shall have smooth surfaces, upon which the wires can bear, free of burrs, fins, sharp edges, and the like, which can result in abrasion of the insulation.

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

20.2 Splices and connections

20.2.1 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 can 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 can be maintained.

20.2.2 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 its becoming loosened due to vibration, if such loosening can result in a risk of fire, electric shock, or injury to persons.

20.2.3 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.

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

20.2.5 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 dielectric strength properties, resistance to heat, resistance to moisture, and the like. Thermoplastic tape wrapped over a sharp edge shall not be acceptable.

20.2.6 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

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connector, a soldering lug, a crimped eyelet, soldering all strands of the wire together, or other equivalent means.

20.2.7 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.

20.2.8 With reference to Clause 20.2.7, 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.

20.3 Separation of circuits

20.3.1 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.

20.3.2 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.

20.3.3 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.

20.4 Overcurrent protection

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

21 Components

21.1 General requirements for components

21.1.1 Except as indicated in Clause 21.1.2, a component of an appliance covered by this Standard shall:

a) Comply with the requirements for that component. A component shall comply with both CSA Group 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;

d) Additionally comply with the applicable requirements of this end product Standard; and

e) Not contain mercury.

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.

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

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a) involves a feature or characteristic not required in the application of the component in the product covered by this Standard;

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

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

21.1.3 A component complying with a CSA Group or UL component standard other than those specified in this Standard is acceptable if the following applies:

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 and National Electrical Code, where appropriate;

2) Considers long-term thermal properties of polymeric insulating materials in accordance with the Standard for Polymeric Materials – Long Term Property Evaluations, 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 may assume user expertise not common in household applications.

21.1.4 A component that is also intended to perform other functions, such as over current 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 Group 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.

21.1.5 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.

21.1.6 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 Group and UL standard, and shall comply with Clause 21.1.1(b) through (d).

21.1.7 With respect to Clause 21.1.6, 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 clothes dryers.

21.2 Mechanical assembly

21.2.1 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.

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21.2.2 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.

21.2.3 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.

21.2.4 Means for 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.

21.2.5 Moisture and lint from the drying operation, unless intentionally collected within the dryer, shall be conveyed to the outside of the enclosure without coming into contact with bare uninsulated live parts. If found to comply with the intent of this requirement, exhaust air that is acceptably filtered may be recirculated through the heater assembly.

21.3 Capacitors

21.3.1 The component requirements for capacitors are not specified except:

a) Capacitors connected across the line or from line to ground shall comply with CSA C22.2 No. 8, CAN/CSA-E60384-1, or CAN/CSA-E60384-14; and UL 60939-3 or UL 60384-14;

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

21.3.2 Capacitors with integral enclosures complying with the standards specified in Clause 21.3.1 are considered to fulfill the requirements of Clause 21.3.3.

21.3.3 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.

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21.3.4 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.

21.3.5 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.

21.3.6 A capacitor complying with UL 810 and CSA C22.2 No. 190 is considered to fulfill the requirements of Clause 21.3.3.

21.3.7 Electromagnetic interference filters with integral enclosures that comply with one of the following standards are considered to comply with the requirements in Clause 21.3.3:

a) UL 60384-14; and

b) CAN/CSA-E60384-14.

21.4 Field-installed devices and accessories

21.4.1 Field-installed devices

21.4.1.1 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 20 and 25;

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 shall be 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.

21.4.2 Field-attached or optional accessories

21.4.2.1 Clauses 21.4.2.2 to 21.4.2.6 apply to accessories intended for installation on or connection to an appliance for the purpose of modifying or supplementing the functions of the appliance.

21.4.2.2 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.

21.4.2.3 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.

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

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

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21.4.2.6 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.

21.5 Heating elements

21.5.1 Sheath-type heating elements shall comply with the following:

a) CSA C22.2 No. 72 and UL 499; or

b) CSA C22.2 No. 72 and UL 1030.

21.5.2 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.

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

21.5.4 An appliance shall be constructed so that the clothes load will be reliably confined to the drum or basket, and will 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.

21.5.5 An appliance in which the heating element is intended for operation only in an air stream shall be wired or controlled so that the element can be operated only when under the cooling effect of the stream. An appliance in which the cooling effect of the motion of a part is necessary to reduce the likelihood of excessive temperatures shall be wired or controlled so that the heating element cannot be operated in the absence of such motion.

Note 1: Controls that could be used to comply with this requirement include centrifugal switches, belt switches, thermally operated switches, and fusible links.

Note 2: More than one control can be necessary if absence of the air can occur at more than one location in the circulation system (e.g., centrifugal switch and a belt switch for motor and belt-drive failure, respectively).

21.5.6 Open-wire, radiation-type heater elements shall be the subject of investigation to determine the extent of guarding required and the precautions necessary to reduce the likelihood of collection of lint on the heater element. Openings in the dryer drum or guard in front of the element shall have no dimensions greater than 8 mm.

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21.6 Lampholders

21.6.1 Lampholders and indicating lamps shall comply with CSA-C22.2 No. 250.13 and UL 8750.

21.6.2 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 Group and UL Standards.

21.6.3 Light emitting diode (LED) light sources shall comply with CSA C22.2 No. 250.4 and UL 8750, unless the LED light source forms a part of a luminaire complying with the appropriate CSA Group 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.

21.6.4 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.

21.6.5 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.

21.6.6 Lamps shall be provided with a means to reduce the likelihood of damage, either by their location or by the provision of an acceptable guard.

21.7 Motors

21.7.1 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 can be integral with the control of the appliance, responsive to motor current, as required by the Canadian Electrical Code and the National Electrical Code, for overload and overheating, and which is sized in accordance with Clauses 21.7.4 and 21.7.5;

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

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

21.7.2 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.

21.7.3 The duration of the locked-rotor test required by Clause 21.7.1 for automatically reset motor-protective devices may be less than 15 days if the protective device permanently opens the circuit in a shorter time, or if the appliance includes other controls, such as a timer, that will positively and reliably limit the operation to a shorter interval.

21.7.4 A separate protective device incorporated in an appliance in accordance with Clause 21.7.1(a), shall be responsive to the motor current, and shall be rated or set in accordance with Table 4.

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21.7.5 With reference to the requirements in Clause 21.7.4, each winding connection of a multispeed motor shall be considered separately.

21.8 Motor overload-protective devices

21.8.1 Overload-protective devices for motors shall comply with the tests specified in Clauses 21.8.2 to 21.8.4. 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.

21.8.2 Protective devices for motors rated 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.

21.8.3 Protective devices for motors rated more than 373 W or more than 250 V shall be tested as in Clause 21.8.2, except that the short-circuit current shall be limited to 1 000 A.

21.8.4 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.

21.9 Protective devices

21.9.1 The accessibility of protective devices shall be determined by the requirements in Clauses 21.9.2 – 21.9.6.

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

21.9.3 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.

21.9.4 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.

21.9.5 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.

21.9.6 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.

21.10 Receptacles

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

Note 1: Stacked clothes dryers may be provided with a dedicated receptacle for the connection of a clothes washer.

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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.

21.10.2 A clothes dryer intended to be stacked on a clothes washer and provided with a dedicated receptacle shall comply with the requirements in Clauses 21.10.3 – 21.10.5.

21.10.3 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 or 250 V.

21.10.4 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 20.

21.10.5 A marking identifying the clothes washer to be used with the dedicated receptacle shall be provided adjacent to the dedicated receptacle; see Clause 6.1.2.36.

21.11 Seals and diaphragms

21.11.1 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.

21.11.2 The test procedure for determining whether a component complies with the requirement in Clause 21.11.1 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 aging, as well as comparison of hardness, tensile strength, and elongation before and after artificial aging.

21.11.3 With reference to Clauses 21.11.1 and 21.11.2, a noncomposite material, when tested to compare its tensile strength and elongation before and after artificial aging, 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.

21.12 Switches

21.12.1 Switches shall be acceptable for the application, and shall have a current and voltage rating not less than that of the load they control when the appliance is operated normally. For switches that comply with C22.2 No. 61058-1 and UL 61058-1, see Clause 21.15.3.

Note: Refer to Clause 21.13 for requirements relating to controls with a switching function.

21.12.2 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 21.12.8.

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

21.12.4 Switches 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 (e.g., motor centrifugal switch).

21.12.5 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

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that is necessary for a motor to change from the start winding to the main winding so that the motor will attain running speed.

21.12.6 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 21.12.7. 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.

21.12.7 In a test to determine whether a switch or other control device complies with the requirement in Clause 21.12.6, the appliance shall be connected to a supply circuit of rated frequency and 110 percent 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/minute. However, with the concurrence of those concerned, a faster rate of operation may be employed.

21.12.8 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 or CAN/CSA-C22.2 No. 61058-1, and UL 1054 or UL 61058-1.

21.12.9 If a cord-connected appliance employs a motor rated more than 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.

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

21.13 Controls

21.13.1 General

21.13.1.1 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.

21.13.1.2 Except as specified in Clause 21.13.4 through Clause 21.13.6, controls shall comply with the standards specified in Clause 21.13.2 for operating controls or Clause 21.13.3 for protective controls.

21.13.1.3 Where reference is made to CAN/CSA-E60730 or UL 60730, this shall include both the Part 1 Standard and any applicable Part 2 Standards.

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

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

21.13.2 Operating controls

21.13.2.1 An operating control shall comply with:

a) CSA C22.2 No. 156, CSA C22.2 No. 24, or CAN/CSA-E60730; and

b) UL 244A, UL 873, or UL 60730.

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Alternatively, an operating control shall comply with the electronic circuit requirements specified in Supplement SB.

21.13.2.2 The cycle selection control, 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.

21.13.2.3 The minimum test parameters for the evaluation of an operating control to CAN/CSA-E60730 and UL 60730 are specified in Table 16.

21.13.2.4 For commercial appliances, as an alternative to the requirements in Clause 21.13.2.1, power conversion equipment intended to control a variable speed motor load (e.g. a variable frequency drive) can comply with UL 61800-5-1. For power conversion equipment that is also provided with electronic motor-overload protection functionality, the motor-overload requirements specified in Clause 21.7 are applicable.

21.13.3 Protective controls

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

a) CSA C22.2 No. 24, CAN/CSA-E60730, or CSA E60691; and

b) UL 244A, UL 873, UL 60691, or UL 60730.

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

a) CSA C22.2 No. 0.8 or CAN/CSA-E60730; and

b) UL 991 and UL 1998, or UL 60730.

Alternatively, an electronic protective control shall comply with the electronic circuit requirements specified in Supplement SB.

21.13.3.3 Electronic motor protection shall be evaluated in accordance with Clause 21.7.1(c), or the electronic circuit requirements specified in Supplement SB.

Note: In the application of the Supplement SB requirements, see Clause SB1.8.

21.13.3.4 Electronic protective controls, not relying on software as a protective component, shall comply with the standards specified in Clause 21.13.3.2, 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 17.

21.13.3.5 The secondary function control (Clause 17.6.2), door interlock (Clauses 17.1.2, 17.7.1(b) and 17.7.2), door lock (Clauses 17.7.1(a)), electronic braking means (Clause 17.7.1(b)), motor overload protection (Clause 21.7), temperature-limiting devices, combination temperature-regulating and -limiting devices, and any control relied upon for compliance with the abnormal operation testing of Clauses 16, 28.14, or 28.15 are considered and shall be tested and evaluated as protective controls.

21.13.3.6 The test parameters and conditions used in the investigation of the electronic protective control as specified by Clause 21.13.3.2 to UL 991 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.

21.13.3.7 The minimum test parameters for the evaluation of a protective control to CAN/CSA-E60730 and UL 60730 are specified in Table 17.

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21.13.4 Temperature-regulating and temperature-limiting devices

21.13.4.1 Protective temperature sensing controls shall have cut-in and cut-out temperatures that do not:

a) deviate from the manufacturer's specified limits in the as-received condition by more than either 6°C or 5 percent, whichever is greater; and

b) drift from the temperatures measured in the as-received condition by more than either 6°C or 5 percent, whichever is greater, after being subjected to the specified number of cycles per Table 17 and, for electronic protective controls, the environmental stress tests of UL 991 or Clause H.26 of CAN/CSA-E60730-1 or UL 60730-1. If the manufacturer declares a tighter tolerance, the deviation and drift shall remain within the manufacturer's declared values.

21.13.4.2 A temperature sensing device, such as a positive temperature coefficient (PTC) thermistor or a negative temperature coefficient (NTC) thermistor, when used in conjunction with an electronic control to perform the same function as a thermostat shall comply with:

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

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

Alternatively, a temperature sensing device shall comply with the electronic circuit requirements specified in Supplement SB.

21.13.4.3 A temperature-limiting device that is relied upon for compliance with the requirements in Clauses 16.5.2 to 16.5.5 shall:

a) be of the manual-reset or non-resettable type; and inaccessible to the user without the use of tools; or

b) de-energize the heating element and the drum-driving force (motor) and necessitate that:

1) the appliance can only be manually restarted for a maximum of five times; or

2) the appliance can only be manually restarted for a maximum of ten times if a visual and/or audible indication is provided indicating a failure condition

21.13.5 Cycle selection controls

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

a) CSA C22.2 No. 177; or

b) CAN/CSA-E730-2-7, and UL 917 or UL 60730-2-7.

Alternatively, a cycle selection control shall comply with the electronic circuit requirements specified in Supplement SB.

21.13.5.2 A cycle selection control incorporating electronic timing or switching circuits, shall comply with the standards specified in Clause 21.13.2.1.

21.13.5.3 If the cycle selection control incorporates electronic secondary function controls for compliance with Clause 17.6.1(c), the control shall be evaluated as specified in Clause 21.13.3. The endurance test shall be conducted in accordance with Clause 17.6.8.

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21.13.6 Door interlock or lock protective controls

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

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

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

c) CSA C22.2 No. 14 and UL 508.

For switches complying with C22.2 No. 61058-1 and UL 61058-1, see Clause 21.15.3.

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

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

21.14 Solenoids

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

a) A spring shall be protected against abrasion and shall be guided or arranged to reduce binding, buckling, or other interference with its free movement.

b) Protective devices may be used to interrupt the flow of current to the solenoid coil. If an integral protective device is provided, it shall be located inside the overwrap insulation of the solenoid coil.

c) Insulation between a crossover lead and the winding to which it is connected is not specified if the coil withstands the induced potential test described in Clause 21.14.2.

d) a slot in a molded bobbin for guiding the crossover or start-lead – unspliced at the windings – of a magnet-coil shall be filled with an insulating material unless:

1) the slot provides a graduated spacing to the winding increasing to the end turns; and

2) the magnet-coil winding withstands the induced potential test described in Clause 21.14.2.

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

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

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

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

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

21.15 Switches and controls

21.15.1 Switches shall comply with the following, as applicable:

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

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

c) C22.2 No. 111 and UL 20.

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

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

21.15.4 Power switches shall be rated as follows:

a) For a voltage not less than the rated voltage of the appliance;

b) For a current not less than the rated current of the appliance;

c) For Continuous Duty;

d) With respect to load

1) Switches for motor-operated appliances: for resistance and motor load if the switch would encounter this load in normal use; or

2) Switches may be regarded as switches for a declared specific load and may be classified based upon the load conditions encountered in the appliance under normal load.

e) For ac if the appliance is rated for ac;

f) For dc if the appliance is rated for dc.

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

a) Power and door-interlock switches: 6000 cycles;

b) Power switches provided with series electronics shall be subject to an additional 1000 cycles of operation with the electronics bypassed;

c) Switches other than power switches, such as speed selector switches, that may be switched under electrical load: 1000 cycles;

d) The following non-power switches are not required to be rated for endurance:

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

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

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

21.16 Overcurrent protection

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

21.16.2 Fuseholders shall comply with the following:

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

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

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

21.17 Electrically operated valves

21.17.1 Electrically operated valves shall comply with the following:

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

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

21.18 Terminals and connectors

21.18.1 Terminals and connectors shall comply with the following:

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

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

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

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

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

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

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

21.19 Pumps

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

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21.20 Insulating devices

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

a) CSA C22.2 No. 18.5 and UL 1565 for wire positioning devices; or

b) UL 635 for insulating bushings.

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

21.21 Adhesives used to secure parts

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

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

a) energize an accessible dead metal part;

b) make a live part accessible;

c) reduce spacings below the minimum acceptable values; or

d) short-circuit live parts.

21.22 Transformers and power supplies

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

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

21.22.3 General purpose transformers shall comply with:

a) CSA C22.2 No. 66.2; and

b) UL 5085-2.

21.22.4 Class 2 power supplies shall comply with:

a) CSA C22.2 No. 223 and UL 1310; or

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

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

a) CSA C22.2 No. 107.1 and UL 1012; or

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

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21.23 Button or coin cell batteries of lithium technologies

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

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

b) the appliance is intended for household use.

22 Supply Connection and External Flexible Cords

22.1 General

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

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

22.2 Permanently connected appliances

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

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

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

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

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

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

a) flexible metallic conduit with conductors; or

b) armored cable;

to extend the point of supply to an accessible location.

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

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

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

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

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

a) have the minimum width of flat surface surrounding the opening as specified in Table 5; or

b) be acceptable when the test gauge for flat surfaces surrounding knockout is applied as specified in CSA-C22.2 No. 0.5 and UL 514A.

22.2.8 A household appliance shall be marked in accordance with Clause 6.1.2.32 if it:

a) has a knockout with a diameter of 21.9 mm minimum to 23.0 mm maximum; or

b) is only intended to be connected to the power supply by means of permanent wiring brought into the appliance.

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

a) two knockouts (concentric or eccentric);

b) an opening inside a knockout;

c) a reducing fitting in an opening; or

d) a single knockout or opening sized in accordance with Table 6.

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

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

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

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

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

22.3 Cord-connected appliances

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

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

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

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

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

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

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

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

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

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

22.3.9 The cord length shall not be less than:

a) 1.8 m for an appliance provided with casters; or

b) 1.5 m for an appliance not provided with casters.

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

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

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

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

a) can subject the cord to mechanical damage or to exposure to a temperature higher than that for which the cord is rated; or

b) can reduce spacings, such as to a metal strain-relief clamp, below the minimum acceptable values.

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

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

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

22.4 Bushings

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

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

23 Terminals for External Conductors

23.1 Wiring terminals or leads intended for connection of the conductors of the supply circuit shall be acceptable for the connection of conductors having an ampacity not less than the rating of the branch circuit marked on the appliance. Leads for supply connection are acceptable only for appliances requiring 3.3 mm^2 or smaller supply conductors.

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

Note: A wire-binding screw can be employed at a wiring terminal intended to accommodate a 5.3 mm^2 or smaller conductor if upturned lugs or the equivalent are provided to hold the wire in position.

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

23.4 A wire-binding screw shall thread into metal.

23.5 A wire-binding screw at a wiring terminal shall not be smaller than M5. A M4 screw may be used at a terminal intended only for the connection of a 2.1 mm^2 conductor.

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

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

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

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23.8 Upturned lugs or a cupped washer shall be capable of retaining a conductor of the size mentioned in Clause 23.1, but not smaller than 2.1 mm^2, under the head of the screw or the washer.

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

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

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

a) a lamp- or element-holder of the Edison-screw-shell type;

b) a single-pole switch; or

c) a single-pole automatic control;

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

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

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

24 Provision for Grounding

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

24.1 General

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

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

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

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

a) bare or provided with insulation having an outer surface that is green with or without one or more yellow stripes;

b) connected to the grounding blade of an attachment plug of the grounding type; and

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

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

a) only electrical components of the appliance are the motor and power-supply cord;

b) power-supply cord enters the motor without being attached to or passing through any other part of the appliance; and

c) motor is mounted in resilient mounting rings that provide between the frame of the motor and all other non-current-carrying metal parts of the appliance:

1) a spacing of not less than 3.2 mm; and

2) insulation resistance measured as described in Clause 11.2 of not less than 50 000 Ω.

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

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

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

a) a small metal part such as an adhesive-attached foil marking, a screw, or a handle that is:

1) on the exterior of the enclosure and separated from all electrical components by grounded metal; or

2) electrically isolated from all electrical components;

b) a panel, cover, or other metal part that is isolated from all electrical components, including wiring, by a barrier or vulcanized fibre, varnished cloth, phenolic composition, or other moisture-resistant insulating material not less than 0.8 mm thick and secured in place;

c) a panel, cover, or other metal part that does not enclose uninsulated current-carrying parts and that is electrically isolated from other electrical components; and

d) a door or the like that can only become energized through a grounded part;

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

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

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

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24.2 Neutral-grounding link

Note: The CE Code, Part I does not permit the use of neutral-link grounding on products intended to be installed in Canada.

24.2.1 An appliance having a nominal rating of 120/208 or 120/240 V shall be equipped with a detachable link or the equivalent by which the non-current-carrying metal parts can be connected to the grounded wiring terminal.

24.2.2 The link mentioned in Clause 24.2.1 shall be located so that it will be readily visible at the field wiring terminals after the appliance has been installed as intended.

24.2.3 The connection between the grounding link mentioned in Clause 24.2.1 and the grounded terminal shall be made at the factory (see Clause 6.1.3).

24.2.4 An appliance provided with a 4-conductor power-supply cord having a bonding conductor shall not be provided with the link mentioned in Clause 24.2.1, and the bonding conductor of the flexible cord shall be connected to the equipment-grounding terminal.

24.2.5 A neutral-grounding link or the equivalent shall not be coloured green.

24.3 Bonding for grounding

24.3.1 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. The likelihood of corrosion of a ferrous metal part in the grounding path shall be reduced by enameling, galvanizing, plating, or other equivalent means.

24.3.2 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.

24.3.3 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.

24.3.4 The bonding connection shall penetrate nonconductive coatings such as paint or vitreous enamel.

24.3.5 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.

24.3.6 If the adequacy of a bonding connection cannot be determined by examination, it shall comply with the requirement in Clause 24.3.11.

24.3.7 A bonding conductor shall have a cross-sectional area not less than that of the bonding conductor of the power-supply cord.

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24.3.8 A bonding conductor:

a) may be smaller than specified in Clause 24.3.7 if it complies with the requirements in Clause 24.3.12; or

b) for a component or separate electrical enclosure, may be smaller than specified in Clause 24.3.7, but not be smaller than the conductors supplying power to the component or components within the separate enclosure.

24.3.9 A bonding conductor intended to be permanently connected to the power supply shall not be smaller than the size specified in Table 7, except as provided in Clause 24.3.8.

24.3.10 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 ground-fault protection 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 ground-fault protection of the motor.

24.3.11 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 8.

24.3.12 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 percent of the rating of the appropriate branch-circuit protective device for the time specified in Table 8.

24.4 Continuity of grounding circuit

24.4.1 The resistance between the point of connection of the equipment-grounding means, at or within the appliance, and any point in the grounding circuit shall not be more than 0.1 Ω.

24.4.2 With reference to Clause 24.4.1, 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-grounding 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 to be included in this measurement.

24.5 Grounding terminals and leads

24.5.1 A wiring terminal or lead for attaching an equipment-bonding conductor shall be provided and shall comply with the requirements in Clause 23.

24.5.2 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.

24.5.3 A wire-binding screw intended for the connection of an equipment-bonding conductor shall have a green-coloured head that is hexagonal, slotted, cross-slotted (Phillips), or any combination of these three

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heads. A pressure terminal connector intended solely for the connection of such a conductor shall be marked in accordance with Clause 6.1.2.35. 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.

24.5.4 A lead intended for attaching an equipment-bonding conductor shall not be smaller than the wire to which it is intended to be connected.

24.5.5 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.

25 Screws and Connections

25.1 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.

26 Creepage Distances, Clearances, and Distances Through Insulation

26.1 Spacings

26.1.1 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 value specified in Table 9. 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.

26.1.2 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.

26.1.3 The spacing requirements specified in Clause 26.1.1 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 9.

26.1.4 Film-coated wire shall be regarded as an uninsulated current-carrying part when spacings are being considered.

26.1.5 At terminal screws and studs to which connection can 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 9 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.

26.1.6 An insulating liner or barrier of vulcanized fibre or similar material employed in lieu of spacings shall:

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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 percent of the spacing required for air alone.

26.2 Alternate spacings – clearances and creepage distances

26.2.1 As an alternative to the specified spacing requirements of Clause 26.1, the spacing requirements in CSA C22.2 No. 0.2 and UL 840 may be used. The spacing requirements in CSA C22.2 No. 0.2 and UL 840 shall not be used for spacings:

a) between field wiring terminals; or

b) between uninsulated current-carrying parts and a metal enclosure.

26.2.2 Appliances shall be considered overvoltage category 2 as specified in CSA C22.2 No. 0.2 and UL 840.

26.2.3 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.

26.2.4 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.

26.2.5 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.

26.2.6 A device having exposed Class 2 outputs that:

a) can be contacted during normal operation or user servicing; and

b) has clearances between the Class 2 circuit and an overvoltage-protected line-voltage circuit that have been evaluated in accordance with Clearance B requirements 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.

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27 Resistance to Rusting and Corrosion

27.1 Iron and steel parts shall be provided with a means to reduce the likelihood of corrosion, such as enameling, 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.

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 might not be required to be protected against corrosion.

Note 2: Bearings, laminations, or minor parts of iron or steel, such as washers, screws, or the like, need not be protected against corrosion.

27.2 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.

28 Polymeric Materials

28.1 General

28.1.1 The requirements of Clause 28 apply to polymeric materials, including thermoset materials, used as enclosures, functional polymeric parts, decorative parts, nonfunctional polymeric parts or liquid containers.

28.1.2 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.

28.1.3 Table 10 specifies the tests applicable to polymeric parts. Table 11 specifies what tests shall be conducted on each part, dependent on its use.

28.1.4 Polymeric material employed to support a live part, in direct contact with an uninsulated live part, or in the vicinity of an uninsulated 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:

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 dead metal parts that may be grounded in service or any surface exposed to user contact.

2) In lieu of volume resistivity requirement the leakage current test of Clause 11 may be conducted to determine compliance.

b) comparative tracking index (CTI) of at least 175 volts (PLC 3 – see note (a) of Table 12) for a moderately contaminate environment. 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; and

Note: See the Figurative examples in UL 746C, Figure 6.1, examples 2, 3, and 4, or CAN/CSA-C22.2 No. 0.17 if additional clarification is needed.

c) a high current arc ignition (HAI) and hot-wire ignition (HWI) as specified in Table 12:

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.

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.

28.1.5 In reference to Clause 28.1.4(c), the high current arc ignition of a material need not be evaluated when:

a) The spacing over the surface of the material is at least 12.7 mm between:

1) Uninsulated live parts of opposite polarity; and

2) Uninsulated live parts and grounded non-current-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 dryer; or

c) The uninsulated live parts are part of a low-power circuit, where the maximum power available does not exceed 15 W.

28.1.6 In reference to Clause 28.1.4(c), the hot wire ignition of a material need not be evaluated when:

a) the material is evaluated by conducting the abnormal overload test or end-product glow-wire test of UL 746C; or

b) the uninsulated live parts are part of a low-power circuit, where the maximum power available does not exceed 15 W.

28.1.7 In reference to Clause 28.1.4, 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.

28.1.8 With respect to Clause 28.1.4(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.

28.2 Mould stress relief

28.2.1 A polymeric part shall be tested as specified in the mould stress relief test in CAN/CSA-C22.2 No. 0.17 and UL 746C. As a result of this test:

a) Spacings shall not be reduced to less than those specified in Table 9;

b) Current-carrying parts or internal wiring shall not be exposed, as determined in accordance with Clause 7;

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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 aging test, Clause 28.11.

28.3 Horizontal burning rate

28.3.1 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.

28.4 Flammability

Note: See Figure 12 for guidance in the application of Clause 28.4.

28.4.1 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 have a flammability rating of 5VA or 5VB.

28.4.2 In reference to Clause 28.4.1, materials not classified 5VA or 5VB may be tested in accordance with the 5V flame test in CAN/CSA-C22.2 No. 0.17 and the 127 mm flammability test described in UL 746C using parts moulded from the polymeric material.

28.4.3 If a metal or 5VA 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 28.4.4).

28.4.4 In addition to complying with the relevant requirements of Clause 28.4.3, 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 Clause 28.4.7 including connections to the components specified in Clause 28.4.6.

28.4.5 In reference to Clauses 28.4.3 and 28.4.4, 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.

28.4.6 In reference to Clause 28.4.4, 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; UL 1054, C22.2 No. 43 and UL 496; C22.2 No. 42 and UL 498; or C22.2 No. 55 and C22.2 No. 61058-1/UL 61058-1) with respect to resistance to ignition, resistance to arcing, or overload and endurance testing.

28.4.7 All electrical connections where the total circuit load is greater than 60 watts during normal operation shall:

a) comply with Clauses 28.4.10, 28.4.11, and 28.4.12; or

b) be evaluated as specified in Clause 16.8.

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 at the end of 5 seconds. To deliver 15 watts at a connector, the

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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.

28.4.8 Electrical connections are not required to comply with Clause 28.4.7 when all mating parts of the electrical connection are provided with a component (e.g. 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 28.4.7.

28.4.9 The requirements in Clause 28.4.7 shall not apply to welded or soldered connections.

28.4.10 With reference to Clause 28.4.7, components such as wire, tubing, sleeving, or tape that are located within 3 mm of an electrical connections as shown in Figure 10 shall have a flammability classification as follows:

a) VW-1 for wire evaluated in accordance with UL 2556/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

c) evaluated in accordance with CSA C22.2 No. 197 and UL 510 or UL 510A for flame-retardant insulating tape.

Note: UL 510 covers tape rated up to 80 C, and UL 510A covers tape rated greater than 80 C.

28.4.11 With reference to Clause 28.4.7, polymeric materials located within 3 mm of an electrical connection as shown in Figure 10 shall have a flammability classification as follows:

a) a minimum V-0 or VTM-0, in accordance with CAN/CSA-C22.2 No. 0.17 and UL 94;

b) a minimum SC-0 or SCTC-0, in accordance with CAN/CSA-C22.2 No. 0.17 and UL 1694;

c) 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 persists for no longer than 2 seconds.

Note: Testing of alternate materials for a given part within 3 mm of the electrical connection is not required when the test of Clause 16.8 is performed on the minimum specified flame rated material.

28.4.12 With reference to Clause 28.4.7, all non-metallic 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 non-metallic parts that are supporting current-carrying electrical connections as shown in Figure 11 shall have a flammability classification as follows:

a) A minimum of V-0, VTM-0, or HF-1, in accordance with CAN/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 CAN/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 28.4.10.

Note 1: Testing of alternate materials within the cylinder is not required when the test of Clause 16.8 is performed on the minimum specified flame rated material.

Note 2: The requirement does not apply to parts having a mass less than 0.5 g which are considered insignificant parts, provided the cumulative effect of insignificant parts located within 3 mm of each other is unlikely to propagate flames that originate inside the appliance by propagating flames from one insignificant part to another.

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28.4.13 With reference to Clause 28.4.12 and Figure 11, 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 11. 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 11. The flame cylinder shall project through all metallic and non-metallic 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 16.8.

28.5 6.8 J impact (ambient and low temperature)

28.5.1 A polymeric part shall be subjected to the impact test specified in Clause 28.5.2. As a result of the impacts:

a) spacings shall not be reduced to less than those specified in Table 9;

b) current-carrying parts or internal wiring shall not be exposed, as determined in accordance with Clause 7; and

c) there shall be no damage that would increase the risk of fire, electric shock, or injury to persons.

28.5.2 Samples of the polymeric part shall be subjected to the impact test described in CAN/CSA-C22.2 No. 0.17 and UL 746C. 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.

b) For Group B, the tests shall be performed on samples that have been conditioned to the low-temperature conditioning specified in UL 746C for indoor equipment. The samples shall be subjected to the impact while still cold.

Note: If the size of the surface is such that the results of a second or third impact would be affected by previous impacts, only one impact needs to be performed.

28.6 Static load

28.6.1 A polymeric part on which a person could stand shall be subjected to the loading described in Clauses 28.6.2 and 28.6.3. As a result of the loading:

a) spacings shall not be reduced to less than those specified in Table 9;

b) current-carrying parts or internal wiring shall not be exposed, as determined in accordance with Clause 7; and

c) a condition shall not be produced that would increase the risk of fire, electric shock, or injury to persons.

28.6.2 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 28.2.

28.6.3 Two hardwood or equivalent material boards having rounded edges and corners, each 25.4 mm thick by 86.5 mm wide by 127 mm long, and separated by a distance of 25.4 mm along the 127 mm edge, shall be placed on the surface under investigation. A 400 N force shall be applied simultaneously to each board for 3 minutes. The test might need to be repeated 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.

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28.7 56.7 J impact

28.7.1 A polymeric part on which a person could jump shall be subjected to the impact described in Clauses 28.7.2 and 28.7.3. As a result of the impact:

a) spacings shall not be reduced to less than those specified in Table 9;

b) current-carrying parts or internal wiring shall not be exposed, as determined in accordance with Clause 7; and

c) there shall be no damage that would increase the risk of fire, electric shock, or injury to persons.

28.7.2 The test shall be conducted on as-received samples.

28.7.3 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 might need to be repeated on different areas of the sample. A different sample shall be used for each subsequent test if the preceding test damages or reduces the integrity of the part.

Note: This test may be conducted at different height and weight combinations resulting in 56.7 J, provided they are not less severe than if conducted as specified.

28.8 Thermal cycling

28.8.1 A polymeric part shall be tested as described in Clause 28.8.2. The part shall show no cracking, leakage, or deterioration that would increase the risk of fire, electric shock, or injury to persons.

28.8.2 Three samples of the polymeric part shall be subjected to 50 cycles of thermal cycling, with each cycle consisting of 1 hour 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 hour in a room ambient of 25°C.

28.9 Crush resistance

28.9.1 Three complete as-received samples of the polymeric enclosure shall each withstand the crushing force specified in the crush-resistance test described in CSA C22.2 No. 94.1 and UL 746C.

28.10 Hot-wire ignition

28.10.1 A polymeric material shall be tested as described in Clause 28.10.2. 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.

28.10.2 Bar specimens shall be subjected to the hot-wire-ignition test specified in CAN/CSA-C22.2 No. 0.17 and UL 746A.

28.11 Thermal aging

28.11.1 A polymeric part shall be tested as described in Clause 28.11.2. As a result of the test:

a) spacings shall not be reduced to less than those specified in Table 9;

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b) current-carrying parts or internal wiring shall not be exposed, as determined in accordance with Clause 7;

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.

28.11.2 Three complete samples of the polymeric part shall be placed in an oven for 1 000 hours at the temperature specified in Table 13. The parts shall be removed from the oven, cooled to room temperature, and examined for compliance with the requirements of Clause 28.11.1.

28.12 Volume resistivity

28.12.1 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.

28.13 Enclosure flammability – large mass consideration

28.13.1 A polymeric part shall be composed of the material that is to be tested as described in CAN/ULC-S102 and UL 723 or UL 94. The flame-spread rating of the part shall not exceed 200.

28.14 Abnormal operation test on enclosures

28.14.1 A polymeric enclosure shall be tested as described in Clause 28.14.2. There shall be no:

a) ignition of the enclosure material;

b) exposure of current-carrying parts, as determined in accordance with Clause 8; or

c) deformation or damage that would increase the risk of fire, electric shock, or injury to persons.

28.14.2 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 test shall be continued until ultimate results occur, but no longer than 7 hours. If the appliance is provided with a timer or the equivalent that will terminate operation in less than 7 hours, the test need not be continued longer than the maximum interval permitted by the timer.

28.15 Abnormal operation test on functional polymeric parts

28.15.1 A functional polymeric part shall be tested as described in Clause 28.15.2. 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.

28.15.2 A functional polymeric part located below a motor, solenoid, relay component, transformer, 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

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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 hours. If the appliance is provided with a timer or the equivalent that will terminate operation in less than 7 hours, 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.

28.16 High-current arc ignition

28.16.1 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.

29 Manufacturing and Production Tests

29.1 Plumbing system leakage test

29.1.1 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.

29.2 Grounding continuity test

29.2.1 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 can become energized.

29.2.2 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 29.2.1.

29.2.3 Only a single test need be conducted if the accessible metal selected is conductively connected to all other accessible metal.

29.3 Electric strength test

29.3.1 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.

29.3.2 The test shall be conducted in accordance with either condition A or condition B of Table 14.

29.3.3 The appliance may be in a heated or an unheated condition for the test.

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29.3.4 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.

Note 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.

Note 2: The test may be conducted before final assembly if the test represents that for the completed appliance.

29.3.5 An appliance employing a solid-state component that is not relied upon to reduce the risk of electric shock and that can be damaged by the electric strength potential can 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 14. The circuitry can 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.

29.3.6 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.

29.3.7 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.

29.3.8 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.

29.3.9 Test equipment other than that described in Clauses 29.3.6 to 29.3.8 may be used if found acceptable to accomplish the intended factory control.

29.3.10 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.

Note 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.

Note 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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TABLES

Table 1
Minimum acceptable distance from an opening to a part that can involve a risk of electric shock

(See Clauses 7.1, 7.2, and 7.9.)

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 7.5.

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 10.1.1, 10.1.3, 10.1.6, and 16.7.1.)

	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	65
	2) resistance method	75
	b) a totally enclosed motor	
	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]

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Table 2 Continued

	Location	°C
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]
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
16	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, in	d
	a) an open motor by the thermocouple or resistance method	120
	b) a totally enclosed motor; thermocouple or resistance method	125
17	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

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Table 2 Continued

Location			°C
18	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.

[b] 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

[c] For an automatic appliance, 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 Clause 10.1.6).

[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 have 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 may 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.

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Table 3
Surface temperatures

(See Clause 10.10.)

Surface	Temperature rise (°C) [d]		
	Surfaces of appliances situated not more than 915 mm above the floor after installation		Surfaces situated more than 915 mm above the floor after installation [e]
	Front surfaces [f]	Other surfaces	
Bare metal	40	45	45
Coated metal [b]	45	55	55
Glass and ceramic	55	60	60
Rubber, plastic and plastic coating > 0,4 mm [a, c]	60	65	65

Table 3 Continued on Next Page

Table 3 Continued

Surface	Temperature rise (°C) [d]		
	Surfaces of appliances situated not more than 915 mm above the floor after installation		Surfaces situated more than 915 mm above the floor after installation [e]
	Front surfaces [f]	Other surfaces	

[a] When the thickness of plastic coating does not exceed 0.4 mm, the temperature rise limits of coated metal or glass and ceramic apply.

[b] Metal is considered coated when a coating having a minimum thickness of 90 µm made by enamel or non-substantially plastic coating is used.

[c] The temperature rise limit applies also for plastic material having a metal finish of thickness less than 0.1 mm.

[d] Temperature rises are not measured on:

– the underside of appliances intended to be used on a working surface or floor;

– the rear surface of appliances which, according to the instructions, shall be placed against a wall; and

– the hot water supply fittings and hoses

[e] For top horizontal surfaces less than 1830 mm from the floor, the temperature rise limits for front surfaces not more than 915 mm above the floor apply.

[f] For door handles and knobs, regardless of installation height above the floor, the temperature rise limits for front surfaces not more than 915 mm above the floor apply.

Table 4
Maximum rating or setting of overcurrent-protective device

(See Clause 21.7.4.)

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 5
Sizes of flat surfaces surrounding connection openings

(See Clause 22.2.7.)

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

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Table 6
Clothes dryer connection opening sizes

(See Clauses 22.2.9 and 22.3.8.)

Rating, W		Nominal diameter of connection opening,[a] mm
120/240 V, 3-wire	120/208 V, 3-wire	
> 0 ≤ 7 200	> 0 ≤ 6 240	28.17
> 7 200 ≤ 9 600	> 6, 240 ≤ 8 320	34.93
> 9 600 ≤ 12 000	> 8 320 ≤ 10 400	44.04
[a] Tolerance of opening diameter +0.79 mm, −0.38 mm.		

Table 7
Minimum acceptable size of bonding conductor on an appliance intended to be permanently connected to the power supply

(See Clause 24.3.9.)

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 8
Duration of overcurrent test

(See Clauses 24.3.11 and 24.3.12.)

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 9
Minimum spacings

(See Clauses 26.1.1, 26.1.3, 26.1.5, 28.2.1, 28.5.1, 28.6.1, 28.7.1, and 28.11.1.)

Spacing involved	Spacings, mm			
	≤ 300 V		> 300 ≤ 600 V	
	Through air	Over surface	Through air	Over surface
a) At field wiring terminals [a]				
1) between current-carrying parts 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) between current-carrying parts and the enclosure	12.5	12.5	12.5	12.5
b) At points other than field wiring terminals and closed-in points				
1) between current-carrying parts of opposite polarity, and between current-carrying parts and non-current-carrying metal parts other than enclosures	1.6[b]	1.6[b]	6.3	6.3
2) between current-carrying parts and the enclosure	6.3	6.3	12.5	12.5
3) between open-coil heating elements and the heater enclosure under any test condition	6.3		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.

[b] At open-coil heating element insulators, the spacings through air and over the surface from the heating element to non-current-carrying metal parts shall be not less than 3.2 mm.

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Table 10
Polymeric materials test summary

(See Clause 28.1.3.)

Test No.	Test
1	Mould stress-relief test (7 h), Clause 28.2.
2	Horizontal burning-rate test, Clause 28.3.
3	Flammability test, Clause 28.4.
4	6.8 J impact test, Clause 28.5.
5	Static load test, Clause 28.6.
6	56.7 J impact test, Clause 28.7.
7	Thermal cycling test, Clause 28.8 (This test is not applicable).
8	Crush resistance test, Clause 28.9.
9	Hot-wire-ignition test, Clause 28.10.
10	Thermal aging test, Clause 28.11.
11	Volume resistivity test, Clause 28.12.
12	Enclosure flammability – large mass consideration, Clause 28.13.
13	Abnormal operation test on enclosures, Clause 28.14.
14	Abnormal operation test on functional polymeric parts, Clause 28.15.
15	High-current arc-ignition test, Clause 28.16.

Table 11
Tests on a polymeric part

(See Clause 28.1.3.)

Group[a]	Description	Applicable test number[b]
1	A decorative or nonfunctional part	2, 12[c,d]
2	A functional polymeric part subjected to a temperature of not more than 65°C and not subjected to impact	1, 2, 12[c,d], 14
3	A functional polymeric part subjected to a temperature of not more than 65°C and subjected to impact	1, 2, 4, 5[e], 6[e], 12[c,d], 14
4	A functional polymeric part subjected to a temperature of more than 65°C and not subjected to impact	1, 2, 10[h], 12[c,d], 14
5	A functional polymeric part subjected to a temperature of more than 65°C and subjected to impact	1, 2, 4, 5[e], 6[e], 10[h], 12[c,d], 14
6	A part serving as an enclosure or supplementary enclosure and subjected to a temperature of not more than 65°C	1, 3[f], 4, 5[e], 6[e], 8[c], 9, 12[c,d], 13
7	A part serving as an enclosure or supplementary enclosure and subjected to a temperature of more than 65°C	1, 3[f], 4, 5[e], 6[e], 8[c], 9, 10[h], 12[c,d], 13
8	A part spaced less than the distances specified in Clause 28.1.4 (b) and (c)[j]	11, 15[g]
9	A part located in the air stream	2[i]

[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 can 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] Material used within its temperature index based on historical data or a long-term thermal aging program need not be subjected to Test No. 10.

[i] This test does not apply to a dryer drum seal or door gasket.

[j] See also Clause 28.1.4.

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Table 12
Material property

(See Clause 28.1.4.)

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 13
Temperatures for oven conditioning

(See Clause 28.11.2.)

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-aging program, that indicates its acceptability for use at the temperature involved. This part shall be the subject of a separate investigation.

Table 14
Production line test conditions

(See Clauses 29.3.2 and 29.3.5.)

Appliance rating, V	Condition A			Condition B		
	Potential, V		Time, s	Potential, V		Time, s
	AC	DC		AC	DC	
≤ 250	1 000	1 400	60	1200	1 700	1
> 250 ≤ 600	1 000 + 2V	1 400 + 2.8V	60	1 200 + 2.4V	1 700 + 3.4V	1
V = maximum marked voltage.						

Table 15
Test conditions for heat pump dryer

(See Clause 19.7.3)

CSA C22.2 No. 236 / UL 1995 Test	Test Conditions
Input Test	Conducted in conjunction with CSA C22.2 No. 112/UL 2158, Clause 9, Power Input and Current Test[1]
Starting Test	Conducted in conjunction with CSA C22.2 No. 112/UL 2158, Clause 8, Starting of Motor-Operated Appliances[1]
Temperature and Pressure Test	Conducted in conjunction with CSA C22.2 No. 112/UL 2158 Heating Test[1]
Fan Motor Failure Test	Conducted per CSA C22.2 No. 236/UL 1995, Clause 51 for the condenser fan motor.
Condenser Water Failure Test	Covered by the testing in CSA C22.2 No. 112/UL 2158, Clause 16.4, Breakdown of Belts or Parts and the Interruption of Water Supply
Overflow Test	Covered by requirement in Clause 19.7.1 of CSA C22.2 No. 112/UL 2158
Limited Short Circuit Test	Covered by Clause 21.8 of CSA C22.2 No. 112/UL 2158
Strength Test	Conducted per CSA C22.2 No. 236/UL 1995, Clause 34
[1] The test voltage, room ambient temperature, pressure measurement and, if applicable, condenser water supply temperature and pressure shall be as specified in CSA C22.2 No. 236/UL 1995.	

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Table 16
Operating control correlation table

(See Clause 21.13.2.3, SA2.1.1.)

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 10, of the appliance
Endurance testing (for electromechanical devices)	a) 6 000 cycles for temperature-regulating controls, and for manual, non-self-resetting operating controls b) 100 000 cycles for other controls
Overvoltage category	Overvoltage Category II
Pollution degree	See Clause 26.2.4

Table 17
Protective control correlation table

(See Clauses 21.13.3.4, 21.13.3.7, and 21.13.4.1.)

Information	Protective control requirement
FMEA	Conduct a failure-mode and effect analysis (FMEA) identifying component failures which could 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 10, of the appliance
Endurance testing (for electromechanical devices)	a) 6 000 cycles for controls as indicated in Clause 21.13.5.3 and 21.13.6 and for manual, non-self-resetting temperature-limiting devices, and other manual, non-self-resetting protective controls b) 100 000 cycles, for automatic, self-resetting temperature controls and other automatic, self-resetting protective controls
Overvoltage Category	Overvoltage Category II
Pollution Degree	See Clause 26.2.4
Radio-frequency electromagnetic field immunity to conducted disturbances	Test Level 3
Radio-frequency electromagnetic field immunity to radiated electromagnetic fields	Field strength of 10 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 21.13.3.4)

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Table 18
Thickness of carbon steel or stainless steel sub-enclosures

(See Clause 22.2.13)

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness, mm (inch)			
Maximum width[b]		Maximum length[c]		Maximum width[b]		Maximum length		Uncoated		Metal coated	
mm	(inches)	mm	(inches)	mm	(inches)	mm	(inches)				
102	(4)	Not limited		159	(6-1/4)	Not limited		0.51	(0.020)	0.58	(0.023)
121	(4-3/4)	146	(5-3/4)	171	(6-3/4)	210	(8-1/4)				
152	(6)	Not limited		241	(9-1/2)	Not limited		0.66	(0.026)	0.74	(0.029)
178	(7)	222	(8-3/4)	254	(10)	318	(12-1/2)				

Note: This table is based on a uniform deflection of the enclosure surface for any given load concentrated at the center of the surface regardless of metal thickness.

[a] A supporting frame is a structure of angle or channel or a folded rigid section of sheet metal that is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and that has sufficient torsional rigidity to resist the bending moments that may be applied via the enclosure surface when it is deflected. Construction that is considered to have equivalent reinforcing may be accomplished by a structure that is as rigid as one built with a frame of angles or channels. Construction considered to be without supporting frame includes: Single sheet with single formed flanges (formed edges); a single sheet that is corrugated or ribbed; and An enclosure surface loosely attached to a frame, for example, with spring clips.

[b] The width is the smaller dimension of a rectangular sheet metal piece that is part of an enclosure. Adjacent surfaces of an enclosure are not prohibited from having supports in common and being made of a single sheet.

[c] "Not limited" applies only where the edge of the surface is flanged at least 12.7 mm (1/2 inch) or fastened to adjacent surfaces not normally removed in use.

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Table 19
Thickness of aluminum, copper, or brass sub-enclosures

(See Clause 22.2.13)

Without supporting frame[a]				With supporting frame or equivalent reinforcing[a]				Minimum thickness	
Maximum width[b]		Maximum length[c]		Maximum width[b]		Maximum length			
mm	(inches)	mm	(inches)	mm	(inches)	mm	(inches)	mm	(inches)
76	(3)	Not limited		178	(7)	Not limited		0.58	(0.023)
89	(3-1/2)	102	(4)	216	(8-1/2)	241	(9-1/2)		
102	(4)	Not limited		254	(10)	Not limited		0.74	(0.029)
127	(5)	152	(6)	267	(10-1/2)	343	(13-1/2)		
152	(6)	Not limited		356	(14)	Not limited		0.91	(0.036)
165	(6-1/2)	203	(8)	381	(15)	457	(18)		

Note: This table is based on a uniform deflection of the enclosure surface for any given load concentrated at the center of the surface regardless of metal thickness.

[a] A supporting frame is a structure of angle or channel or a folded rigid section of sheet metal that is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and that has sufficient torsional rigidity to resist the bending moments that may be applied via the enclosure surface when it is deflected. Construction that is considered to have equivalent reinforcing may be accomplished by a structure that is as rigid as one built with a frame of angles or channels. Construction considered to be without supporting frame includes: Single sheet with single formed flanges (formed edges); a single sheet that is corrugated or ribbed; and An enclosure surface loosely attached to a frame, for example, with spring clips.

[b] The width is the smaller dimension of a rectangular sheet metal piece that is part of an enclosure. Adjacent surfaces of an enclosure are not prohibited from having supports in common and being made of a single sheet.

[c] "Not limited" applies only when the edge of the surface is flanged at least 12.7 mm (1/2 inch) or fastened to adjacent surfaces not normally removed in use.

Table 20
Supplementary overcurrent protective device current rating

(See Clause 21.10.4.)

Maximum supplementary overcurrent protective device rating	Minimum cord conductor size rating		Minimum internal conductor size	
A	AWG	(mm^2)	AWG	(mm^2)
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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FIGURES

Figure 1

Articulated probe with web stop

(See Clauses 7.1, 7.3, 7.9, and 28.4.3.)

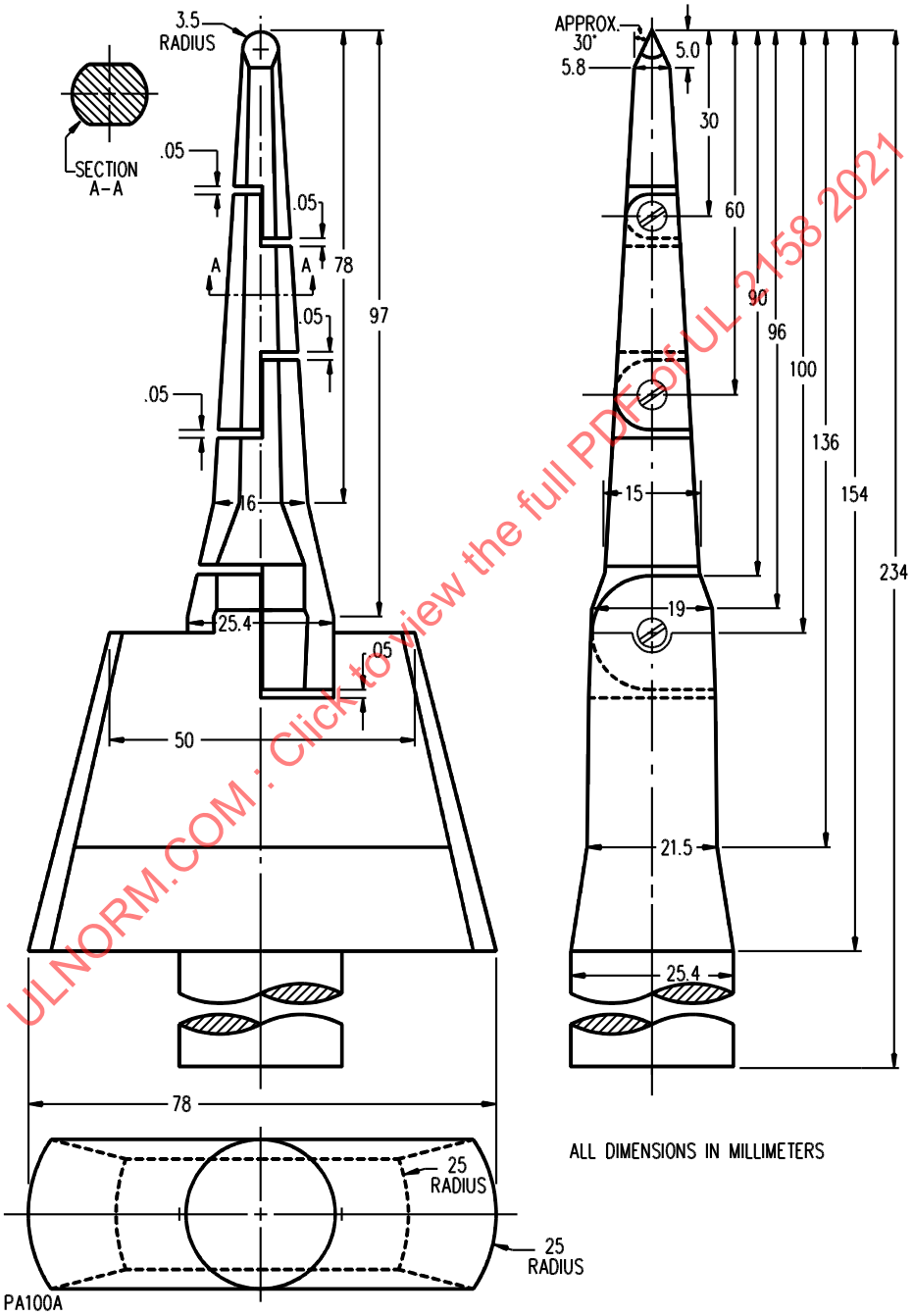

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Figure 2

Probe for film-coated wire

(See Clauses 7.2 and 7.3.)

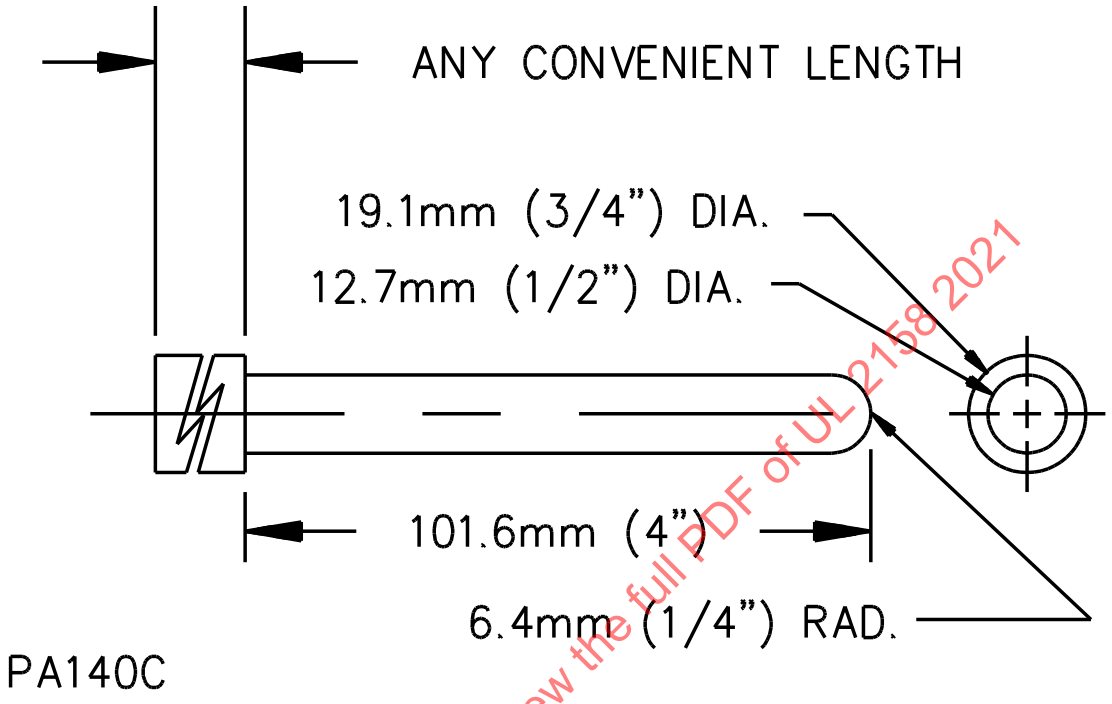

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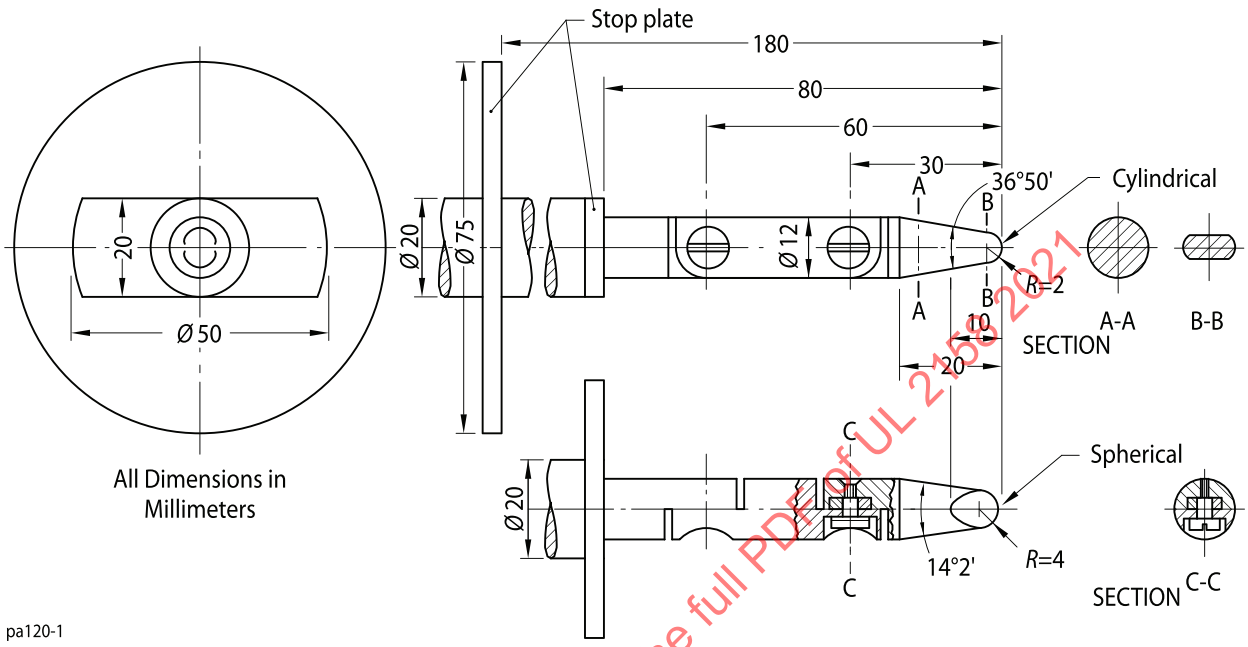
Figure 3

IEC accessibility probe with stop plate

(See Clauses 7.2 and 7.3.)



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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 degrees with a 0 to +10 degree tolerance.

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Figure 4

Probe for uninsulated current-carrying parts

(See Clauses 7.2 and 7.3.)

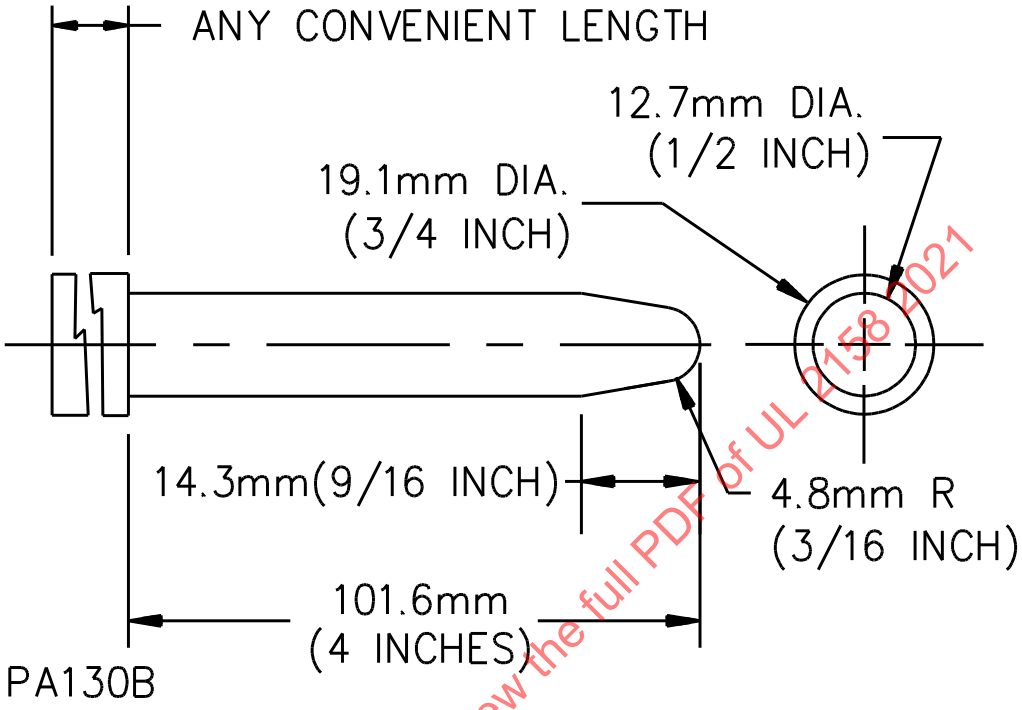

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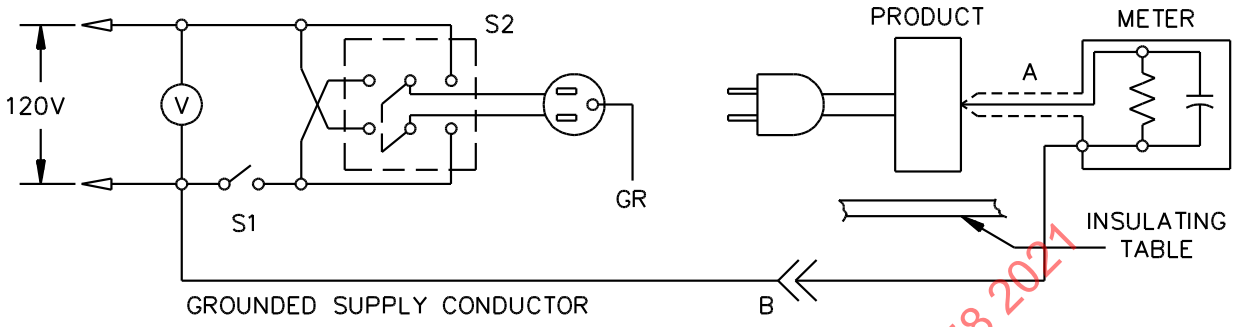
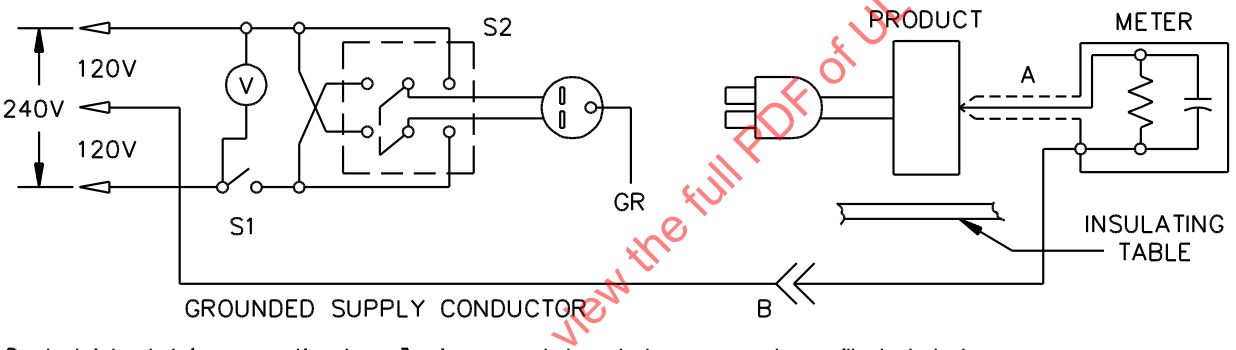
Figure 5

Leakage current measurement circuits

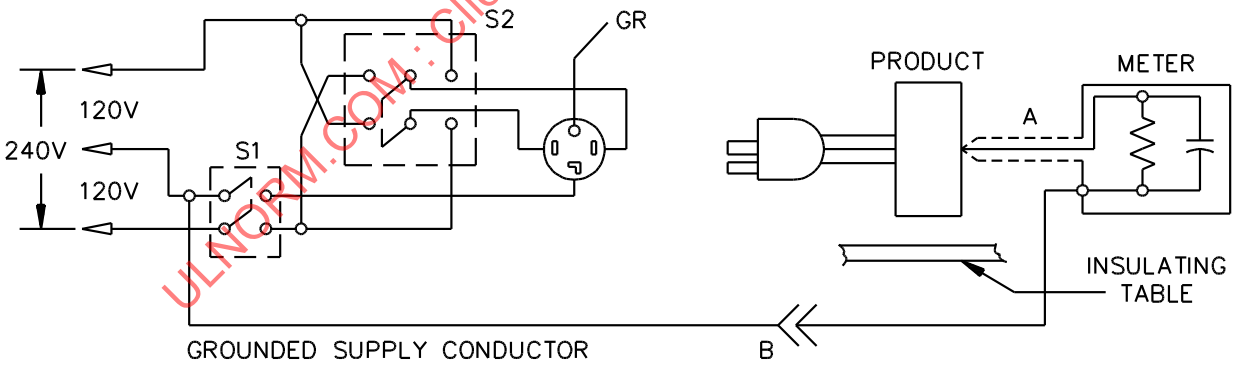
(See Clause 11.1.2.)



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.

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NOTES –

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 6

Two-voltmeter method of measuring insulation resistance

(See Clause 11.2.2.)

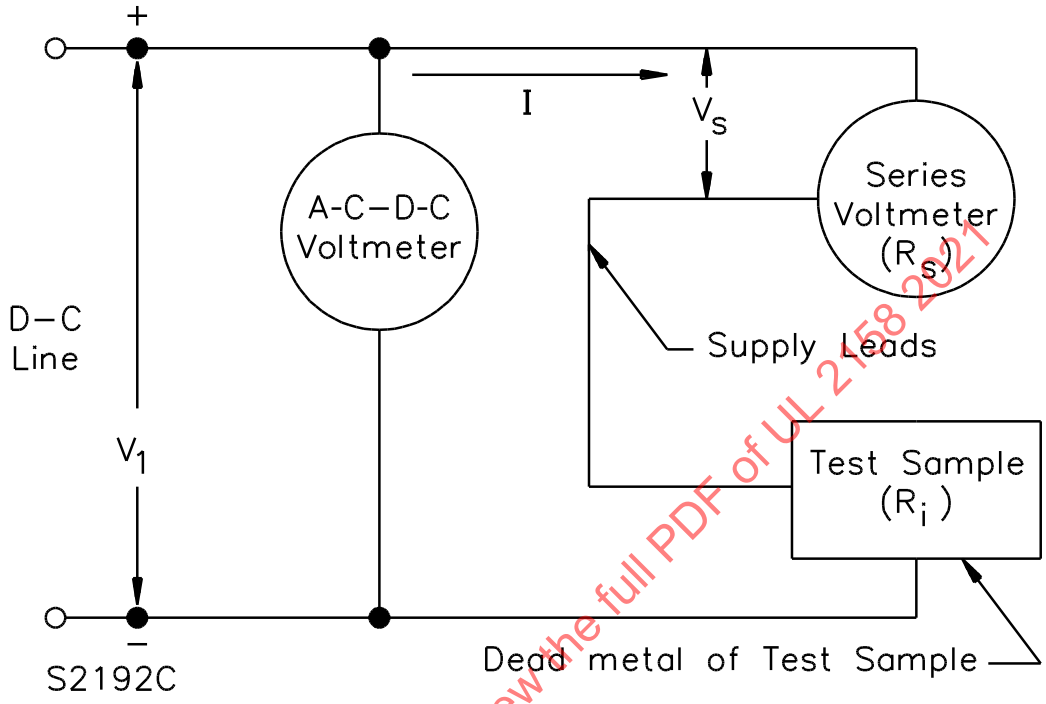

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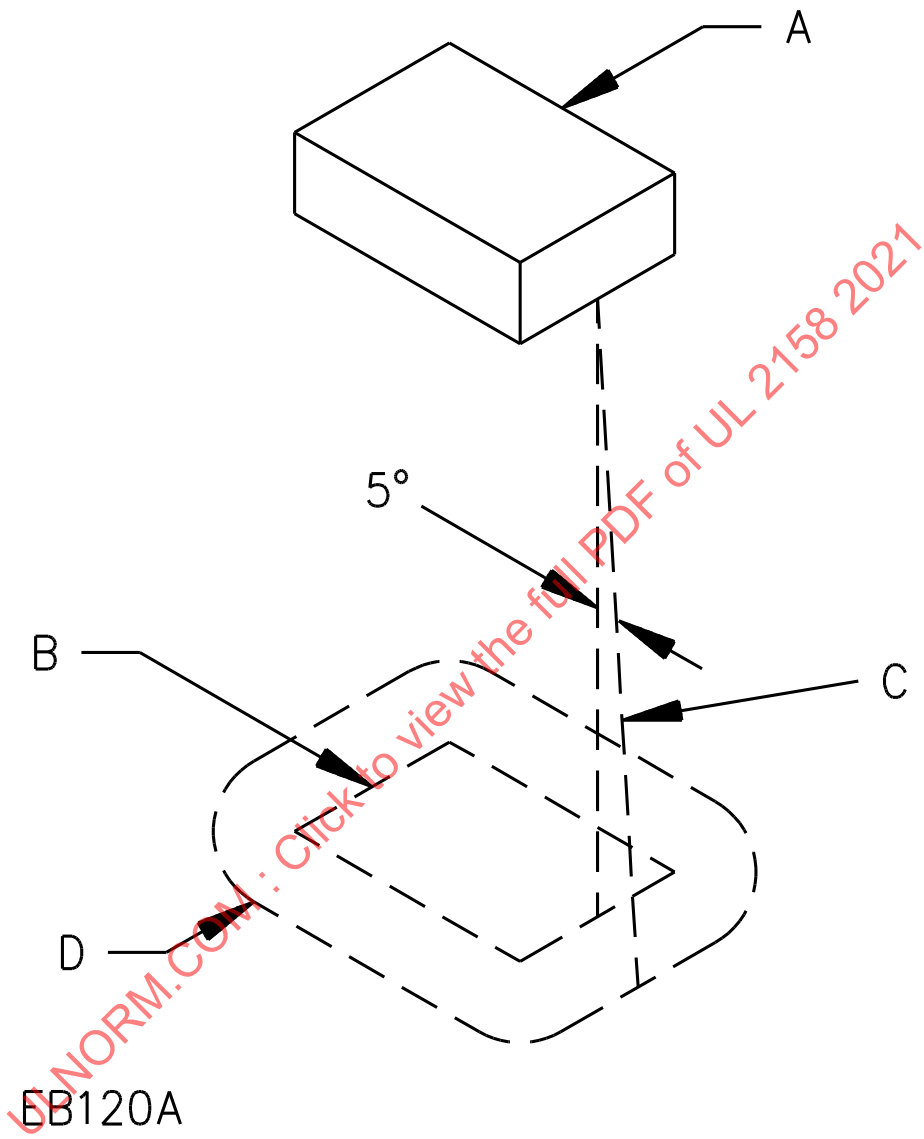
Figure 7

Location and extent of barrier

(See Clause 19.5.9.)



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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 degrees 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.

Figure 8

Grounding symbol

(See Clause 6.1.2.35.)

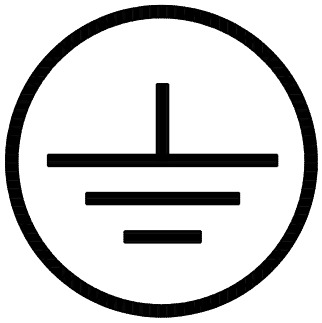

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Figure 9

Sample configuration for fire containment tests

(See Clauses 16.6.11 and 16.7.12.)

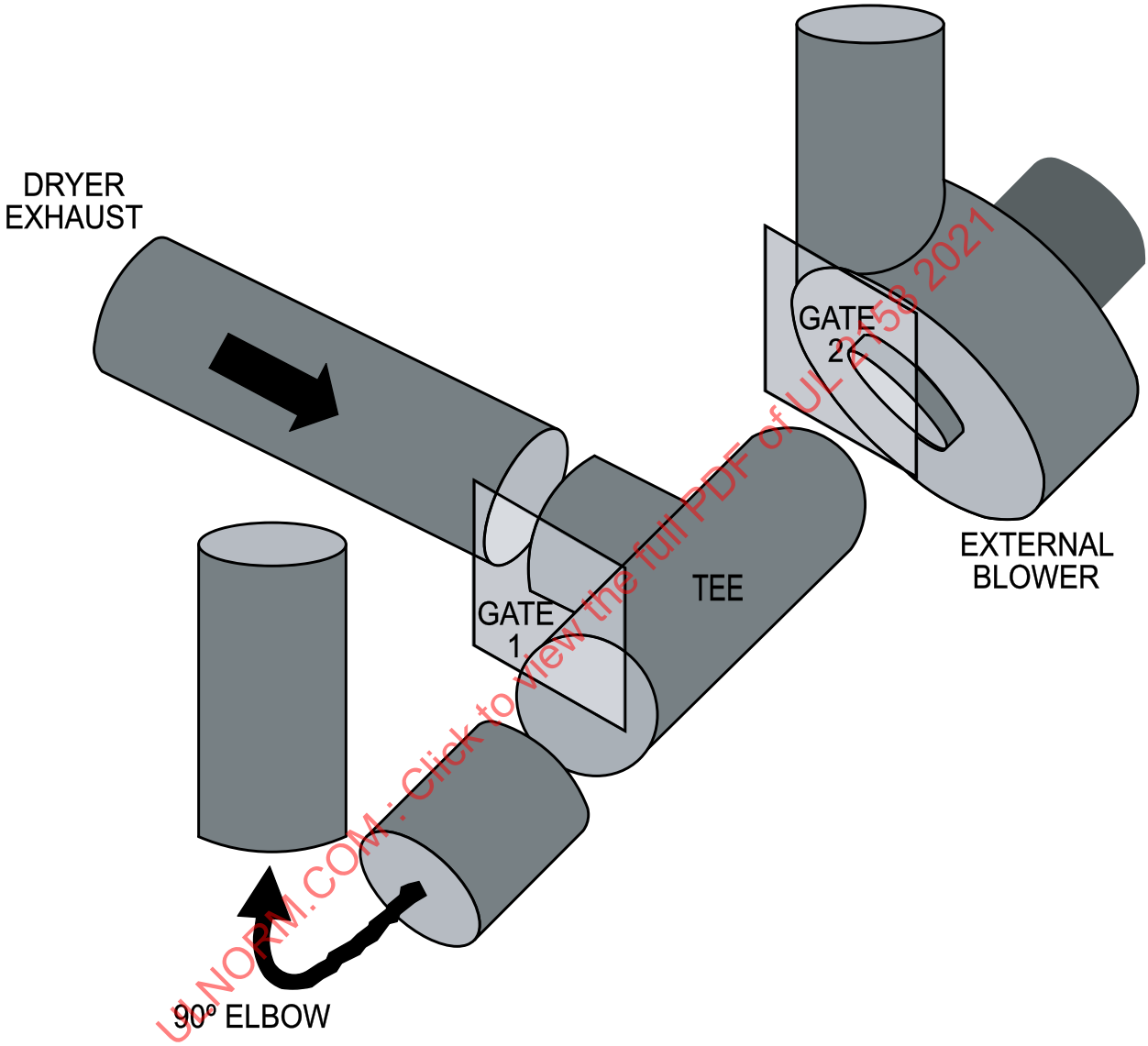

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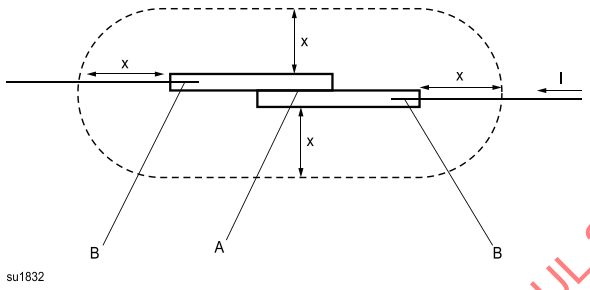
Figure 10

Definition of within 3 mm of an electrical connection

(See Clauses 3.42, 28.4.10, and 28.4.11.)



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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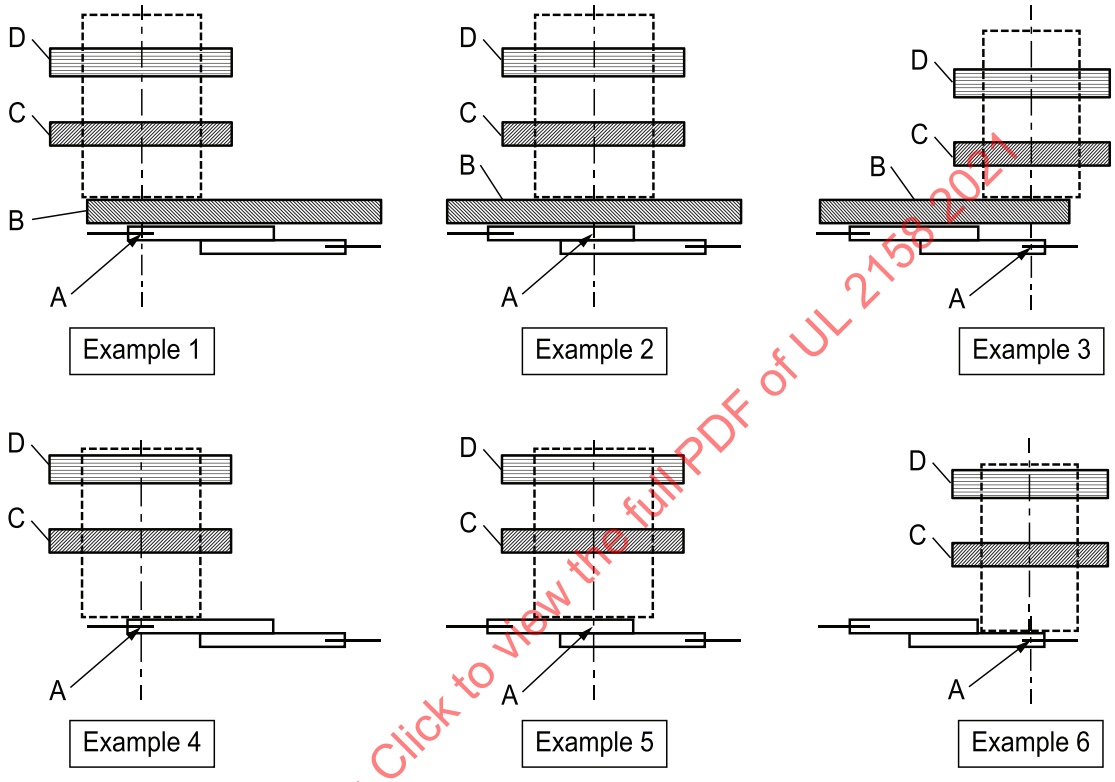
Figure 11

Placement of flame cylinder

(See Clause 28.4.12 and 28.4.13.)



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Note: With reference to Clauses 28.4.12 and 28.4.13, the cylinder shall project through all metallic and non-metallic material. If "C" is intended to act as a barrier to "D", then the adequacy of the barrier shall be demonstrated by testing as described in Clause 16.8.

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

Figure 12

Hot coil test flow chart

(See Clause 28.4.)

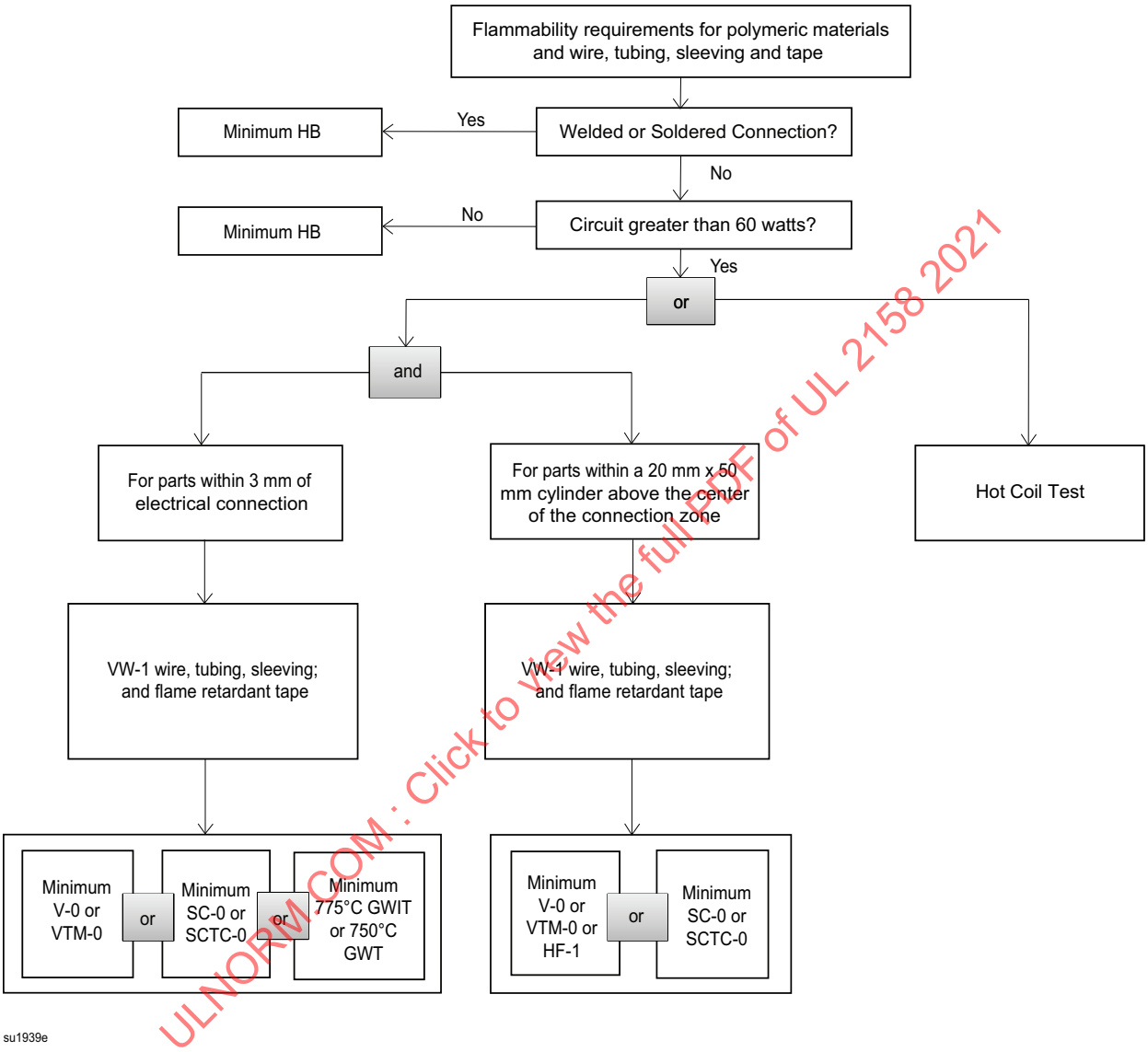

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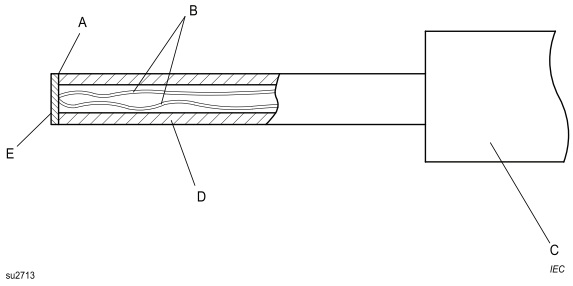
Figure 13

Probe for measuring surface temperature

(from IEC 60335-2-11, IEC 807/02)

(See Clause 10.10.3.)



Key

A Adhesive

B Thermocouple wires 0,3 mm diameter to IEC 60584-1 Type K (chrome alumel)

C Handle arrangement permitting a contact force of 4 N ±1 N

D Polycarbonate tube: inside diameter 3 mm, outside diameter 5 mm

E Tinned copper disc: 5 mm diameter, 0,5 mm thick

Note: The contact face of the disc is flat.

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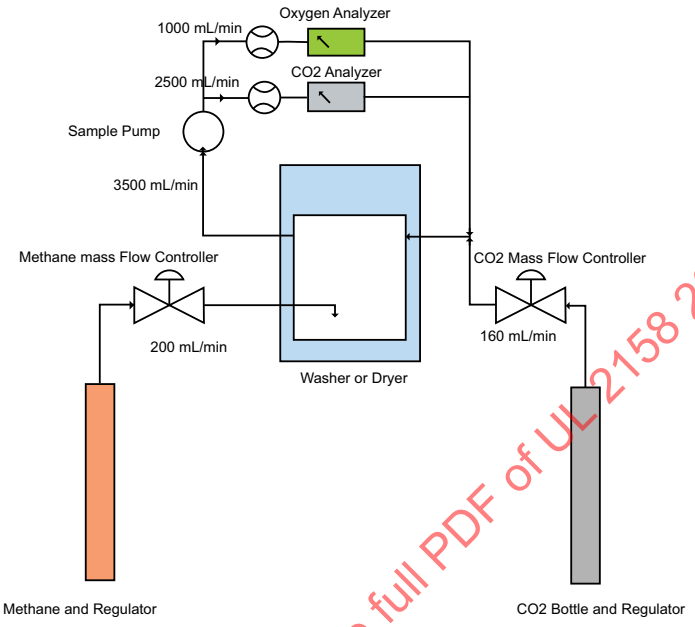
Figure 14

Ventilation test schematic

(See Clause 17.8.2)



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SUPPLEMENT SA – (Normative) Safety of Smart Enabled Electric Clothes Dryers

SA1 Scope

SA1.1 These requirements apply to electric clothes dryers intended to receive and respond to communication signals or data relating to power billing rate or demand response or communication signals from a remote user interface, such as a smart phone or computer. The smart enabled control response may include, but is not limited to, status indication, delayed start, remote stop of a function, remote start, adjusted temperature setting operation, or extended timer ON or OFF operation.

SA1.2 Appliances covered by Clause SA1.1 are commonly identified as “smart” appliances or “smart enabled” and are intended to interact with the “Smart Grid”[a] or other communication networks not identified as “Smart Grid”.

[a] US Energy Independence and Security Act of 2007

SA1.3 These requirements do not address the integrity of any output signal or data to the network devices or interoperability with other devices.

SA1.4 These requirements shall be applied in addition to the requirements specified in this Standard.

SA1.5 These requirements contemplate “smart enabled” technology as described by the U.S. Energy Independence and Security Act of 2007 that is integral with the appliance or incorporated as an accessory (wired to the appliance or wireless with a corresponding appliance receiver) on the appliance or in the same occupancy as the appliance.

SA1.6 These requirements encompass accessory devices to which multiple appliances can communicate and be smart enabled by providing direction for investigation of such devices in addition to the requirements of standards generally applicable to those devices.

SA1.7 These requirements do not apply to communication network devices that control appliances via simple power on-off, building wiring devices, panelboard mounted devices or utility meters.

SA2 General

SA2.1 Controls

SA2.1.1 Controls that respond to external communication signals or data shall comply with the construction and performance requirements of CAN/CSA-E60730-1 and UL 60730-1 and be tested as an operating control utilizing the parameters specified in Table 16. If the control also incorporates protective functions, these control functions shall be evaluated to the requirements for protective controls.

SA2.1.2 With respect to Clause SA2.1.1, the requirement is not applicable to controls located in low voltage circuits where the maximum power available does not exceed 15 W.

Note: This does not exempt the control from investigation for compliance with Clause SA3.1.

SA2.1.3 With respect to Clause SA2.1.1, compliance with the relevant requirements in Supplement SB is considered to fulfill this requirement.

SA2.1.4 With respect to Clause SA2.1.1, a communication device that is not integral with the appliance control (e.g., on a separate printed wiring board) and complying with CAN/CSA-C22.2 No. 60950-1 and UL 60950-1 or CSA C22.2 No. 62368-1 and UL 62368-1 is considered to fulfill this requirement.

SA2.1.5 For the purposes of application of CAN/CSA-E60730-1 and UL 60730-1, Electromagnetic compatibility (EMC) emission testing is not applicable to controls which are integral with the appliance or

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incorporated as an accessory (wired or wireless) on the appliance or in the same occupancy as the appliance.

SA2.1.6 With respect to the Endurance Testing indicated in Table 16, the control shall remain operational and comply with the Electric Strength Test of CAN/CSA-E60730-1 and UL 60730-1.

SA2.1.7 When the control enclosure forms part of the overall appliance enclosure, the enclosure material shall have a flammability rating in accordance with Clause 28.4. The enclosure for a low voltage circuit only shall have a minimum flammability rating of HB.

SA2.2 Separation of circuits

SA2.2.1 The separation of communication circuits from power and control circuits shall be evaluated for risk of electric shock in accordance with Clause 23.3.

SA2.2.2 With respect to Clause SA2.2.1, compliance with the separation of circuits requirements of the following standards are considered to fulfill this requirement:

a) CAN/CSA-E60730-1 or CAN/CSA-C22.2 No. 60950-1 or CSA C22.2 No. 62368-1; and

b) UL 60730-1 or UL 60950-1 or UL 62369-1.

SA2.3 Communication and display devices

SA2.3.1 A communication or display device, such as a router or monitor, provided as an accessory for use with the appliance, shall comply with CAN/CSA-C22.2 No. 60950-1 and UL 60950-1 or CSA C22.2 No. 62368-1 and UL 62368-1.

SA2.3.2 The power supply cord of an external communication or display device shall comply with this Standard or CAN/CSA-C22.2 No. 60950-1 and UL 60950-1, or CSA C22.2 No. 62368-1 and UL 62368-1 except Types NISP-2, NISPE-2, NISPT-2 are not allowed.

SA2.3.3 With respect to Clause SA2.3.2, the requirement is not applicable to external communication or display devices powered via connection to communication or data ports on the appliance which are located in low voltage circuits. See SA2.4.

SA2.3.4 If the external communication or display device is grounded via bonding with the appliance enclosure, the bonding requirements of the appliance standard shall be applied.

SA2.3.5 Grounding connections for external communication or display devices shall be made before power connections and shall break only after power connections are broken (“make first, break last”).

SA2.3.6 Functional grounding shall not be relied upon for equipment grounding or bonding.

Note: Functional grounding is grounding of a point in an appliance or in a system, that is necessary for a purpose other than safety.

SA2.4 Communication conductors and cables

SA2.4.1 External communication conductors and cables shall comply with CAN/CSA-C22.2 No. 60950-1 and UL 60950-1 or CSA C22.2 No. 62368-1 and UL 62368-1.

SA2.4.2 Communication conductors and cables within the appliance shall be evaluated as internal wiring in accordance with this appliance Standard.

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SA2.5 Communication connectors

SA2.5.1 Communication connectors and data ports accessible to the user and service personnel shall comply with CAN/CSA-C22.2 No. 60950-1 and UL 60950-1 or CSA C22.2 No. 62368-1 and UL 62368-1. Otherwise, communication connectors and data ports shall be evaluated in accordance with this appliance Standard.

SA2.5.2 With the exception of communication-on-power-line technology, an appliance plug, flatiron plug, jumbo appliance plug, motor attachment plug or other conventional power cord connectors, such as NEMA or IEC standardized configurations, shall not be used for communication circuit connections.

SA2.6 Smart enabled or remote operation

SA2.6.1 Any functionality enabled in response to external communication or data signals shall be considered when determining the normal and abnormal conditions of the appliance.

SA2.6.2 The appliance shall include a means for the consumer to override any power reduction, delayed start, or remote operation commands.

SA2.6.3 A control on the appliance shall be manually adjusted to the setting for delayed start or remote operation before the appliance can be operated in this mode. See Clause SA3.5.

SA2.6.4 Remote user functionality not involving the automatic restarting, remote starting of a delayed cycle, or remote operation of the appliance does not require a control on the appliance to be manually adjusted for remote operation. Examples of this type of remote user functionality are:

a) reading the appliance's status information;

b) cancelling or pausing an operating cycle; or

c) changing the appliance's user configurable settings (e.g. cycle temperature).

SA2.7 Remote safety firmware/Safety software updates

SA2.7.1 The following clauses apply when the manufacturer declares the appliance has Class B firmware or software and has the functionality to remotely update this firmware or software.

Note: An update occurs when firmware or software replaces or modifies the previous version of the Class B firmware or software. Additionally, an update occurs when the same version of Class B firmware or software is replaced during the remote update process.

For example, consider a software update that includes both Class A and Class B software. If the Class A software is a modified version of the original and the Class B software has not been modified, though will be re-installed on a microcontroller, then this is considered a software update and subjected to the relevant requirements of Clause SA2.7.

SA2.7.2 The Class B firmware or software intended to be updated, shall comply with UL 60730-1 Clause H.11.12, Controls Using Software.

SA2.7.3 The remotely actuated control function, including the software update function, shall comply with UL 60730-1, 5th edition, Clause H.11.12.4, Remotely Actuated Control Functions.

With respect to transmission faults, Note 1 of Clause H.11.12.4.1.3.1, Transmission, is considered normative.

Note: Remotely actuated control functions may be connected to separate, independent devices, which may themselves contain control functions or provide other information. Any data exchange between these devices shall not compromise the integrity of the Class B control function. A remotely actuated control function is a function providing any operation by control devices through external means. This includes, but is not limited to, (a) the use of communication lines/protocols, (b) additional hardware and/or software, (c) IR/RF transmission, or all combinations of a) to c) via Internet using, for example modems, portable telephones, etc.

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SA2.7.4 User authorization is required prior to any remote update of Class B firmware or software. This will be evaluated in accordance with UL 60730-1, Clause H.11.12.4.4.3.

Note: User authorization can be a one-time event. This one-time event may be when the consumer registers their appliance with the manufacturer, or downloads the application needed to remotely operate the appliance on their smart device (e.g. cell phone, tablet, etc.).

SA2.7.5 The remote update of firmware or software shall occur when the appliance is in a ready-state, that is, with all loads de-energized. The software that enforces the appliance to be in a ready-state shall be at least Class A.

SA2.7.6 The correct operation of the appliance's safety functions shall be maintained after the Class B firmware or software is updated.

Note: When determining which safety functions need to be verified after the update has been completed, consideration is to be given to the specific aspects of the software that have been updated.

Compliance is checked by a functional test of a remote software update and then a functional test to verify the proper operation of the appliance's protective control functions.

SA3 Functional Safety

SA3.1 Controls actuated in response to external communication or data signals shall not introduce a hazardous operating condition or a state that can lead to a hazardous operating condition.

SA3.2 With respect to Clause SA3.1, the control shall not:

a) Render inoperative any protective control or protective control function within the appliance;

b) Alter the response to or expected performance of user actuation of controls, movement of doors, covers or lids, or contact with external and functional surfaces of the appliance resulting in exposure of hazardous electrical, moving or hot parts;

c) Enable automatic restart of an interrupted drying cycle;

d) Enable start of a delayed drying cycle or allow remote operation;

e) Alter the order of appliance control response (e.g., force a protective control to operate where normally another control would respond); or

f) Supersede the response of any protective control.

Note: Examples of protective control functions include temperature limiting and interlocking functions.

SA3.3 With respect to Clause SA3.2(b), if the altered response or performance does not introduce a hazardous condition (e.g., a rotating part stops more quickly), this requirement is not applicable.

SA3.4 With respect to Clause SA3.2(c), the pausing of a normal operating cycle (stopping and restarting after a period of time) is acceptable if:

a) a door lock complying with 17.7.4 and 17.7.5 or a door interlock complying with Clause 17.7.2 is actuated when the appliance cycle is interrupted, and

b) when the door lock or interlock is deactivated before the operating cycle is restarted, a separate action from closing the door is necessary for the user to reinitiate the paused cycle.

SA3.5 With respect to Clause SA3.2(d), a delayed drying cycle or remote operation is acceptable if:

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a) a door lock complying with Clauses 17.7.4 and 17.7.5 or a door interlock complying with Clause 17.7.2 is actuated when the appliance is set for delayed start or remote operation by the user in accordance with Clause SA2.6.3, and

b) when the door lock or interlock is deactivated before the drying cycle is started, a separate action from closing the door is necessary for the user to re-initiate the delayed start or remote operation cycle.

SA3.6 Compliance with Clause SA3.1 shall be determined using methods appropriate for determining the performance and reliability of protective control functions in accordance with Clauses 21.13.3.1 and 21.13.3.2.

SA3.7 With respect to Clause SA3.6, the performance and reliability evaluation is not required if it is obvious from examination of circuit diagram(s) that the control operates wholly independent of the appliance protective control(s) and therefore is incapable of adversely affecting their operation.

SA4 Resistance to Electromagnetic Phenomena (Immunity)

SA4.1 The appliance protective control functions shall remain operable when subjected to conducted or radiated emissions from integral communication circuitry of the smart enabled control or any accessory thereof.

SA4.2 Compliance with Clause SA4.1 is determined using the communication circuit source(s) adjusted to its maximum factory setting(s) in addition to any intermediate settings that are determined to present a risk to the acceptable operation of the protective control function. The protective control function shall be tested in accordance with the Electromagnetic compatibility (EMC) requirements – immunity testing of CAN/CSA-E60730-1 and UL 60730-1, as appropriate.

SA4.3 With respect to Clause SA4.2, if it is determined that the source within the appliance or its accessory(ies) produces emissions addressed by the standard test conditions for the Electromagnetic compatibility (EMC) requirements – immunity testing of CAN/CSA-E60730-1 and UL 60730-1, it is not necessary to repeat the tests.

SA5 Marking and Instructions

SA5.1 Accessory devices shall be marked with the manufacturer's name (or symbol), a part or catalog number, and electrical ratings. Literature packaged with the accessory shall identify, the appliance(s) for which it is intended to be used. Additional literature or markings shall be required, as appropriate, when CAN/CSA-E60730-1 and UL 60730-1 or CAN/CSA-C22.2 No. 60950-1 and UL 60950-1 or CSA C22.2 No. 62368-1 and UL 62368-1 requirements are applied.

SA5.2 With respect to Clause SA5.1, accessories not affecting compliance of the appliance with Functional Safety, Clause SA3, need not identify the intended appliance(s).

SA5.3 With respect to Clause SA5.1, battery operated devices can be marked with information identifying the appropriate battery(ies) in lieu of electrical ratings.

SA5.4 All electrical and communication cable connections shall be identified for their purpose.

SA5.5 Literature packaged with the appliance shall identify the intended accessory device(s). A specific part or catalog number is not required if the manufacturer identifies a "family" of devices and limits the identification of devices within that family to those which are investigated in combination with the appliance.

SA5.6 With respect to Clause SA5.5, accessories not affecting compliance of the appliance with Functional Safety, Clause SA3, need not be identified.

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SA5.7 The manual means of actuating delayed or remote operation of the appliance shall be clearly indicated via marking adjacent to the user actuator. See Clause SA2.6.3.

SA5.8 User instructions provided with the appliance shall identify accessories, their method of connection, operation, and any precautions to be taken in their use. The means to enable delayed or remote operation shall be identified, including an illustration depicting the location of the actuating means with information on how to enable or disable the function.

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