UL 749

STANDARD FOR SAFETY

Household Dishwashers

UL Standard for Safety for Household Dishwashers, UL 749

Twelfth Edition, Dated May 25, 2023

Summary of Topics

This new edition of ANSI/UL 749 dated May 25, 2023 includes the following changes in requirements:

- ***DW Terminal Blocks***
- ***Terminal Blocks***
- ***Remote Operation of Smart Dishwashers***
- ***Remote Safety Firmware/Software Update Requirements***
- ***Appliance Filter Requirements***
- ***Annex D – Alternative Electronic Circuit Requirements***
- ***Liquid Leaking from an Auxiliary Reservoir Requirements***
- ***Circuit Interrupters with Fire Extinguishing Agent for Use in Electrical Appliances***
- ***Leakage Current Detection Requirements***
- ***Switch Requirements***
- ***Control Requirement Revisions – (removal of legacy standards)***
- ***Clarifications to the Control Requirements***
- ***French Language Requirements***
- ***Double Insulation Requirements***
- ***Nichrome Wire Test Clarification***
- ***Update to NiCr Wire Test***
- ***Unintentional Operation***
- ***Miscellaneous Revisions to Clarify the Standard***

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated April 29, 2022, November 11, 2022 and February 17, 2023.

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CSA Group
CSA C22.2 No. 167:23
Ninth Edition

ULSE Inc.
UL 749
Twelfth Edition

Household Dishwashers

May 25, 2023

Approved American National Standard

ANSI/UL 749-2023

Commitment for Amendments

This standard is issued jointly by the Canadian Standards Association (operating as "CSA Group") and ULSE Inc. (ULSE). Comments or proposals for revisions on any part of the standard may be submitted to CSA Group or ULSE at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of CSA Group and ULSE. CSA Group and ULSE 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 Standard is subject to review within five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to inquiries@csagroup.org and include "Proposal for change" in the subject line: Standard designation (number); relevant clause, table, and/or figure number; wording of the proposed change; and rationale for the change.

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This ANSI/UL Standard for Safety consists of the Twelfth edition.

The most recent designation of ANSI/UL 749 as an American National Standard (ANSI) occurred on May 25, 2023. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

The Department of Defense (DoD) has adopted UL 749 on August 2, 1994. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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

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Preface

This is the harmonized CSA Group and ULSE standard for Household Dishwashers. It is the ninth edition of CSA C22.2 No. 167 and the twelfth edition of UL 749. This edition of CSA C22.2 No. 167 supersedes the previous editions published in 2018. This edition of UL 749 supersedes the previous edition published in 2018.

This harmonized standard was prepared by CSA Group and ULSE. The efforts and support of the Harmonization Committee for Household Dishwashers and the Association of Home Appliance Manufactures (AHAM) are gratefully acknowledged.

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

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

Application of Standard

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

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

Level of harmonization

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

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 and basic safety principles and requirements. 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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Household dishwashers

1 Scope

1.1 This Standard applies to electric household dishwashers intended to be used in nonhazardous locations in accordance with CSA C22.1, Canadian Electrical Code, Part I (CE Code, Part I) and the National Electrical Code (NEC), NFPA 70, on circuits having a nominal voltage not exceeding 250 V.

1.2 This standard applies to both cord-connected appliances and permanently-connected appliances.

1.3 This Standard applies to smart-enabled household dishwashers that are 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. See Annex B.

1.4 This standard applies to household dishwashers generating ozone during normal operation. See Annex C.

1.5 This standard does not apply to commercial appliances. Commercial appliances are covered under the scope of the Standard for Commercial Dishwashing Machines, CSA C22.2 No. 168, or the Standard for Commercial Dishwashers, UL 921.

2 Referenced Publications

2.1 Where reference is made to other publications, such reference shall be considered to refer to the latest edition and any revisions thereto.

AHAM DW-2, *Household Electric Dishwashers*

ANSI Z97.1, *Safety Glazing Materials Used in Buildings-Safety Performance Specifications and Methods of Test*

ASME B94.11M, *Twist drills*

ANSI/ASME B1.20.1, *Pipe Threads, General Purpose, Inch*

ASSE 1001, *Performance Requirements for Atmospheric Type Vacuum Breakers*

ASTM A90/A90M-13, *Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings*

ASTM A653/A653M-15, *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*

ASTM D638, *Standard Test Method for Tensile Properties of Plastics*

ASTM D1822, *Standard Test Method for Tensile-Impact Energy to Break Plastics and Electrical Insulating Materials*

ASTM E162, *Standard Tests Method for Surface Flammability of Materials Using a Radiant Heat Energy Source*

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

ASTM G30-97 (2009), *Standard Practice for Making and Using U-Bend Stress-Corrosion Test Specimens*

ASTM G36, *Standard Practice for Evaluating Stress-Corrosion-Cracking Resistance of Metals and Alloys in a Boiling Magnesium Chloride Solution*

CSA B64 Series-11, *Backflow preventers and vacuum breakers*

CSA C22.1, *Canadian Electrical Code, Part I*

CSA C22.2 No. 0-10, *General Requirements – Canadian Electrical Code (CEC), Part II*

CSA C22.2 No. 0.1, *General Requirements for Double-Insulated Equipment*

CSA C22.2 No. 0.2, *Insulation Coordination*

CSA C22.2 No. 0.8, *Safety Functions Incorporating Electronic Technology*

CSA C22.2 No. 0.15, *Adhesive Labels*

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

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

CSA C22.2 No. 14, *Industrial Control Equipment*

CSA C22.2 No. 18.1, *Metallic Outlet Boxes*

CSA C22.2 No. 18.2, *Nonmetallic Outlet Boxes*

CSA C22.2 No. 18.3, *Conduit, Tubing, and Cable Fittings*

CSA C22.2 No. 18.5, *Positioning Devices*

CSA C22.2 No. 21, *Cord Sets and Power Supply Cords*

CSA C22.2 No. 24, *Temperature-Indicating and -Regulating Equipment*

CSA C22.2 No. 38, *Thermoset-Insulated Wires and Cables*

CSA C22.2 No. 39, *Fuseholder Assemblies*

CSA C22.2 No. 42, *General Use Receptacles, Attachment Plugs, and Similar Wiring Devices*

CSA C22.2 No. 42.1, *Cover Plates for Flush-Mounted Wiring Devices*

CSA C22.2 No. 43, *Lampholders*

CSA C22.2 No. 49, *Flexible Cords and Cables*

CSA C22.2 No. 55, *Special Use Switches*

CSA C22.2 No. 65, *Wire Connectors*

CSA C22.2 No. 66.1, *Low Voltage Transformers – Part 1: General Requirements*

CSA C22.2 No. 66.2, *Low Voltage Transformers – Part 2: General Purpose Transformers*

CSA C22.2 No. 66.3, *Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers*

CSA C22.2 No. 72, *Heater Elements*

CSA C22.2 No. 74, *Equipment for Use with Electric Discharge Lamps*

CSA C22.2 No. 75, *Thermoplastic Insulated Wires and Cables*

CSA C22.2 No. 77, *Motors with Inherent Overheating Protection*

CSA C22.2 No. 100, *Motors and Generators*

CSA C22.2 No. 107.1, *General Use Power Supplies*

CSA C22.2 No. 108, *Liquid Pumps*

CSA C22.2 No. 111, *General-Use Snap Switches*

CSA C22.2 No. 127, *Equipment and Lead Wires*

CSA C22.2 No. 139, *Electrically Operated Valves*

CSA C22.2 No. 144, *Ground Fault Circuit Interrupters*

CSA C22.2 No. 153, *Electrical Quick-Connect Terminals*

CSA C22.2 No. 156, *Solid-State Speed Controls*

CSA C22.2 No. 158, *Terminal Blocks*

CSA/ANSI Z83.21:20/CSA C22.2 No. 168, *Commercial Dishwashers*

CSA C22.2 No. 177, *Clock-Operated Switches*

CSA C22.2 No. 182.3, *Special Use Attachment Plugs, Receptacles, and Connectors*

CSA C22.2 No. 188, *Splicing Wire Connectors*

CSA C22.2 No. 190, *Capacitors for Power Factor Correction*

CSA C22.2 No. 197, *PVC Insulating Tape*

CSA C22.2 No. 198.1, *Extruded Insulating Tubing*

CSA C22.2 No. 198.3, *Coated Electrical Sleeving*

CSA C22.2 No. 210, *Appliance Wiring Material Products*

CSA C22.2 No. 223, *Power Supplies with Extra-Low-Voltage Class 2 Outputs*

CSA C22.2 No. 235, *Supplementary Protectors*

CSA C22.2 No. 248.1, *Low-Voltage Fuses – Part 1: General Requirements*

CSA C22.2 No. 250.4, *Portable Luminaires*

CSA C22.2 No. 2459, *Insulated Multi-pole Splicing Wire Connectors*

CSA C22.2 No. 2556, *Wire and cable test methods*

CSA C22.2 No. 4248.1, *Fuseholders – Part 1: General Requirements*

CSA C22.2 No. 4248 series

CSA Component Acceptance Notice No. 5A

CAN/CSA-C22.2 No. 61058-1, *Switches for Appliances – Part 1: General Requirements*

CAN/CSA-C22.2 No. 60950-1, *Information Technology Equipment – Safety – Part 1: General Requirements*

CSA E60730-1, *Automatic electrical controls – Part 1: General requirements*

CAN/CSA-E60730-2-6, *Automatic electrical controls – Part 2-6: Particular requirements for automatic electrical pressure sensing controls including mechanical requirements*

CAN/CSA-E60730-2-7, *Automatic electrical controls – Part 2-7: Particular requirements for timers and time switches*

CAN/CSA-E60730-2-8, *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, *Automatic Electrical Controls for Household and Similar Use – Part 2-9: Particular Requirements for Temperature Sensing Controls*

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

CSA C22.2 No. 60691, *Thermal Links – Requirements and Application Guide*

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

IEC 60127-1-06, *Miniature fuses – Part 1: Definitions for miniature fuses and general requirements for miniature fuse-links*

IEC 60335-1, *Safety of Household and Similar Electrical Appliances, Part 1: General Requirements*

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 60695-11-10:2013, *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*

IEC 61000-4-3-06, *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 61000-4-6-13, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-11-04, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61000-4-13-02, *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 70, *National Electrical Code*

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*

UL 94, *Test for Flammability of Plastic Materials for Parts in Devices and Appliances*

UL 101, *Leakage Current For Utilization Equipment*

UL 157, *Gaskets and Seals*

UL 224, *Extruded Insulating Tubing*

UL 248-1, *Low-Voltage Fuses – Part 1: General Requirements*

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UL 310, *Electrical Quick-Connect Terminals*

UL 355, *Cord Reels*

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UL 486A-486B, *Wire Connectors*

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UL 723, *Tests for Surface Burning Characteristics of Building Materials*

UL 746A, *Polymeric Materials – Short Term Property Evaluations*

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UL 758, *Appliance Wiring Material*

UL 778, *Motor-Operated Water Pumps*

UL 796 *Printed Wiring Boards*

UL 810, *Capacitors*

UL 817, *Cord Sets and Power-Supply Cords*

UL 840, *Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment*

UL 873, *Temperature-Indicating and -Regulating Equipment*

UL 906, *Outline for Solenoids*

UL 921, *Commercial Dishwashers*

UL 935, *Fluorescent-Lamp Ballasts*

UL 943, *Ground-Fault Circuit-Interrupters*

UL 969, *Marking and Labeling Systems*

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

UL 1004-1, *Rotating Electrical Machines – General Requirements*

UL 1004-2, *Impedance Protected Motors*

UL 1004-3, *Thermally Protected Motors*

UL 1004-7, *Electronically Protected Motors*

UL 1012, *Power Units Other Than Class 2*

UL 1029, *High-Intensity-Discharge Lamp Ballast*

UL 1030, *Sheathed Heating Elements*

UL 1053, *Ground-Fault Sensing and Relaying Equipment*

UL 1059, *Terminal Blocks*

UL 1077, *Supplementary Protectors for Use in Electrical Equipment*

UL 1097, *Double Insulation Systems for Use in Electrical Equipment*

UL 1310, *Class 2 Power Units*

UL 1332, *Organic Coatings for Steel Enclosures for Outdoor Use Electrical Equipment*

UL 1434, *Thermistor-Type Devices*

UL 1439, *Tests for Sharpness of Edges on Equipment*

UL 1441, *Coated Electrical Sleeving*

UL 1446, *Safety Systems of Insulating Materials*

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, *Component Connectors for Use in Data, Signal, Control and Power Applications*

UL 1998, *Software in Programmable Components*

UL 2353, *Single- and Multi-Layer Insulated Winding Wire*

UL 2459, *Insulated Multi-Pole Splicing Wire Connectors*

UL 2557, *Membrane Switches*

UL 4248-1, *Fuseholders – Part 1: General Requirements*

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UL 60730-2-9, *Automatic Electrical Controls – Part 2-9: Particular Requirements for Temperature Sensing Controls*

UL 60730-2-15, *Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Air Flow, Water Flow and Water Level Sensing Controls*

UL 60730-2-18, *Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Water and Air Flow Sensing Controls, Including Mechanical Requirements*

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

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

UL 61058-1 series

UL 60692, *Outline of Investigation for Circuit Interrupters with Fire Extinguishing Agent for Use in Electrical Appliances and Components* – Issue 1

UL 60939-3, *Passive Filter Units for Electromagnetic Interference Suppression – Part 3: Passive Filter Units for Which Safety Tests are Appropriate*

3 Definitions

3.1 For the purposes of this standard, where practical, the term “appliance” has been used instead of "dishwasher" or "machine."

3.2 The definitions in 3.3 – 3.32 apply in this standard.

3.3 APPLIANCE, AUTOMATIC – An appliance equipped with a timer switch or an equivalent control that, after the appliance has been energized, governs the sequence and duration of the various portions of the operating cycle, including its termination.

3.4 APPLIANCE, BUILT-IN – An appliance that is constructed to be permanently installed in a cabinet or wall.

3.5 APPLIANCE, CORD-CONNECTED – An appliance that is connected to the electrical supply by a power-supply cord terminating in an attachment plug of configuration 5-15P or 5-20P.

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

3.7 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 may serve as a portion of an enclosure and as a functional part.

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

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

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

b) A Class 2 transformer; or

c) A Class 2 power supply.

Note: 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.

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

3.11 CONTROL, PROTECTIVE – Control, the operation of which is intended to prevent the risk of electric shock, fire, or injury to persons during 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.

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

Note: With respect to Separation of Circuits, 21.3, this term refers to parts in both low-voltage and line-voltage circuits.

3.13 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.

3.14 ENCLOSURE – A material used to:

a) Limit accessibility of all or any parts of the product that might otherwise present a risk of electric shock or injury to persons; and

b) Retard propagation of flame initiated by electrical disturbances that might occur within the product.

3.15 FIELD WIRING TERMINAL – A terminal to which a wire can be connected in the field. A wire that is provided as part of the appliance and is provided with a means of making the connection that is factory-assembled to the wire is not considered a field wiring terminal. The following are examples of means of making wiring connections:

a) A pressure wire connector;

b) Soldering lugs;

c) A soldered loop; or

d) A crimped eyelet.

3.16 FLAME CYLINDER – A projection of a vertical cylinder having a diameter of 20 mm (0.79 in) and a height of 50 mm (2 in), placed above the center of the connection zone(s) and on top of any polymeric parts that are supporting current-carrying electrical connections as shown in Figure 30.3.

3.17 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.

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

3.19 LOCATION, OUTDOOR – An area that is open and subjected to the full effects of weathering. A dishwasher intended for installation in a protected location is required to comply with the requirements for dishwashers intended for installation outdoors.

3.20 LOCATION, PROTECTED – An outdoor location that is partially protected from the effects of weathering by installation in a cabinet or wall or by the use of a roof, canopy, marquee, or similar protective structure.

3.21 LOW-POWER CIRCUIT – Circuits where the power available is limited to 15 watts.

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

3.23 NORMAL CYCLE – The cycle type recommended by the manufacturer for completely washing a full load of normally soiled dishes, including the power-dry feature.

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

3.25 PART, FUNCTIONAL – A part 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.

3.26 POWER-DRY FEATURE – That function in a cycle in which electrically generated heat is introduced into the washing compartment for the purpose of improving the drying performance of the appliance.

3.27 RISK OF ELECTRIC SHOCK – For indoor use appliances, 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:

a) 30 V rms;

b) 42.4 V peak;

c) 60 V dc continuous; or

d) 24.8 V peak for DC interrupted at a rate of 200 Hz or less with approximately 50 percent duty cycle.

For outdoor use appliances, or appliances used in a protected location, 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:

1) 15 V rms;

2) 21.2 Vac peak; or

3) 30 V continuous dc.

Note: Either a low-voltage circuit or the secondary circuit of a Class 2 circuit does not involve a risk of electric shock.

3.28 RISK OF FIRE – A risk of fire is considered to exist at any two points in a circuit where a power of more than 15 watts can be delivered into an external resistor connected between the two points at the end of 5 seconds.

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

3.29 TEMPERATURE-LIMITING DEVICE – A device that:

a) Functions only under conditions that produce abnormal temperatures; and

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

3.30 TEMPERATURE-REGULATING AND -LIMITING DEVICE, COMBINED – 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.

3.31 TEMPERATURE-REGULATING DEVICE – A device that:

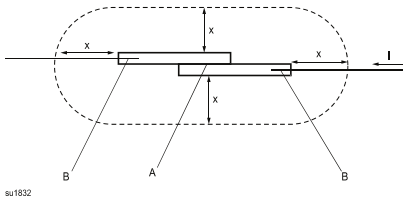
a) Regulates temperature; and

b) Functions during normal operation of the appliance.

3.32 WITHIN 3MM – Falling within the dotted boundary formed by the cylinder with hemispherical ends, as shown in Figure 3.1.

Figure 3.1

Definition of "Within 3 mm of an Electrical Connection"



Note: "Within 3 mm of an electrical connection" means falling within the dotted boundary formed by the 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

4 General Requirements

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

4.2 In Canada, general requirements applicable to this standard are given in CSA C22.2 No. 0 and grounding and bonding requirements are given in C22.2 No. 0.4.

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 specified in (a) or (b).

5.1.2 The test voltage (V_t) used during the heating tests of Section 12 and the abnormal operation tests of Section 17 shall be adjusted so that the calculated (see formula below) heating circuit input (W_t) is achieved during the heated wash cycle of the appliance. This compensates for heating elements with inputs at V_s (see 5.1.1) that are different than their rated (marked) inputs.

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

where

W_t = the calculated heating circuit input, W

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

V_s = the supply circuit voltage specified in 5.1.1

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

5.1.3 If it is necessary to increase the heater test voltage as specified in 5.1.2 through a separate circuit, the rest of the appliance shall be supplied at the voltage specified in 5.1.1.

5.1.4 If an appliance is rated for more than one frequency, testing shall be conducted at the frequency that would result in the highest temperature condition.

5.2 Cheesecloth for heating and abnormal tests

5.2.1 Whenever cheesecloth is required for a test in this standard, the cloth shall be bleached cheesecloth measuring approximately 34 g/m^2 (lbs-/ft^2) with a thread count in the range of 10 – 13 × 9 – 12 threads/cm.

5.3 Test temperature

5.3.1 The tests shall be conducted in a draft-free location and, unless otherwise specified, at an ambient temperature in the range of 10 – 40 °C (50 – 104 °F).

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 thermocouples as specified in the Initial Calibration Tolerances for Thermocouples table in ASTM E230/E230M.

5.5 Dishwashing detergent

5.5.1 If a dishwashing detergent is required for a test in this standard, it shall:

a) Have the following formula by mass:

Sodium carbonate	40 %
Sodium tripolyphosphate	25 %
Sodium sulfate	15 %
Water	10 %
Sodium silicate solids	8 %
Nonionic surfactant (low-foaming alcohol alkoxylate)	1 %
Sodium dichloroisocyanurate	1 %

or

b) Be a powdered dishwashing detergent as specified in AHAM DW-1, or any other powdered dishwashing detergent having similar properties.

5.6 Rinse agent

5.6.1 If a rinse agent is required for a test in this standard, it shall be a rinse agent recommended by the manufacturer.

5.7 Place setting

5.7.1 If a test load or a place setting is required for a test in this standard, the place setting shall consist of dishes and cutlery as specified in AHAM DW-2.

5.8 High-sudsing detergent

5.8.1 If a high-sudsing detergent is required for a test in this standard, it shall be any commercially available liquid handwashing dish soap.

5.9 Water temperature

5.9.1 If a test in this standard requires that an appliance be connected to a water supply, an appliance shall be connected to a hot-water supply with a nominal water temperature of 60 ±2 °C (140 ±3.6 °F).

5.9.2 For an appliance with a water-heating feature intended to be connected to a cold-water supply in accordance with the installation instructions of 8.3.5, testing shall be repeated with the appliance connected to a cold-water supply with a nominal temperature of 15 ±5 °C (59 ±9 °F), unless the water temperature does not affect the test results.

5.9.3 For an appliance with a water-heating feature intended to be connected to a hot-water supply in accordance with the installation instructions of 8.3.5, testing shall be repeated with the appliance connected to a hot-water supply with a nominal temperature of 50 ±2 °C (122 ±3.6 °F), unless the water temperature does not affect the test results.

6 Classification

6.1 Appliances shall be grounded or double-insulated with respect to electric shock.

6.2 Appliances shall have the appropriate degree of protection against ingress of water that might introduce a risk of fire or electric shock (see 15.5).

7 Marking

Advisory Note: *In Canada, there are two official languages, English and French. Therefore, it is necessary to have CAUTION, WARNING, and DANGER markings in both English and French. Annex E provides acceptable examples of French translations of the markings specified in this standard. Markings required by this standard may have to be provided in other languages to conform with the language requirements of the country where the product is to be used.*

7.1 General

7.1.1 A marking that is required to be permanent shall be moulded, die-stamped, paint-stencilled, stamped, or etched metal that is permanently secured or indelibly stamped on a pressure-sensitive label secured by adhesive. Adhesive labels shall comply with CSA C22.2 No. 0.15 and UL 969. If adhesive labels will be exposed to detergents or rinse agents, they shall also comply with 7.1.2 and 7.1.3.

7.1.2 After being conditioned as described in 7.1.3, an adhesive label, immediately following removal from each test medium, and after being exposed to room temperature for 24 h following removal from each medium, shall:

a) Demonstrate good adhesion and not have curled edges;

b) Resist defacement or removal, as demonstrated by scraping across the test panel with a flat metal blade 0.81 mm (0.03 in) thick held at right angles to the test panel; and

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

7.1.3 Three samples of the label specified in 7.1.2 shall be applied to test surfaces as intended in the application and shall be conditioned for 24 h in a controlled atmosphere maintained at 23 ±2 °C (73.4 ±3.6 °F). with a 50 ±5 percent relative humidity. The samples shall then be immersed for 48 h in a solution representative of the solution used during a normal cycle, maintained at the temperature the solution would attain during a normal cycle, but not less than 23 ±2 °C (73.4 ±3.6 °F).

7.1.4 A marking on a readily removable part shall not be acceptable.

7.1.5 A cautionary marking that is required to be permanent shall be located on a part that:

a) Requires the use of a tool for removal;

b) Cannot be removed without impairing the operation of the appliance; or

c) Is not removed during routine servicing of the appliance.

7.1.6 A cautionary marking may be located on a front panel that is removed for routine servicing, if a tool is required to remove the panel.

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

7.1.8 A cautionary marking shall be prefixed by the word "CAUTION", "WARNING", or "DANGER" in letters not less than 3.2 mm (0.13 in) high. The remaining letters of such a marking shall not be less than 1.6 mm (0.06 in) high.

7.2 Appliance markings

7.2.1 An appliance shall be rated in V and Hz.

7.2.2 A permanently connected appliance or a cord-connected undercounter appliance having a motor load:

a) Of 93 W (output) or less shall have a single current rating in A. For an appliance with a full-load power factor of 0.80 or more, the rating may be in W or kW; or

b) Of more than 93 W shall have the following ratings clearly identified:

1) The current rating of the motor in A; and

2) The rating of the total load other than the motor load (heater load, lighting load, and the like) in A, or in W or kW.

7.2.3 If an appliance is required to have a dual rating in accordance with 7.2.2(b), and if the appliance is controlled so that the motor load and the load other than the motor load are never connected simultaneously, the appliance may also be marked to indicate the maximum load that will be connected at one time.

7.2.4 A portable appliance shall be rated in A. For an appliance with a full-load power factor of 0.80 or more, the rating may be in W or kW.

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

7.2.6 An appliance requiring the use of supply conductors rated above 60 °C (140 °F) shall be marked with the following statement, or the equivalent, at or near the point where the supply connections are to be made and located so that it will be readily visible during and after installation:

"USE SUPPLY CONDUCTORS RATED FOR AT LEAST ____ °C (____ °F)."

7.2.7 The marking specified in 7.2.6 shall include both °C and °F. The temperature rating of the conductors required by the heating test (see Section 12) shall be placed in the marking.

7.2.8 An appliance 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 time-delay fuse (see 10.2), shall be plainly and permanently marked, in a location that is visible during installation and inspection, with the following or the equivalent:

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

Note: A portable appliance is limited to 1500 W and a 15 A circuit. See 11.4.

7.2.9 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.

7.2.10 The marking specified in 7.2.9 shall withstand the environmental conditions to which the heating element is subjected.

7.2.11 If an appliance employs a non-current-carrying metal part that is not grounded as specified in 25.1.6 and 25.5, the appliance shall be permanently marked with the following or equivalent:

"WARNING: Certain internal parts are intentionally not grounded and may present a risk of electric shock only during servicing. Service Personnel – Do not contact the following parts while the appliance is energized: (list of ungrounded parts)."

7.2.12 The marking specified in 7.2.11 shall be located close to each ungrounded part, and it shall be readily visible before or when the part becomes accessible for servicing.

7.2.13 If all approaches to ungrounded parts can be adequately covered by one marking, then only one marking as specified in 7.2.11, at the approach to the ungrounded parts, shall be required.

7.2.14 If the marking specified in 7.2.11 is located on the ungrounded part, only one marking shall be required.

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

7.2.16 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 following:

a) Manufacturer's 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 or model number, type, 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.

7.2.17 An appliance that is shipped from the factory with any of its outer enclosure panels uninstalled or omitted (e.g., kick or toe panel, side panels, or back) shall be plainly and permanently marked, at such a location that the marking will be visible when connections to the power-supply circuit are made, with the following or equivalent:

"WARNING: To reduce the risk of electric shock, fire, or injury to persons, the installer must ensure that the dishwasher is completely enclosed at the time of installation."

7.2.18 An appliance provided with double insulation that complies with 25.1.3 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"

7.2.19 An appliance shall not be marked with a double-insulation symbol (a square within a square), the words "DOUBLE INSULATION", or the equivalent unless the appliance complies with 25.1.3.

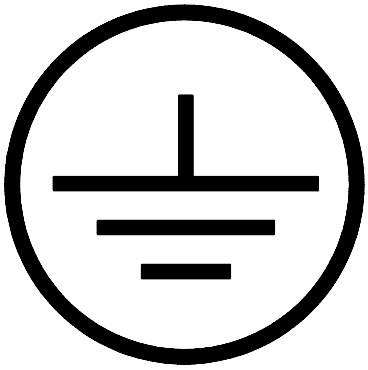
7.2.20 If an appliance can be readily adapted upon installation for connection to a supply circuit of either of two voltages, complete instructions, including identification of terminals, for making the connections for the different voltages shall be included in the permanent marking of the appliance. If the appliance employs an attachment plug, instructions shall be provided to indicate the type of plug that should be used if the appliance is reconnected for the alternative voltage. The information required by this clause may be shown on a circuit diagram.

7.2.21 An appliance that has plug-in provisions for the installation of an electrical accessory shall be plainly and permanently marked with the name and model number of the accessory. Instructions for the installation of the accessory shall be marked on the accessory or shall be included in literature supplied with the accessory.

7.2.22 With reference to 25.4.3, a pressure terminal connector intended for connection of an equipment-bonding conductor shall be identified by being marked "G," "GR," "GND," "Ground," or "Grounding," with the grounding symbol illustrated in Figure 7.1, or a similar marking, or by a marking on the wiring diagram provided on the appliance.

Figure 7.1

Grounding Symbol



IEC417, Symbol 5019

7.2.23 A dishwasher intended for installation outdoors (either in a protected location or outdoor location) shall be marked, on or adjacent to the marked electrical rating, with one of the following statements as applicable:

a) "Suitable for Protected Locations – See Installation Instructions"; or

b) "Suitable for Outdoor Locations".

8 Instructions

Advisory Note: *In Canada, there are two official languages, English and French. Therefore, it is necessary to have CAUTION, WARNING, and DANGER instructions in both English and French. Annex E provides acceptable examples of French translations of the instructions specified in this standard. Instructions required by this standard may have to be provided in other languages to conform with the language requirements of the country where the product is to be used.*

8.1 General

8.1.1 Instructions providing information equivalent to the marking required by 7.2.17 shall be packed with an appliance that is shipped from the factory with any of its outer enclosure panels uninstalled or omitted (e.g., kick or toe panel, side panels, or back).

8.1.2 An appliance that can be converted from cord-connected to permanently connected shall be provided with instructions for such conversion. These instructions may be packed inside the appliance.

8.1.3 An appliance shall be provided with legible instructions pertaining to the following:

a) A risk of fire, electric shock, or injury to persons associated with use of the appliance as specified in 8.2;

b) Installation as specified in 8.3;

c) Operation as specified in 8.4; and

d) If applicable, user maintenance as specified in 8.5.

8.1.4 The instructions required by 8.1.3 shall be:

a) In separate manuals; or

b) Combined in one or more manuals, if 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.

8.1.5 The instructions and warning statements required by 8.1.1 through 8.1.3 shall be provided as printed material. If any electronic media instructions are provided, the instructions and warning statements required by 8.1.1 through 8.1.3 shall also be included within the electronic media instructions. All other instructions may be provided in electronic read-only media format only, such as CD-ROM.

8.1.6 The printed instruction material referenced in 8.1.5 shall contain detailed instructions of how to obtain a printed copy of the material contained in electronic format.

8.1.7 The headings and statements required by 8.2.2, 8.2.3, 8.3.1, 8.4.2, and 8.5.2 and cautionary prefixes, such as "WARNING" and "DANGER", required by 8.2.3 and 8.2.4 shall be entirely in upper-case letters or otherwise emphasized to distinguish them from the rest of the text.

8.1.8 The text of all required instructions shall be in the words specified or words that are equivalent, clear, and understandable. However, there shall be no substitutes for the words "WARNING" or "DANGER".

8.1.9 An illustration may be used with a required instruction to clarify the intent, but it shall not replace the written instruction.

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

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

8.2.2 The heading "IMPORTANT SAFETY INSTRUCTIONS" or the equivalent shall precede the list of instructions required by 8.2.3, and the statement "SAVE THESE INSTRUCTIONS" or the equivalent shall either precede or follow the list (see 8.1.7).

8.2.3 The instructions required by 8.2.1 shall include the items in the following list, as applicable, and any other instructions the manufacturer considers to be necessary for the appliance (see 8.1.7).

IMPORTANT SAFETY INSTRUCTIONS

WARNING – When using your dishwasher, follow basic precautions, including the following:

a) Read all instructions before using the dishwasher.

b) Use the dishwasher only for its intended function.

c) Use only detergents or wetting agents recommended for use in a dishwasher and keep them out of the reach of children.

d) When loading items to be washed:

1) Locate sharp items so that they are not likely to damage the door seal; and

2) Load sharp knives with the handles up to reduce the risk of cut-type injuries.

e) Do not wash plastic items unless they are marked "dishwasher safe" or the equivalent. For plastic items not so marked, check the manufacturer's recommendations.

Note: This statement may be omitted for an appliance that employs a heating element that is located or guarded such that melted plastic items are not likely to contact it.

f) Do not touch the heating element during or immediately after use.

g) Do not operate your dishwasher unless all enclosure panels are properly in place.

h) Do not tamper with controls.

i) Do not abuse, sit on, or stand on the door or dish rack of the dishwasher.

j) To reduce the risk of injury, do not allow children to play in or on a dishwasher.

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

l) Remove the door to the washing compartment when removing an old dishwasher from service or discarding it.

SAVE THESE INSTRUCTIONS

8.2.4 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) or (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 8.2.3 (see 8.1.7).

a) For a grounded, cord-connected appliance:

GROUNDING INSTRUCTIONS

This appliance must be grounded. In the event of a 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 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 if you are in doubt 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 of a double-insulated appliance requires extreme care and knowledge of the system and should be done only by qualified service personnel. Replacement parts must be identical to those parts being replaced. A double-insulated appliance is marked with the words "DOUBLE INSULATION" or "DOUBLE-INSULATED." The double-insulation symbol (a square within a square) may also be marked on the appliance.

8.3 Installation instructions

8.3.1 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.

8.3.2 Where the installation instructions for a built-in dishwasher specify that the appliance can be connected by means of a power-supply cord not already attached to the appliance by the manufacturer, the instructions shall specify that a power-supply cord kit marked for use with dishwashers shall be used. The cord kit shall comply with 23.6. The part or model number of the power-supply cord kit shall be included in the appliance installation instructions.

8.3.3 The installation instructions provided with a cord-connected undercounter appliance shall include the following instructions or equivalent information:

a) The power-supply receptacle for the appliance shall be installed in a cabinet or on a wall adjacent to the undercounter space in which the appliance is to be installed;

b) There shall be an opening through the partition between the compartments specified in (a) that is large enough for the attachment plug to pass through. The longest dimension of the opening shall not be more than 38 mm (1.5 in);

c) The edges of the opening specified in (b) shall, if the partition is wood, be smooth and rounded, or, if the partition is metal, be covered with an edge protector provided for this purpose by the manufacturer; and

d) Care shall be exercised, when the appliance is installed or removed, to reduce the likelihood of damage to the power-supply cord.

8.3.4 The installation instructions provided with an appliance having a water-supply hose that is intended to be connected to the sink faucet shall include the following or the equivalent:

“A hose that attaches to a sink spray can burst if it is installed on the same water line as the dishwasher. If your sink has one, it is recommended that the hose be disconnected and the hole plugged.”

8.3.5 With reference to 5.9.2 and 5.9.3, an appliance with a water-heating feature shall be identified as such by a marking on the appliance or indicated in the installation instructions provided by the manufacturer. In addition, the installation instructions shall identify whether the appliance is intended for connection to a cold- or hot-water supply.

8.3.6 Complete installation instructions shall be provided with a dishwasher intended for outdoor location. For dishwashers intended for use in a protected location, the instructions shall include the manufacturer's recommendations concerning installation of the dishwasher in a cabinet or wall or the use or installation of any canopy, marquee, shelter, or similar structure, intended for the protection of the machine from the effects of weather. The manufacturer's instructions shall be located where they are accessible without removing a panel, a cover, an accessory, a subassembly, or similar component. Manufacturer's instructions that are located inside the machine and accessible through a door on the front of the machine meet the intent of this requirement.

8.3.7 The installation instructions for a cord-connected dishwasher intended for installation outdoors (either in a protected location or outdoor location) shall include the following statement, or equivalent: "WARNING – Risk of Electric Shock. Do Not Use an Extension Cord. Connect Dishwasher Cord Directly to a Dedicated Outlet Suitable for Installation in Damp or Wet Locations and Protected by a Ground-Fault Circuit-Interrupter (GFCI) in Accordance with Local Codes. If an Outlet is Not Provided, Contact a Qualified Electrician for Proper Installation".

8.4 Operating instructions

8.4.1 The operating instructions shall include all information needed to operate the appliance as intended. Instructions and warnings provided in accordance with the requirements of 8.2 may be omitted from the operating instructions if there is a reference to the applicable instructions and warnings in the operating instructions.

8.4.2 The heading "OPERATING INSTRUCTIONS" or the equivalent shall precede the instructions required by 8.4.1.

8.4.3 For a front-opening countertop appliance with a capacity of no more than six place settings, the maximum number of place settings shall be specified in the operating instructions provided with the appliance.

8.4.4 The operating instructions for a dishwasher employing an Equipment Protective Device in accordance with 20.2.3(a) that is provided with Test and Reset buttons shall identify the location of the protective device and be provided with the following: "Press the TEST button (then the RESET button) every month to assure proper operation."

8.5 User-maintenance instructions

8.5.1 User-maintenance instructions shall include all information needed for cleaning and servicing operations, such as removing deposits from the heating element, lubrication, and adjustments, that are intended to be performed by the user.

8.5.2 The heading "USER-MAINTENANCE INSTRUCTIONS" or the equivalent shall precede the instructions required by 8.5.1.

9 Protection Against Accessibility to Current-Carrying Parts

9.1 General

9.1.1 An appliance shall be provided with an enclosure of suitable material to isolate all parts that could present a risk of fire, electric shock, or injury to persons under any condition of normal use.

9.1.2 When determining accessibility of live parts for a built-in dishwasher intended for installation outdoors, 9.2 shall be applied.

9.2 Enclosures for other than built-in appliances

9.2.1 Enclosures of appliances other than built-in appliances and enclosures for appliances intended for installation outdoors shall prevent access to internal current-carrying parts as specified in 9.2.3 to 9.2.10.

9.2.2 Appliances intended for protected locations and outdoor location shall be provided with a complete enclosure.

9.2.3 Enclosures shall prevent a probe as shown in the following:

a) Figure 9.1 from touching insulated internal wiring, other than as specified in 9.4.5; and

b) Figure 9.2 from:

1) Touching an uninsulated current-carrying part or film-coated wire; and

2) Relocating any non-current-carrying metal parts such that:

i) The parts touch an uninsulated current-carrying part or film-coated wire; or

ii) Electrical spacings are reduced below the minimum values specified in Sections 27 and 28.

Figure 9.1

IEC Articulate Probe

Note: All dimensions are in millimeters.

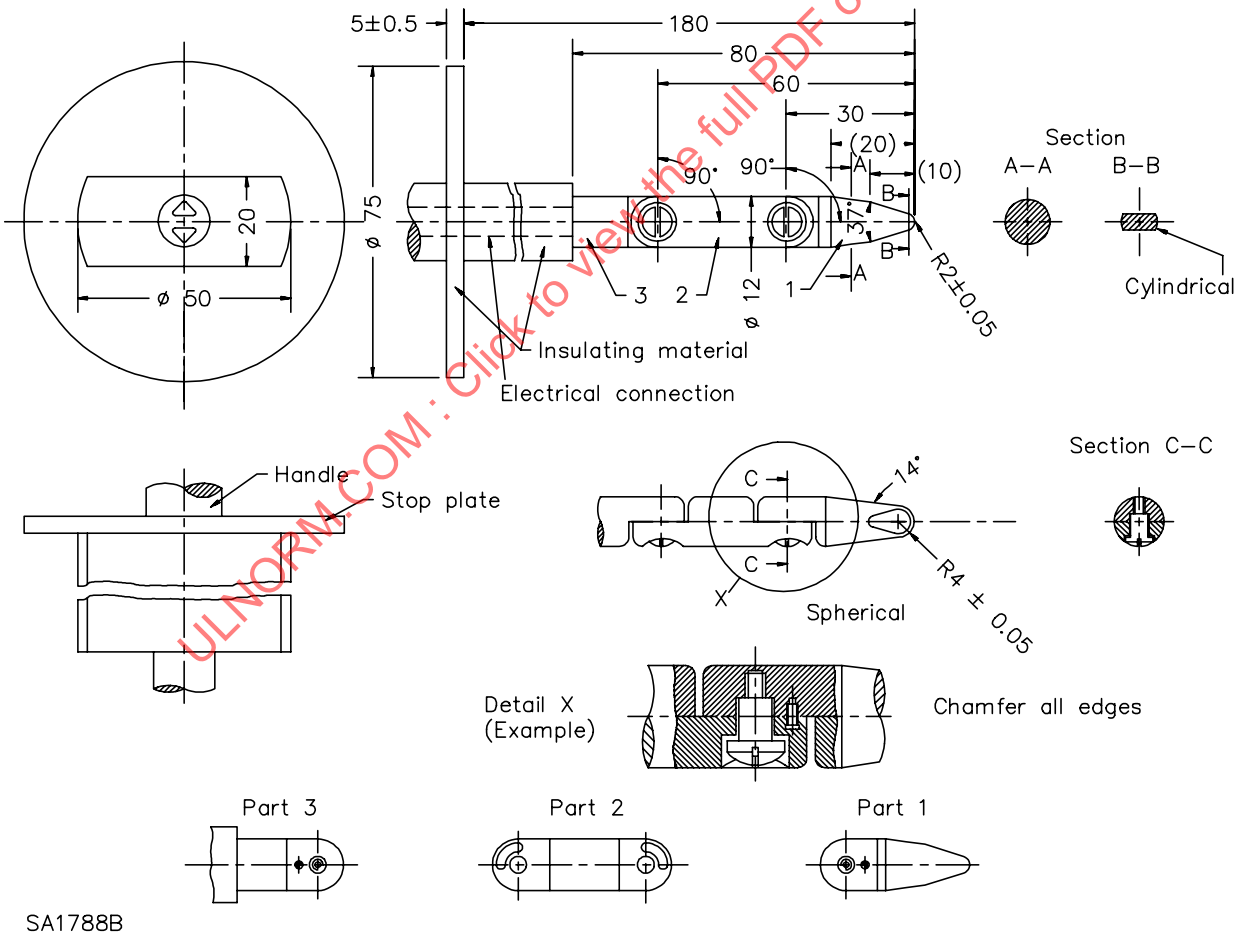
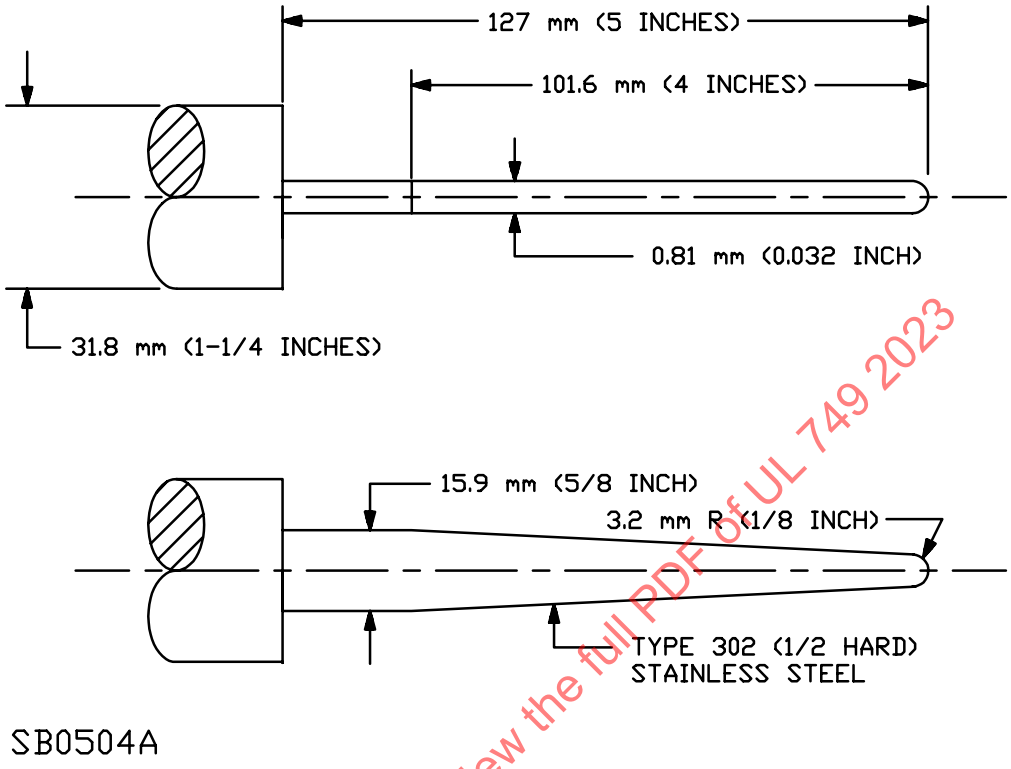


Figure 9.2

Knife Probe



9.2.4 The enclosure openings located in the top, back, sides, and front of the appliance and the interior surfaces of the washing compartment, including the door, that are accessible when the loading door is open shall comply with the requirements of 9.2.3, 9.2.8, and 9.2.9, as applicable.

9.2.5 During the examination of the dishwasher interior surfaces, the dish racks shall be moved to any normal position giving the greatest accessibility to the probe, but shall not be removed from the appliance.

9.2.6 During the use of the probe on appliances weighing 22 kg (48.5 lb) or less when empty, there shall be sufficient clearance from supporting and other adjacent surfaces for unrestricted use of the probe (e.g., the appliance can be tipped over).

9.2.7 During the use of the probe on appliances weighing more than 22 kg (48.5 lb), if the front, sides, and back of the appliance can be positioned no more than 38.1 mm (1.5 in) above the surface upon which the appliance rests, the tip of the probes shall be inserted up to 150 mm (5.9 in) 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 (1.5 in), accessibility through the opening created between the bottom of the appliance and the supporting surface shall be evaluated in accordance with Table 9.1.

Table 9.1
Minimum Acceptable Distance from an Opening to a Part that Could Involve a Risk of Electric Shock

Minor dimensions of opening[a]		Minimum distance from opening to part	
mm	(in)	mm	(in)
19.1	(0.7)	114.0	(4.49)
25.4	(1.0)	165.0	(6.50)
31.8	(1.2)	190.0	(7.48)
38.1	(1.5)	318.0	(12.52)
47.6	(1.9)	394.0	(15.51)
54.0	(2.1)	444.0	(17.48)
> 54.0 – 152.0	(> 2.1 – 6.0)	762.0	(30.00)

[a] See 9.2.6 to 9.2.10

Notes:

1) Between 19.1 mm (0.75 in) and 54.0 mm (2.12 in), interpolation is used to determine a value between values specified in the table.

2) Any dimension less than 25.4 mm (1 in) applies to a motor only.

9.2.8 Where an opening in an enclosure has a minor dimension (see 9.2.10):

a) Less than 25.4 mm (1 in);

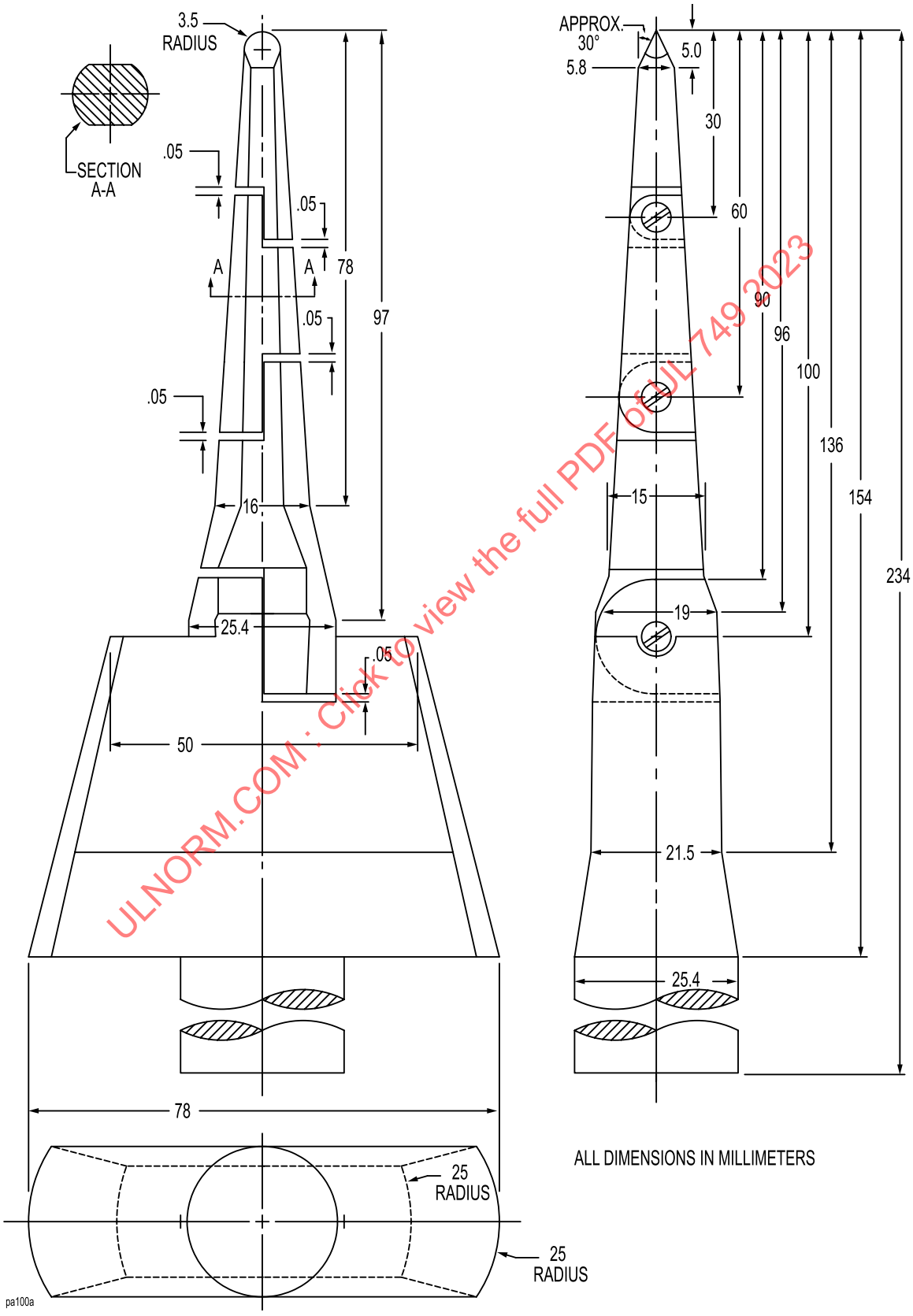
1) An uninsulated current-carrying part shall not be contacted by the probe illustrated in Figure 9.3; and

2) Film-coated wire shall not be contacted by the probe illustrated in Figure 9.1; or

b) Of 25.4 mm (1 in) or more, an uninsulated current-carrying part or film-coated wire shall be positioned from the opening as specified in Table 9.1, to reduce the likelihood of electric shock resulting from unintentional contact with such a part or wire.

Figure 9.3

Articulate Probe with Web Stop



9.2.9 An accessible motor with an integral enclosure that has an opening with a minor dimension (see 9.2.10):

a) Of less than 19.1 mm (0.75 in) is acceptable, if uninsulated current-carrying parts or film-coated wire cannot be contacted by the probe illustrated in Figure 9.1; or

b) Of 19.1 mm (0.75 in) or more is acceptable, if an uninsulated current-carrying part or film-coated wire is spaced from the opening as specified in Table 9.1.

9.2.10 With reference to the requirements in 9.2.8 and 9.2.9, 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.

9.2.11 With reference to 9.2.9, an accessible motor is a motor that:

a) Can be contacted without opening or removing any part, except as indicated in 9.4.3; or

b) Is located so as to be accessible to contact when evaluating the dishwasher enclosure as specified in 9.2.8.

9.3 Enclosures for built-in appliances

9.3.1 Except as specified in 9.1.2, enclosures of built-in dishwashers shall prevent access to internal current-carrying parts as specified in 9.3.2 to 9.3.4.

9.3.2 Openings in the front and inside the washing compartment shall be examined in accordance with 9.2.1. The front shall include the whole front plus those portions of the sides accessible from the front when the appliance is installed in a simulated cabinet enclosure. A 9.5 mm (0.37 in) clearance shall be between each side and the simulated enclosure.

9.3.3 When applied to the sides, the tip of the probe as shown in:

a) Figure 9.3 shall not touch uninsulated current-carrying parts that could present a risk of electric shock. When testing for uninsulated current-carrying parts, the probe shall be inserted as far as the enclosure will permit; and

b) Figure 9.1 shall not touch insulated internal wiring, other than as specified in 9.4.5, or film-coated wire. The tip of the probe shall be inserted up to 150 mm (5.9 in) inside the planes of the sides as defined in 9.3.4.

9.3.4 For the purpose of the probe test, the sides, back, and top of a built-in appliance shall be the planes defined by the inside surfaces of the sides, back, and top of the smallest rectangular compartment that will completely enclose the appliance.

9.4 All dishwashers

9.4.1 For any probe test, the probe shall be inserted, rotated, or angled before, during, and after insertion through the opening to any position that is necessary to examine the enclosure.

9.4.2 The probes in Figure 9.3 and Figure 9.1 shall be used to determine the accessibility provided by the opening and not to determine the strength of a material. They shall be applied with the minimum force necessary to determine accessibility. The probe in Figure 9.2 shall be applied with a force not exceeding 22 N (4.9 lb-f).

9.4.3 During examination with the probes, any part that can be removed without the use of a tool shall be removed or moved to the position that gives greatest accessibility to the probes.

9.4.4 When used as enclosures, wire screens, expanded metal mesh, etc., together with the methods of fastening, shall be subjected to investigation.

9.4.5 During an examination in accordance with 9.2.1 to 9.2.9, the probe may touch insulated internal wiring, provided that the wiring is secured within the enclosure so that it is unlikely to be subjected to stress or mechanical damage.

10 Starting of Motor-Operated Appliances

10.1 An appliance shall start and operate as intended on a circuit protected by an ordinary (not a time-delay) fuse having a current rating corresponding to that of the branch circuit to which the appliance should be connected.

10.2 For the test in 10.3, a time-delay fuse may be employed if the appliance:

a) Will start and operate as intended on a circuit protected by a time-delay fuse; and

b) Is marked in accordance with 7.2.8.

10.3 To determine if an appliance complies with the requirements in 10.1, the appliance shall be connected to a supply circuit of the rated test voltage and rated frequency. The appliance shall be started three times with the timer mechanism 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 operation of the appliance is unacceptable if the fuse opens or an overload protector provided as part of the appliance trips.

11 Power Input and Current

11.1 When operated as described in 11.3, the input current to an appliance rated in accordance with 7.2.2(a) or 7.2.4 shall not be more than 110 percent of the marked rating.

11.2 When operated as described in 11.3, an appliance rated in accordance with 7.2.2(b) shall not have an input current to:

a) The motor more than 110 percent of the marked rating of the motor load; and

b) A load other than the motor load more than 105 percent of the marked rating of such a load.

11.3 The appliance shall be operated as described in 12.9. Only the steady-state input current to an appliance during any condition of intended operation (e.g., washing, rinsing, or drying) shall be measured. The input during a period of acceleration shall not be measured.

11.4 The input to a portable cord-connected dishwasher for use on nominal 120 V branch circuits protected by overcurrent devices rated or set at not more than 15 A shall not exceed 1500 W at 115 V.

12 Heating

12.1 An appliance tested as described in 12.2 to 12.9 shall not:

a) At any point reach a temperature high enough to result in a risk of fire or damage to any material used; or

b) Exceed the temperature rises specified in Table 12.1.

Table 12.1
Maximum Acceptable Temperature Rises

Materials and components	°C	(°F)
A. Motors		
1) Class A insulation systems on coil windings of a motor and on vibrator coils		
a) in an open motor and on vibrator coils – thermocouple or resistance method	75[a]	(135[a])
b) in a totally enclosed motor – thermocouple or resistance method	80	(144)
2) Class B insulation systems on coil windings of a motor		
a) in an open motor – thermocouple or resistance method	95[a]	(171)[a]
b) in a totally enclosed motor – thermocouple or resistance method	100	(180)
3) Class F insulation systems on coil windings of an ac motor having a frame diameter of 178 mm (7 in) or less, not including a universal motor, in an open motor by the thermocouple or resistance method	120	(216)
B. Components		
1) Capacitors:		
a) electrolytic	40[b]	(72[b])
b) other types	65[c]	(117[c])
2) Fuses	65[d]	(117[d])
3) Relay, solenoid, and coils (except motor coil windings) with:		
a) Class 105 insulation systems:		
Thermocouple method	65[a]	(117[a])
Resistance method	85	(153)
b) Class 130 insulation systems:		
Thermocouple method	85[a]	(153[a])
Resistance method	105	(189)
4) Sealing compound – this is a maximum temperature, not a temperature rise	40 (72) less than melting point	
C. Conductors		
Insulated wires and cords	35[d]	(63[d])
D. Electrical insulation – general		
1) Fiber employed as electrical insulation	65	(117)
2) Moulded phenolic composition employed as electrical insulation or as a part the deterioration of which could result in a risk of fire or electric shock	125[d]	(225[d])
3) Varnished-cloth insulation	60	(108)
E. Surfaces		
1) A surface upon which a unit might be placed or mounted for operation, and surfaces that might be adjacent to the unit when it is so placed or mounted.	65	(117)
2) Any point within a terminal box or wiring compartment of a permanently connected appliance in which power-supply conductors are to be connected, including such conductors themselves, unless the appliance is marked in accordance with 7.2.6.	35	(63)
3) Wood or other combustible material, including the inside surface of the test enclosure and the surface supporting the appliance.	65	(117)
[a] 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, if the temperature as		

Table 12.1 Continued on Next Page

Table 12.1 Continued

Materials and components	°C	(°F)

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 (°F), thermocouple method
A (1)	5 (9)
A (2)	10 (18)
B (3)(a)	15 (27)
B (3)(bi)	20 (36)

[b] For an electrolytic capacitor that is physically integral to or attached to a motor, the maximum acceptable temperature rise on insulating material integral to the capacitor enclosure shall not be more than 65 °C (117 °F).

[c] A capacitor that operates at a temperature rise of more than 65 °C (117 °F) may be evaluated on the basis of its marked temperature limit.

[d] These limitations shall not apply to classes of fuses, compounds, and components that have been investigated and found to be acceptable for use at higher temperatures.

12.2 A motor-protective device or equipment protective device (20.2.3) shall not operate during the heating test.

12.3 All temperatures in Table 12.1 are based on an assumed ambient temperature of 25 °C (77 °F). An observed temperature shall be corrected by addition [if the ambient temperature is lower than 25 °C (77 °F)] or subtraction [if the ambient temperature is higher than 25 °C (77 °F)] of the difference between 25 °C (77 °F) and the ambient temperature.

12.4 A thermocouple shall be used for determining the temperature of a coil or winding if it can be mounted, without removal of encapsulating compound or the like, on the following:

a) Integrally applied insulation of a coil without a wrap; or

b) Outer surface of a wrap that is not more than 0.81 mm (0.03 in) thick and consists of cotton, paper, rayon, or the like, but not of thermal insulation.

12.5 The rise-of-resistance method shall be used if the thermocouple measurement cannot be conducted in accordance with 12.4. For a thermocouple-measured temperature of a motor coil as specified in Table 12.1, items A(1) and A(2), the thermocouple shall be mounted on the integrally applied insulation on the conductor.

12.6 A permanently connected appliance or a cord-connected undercounter appliance shall be mounted in an enclosure constructed of nominal 9.5 mm (0.37 in) 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 if a countertop is provided as part of the appliance. Each part of the enclosure shall be brought into the closest contact with the corresponding surface of the appliance as the configuration of the appliance permits. Temperatures shall be measured at points on each of the enclosure surfaces.

12.7 A free-standing dishwasher shall be enclosed at the sides and rear by nominal 9.5 mm (0.37 in) unpainted plywood panels extending from the floor to the top of the dishwasher and located as close to the appliance as the construction permits.

12.8 If the appliance incorporates a reel for the power-supply cord, one-third of the length of the cord shall be unreeled for the heating test.

12.9 The appliance shall be operated for two complete cycles of the longest duration available at the highest heat setting. An interval of 15 min, with the door open, shall be allowed between successive cycles, to represent the time required for unloading and reloading the appliance. With the concurrence of those concerned, the interval between cycles may be shortened. Water temperature at the beginning of each cycle shall be in accordance with 5.9. The outlet of the hose from the drain pump shall be 900 mm (35.43 in) above the floor on which the appliance rests.

13 Leakage Current

13.1 A household dishwasher shall comply with leakage current requirements in UL 101 and 13.2, and shall not exceed the limits defined in Table 13.1, Maximum allowable leakage current.

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

Table 13.1
Maximum Allowable Leakage Current

Type of appliance	Indication in MIU (for a 60 Hz sine wave leakage current, the values are approximately milliamperes, rms)
Cord-connected portable appliance	0.50 MIU
Built-in appliance and permanently-connected appliance	0.75 MIU

14 Insulation Resistance

14.1 Following the moisture resistance tests of Section 15, for a dishwasher intended for permanent installation, the insulation resistance between current-carrying parts and non-current-carrying parts shall be measured as specified in 14.2. In addition, when evaluating the resilient motor mounting as specified in 25.1.5, the insulation resistance shall be measured as specified in 14.2.

14.2 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 appliance being tested. See Figure 14.1. The insulation resistance shall be calculated by the formula:

$$Insulation\ \ Resistance = \frac{(V_1 - V_2)R_2}{V_2}$$

in which:

V_1 is the measured supply line voltage, in volts.

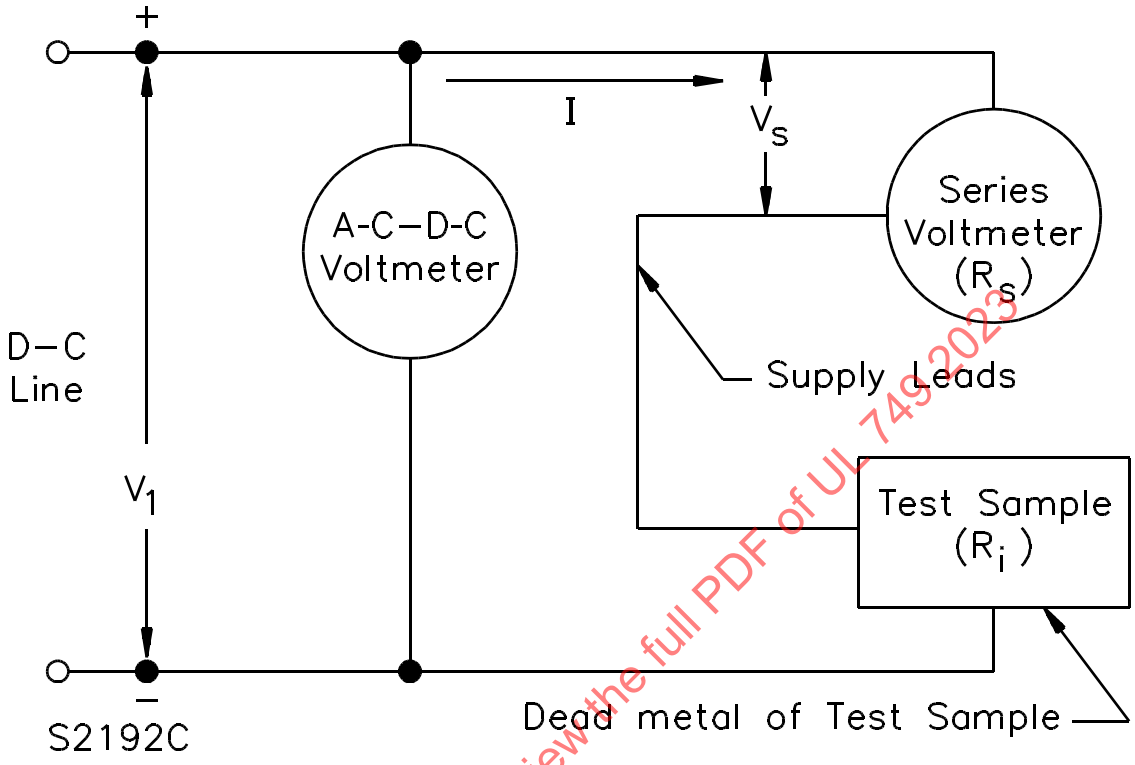
V_2 is the voltage measured by a voltmeter in series with one of the leads of the appliance heater being tested, in volts.

R_2 is the resistance of the voltmeter measuring V_2, in ohms.

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 14.1.

Figure 14.1

Two-Voltmeter Method of Measuring Insulation Resistance



15 Moisture Resistance

15.1 General

15.1.1 With the agreement of all parties involved in the investigation of an appliance:

a) One sample appliance may be used for more than one of the tests specified in Section 15; and

b) The duration of a test may be shortened.

15.1.2 Where the minimum insulation resistance is specified in 15.2 through 15.7, it shall be measured as specified in Section 14.

15.1.3 The salt-water test solution for the tests of 15.3, 15.5, and 15.6 shall consist of 0.5 grams (±0.05 grams) of NaCl per liter of distilled water.

15.2 Humidity conditioning

15.2.1 An appliance that employs insulating material that might become moist during conditions of normal operation of the appliance introducing a risk of fire or electric shock shall be conditioned as specified in 15.2.2. After conditioning, the appliance shall comply with the following, as applicable:

a) A cord-connected appliance shall comply with the leakage current requirements in Section 13; and

b) A permanently connected appliance shall have an insulation resistance of not less than 50,000 Ω between current-carrying parts and interconnected non-current-carrying metal parts.

15.2.2 An appliance shall be conditioned for 24 h in moist air at a temperature of 32 ±2 °C (89.6 ±3.6 °F) and 88 ±2 percent relative humidity.

15.3 Liquid overflowing from an auxiliary reservoir

15.3.1 An appliance that employs auxiliary reservoirs, such as a reservoir for a cleaning agent or rinsing agent, where liquid overflowing from the reservoir might result in a risk of electric shock, shall comply with the following, as applicable:

a) A cord-connected appliance shall:

1) Show no obvious wetting (see 15.7.1.5) of any electric component that is likely to occur while being conditioned as specified in 15.3.2;

2) Comply with the abnormal leakage current requirements of 5 MIU in Section 13 while being conditioned as specified in 15.3.2; and

3) Comply with the electric strength requirements in Section 16 after being conditioned as specified in 15.3.2; and

b) A permanently connected appliance shall:

1) Show no obvious wetting (see 15.7.1.5) of any electric component that is likely to occur while being conditioned as specified in 15.3.2;

2) Comply with the electric strength requirements in Section 16 after being conditioned as specified in 15.3.2; and

3) Have an insulation resistance of not less than 50,000 Ω between current-carrying parts and interconnected non-current-carrying metal parts after being conditioned as specified in 15.3.2.

15.3.2 Salt-water test solution shall be poured into the auxiliary reservoir through an orifice 9.5 mm (0.37 in) in diameter. The reservoir shall be filled to the level recommended by the manufacturer, if the level is plainly marked. If the level is not plainly marked, the reservoir shall be filled to the maximum capacity. Additional salt-water test solution, equal to 50 percent of the specified volume, but not more than 500 mL (16.91 oz), shall then be poured into the reservoir.

15.4 Oversudsing

15.4.1 An appliance shall be tested as specified in 15.4.2 and 15.4.3 to determine if an oversudsing condition results in a risk of electric shock. As a result of the test, an appliance shall comply with the following, as applicable:

a) A cord-connected appliance shall comply with the requirements in 15.3.1(a), but shall be operated as specified in 15.4.3.

b) A permanently connected appliance shall comply with the requirements in 15.3.1(b), but shall be operated as specified in 15.4.3.

15.4.2 A portable appliance shall be installed in accordance with the manufacturer's instructions, and an undercounter or built-in appliance shall be installed under a 610 mm (24.02 in) deep counter in accordance with the manufacturer's instructions.

15.4.3 The appliance shall be leveled prior to the test. A high-sudsing detergent shall be added to the washing compartment, or to the detergent dispenser, if the appliance is so equipped. If the detergent is

intended to be added directly to the washing compartment, the amount shall be in accordance with the operating instructions for the appliance. If the appliance incorporates a detergent dispenser, the dispenser shall be filled with the detergent. The detergent shall be powdered or liquid, whichever the appliance is intended to employ. The appliance shall be operated through one complete normal cycle without dishes and with the selector switch set to give the maximum flow of water at the maximum temperature.

15.4.4 As an alternative, the test specified in 15.4.3 may be conducted once in one direction of polarity and repeated again in the reverse direction of polarity while being operated as specified in 15.4.3. Two leakage current measurements shall be made, one for one polarity during operation of the appliance and one for the reverse polarity after operation of the appliance.

15.5 Liquid spillage – all appliances

15.5.1 An appliance shall be tested as specified in 15.5.2 to 15.5.5 to determine if liquids spilled or dripped onto the front of an appliance or onto the door or door assembly results in a risk of electric shock. As a result of the test, an appliance shall comply with the following, as applicable:

a) A cord-connected appliance shall comply with the requirements in 15.3.1(a), but shall be conditioned as specified in 15.5.4 and 15.5.5.

b) A permanently connected appliance shall comply with the requirements in 15.3.1(b), but shall be conditioned as specified in 15.5.4 and 15.5.5.

15.5.2 An undercounter or built-in appliance shall be installed under a 610 mm (24.02 in) deep counter in accordance with the manufacturer's instructions.

15.5.3 A portable appliance shall be set up in accordance with the manufacturer’s instructions.

15.5.4 With the door of the appliance completely closed, 200 mL (6.76 oz) of the salt-water test solution shall be poured into the area specified in 15.5.6 or poured onto the appliance in such a manner that the water will run into the area under consideration. The salt-water test solution shall be poured in a direction from the back of the appliance towards the front, from a height of 150 mm (5.91 in) and within 2 s. After the salt-water test solution has been poured, the door of the appliance shall be completely opened and then completely closed.

15.5.5 For each area specified in 15.5.6, the test shall be repeated with the door completely opened prior to the pouring of the salt-water test solution. The salt-water test solution shall be poured into the area under consideration, from a height of 150 mm (5.91 in) and within 2 s. After the salt-water test solution has been poured, the door of the appliance shall be completely closed.

15.5.6 Consideration shall be given to all accessible areas, particularly openings in the front of the appliance and in the door or door assembly. If the location of two or more areas or openings is such that one spillage would normally reach both, it is not necessary to subject each area to a separate test.

15.5.7 A rear-mounted console on the top of a portable appliance shall not be subjected to the spillage test.

15.6 Liquid spillage – portable appliances

15.6.1 A portable appliance shall be tested as specified in 15.6.2 to determine if liquid dripping from spilled water or wet objects placed anywhere on the working (top) surface of a portable appliance results in a risk of electric shock. As a result of the test, a portable appliance shall comply with the following as applicable:

a) A cord-connected appliance shall comply with the requirements in 15.3.1(a), but shall be conditioned as specified in 15.6.2.

b) A permanently connected appliance shall comply with the requirements in 15.3.1(b), but shall be conditioned as specified in 15.6.2.

15.6.2 The portable appliance shall be installed in accordance with the manufacturer's instructions, and 200 mL (6.76 oz) of salt-water test solution shall then be poured anywhere on the working (top) surface of the appliance. The salt-water test solution shall be poured from a height of 50 mm (1.97 in) and within 15 s.

15.7 Wetting of electrical components

15.7.1 Parts subject to flexing

15.7.1.1 An appliance shall be tested as specified in 15.7.1.2 to 15.7.1.5 to determine if deterioration of a polymeric part, such as a boot, diaphragm, or seal, that is subject to flexing during normal operation of the appliance results in a risk of electric shock. As a result of the test, an appliance shall comply with the following, as applicable:

a) A cord-connected appliance shall comply with the requirements in 15.3.1(a), but shall be operated as specified in 15.7.1.3 and 15.7.1.4.

b) A permanently connected appliance shall comply with the requirements in 15.3.1(b), but shall be operated as specified in 15.7.1.3 and 15.7.1.4.

15.7.1.2 The requirements in 15.7.1.1 and 15.7.1.3 to 15.7.1.5 shall not apply to a part that is subject to infrequent motion of small amplitude, such as that experienced during operation by a diaphragm covering a pressure-sensitive switch.

15.7.1.3 The appliance shall be leveled prior to the test. The appliance shall be connected to the water supply (see 5.9.1 to 5.9.3) and operated as follows:

a) Through one complete normal cycle with the boot, diaphragm, seal, or the like removed; or

b) Through one complete normal cycle with the boot, diaphragm or the like installed as intended. After the appliance has completed the cycle, the boot, diaphragm, or the like shall be removed. Water shall be placed in the vessel described in 15.7.1.4 and maintained at the maximum at-rest level of the water in the appliance during normal operation. The free end of the flexible tube (see 15.7.1.4), 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 22.9 is considered to comply with this requirement.

15.7.1.4 The vessel specified in 15.7.1.3 shall be flat-bottomed, of any convenient dimensions, and have a 1.6 mm (0.06 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 (0.37 in) and shall be of whatever length is necessary for conditioning as described.

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

15.7.2 Switches and similar devices

15.7.2.1 An appliance shall be tested as specified in 15.7.2.2 and 15.7.2.3 to determine if deterioration of a timer switch, float- or pressure-operated switch, or similar device results in a risk of electric shock. As a result of the test, an appliance shall comply with the following, as applicable:

a) A cord-connected appliance shall comply with the requirements in 15.3.1(a), but shall be operated as specified in 15.7.2.2.

b) A permanently connected appliance shall comply with the requirements in 15.3.1(b), but shall be operated as specified in 15.7.2.2.

15.7.2.2 An appliance shall be connected to the water supply (see 5.9.1 to 5.9.3) and operated through one complete normal cycle. The timer switch shall then be defeated, and the appliance shall be started in the fill portion of the cycle. If a means is not provided to reduce the likelihood of overfilling of the appliance, the fill shall be continued for an additional 15 min following the first evidence of overflow of the washing compartment. If a second device is provided to reduce the likelihood of overfilling, the actuation of this device shall terminate the test. If both a timer and a fill switch are provided, a second test shall be conducted as described above, with the timer operating normally and with the fill switch defeated.

15.7.2.3 A rubber barrier or rim seal of a washing compartment shall not be removed when a test is being conducted to simulate malfunction of a timer switch, float- or pressure-operated switch, or similar device.

15.8 Rain test

15.8.1 An appliance intended to be installed outdoors shall be tested as specified in 15.8.2 to determine if rain exposure results in a risk of electric shock. As a result of the test, an appliance shall comply with the following, as applicable:

a) A cord-connected appliance shall comply with the requirements in 15.3.1(a), but shall be operated as specified in 15.8.2.

b) A permanently connected appliance shall comply with the requirements in 15.3.1(b), but shall be operated as specified in 15.8.2.

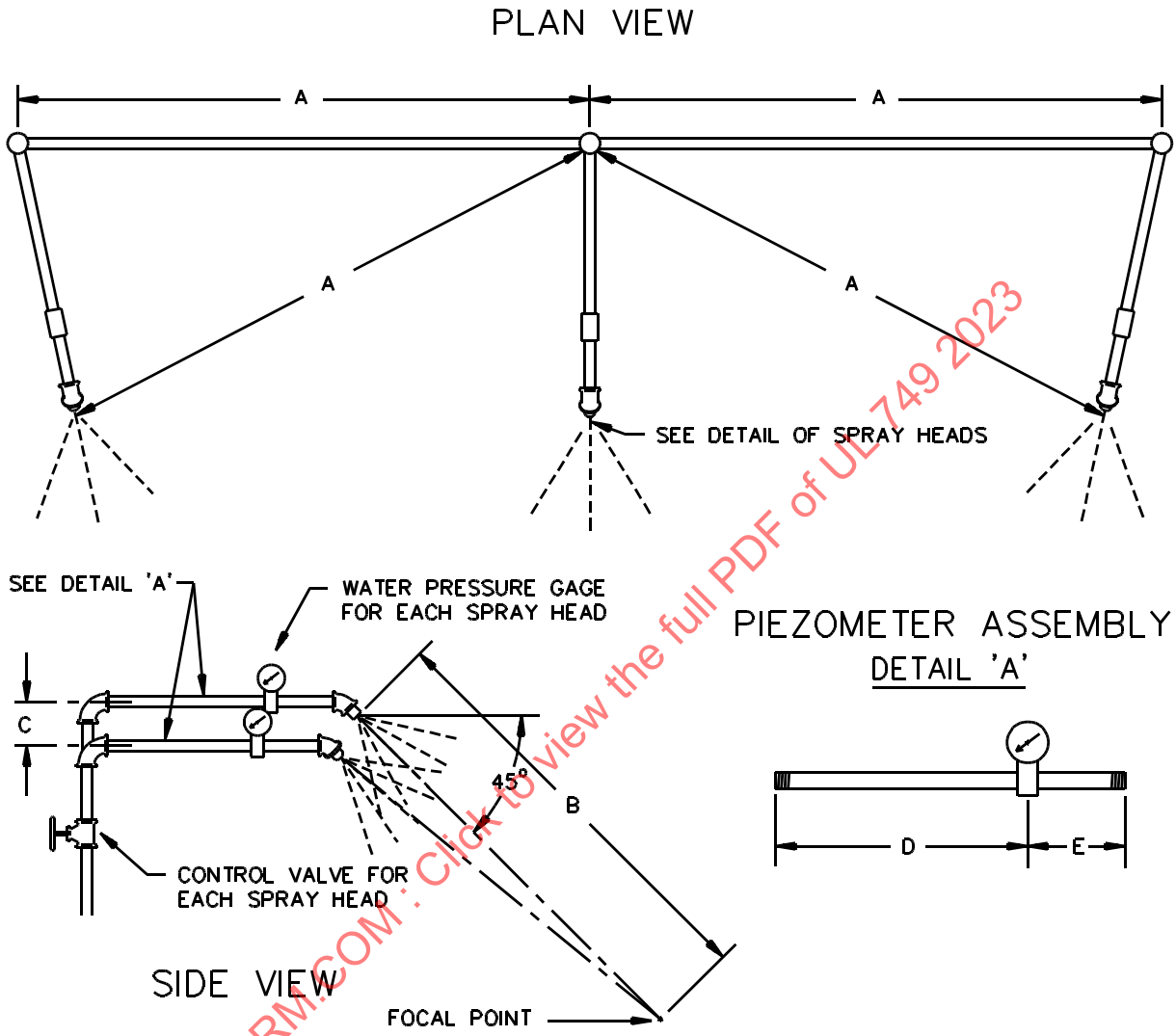
15.8.2 The dishwasher shall be positioned and leveled in accordance with the manufacturer's installation instructions. A dishwasher intended for installation outdoors in a protected location shall be provided with a representative shelter, such as a roof, canopy, marquee, or similar structure, which shall be positioned over the unit, in accordance with the manufacturer's instructions. The dishwasher shall be subjected to the rain exposure equivalent of a beating rain under conditions most likely to cause entrance of water into or onto the electrical components, such as doors opened or closed, the dishwasher operating or not operating, different dishwasher orientations and surfaces under test, etc. The duration of the exposure shall be 1 hour.

Note: See 7.2.23 for markings and 8.3.6 for installation instructions for dishwashers intended for installation in protected locations.

15.8.3 The rain test apparatus shall consist of three spray heads mounted in a water supply pipe rack as shown in Figure 15.1. Spray heads shall be constructed in accordance with the details shown Figure 15.2. The water pressure for all tests shall be maintained at 34 kPA (5 psig) at each spray head. The distance between the center nozzle and the dishwasher shall be measured to the nearest surface under test. The dishwasher shall be brought into the focal area of the three spray heads in such a position and under such conditions that the greatest quantity of water will enter it. The spray shall be directed at an angle of 45 degrees to the vertical toward the openings closest to current-carrying parts.

Figure 15.1

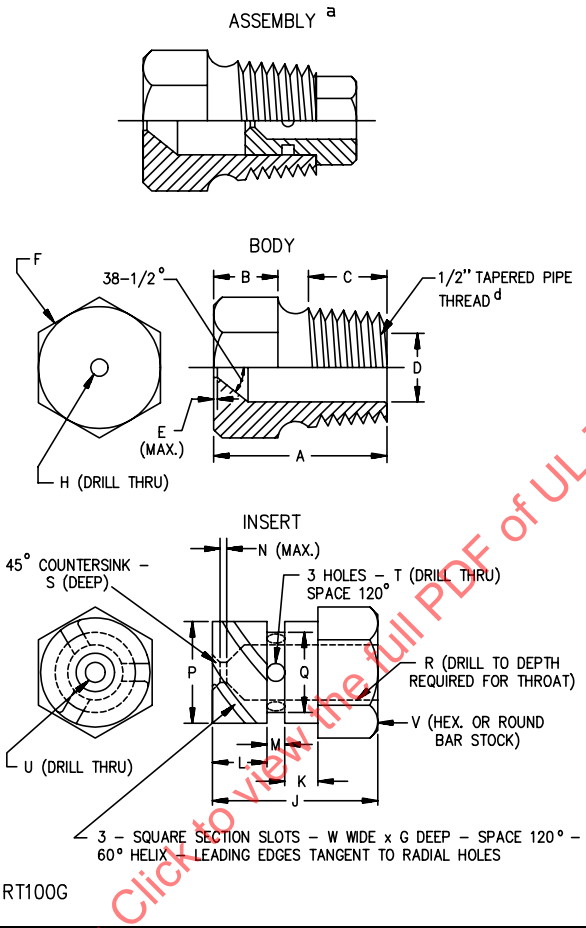
Rain-Test Spray-Head Piping



Item	inch	mm
A	28	710
B	55	1400
C	2–1/4	55
D	9	230
E	3	75

RT101E

Figure 15.2
Rain-Test Spray Head



item	inch	(mm)	item	inch	(mm)
A	1-7/32	(31.0)	N	1/32	(0.80)
B	7/16	(11.0)	P	.575	(14.61)
C	9/16	(14.0)		.576	(14.53)
D	.578	(14.68)	Q	.453	(11.51)
	.580	(14.73)		.454	(11.53)
E	1/64	(0.40)	R	1/4	(6.35)
F	c	c	S	1/32	(0.80)
G	.06	(1.52)	T	(No. 35)[b]	(2.80)
H	(No. 9)[b]	(5.0)	U	(No. 40)[b]	(2.50)
J	23/32	(18.3)	V	5/8	(16.0)
K	5/32	(3.97)	W	0.06	(1.52)
L	1/4	(6.35)			
M	3/32	(2.38)			

[a] Nylon Rain-Test Spray Heads are available from Underwriters Laboratories.

[b] ASME B94.11M, Twist Drills.

[c] Optional – To serve as a wrench grip.

[d] ASME B1.20.1, Pipe Threads, General Purpose (Inch).

15.8.4 Gaskets required to seal electrical enclosures against the entrance of rain and condensate shall be held in place by mechanical fasteners or adhesives, except as indicated in 15.8.5, and shall comply with the requirements of 30.14.1 – 30.14.4. Sealing compounds required to seal electrical enclosures shall comply with the requirements of 30.14.5. Adhesives required to secure gaskets shall comply with the requirements of 30.14.6. Gaskets shall be neoprene, rubber, or thermoplastic. Other materials may be used when they have equivalent properties.

15.8.5 With respect to 15.8.4, gaskets that are prevented from displacement either by their location or placement of other components in the enclosure when the cover is removed and that would be reengaged in the intended manner when the cover is replaced are not required to be held by mechanical fasteners or adhesives. Consideration shall be given to the intended mounting of the gasket in the application.

15.9 Hose rupture test

15.9.1 Except as specified in 15.9.3, an appliance intended to be installed outdoors shall be tested as specified in 15.9.2 to determine if rupturing of water containing components due to freezing results in a risk of electric shock. As a result of the test, an appliance shall comply with the following, as applicable:

a) A cord-connected appliance shall:

1) Show no obvious wetting (see 15.7.1.5) of any electric component that is likely to occur while being conditioned as specified in 15.9.2;

2) Comply with the abnormal leakage current requirements of 5 MIU in Section 13 while being conditioned as specified in 15.9.2; and

3) Comply with the electric strength requirements in Section 16 after being conditioned as specified in 15.9.2; and

b) A permanently connected appliance shall:

1) Show no obvious wetting (see 15.7.1.5) of any electric component that is likely to occur while being conditioned as specified in 15.9.2;

2) Comply with the electric strength requirements in Section 16 after being conditioned as specified in 15.9.2; and

3) Have an insulation resistance of not less than 50,000 Ω between current-carrying parts and interconnected non-current-carrying metal parts after being conditioned as specified in 15.9.2.

15.9.2 The dishwasher shall be positioned and leveled as intended in use and investigated for wetting caused by leakage from a water carrying hose after 5 minutes of operation under conditions of normal operation. The inlet water pressure to the dishwasher shall be maintained at 275-415 kPa gauge (40-60 psig) for the duration of the test. The following requirements shall apply:

a) For this test, each internal water carrying hose shall have a 6.4 mm (1/4 in) diameter hole drilled in the hose in any location that can result in the solution reaching a live part, film-coated wire, or insulation. If the inside diameter of the hose is less than 6.4 mm (1/4 in), the size of the hole drilled in the tubing shall be equal to the inside diameter of the tubing. One location shall be tested at a time.

b) For internal hose connections, each connection shall be disconnected, one at a time, such that the leakage is directed toward electrical components. One hose connection shall be tested at a time.

15.9.3 The test of 15.9.2 is not necessary if it can be determined by inspection that the routing of the hoses and guarding of the live parts from hose leakage is adequate to protects against a risk of electric shock.

15.10 Liquid leaking from an auxiliary reservoir

15.10.1 An appliance that employs auxiliary reservoirs, such as a reservoir for cleaning agent or rinsing agent, shall show no evidence of wetting of electrical wire insulation after being conditioned as specified in 15.10.5.

15.10.2 An appliance that uses an appliance wiring material (AWM) style that uses a covering layer in addition to the electrical insulation layer or uses tubing intended to protect the wire is considered to comply with 15.10 if the AWM with the secondary layer complies with Immersion Test No. 2 specified in 30.8.1(b) as follows:

a) For AWM with a polymeric covering or polymeric tubing, three samples of the AWM with the covering or tubing shall be immersed in 100 percent concentration of the rinse agent. The samples shall be immersed for 1,000 h at a temperature 10 °C (18 °F) above the temperature to which the part is subjected during normal operation, but not less than 70 °C (158 °F).

b) For AWM with a rubber-based covering or rubber-based tubing, three samples of the AWM with the covering or tubing shall be immersed for 168 h immersion in 100 % rinse aid solution at boiling temperature.

As a result of the test, the AWM or tubing samples shall show no cracking, leakage, deterioration, or evidence of wetting of the electrical insulation layer.

15.10.3 15.10.1 shall not apply to wiring within Class 2 circuits where the power available is limited to 15 watts.

15.10.4 With the door of the appliance disassembled, a 3 mm (1/8 in) diameter hole shall be drilled in the reservoir in a location most likely to result in wetting of electrical wiring and such that the maximum amount of liquid will drain from the reservoir. One 3 mm (1/8 in) diameter vent hole shall also be drilled at the top of the reservoir and shall be located in a location high enough that it will not leak rinse agent as the door is cycled during conditioning. The door assembly shall be reassembled to meet the production intent configuration.

Note: When identifying the hole location, consideration should be mostly given to source of leak location(s) (e.g., weld seams, seals, gates).

15.10.5 With the door in the horizontal position, the reservoir shall be filled with 100 mL (3.4 oz) of non-transparent rinse agent or to the maximum fill level of the reservoir; see 5.6.1. The door shall be actuated a minimum of 20 times from fully open to fully closed at a rate of 3 seconds to close and 3 seconds to open, or until all liquid has drained from the reservoir. This sequence shall be repeated a minimum of 4 additional times until a volume of 400 mL (13.5 oz) has been allowed to leak from the reservoir.

15.10.6 After conditioning as specified in 15.10.5, an appliance shall be visually inspected for evidence of wetting of electrical wire insulation as follows. For the visual inspection, the door shall be orientated in its closed position. The following requirements shall apply:

a) An appliance that does not employ absorbent material within the door assembly, such as acoustic insulation, shall be immediately inspected after the conditioning; or

b) An appliance that does employ absorbent material shall be inspected 24 h (±1 hour) after the conditioning.

Note: The 24 h is intended to allow time for the rinse agent to absorb into the insulation.

15.11 Washing test

15.11.1 General

15.11.1.1 An appliance shall be tested as specified in 15.11.1.2 – 15.11.2.6 to determine if cleaning the area of a dishwasher door that encloses line-voltage circuits, results in an increased risk of electric shock. This requirement is also applicable for unique exposure conditions on portable or free-standing models that could result in an increased risk of electric shock. As a result of the test, an appliance shall comply with 15.11.2.4 and 15.11.2.6.

15.11.1.2 In the application of these requirements, consideration shall be given to all accessible areas, particularly openings at the latch, around pushbuttons, lights or displays, windows, handle mounts, vent openings, at the knob/selection switches, and any seam or separation of mating panels on the dishwasher door. On portable or free-standing models, additional consideration shall be given to areas such as around cord reels, power cord strain relief, and the like.

15.11.1.3 The appliance shall be isolated from the ground circuit by disconnecting the normal grounding means. The appliance shall be connected so that the component to be tested is on the ungrounded side of the supply. Control knobs, guards, panels, and similar components that are located in the area to be cleaned, and are removable without the use of tools, shall be removed during the testing. Lamps shall be left in place.

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

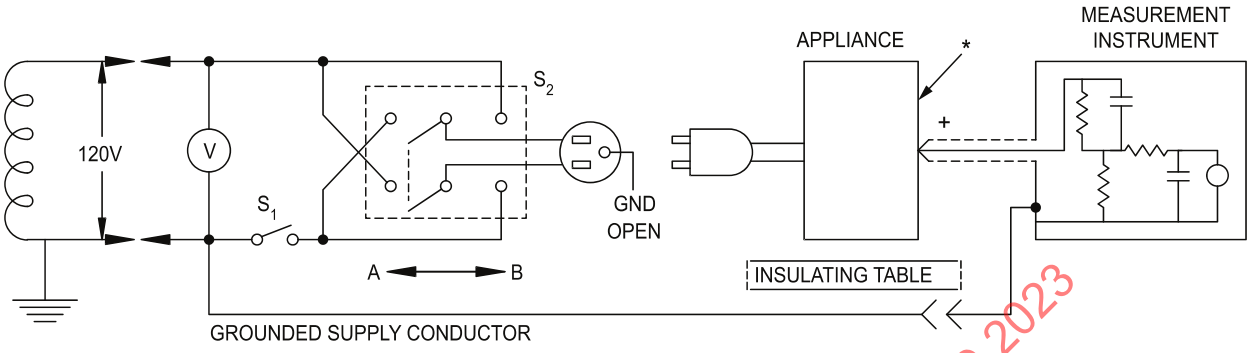
15.11.1.4 The test sponge shall be approximately 40 by 75 by 125 mm (1-5/8 by 3 by 5 in), capable of retaining from 75 g to 100 g (2.6 oz to 3.5 oz) of solution, and shall have a metal backing on one of the 75 by 125 mm (3 by 5 in) faces.

15.11.1.5 The leakage current meter shall be connected between the metal backing on the sponge and the grounded conductor of the power supply as shown in Figure 15.3.

Figure 15.3

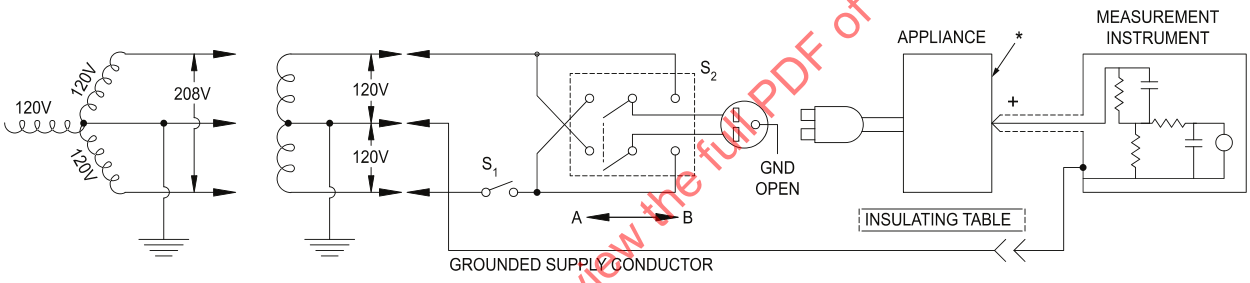
Component Washing Current Measurement Circuits

Leakage current measurement circuit used for appliances intended for connection to 120 V circuits



lc105e

Leakage current measurement circuit used for grounded or ungrounded 208 V or 240 V appliances intended for connection to three-wire neutral grounded circuits



lc205h

* Sponge with metal backing as described in 15.11.1.4

15.11.1.6 The sponge shall be saturated in a solution consisting of 10 g (0.022 lb) (2 tsp) of sodium bicarbonate and 4.5 g (0.0099 lb) of chip soap or liquid hand soap, Ivory brand or equivalent, in 0.95 L (1 qt) of water at 25 °C (77 °F) ±5 °C (9 °F). After saturation, the sponge shall be weighed to ensure that between 75 g (0.17 lb) and 100 g (0.22 lb) of solution have been absorbed.

Note: It is recommended that test personnel be properly insulated.

15.11.2 Test

15.11.2.1 The dishwasher shall be energized during this test.

15.11.2.2 For each of the following modes in 15.11.2.3 and 15.11.2.5, the saturated sponge shall be wiped six times using a force of approximately 8.9 to 13.4 N (2 to 3 lbf) applied to the metal-backed side, over all the areas described in 15.11.1.1 and 15.11.1.2. The sponge shall be wiped directly over low-profile switches (such as rocker switches). The sponge shall be re-saturated in the test cleaning solution after the third wipe as specified in 15.11.1.6. Each wipe shall consist of a motion in one direction with sufficient coverage of the area under test, at a rate not to exceed 0.38 m/sec (15 in/sec).

15.11.2.3 The test shall be conducted with the dishwasher energized in standby mode (e.g., the initial state of the appliance, with power to appliance but not operating), at an input voltage in accordance with 5.1.1 with the door closed. The test shall be repeated with the door open.

Note: The door open condition is intended to apply the test sponge to areas such as controls on the top edge of the dishwasher door, and latch openings on the inside of the door. The open door is intended to be in the position resulting in the greatest penetration of the test solution.

15.11.2.4 The leakage current shall be monitored in accordance with Section 13 and shall not exceed the limits defined in Table 13.1 in standby mode, for both positions of S1 and both positions of S2.

15.11.2.5 The test shall be repeated with the dishwasher in maximum current draw mode. An equal number of wipes shall be applied at each position of the switch or control such that the total number of wipes is six (e.g., three wipes at each position for 2-position switch; two wipes at each position for 3-position switch).

15.11.2.6 The leakage current shall be monitored in accordance with Section 13 and shall not exceed the limits defined in Table 13.1 for all loads that can be energized during a cycle (a complete cycle is not required) and at the end of the cycle (not operating). The leakage current shall be measured with switch S1 closed, for both positions of switch S2.

16 Electric Strength

16.1 An appliance shall be tested as specified in 16.2 and 16.3. As a result of the test, the appliance shall withstand for 1 min without breakdown the application of a DC potential or an AC 50 or 60 Hz essentially sinusoidal potential between current-carrying parts and non-current-carrying metal parts. This potential shall be 1,000 V AC or 1400 V DC for an appliance of any rated voltage up to 250 V.

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

16.2 If internal wiring or connections are subject to motion during intended use of the appliance (e.g., a wire running from the stationary portion of the enclosure to the access door, or a brush-and-slip-ring connection of a cord reel), the parts involved shall be moved through three or more cycles of operation while the test potential is being applied.

16.3 The appliance shall be tested using a 500 VA or larger-capacity transformer, the output voltage of which is DC or essentially sinusoidal and can be varied. The applied potential shall be increased from zero until the required test level is reached and shall be held at that level for 1 min. The increase in the applied potential shall be at a uniform rate and as rapid as is consistent with its value being correctly indicated by a voltmeter. The appliance shall be in a well-heated condition, such as after being operated through one normal cycle, and all controls shall be in the ON position.

17 Abnormal Operation

17.1 Where references are made to constant or stabilized temperatures, a temperature is considered to be constant or stable when three successive readings taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 5 min intervals, indicate no change.

17.2 Burnout test on components

17.2.1 As specified in 20.2.5, an unenclosed relay, a solenoid, or the like, including a solenoid valve and a motor-starting relay, shall be tested as specified in 17.2.2 to 17.2.4. As a result of the test, the component shall not emit flame or molten metal, other than solder, nor shall it cause glowing or flaming of the cheesecloth or tissue paper.

17.2.2 The component specified in 17.2.1 shall be covered with a double layer of white cheesecloth and supported on a softwood surface covered with a double layer of white tissue paper. The component shall be connected to a power-supply circuit that is protected by a fuse of the maximum current rating that is accommodated by the fuseholder of the branch circuit to which the appliance would normally be connected, but not less than 20 A. During the test, the plunger of a solenoid, a solenoid valve, or a relay (other than a motor-starting relay) shall be blocked in the open position. The test shall be continued for 7 h unless the ultimate results occur sooner. Opening of the branch circuit fuse is considered to be the end of the test.

17.2.3 During the test, the contact of a motor-starting relay shall be blocked in the open or closed position, whichever results in more current through the relay coil, and the motor and other components of the appliance shall remain connected during the test.

17.2.4 If the component specified in 17.2.1 is positively and reliably controlled by an automatic timer, protector, or the like, so that operation of the component is limited to a shorter interval, the test shall be terminated at the conclusion of such an interval.

17.2.5 As specified in 22.3.3(d), an electrolytic capacitor, when subjected to overvoltage to cause breakdown, shall not ignite cotton placed around openings in the enclosure when tested as described in 17.2.6.

17.2.6 Three samples of the capacitor shall be mounted in the intended manner, with cotton placed around the openings in the enclosure, and subjected to overvoltage to cause breakdown.

17.3 Stopped timer

17.3.1 An appliance shall be tested as specified in 17.3.2 to 17.3.6. As a result of the test, there shall be no evidence of the following conditions:

a) Emission of molten metal on supporting or adjacent surfaces (e.g., walls) of the appliance;

b) Glowing or flaming of combustible material upon which the appliance might be placed or of wall surfaces adjacent to the appliance; or

c) Severe charring or burning of the cheesecloth specified in 17.3.3.

17.3.2 To determine compliance with 17.3.1, separate abnormal tests shall be conducted with the appliance operating continuously in one mode until the ultimate result has been determined. The timer shall be stopped at any position while the test is being conducted. Opening of the branch circuit fuse specified in 17.3.3 is considered to be the end of the test.

17.3.3 The appliance shall be supported on a surface of plywood covered with four thicknesses (two layers) of cheesecloth. Temperature controls such as thermostats shall be set at the maximum heat position, if known to be reliable, or defeated, if not known to be reliable. Single-pole switching devices connected in the identified conductor shall be defeated. The appliance shall be connected to a power-supply circuit that is protected by a fuse rated not less than four times the motor full-load current, but in no case less than 30 A.

17.3.4 If an appliance has a cord reel, the cord shall be unreeled so that one-third of the total length is outside the appliance for the test specified in 17.3.2 and 17.3.3.

17.3.5 For appliances with a heater element supported only by polymeric material, regulating-type thermostats shall be defeated for the test specified in 17.3.2 and 17.3.3.

Note 1: For appliances equipped with semiconductor controls, continuous operation for 7 h, or more, might be necessary to ensure that the ultimate result has been observed.

Note 2: The ultimate result could be constant temperatures, opening of the circuit by a fuse or thermal protector, or the opening of a winding without the creation of a risk of fire, electric shock, or injury to persons.

17.3.6 Appliances shall be tested under the following conditions:

a) With any motor(s) stalled;

b) With solenoid armatures blocked open;

c) With appliances having heater elements operated without water; and

d) With appliances having heater elements energized as specified in 5.1.2, with nonmetallic racks and dispensers, if supplied with the appliance, placed as close to the heater element as in normal use.

17.3.7 With respect to the test specified in 17.3.2 and 17.3.6, heating elements shall not be considered protective devices.

17.3.8 The test of 17.3.6 may be conducted with two or more conditions simultaneously applied, and in the event of failure each condition shall be tested separately.

17.4 Cord reels

17.4.1 An appliance shall be tested as specified in 17.4.2. As a result of the test, there shall be no deterioration of the insulation on the supply cord and cord reel that results in a risk of fire or electric shock.

17.4.2 An appliance shall be connected to a power-supply circuit at rated voltage applied through the highest-rated fuse that can be installed in the branch-circuit fuseholder. The motor or highest-rated motor (if there is more than one) shall be stalled. The cord shall be as completely rolled on the cord reel as the construction will permit. A 3 A fuse shall be connected between the accessible non-current-carrying conductive parts of the appliance and ground. The power shall be left connected until the branch-circuit

fuse opens the circuit or until temperatures stabilize. The operation of the appliance is unacceptable if the 3 A fuse opens.

17.4.3 After the test specified in 17.4.2, the appliance shall be subjected to the electric strength test requirements in Section 16. After the test, the supply cord and cord reel shall be visually inspected to determine compliance with 17.4.1.

17.5 Hot coil ignition test

17.5.1 If specified by 30.3.4(b), an electrical connection shall be tested as specified in 17.5.2 to 17.5.11. Each connection shall be evaluated using one connector sample. Multiple connections may be independently evaluated within the same appliance if they are located such as to 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 17.5.4 as indicated by broken threads of the cheesecloth. Browning of the cheesecloth is acceptable provided that all individual threads are unbroken.

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

17.5.2 The test shall be considered inconclusive and then repeated if there is evidence of either of the following:

a) 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.

17.5.3 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 (2,000 ft) above sea level.

17.5.4 For a built-in product, the appliance shall be placed inside an enclosure constructed from painted plywood, cement board, or calcium silicate board with a minimum thickness of 9.5 mm (0.37 in). The appliance shall be leveled, starting with any adjustable feet at the maximum distance from the bottom of the appliance to the supporting surface. The feet shall be positioned such that they create the largest area under the unit allowed in the installation instruction. The enclosure shall consist of a bottom, a back, two sides, and a top. Each part of the enclosure shall be brought into the closest contact with the corresponding surface of the appliance as the configuration of the appliance permits. The following requirements shall apply:

a) The top, two sides, and back inside surfaces of the test enclosure 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. A single layer of cheesecloth shall be draped from the top of the enclosure to the supporting surface and shall be secured to the sides such that it is held in close contact with the front of the appliance.

b) If agreeable to those concerned, portions of the appliance may be tested by placing cheesecloth only in the area of the anticipated breach.

17.5.5 For a portable dishwasher, 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.

17.5.6 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. The manufacturer shall place the wiring diagram in the test appliance as intended.

17.5.7 The appliance shall be supported on a non-conductive surface. 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.

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

17.5.9 The coil shall be:

a) Nichrome wire [80 % Nickel, 20 % Chromium, 22 or 20 AWG, in accordance with ASTM B344]; or

b) FeCrAl alloy wire [72.2 % Iron, 22 % Chromium, 5.8 % Aluminum; 22 or 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.

17.5.10 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. The following requirements shall apply:

a) When inserting the coil into the part under test, a single strand of wire with a minimum length of 100 mm (4.0 in) 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; and 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/inch) to accommodate the wire.

b) When externally wrapping a connector or uninsulated terminal, a minimum 50 mm (2.0 in) of wire specified in 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 hot coil wire to prevent shorting out portions of the hot coil wire.

d) In the case of switching devices, a coil of nichrome wire shall be placed inside the device in the position of the contacts and appropriately supported to prevent movement during the test. See 30.3.5.

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

Note: With reference to (a) and (d), the preferred method of wrapping a coil is wrapping the wire around the threads of a 6-8 AWG wood screw with a nominal root diameter of 2.4 mm (0.094 in) and a thread per 25.4 mm (1 in) count of 8.

17.5.11 The hot coil shall be energized such that current in the circuit is immediately increased to the current setting per Table 17.1, and held constant for 20 minutes. If no ignition is detected within 20 minutes, the current shall be removed from the hot coil. If ignition is detected within 20 minutes, any burning of non-metallic combustible materials shall be allowed to cease naturally even if the burning goes beyond 20 minutes. If ignition of the cheesecloth occurs during the 20 minutes, the fire shall be extinguished as soon as possible. If the hot coil fractures prematurely, the test shall be repeated.

Table 17.1
Current Setting for Hot Coil Ignition Test

AWG	Type	Test current A
22	Nichrome	11.0
20	Nichrome	13.9
22	FeCrAl alloy	9.7
20	FeCrAl alloy	12.5

17.5.12 With reference to 17.5.11, the actuation of a circuit interrupter with fire extinguishing agent (CIFEA) device during the nichrome wire test to deenergize the nichrome wire, or that extinguishes any flames and prevents flame propagation before ignition of the cheesecloth, is considered an acceptable result; see 22.21.

17.6 Resistance to overvoltage

17.6.1 The appliance shall be tested as specified in 17.6.2 and 17.6.5. As a result of the test there shall be no evidence of the following:

a) Severe charring or burning of the cheesecloth specified in 17.6.2; or

b) Opening of the 3 A ground fuse.

17.6.2 When operated as described in 17.6.4 and 17.6.5, the appliance shall be placed inside an enclosure and cheesecloth applied in accordance with the Hot Coil Ignition Test, 17.5. All racks, utensil holders, and the like shall be installed in the unit in accordance with the manufacturer's recommendations. The same unit may be used for each sequential test. If a product failure occurs that prevents the appliance from operating, the appliance shall be repaired or replaced prior to testing at the subsequent voltages.

Note: This test might result in fire. Appropriate safety precautions are needed to prevent the spread of fire.

17.6.3 The appliance shall be connected to a single phase power supply capable of supplying 220V between line and neutral and shall be protected by a fuse of the maximum current rating that is accommodated by the fuseholder of the branch circuit to which the appliance would normally be connected, but not less than 30 A. A 3 A fuse shall be connected between the non-current-carrying conductive parts of the appliance and ground. Opening of the branch circuit fuse is considered to be the end of the test. In addition, if overvoltage protection, that complies with Table 17.2, actuates, this is considered the end of the test.

If the appliance fails to operate due to loss of supply connection, the connection shall be re-secured and the test repeated.

Table 17.2
Protective Control Correlation Table

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.
Control Functions	Class B control function
Software class	Software Class B
Operating Ambient	Determined via Heating Test, Section 12, of the appliance
Endurance Testing (for electro-mechanical switching devices)	100,000 cycles, except as indicated in 22.11.4.2 and 22.11.6.4,
Overvoltage Category	Overvoltage Category II
Pollution Degree	See 28.4
Enclosure Flammability	Minimum V-1, except as indicated in 30.3
Applicable test levels (EMC)	Test Level 3 unless otherwise specified.
Harmonics and interharmonics including mains signaling at a.c. power port, low frequency immunity tests	N/A
Voltage dips, voltage interruptions and voltage variations in the power supply network	During operating cycle
Radio-Frequency Electromagnetic Field Immunity To Conducted Disturbances	Test Level 3
Radio-Frequency Electromagnetic Field Immunity To Radiated Electromagnetic Fields	Test Level 3
Electrical Fast Transient / Burst Immunity	Test Level 3 applied for 1 minute in each polarity
Ring Wave Immunity	Test Level based on maximum rated voltage and overvoltage category – For residential dishwashers, a rated voltage up to 300V and an overvoltage category II is appropriate.
Surge Immunity	Installation Class 3
Electrostatic Discharge	Test Level 3
Test of influence of supply frequency variations	Test Level 2 and 3
Power frequency magnetic field immunity	Applicable to constructions where magnetic sensitive switches/controls are used in the appliance. Test Level 3
Thermal Cycling (for electronic devices)	T max = 40 °C (104 °F), unless declared more severe; T min = 0 °C (32 °F), unless declared more severe.

17.6.4 The door of the appliance shall be closed and latched. If the appliance is provided with an on/off switch, it shall be set to the on position. The appliance shall be energized in the stand-by mode and the supply voltage shall be immediately increased to 160 V and held constant for 3 h. The test shall be repeated at 190 V and 220 V. If the dishwasher is provided with lampholders and lamps that are powered by a line-voltage circuit, the tests shall be repeated with the door open.

17.6.5 The appliance shall be operated for a complete cycle of the longest duration available at the highest heat setting at each input voltage of 160 V, 190 V, and 220 V. If the same appliance is tested sequentially, it shall be allowed to cool between cycles. If the appliance fails to operate, the voltage shall be held constant for the expected duration of the selected cycle.

17.7 Lampholder endurance

17.7.1 A dishwasher that is provided with a lamp(s) for the purpose of illuminating the washing compartment shall be tested as specified in 17.7.3 and 17.7.4 with lamps on. As a result of the test, the lamp and lampholder circuit in the appliance shall:

a) Present no exposure to current-carrying parts that could pose an increased risk of electric shock when the Figure 9.3 probe is applied in any direction that is accessible during use or installation;

b) Show no obvious wetting of any electric component after being operated through one complete normal cycle;

c) For cord connected appliances: comply with the abnormal leakage current requirements of 5 MIU in Section 13 while being conditioned as specified in 17.7.3 – 17.7.4; or for permanently connected appliances, have an insulation resistance of not less than 50,000 Ω between current-carrying parts and interconnected non-current-carrying metal parts after being conditioned as specified in 17.7.3 – 17.7.4; and

d) Comply with the electric strength requirements in Section 16.

17.7.2 The requirements in 17.7.1 shall not apply to a lamp(s) within a low-voltage circuit in accordance with 3.9.

17.7.3 The dishwasher shall be evaluated within an enclosure as described in 12.6 and 12.7 with the door in the most onerous position during the test. Installation within the enclosure shall include all acoustical insulation, panels, and trim pieces supplied by the manufacturer. A thermocouple shall be used to measure the temperature of each lampholder.

17.7.4 The dishwasher shall be energized continuously at 1.1 times the rated voltage for 7 h unless the temperature becomes constant earlier, or the ultimate result occurs. If a thermal device or timer is required to meet the requirements listed in 17.7.1, then that device shall be evaluated as a protective control. If a thermal device or timer is not required to meet these requirements, then it shall be defeated for the duration of this testing. Actuation of a protective control that removes power without intervention by the user, from the lampholder circuit, is considered to be the ultimate result.

18 Stability and Mechanical Hazards

18.1 General

18.1.1 If the operation of an appliance could result in a risk of injury to persons, protection shall be provided to reduce such risk.

18.2 Stability

18.2.1 The stability of a portable appliance shall be such that it is not likely to be readily overturned during intended use.

18.2.2 A front-opening portable countertop appliance shall not overturn when tested as described in 18.2.3 or 18.2.4, as applicable.

18.2.3 A front-opening countertop appliance with a rated capacity of more than six place settings, or a front-opening portable appliance, shall be placed on a smooth horizontal surface. With no dishes and with no more water than the normal leftover water after draining in the appliance, and with the racks in their normal outermost position (alternatively, one at a time), a 23 kg (50.71 lb) weight shall be suspended from or applied to the center of the outer edge of the open door or drawer. The front casters shall be turned to the most unfavorable position.

18.2.4 A front-opening countertop appliance with a rated capacity of six place settings or less shall be tested as described in 18.2.3. A 7 kg (15.43 lb) weight shall be used for the test.

18.2.5 A top-opening appliance shall be placed on a smooth horizontal surface. The side of the appliance opposite the hinged side of the cover (usually the front side) shall be raised until the appliance is at an angle of 10 degrees to its normal position, with the casters turned to the most unfavorable position. No water or dishes shall be in the appliance, and the cover shall remain closed during the test. The appliance shall not be acceptable if it overturns as a result of the test.

18.3 Sharp edges

18.3.1 An enclosure, opening, frame, guard, knob, handle, or the like that is accessible after installation as intended during normal operation or user-maintenance shall not result in a risk of injury to persons. Accessibility shall be determined as specified in Section 9; however, for a built-in appliance, accessibility from the sides in accordance with 9.2.3 is not evaluated.

18.3.2 Whenever referee measurements are necessary to determine that a part, as mentioned in 18.3.1, is not sufficiently sharp to constitute a risk of injury to persons, the method described in UL 1439, shall be employed.

18.4 Automatic restarting of the motor

18.4.1 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.

18.4.2 To comply with the requirement in 18.4.1, an interlock shall be used in the appliance if moving parts or the like could result in a risk of injury to persons upon automatic restarting of the motor.

18.5 Moving parts

18.5.1 A pulley, belt, gear, rotor of a motor, and the like shall be enclosed or guarded to reduce the risk of injury to persons.

18.5.2 With reference to the requirement in 18.5.1, the degree of protection required of the enclosure shall depend upon the general design and intended use of the appliance. Among the factors that shall be considered in judging the acceptability of exposed moving parts are the following:

a) The degree of exposure;

b) The sharpness of the moving parts;

c) The likelihood of unintentional contact with the moving parts;

d) The speed of movement of those parts; and

e) The likelihood that fingers, arms, or clothing might be drawn into the moving parts, e.g., at points where gears mesh, where belts travel onto a pulley, or where moving parts close in a pinching or shearing action.

18.5.3 Moving parts capable of causing injury shall:

a) Not be accessible through an opening in the enclosure with a minor dimension (see 9.2.9) less than 25.4 mm (1 in) by use of a probe as shown in Figure 9.3;

b) Not be accessible through an opening in the integral enclosure of an accessible motor with a minor dimension (see 9.2.9) of less than 19.1 mm (3/4 in) by use of a probe as illustrated in Figure 9.1; or

c) Be positioned from an opening in the enclosure with a minor dimension (see 9.2.8) greater than indicated in (a) or (b) as specified in Table 9.1.

18.5.4 The dishwasher shall be installed and the accessibility probes applied as specified in Section 9.

18.6 Guards, interlocks, and the like

18.6.1 The details of guards, releases, interlocks, and the like are not specified, but the necessity for such accessories and their adequacy, if provided, shall be determined from a study of the complete appliance, its operating characteristics, and the likelihood of injury to persons resulting from other than gross negligence.

18.6.2 If opening the loading door during operation exposes a moving part that could result in a risk of injury to persons, permits water to splash or run from the washing compartment, permits the escape of hot vapour, or exposes a heating element, an appliance shall be provided with an interlock:

a) To prevent opening of the loading door during operation; or

b) When the loading door is opened; to:

1) Remove the driving force from the moving part;

2) Stop the spraying of water; and

3) De-energize any exposed heating element.

18.6.3 An interlock shall be such that it cannot be:

a) Inadvertently operated; or

b) Readily defeated without:

1) Disassembling or damaging the appliance;

2) Making or altering wiring connections to the interlock circuit; or

3) Using a tool (including tools used by authorized service personnel).

Note: With reference to 18.6.3(b), operation of an interlock in normal use is not intended to inconvenience the user so as to encourage deliberate defeat of the interlock.

18.6.4 With reference to 18.6.3(a), an interlock shall be recessed or guarded to reduce the likelihood of inadvertent operation. An interlock shall not be actuated when the articulated probe shown in Figure 9.3 is inserted into an external interlock actuator opening per the requirements in 9.4.2.

18.7 Unintentional operation

18.7.1 To start any dishwasher cycle, including a cycle with a delay function, at least one operation shall be performed in addition to closing the door. This additional operation shall be performed no more than 4 seconds prior to closing the door or anytime after closing the door. Examples of the additional operation include: push button, rotate knob, secondary manual latch operation.

18.7.2 If a dishwasher cycle is interrupted by opening the door after the initial start, or if the delay function is interrupted, the dishwasher shall comply with 18.7.1, unless the door was open for less than 5 seconds before re-closing.

Note: An example of a delay function would be a feature which delays the start of a dishwasher cycle.

18.7.3 The requirements of 18.7.1 do not apply if the dishwasher is provided with detection sensors capable of reliably detecting the potential presence of a person within the dishwasher volume, and preventing dishwasher operation. An electronic circuit relied upon for proper functioning of the detection sensor shall be evaluated in accordance with 22.11.3.

18.7.4 The requirements of 18.7.1 do not apply if the dishwasher doors do not lock from the outside. Examples of doors that lock from the outside are doors that require a secondary operation on the outside of the unit to open the door (i.e., “squeeze” latch or “throw” latch).

19 Mechanical Strength

19.1 General

19.1.1 An enclosure shall be judged with respect to size, shape, thickness of material, and suitability for the particular application.

19.1.2 An enclosure shall:

a) Have the strength and rigidity necessary to resist the abuses to which they might be subjected without increasing the risk of fire, electric shock, or injury to persons that could result from reduction of spacings, loosening or displacement of parts, or other similar conditions;

b) Afford protection against accidental contact with current-carrying (see Section 9) or moving parts [see 3.14(a) and 18.5];

c) Afford protection for the equipment against the deleterious effects of moisture or other injurious materials that might be encountered in normal operation; and

d) Retard propagation of flame initiated by electrical disturbances that might occur within the product [see 3.14(b) and 30].

19.2 Frame and enclosure

19.2.1 The frame and enclosure of an appliance shall have the necessary strength and rigidity to resist the abuses likely to be encountered during normal use. 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 1: For nonmetallic materials, refer to Section 30.

Note 2: For glass materials, refer to 19.2.10 – 19.2.13.

19.2.2 For an unreinforced, flat surface, cast metal shall not be less than 3.2 mm (0.09 in) thick, malleable iron shall not be less than 2.4 mm (0.13 in) thick, and die-cast metal shall not be less than 2.0 mm (0.01 in) thick.

Note: Metal of lesser thickness, but not less than 2.4 mm (0.09 in), 1.6 mm (0.06 in), and 1.2 mm (0.05 in), respectively, may be acceptable, if the surface under consideration is curved, ribbed, or otherwise reinforced or sized to provide mechanical strength equivalent to that required.

19.2.3 Metal of lesser thickness may be used if found acceptable when judged under factors specified in 19.2.6.

19.2.4 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. The sheet metal shall give stiffness and protection equivalent to that obtained if blank, flat steel not less than 0.65 mm (0.02 in) thick were used.

19.2.5 Generally, the use of sheet steel having a thickness less than 0.65 mm (0.02 in) if uncoated or 0.74 mm (0.03 in) if galvanized or of nonferrous sheet metal having a thickness less than 0.91 mm (0.04 in) shall not be acceptable other than for relatively small areas or for surfaces that are curved or otherwise reinforced.

19.2.6 Among the factors that shall be considered when judging an enclosure shall be:

a) Mechanical strength;

b) Resistance to impact;

c) Moisture-absorptive properties;

d) Combustibility;

e) Resistance to corrosion; and

f) Resistance to distortion at temperatures to which the enclosure might be subjected under conditions of normal or abnormal use.

19.2.7 For a nonmetallic enclosure, all of the factors specified in 19.2.6 shall be considered with respect to thermal ageing.

19.2.8 Other than as specified in Section 9, an appliance shall be provided with an enclosure that is:

a) Of material found acceptable by investigation for the application and that houses all parts that might present a risk of fire, electric shock, or injury to persons under any condition of use; and

b) Mounted in place when the appliance is shipped from the factory, unless the appliance is marked in accordance with 7.2.17.

19.2.9 An electrical part of an appliance shall be located or enclosed so that protection against unintentional contact with uninsulated current-carrying parts and internal wiring of line-voltage circuits will be provided (see 21.1.2).

19.2.10 The glass portion of the enclosure:

a) Shall be mechanically secured in a manner that requires a tool for removal, or shall be secured using an adhesive that complies with 22.19.1 so that the glass cannot be readily displaced during normal use; and

b) Shall not be used for the support of any electrical component.

19.2.11 The glass portion of the enclosure shall:

a) Be a non-shattering or tempered type that complies with the requirements in ANSI Z97.1 Class A; or

b) Withstand the impact described in 19.2.12.

19.2.12 The glass portion of an enclosure shall be tested as described in 19.2.13. As a result of the impact test:

a) Spacings shall not be reduced to less than those specified in Table 19.1;

b) Current-carrying parts or internal wiring shall not be exposed, as determined in accordance with Section 9;

c) There shall be no damage that could result in a risk of fire, electric shock, or injury to persons (See 18.5.3); and

d) There shall be no cracking or breaking of the glass to the extent that glass pieces are released or dropped from their normal position.

Table 19.1
Minimum Spacings

Spacing involved		Spacings, mm (in)	
		Through air	Over surface
A.	At field wiring terminals between current-carrying parts		
	i) of opposite polarity and between current-carrying parts and non-current-carrying metal parts other than the enclosure	6.3 (0.25)	9.5 (0.37)
	ii) and a metal enclosure	12.5 (0.49)	12.5 (0.49)
B.	At points other than field wiring terminals and closed-in points between current-carrying parts [a]		
	i) of opposite polarity and between current-carrying parts and non-current-carrying metal parts other than the enclosure	1.6 (0.06)	1.6 (0.06)
	ii) and a metal enclosure	6.3 (0.25)	6.3 (0.25)
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[a]	1.2 (0.05)	1.2 (0.5)

[a] This shall include spacings at the commutator of a motor or at a heating element.

19.2.13 The glass portion of an enclosure shall be subjected to the resistance to impact test for floor-supported appliances described in UL 746C, except using an impact value of 3.4 J (2.5 ft-lb), and CAN/CSA-C22.2 No. 0.17, except using a vertical distance of 690 mm.

19.2.14 With reference to 19.2.13, the location of the impacts shall be at least 1 inch away from edges and at least 2 inches away from corners or through-holes (handle area, etc.).

Note: A new sample may be utilized for each impact impacted in accordance with 19.2.12.

20 Construction

20.1 Current-carrying parts

20.1.1 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.

20.1.2 Plated iron may be used for a current-carrying material specified in 20.1.1 if the material:

a) Has a temperature during normal operation of more than 100 °C (212 °F);

b) is within a motor or associated governor; or

c) is acceptable in accordance with 22.1.1(a).

20.1.3 Unplated iron or steel shall not be used for the current-carrying material specified in 20.1.1. Stainless steel and other corrosion-resistant alloys and plated steel may be used for a current-carrying part regardless of temperature.

20.1.4 An uninsulated current-carrying part shall be secured to the mounting surface so that it is prevented from turning or shifting if such motion could result in a reduction of spacings below the minimum acceptable values.

20.1.5 Friction between surfaces shall not be acceptable as a means of preventing shifting or turning of current-carrying parts. A lock washer is an acceptable means of preventing shifting or turning.

20.2 Bottom openings

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

20.2.2 With reference to 20.2.1, a barrier shall be used to reduce the likelihood of molten metal, burning material, or the like from falling onto 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 molten metal or burning insulation 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) that will reduce the likelihood that the temperature of the motor windings will exceed 125 °C (257 °F) under the maximum load under which the motor will run without causing the protector to cycle and that the temperature will exceed 150 °C (302 °F) with the rotor of the motor locked;

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

c) Under the grounded sheath of a heater assembly, unless the dishwasher is provided with a device as specified in 20.2.3.

20.2.3 With respect to 20.2.2(c), a barrier is not required below the grounded sheath of a heater assembly if a device is provided to disconnect all ungrounded conductors supplying power to the heating element, or the entire dishwasher, when a fault is detected from the heating element to the sheath. The

device shall be a manual reset or non-resettable device. A device complying with one of the following is considered to meet this requirement:

a) An equipment protective device as specified in 22.20; or

b) An appliance control evaluated as an operating control with Type 2 action in accordance with 22.11.8.2(a).

20.2.4 To comply with the requirement in 20.2.1, a component such as a switch, relay, or solenoid shall be individually and completely enclosed.

20.2.5 A component as specified in 20.2.4 shall not be required to be enclosed if:

a) It complies with 17.2.1; or

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

20.2.6 The terminals of a component as specified in 20.2.4 shall not be required to be enclosed.

20.2.7 The barrier specified in 20.2.2 shall:

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

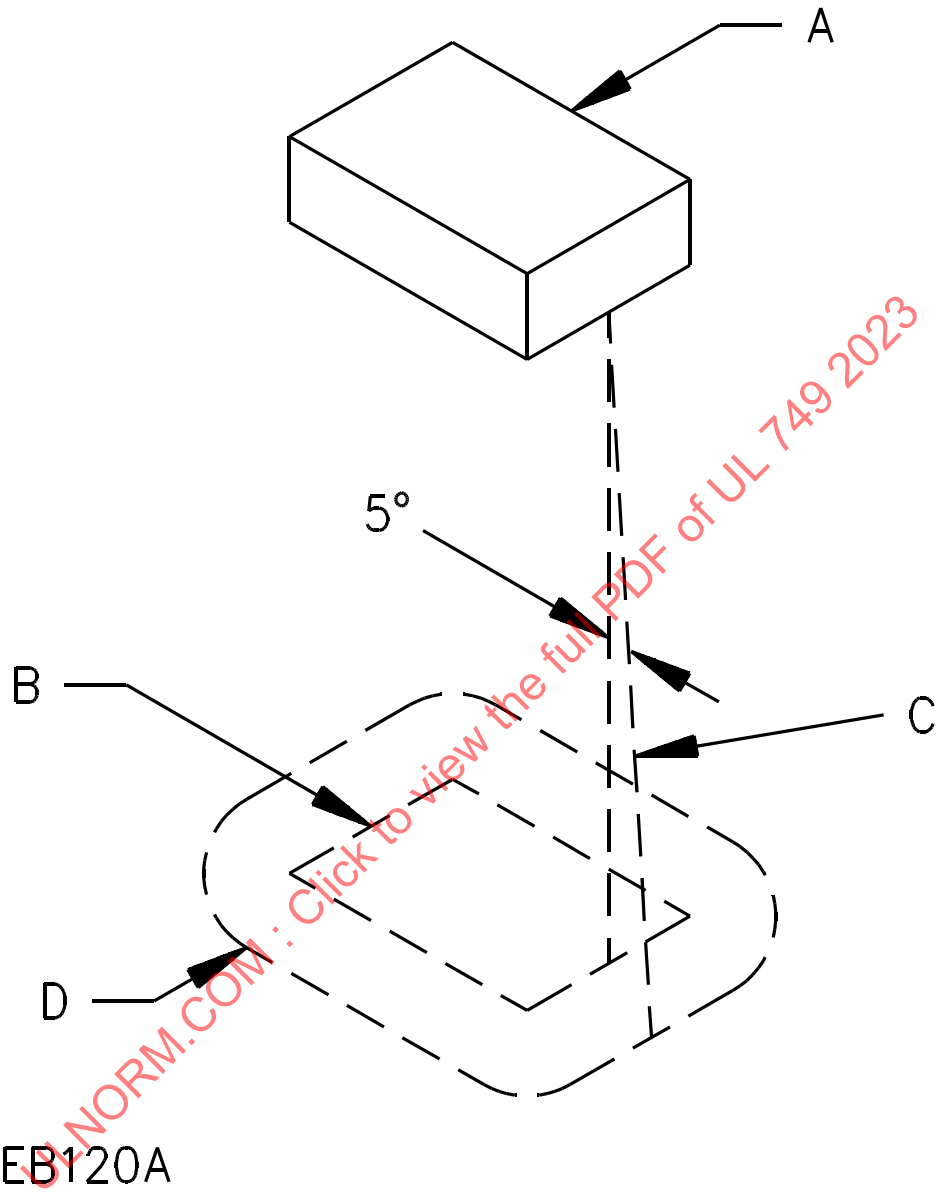
b) Be located as illustrated in Figure 20.1;

c) Have an area in accordance with Figure 20.1; and

d) Have a flammability rating of V-1 minimum.

Figure 20.1

Location and Extent of Barrier



A Region to be shielded by barrier. This will consist of the entire component if it is not otherwise shielded and will consist of the unshielded portion of a component that is partially shielded by the component enclosure or equivalent.

B Projection of outline of component on horizontal plane.

C Inclined line that traces out minimum area of barrier. When moving, the line is always

1) Tangent to the component;

2) 5° from the vertical; and

3) Oriented so 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.

20.2.8 With reference to the barrier specified in 20.2.2, 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.

20.3 Electrical insulation

20.3.1 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 CSA C22.2 No. 198.3 and UL 1441; and

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

Note: UL 510 covers tape rated up to 80 °C (176 °F), and UL 510A covers tape rated greater than 80 °C (176 °F).

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

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

20.3.4 If an investigation is necessary to determine if 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 might have a bearing on the risk of fire, electric shock, and injury to persons, in conjunction with the conditions of actual use.

20.3.5 Thermoplastic materials shall not generally be acceptable for the sole support of an uninsulated current-carrying part but may be employed if shown to be acceptable by means of an investigation in accordance with UL 746C and CAN/CSA-C22.2 No. 0.17.

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

20.4 Sound and thermal insulation

20.4.1 Electrically conductive sound (acoustic) or heat-insulating material shall not be located so that it contacts uninsulated current-carrying parts.

Note: Some types of mineral-wool 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.

20.4.2 A polymeric sound or thermal insulating material suitable for use in direct contact with live parts as specified in 20.3.5 shall be considered suitable for use in contact with uninsulated current-carrying parts.

20.4.3 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 Section 13, the Moisture Resistance Tests of Section 15, and the Electric Strength Test of Section 16 with the insulation installed in contact with the uninsulated current-carrying parts.

20.5 Plumbing requirements

20.5.1 A dishwasher shall comply with the plumbing requirements specified in Annex A of this standard.

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

21 Internal Wiring

21.1 General

21.1.1 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 might not be completely enclosed and some of it might be in the form of flexible cord.

21.1.2 The internal wiring and connections between parts of an appliance shall be protected or enclosed. A length of flexible cord complying with 23.2.2 may be employed for an external (unenclosed) connection between such parts if flexibility is necessary.

21.1.3 The protection of insulated wiring required by 21.1.2 shall be considered to exist if it complies with the requirements of 9.4.5.

21.1.4 A conductor shall not be smaller than 20 AWG (0.52 mm^2). Integral leads not more than 150 mm (5.9 in) long of a small electrical component, such as a relay coil or a timer motor, may be smaller than 20 AWG (0.52 mm^2), but shall not be smaller than 24 AWG (0.21 mm^2).

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

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

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

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

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

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

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

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

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

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

c) Exposure to moisture; and

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

21.1.7 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.

21.1.8 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 specified in 23.7.2 or shall have smooth surfaces, upon which the wires might bear, free of burrs, fins, sharp edges, and the like, which could result in abrasion of the insulation.

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

21.2 Splices and connections

21.2.1 Splices and connections shall be mechanically secure and shall provide adequate and reliable electrical contact. Soldered connections shall be made mechanically secure before being soldered if breaking or loosening of the connection could result in a risk of fire, electric shock, or injury to persons.

21.2.2 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 could result in a risk of fire, electric shock, or injury to persons.

21.2.3 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.

21.2.4 Splices shall be provided with insulation equivalent to that of the wires involved if the spacing between the splice and other metal parts is found not likely to be permanently maintained (see 20.3).

21.2.5 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 another type of tubing is acceptable, consideration shall be given to such factors as its electric strength properties, resistance to heat, resistance to moisture, and the like. Thermoplastic tape wrapped over a sharp edge shall not be acceptable (see 20.3).

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

21.2.7 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.

21.2.8 With reference to 21.2.7, 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 (see 22.16).

21.2.9 The ampacity of conductors shall be such that the limiting temperature for the insulation is not exceeded under normal conditions of use (see Section 12).

21.2.10 In an appliance not supplied with a complete enclosure, the internal wiring shall be:

a) Cabled, routed, or secured so that damage to the wiring prior to or during installation will be unlikely; and

b) Located and secured so that contact with combustible surfaces adjacent to the appliance after installation will be unlikely.

21.3 Separation of circuits

21.3.1 Uninsulated current-carrying parts and insulated conductors of a line-voltage circuit and a low-voltage circuit shall be reliably segregated or separated from each other. Conductors provided with insulation acceptable for the line voltage involved shall not require separation or segregation.

21.3.2 Segregation of low-voltage and line-voltage circuits may be accomplished by clamping or routing of conductors, or by an equivalent means that provides permanent separation, such as a barrier.

21.3.3 Low-voltage circuits intended to be in the same field wiring compartment with any other circuits shall be provided with insulation acceptable for the highest potential involved and shall be permanently separated from all other circuits by at least a 6.4 mm (0.25 in) spacing.

21.3.4 Low-voltage circuits may be segregated from other circuits in the field wiring compartment by arranging the location of openings in an enclosure for the various conductors – with respect to the terminals or other uninsulated current-carrying parts – so that there is no likelihood that intermingling of the conductors or parts of low-voltage circuits and any other circuits can occur.

21.3.5 With reference to 21.3.4, if the number of openings in the enclosure does not exceed the minimum required for the proper wiring of the appliance, and if each opening is located opposite a set of terminals, it shall be assumed that a conductor entering an opening will be connected to the terminal opposite that opening. If more than the minimum number of openings are provided, the possibility of a conductor's entering an opening other than the one opposite the terminal to which it is intended to be connected and the likelihood of its contacting insulated conductors or uninsulated current-carrying parts connected to a different circuit shall be investigated.

21.3.6 To determine if an appliance complies with the requirement in 21.3.3, it shall be wired as intended for normal operation with a reasonable amount of slack left in each conductor within the enclosure, and not more than average care shall be used in stowing the slack into the wiring compartment.

21.4 Barriers

21.4.1 If a barrier is used to provide separation of circuits as specified in 21.3.1 to 21.3.3, it shall be of metal or of insulating material that has adequate mechanical strength if exposed or otherwise likely to be subjected to mechanical damage, and it shall be reliably held in place (see UL 746C).

21.5 Endurance test

21.5.1 Where the operation of a movable part of an appliance, other than a cord reel, might mechanically affect the wiring or other insulated parts, the part shall be operated as specified in 21.5.2. As a result of the operation, there shall be no malfunction of the movable parts. After operation, the appliance shall comply with the electric strength requirements in Section 16.

21.5.2 The movable part shall be subjected to 30,000 cycles of operation. For the first 20,000 cycles, any wiring or insulated current-carrying part that is flexed shall be de-energized; for the remaining 10,000 cycles, such parts shall be energized so as to represent the maximum load encountered during the intended operation of the appliance. The test shall be conducted at the rate of 12 cycles/min. The part shall be operated in the intended manner so that it will reach the actual limits of travel in both directions during each cycle and under the conditions that will result in maximum wear on all parts.

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

22 Components

A component of a product covered by this standard shall comply with the requirements for that component. See Section 2 for a list of standards covering components generally used in the products covered by this standard. A component shall comply with the CSA or UL standards as appropriate for the country where the product is to be used.

22.1 General

22.1.1 Except as indicated in 22.1.2, 22.1.3, and 22.1.4, a component of an appliance covered by this standard shall:

a) Comply with the requirements for that component as specified in this standard;

b) Be used in accordance with its rating(s) 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 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 be used only under those specific conditions.

22.1.2 A component of an appliance covered by this standard is not required to comply with a specific component requirement that:

a) Involves a feature or characteristic not required in the application of the component in the appliance;

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.

22.1.3 A component complying with a CSA or UL component standard other than those specified in this standard shall be acceptable if:

a) The component also complies with the applicable component standard(s) specified in this standard; or

b) The component standard:

1) Is compatible with the ampacity and overcurrent protection requirements in the Canadian Electrical Code and National Electrical Code, where appropriate;

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

3) Any use limitations of the other component standard(s) are 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, could assume user expertise not common in household applications.

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

22.1.5 A component that is also intended to perform other functions, such as overcurrent protection, ground-fault circuit-interruption, surge suppression, any other similar functions, or any combination thereof, shall comply additionally with the requirements of the applicable CSA and UL standards 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.

22.1.6 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 and UL standards, and shall comply with 22.1.1 (b) – (d).

22.1.7 With respect to 22.1.6, 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 household dishwashers.

22.2 Mechanical assembly

22.2.1 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.

22.2.2 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.

22.2.3 Means of reducing the likelihood of the turning of a switch shall not be required 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;

b) The means of 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.

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

22.3 Capacitors

22.3.1 The component requirements for a capacitor are not specified except:

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

1) CSA C22.2 No. 8 or CSA E60384-14;

2) UL 60939-3 or UL 60384-14; and

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

22.3.2 Capacitors with integral enclosures complying with the standards specified in 22.3.1 are considered to fulfill the requirements of 22.3.3 and 22.3.4.

22.3.3 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 (0.02 in) thick or shall be constructed to afford equivalent protection;

b) A capacitor having a sheet-steel container or enclosure thinner than 0.51 mm (0.02 in) 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;

c) The individual enclosure of an electrolytic capacitor with means of venting may be such as to provide protection against mechanical damage only, and no minimum enclosure thickness shall be specified; or

d) The individual enclosure of an electrolytic capacitor not provided with means of venting and with an opening more than 1.6 mm (0.06 in) wide between the capacitor enclosure, and the motor shall not be required to comply with the requirement for enclosure thickness if it is found acceptable when tested as described in 17.2.5.

22.3.4 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.

22.3.5 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.

22.3.6 A capacitor complying with the requirements for protected oil-filled capacitors specified in the requirements for capacitors in CSA C22.2 No. 190 and UL 810, shall be considered to be constructed so as to reduce the likelihood of expelling the dielectric medium.

22.4 Field-attached or optional accessories

22.4.1 22.4.2 to 22.4.6 shall apply to accessories intended for installation on or connection to an appliance for the purpose of modifying or supplementing the functions of the appliance.

22.4.2 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.

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

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

22.4.5 Any installation that requires field rearrangement of components or wiring, cutting or splicing of wiring, or soldering of connections shall not be acceptable.

22.4.6 As part of the investigation of an accessory, it 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.

22.5 Heating elements

22.5.1 Sheath-type heating elements that are immersed in water in normal use shall comply with CSA C22.2 No. 72 and UL 1030.

22.5.2 Sheathed and non-sheathed heating elements that are not immersed in water in normal use shall comply with the following standards:

a) CSA C22.2 No. 72 and UL 499, and the Thermal Endurance Test of UL 1030; or

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

22.5.3 In reference to 22.5.2(a), if requested by the manufacturer, for a heating element designed to operate in a water-cooled condition (e.g., with continuous water circulation), then the Thermal Endurance Test of UL 1030 shall be conducted with the heating element subjected to the water-cooled condition that simulates its intended end-use application.

22.5.4 Heating elements shall be supported in a substantial and reliable manner, and provided with means of reducing the likelihood of mechanical damage and contact with outside objects. Heating elements shall be supported by a means which allows thermal expansion during operation to occur without restriction.

22.5.5 An appliance that employs a heating element with a metallic tubular sheath that is in direct contact with water and detergent shall employ the following:

a) A heating element with a sheath material composed of a metal alloy with a minimum of 18 percent nickel;

b) A sheath material in accordance with 22.5.6; or

c) A device as specified in 22.11.8.

Note: This requirement does not apply to flow-through heater applications where the sheath is not in direct contact with water.

22.5.6 The sheath material of a heater assembly shall be subjected to a stress corrosion cracking comparison test in accordance with ASTM G36 and supported using a U-bend fixture in accordance with ASTM G30. The proposed material shall be compared to a baseline material fabricated from a metal alloy composed of 20 % nickel, 60 % iron, and 20 % chromium. Coupons of identical wall thickness, length, and width shall be fabricated for the test. Testing shall be done sequentially such that the alloy comparison is done under the same conditions. As a result of the test, using a statistically relevant sample size, the proposed material shall not crack statistically sooner than the baseline material.

22.6 Lampholders

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

22.6.2 Lighting ballasts shall comply with CSA C22.2 No. 74 and UL 8750, unless the LED light source forms a part of a luminaire complying with the appropriate CSA and UL Standards. Individual light emitting diodes mounted on the printed wiring board of a control and intended for indicating purposes shall be evaluated with the control.

22.6.3 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.

22.6.4 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 maintenance.

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.

22.7 Motors

22.7.1 A motor shall comply with CSA C22.2 No. 100 and UL 1004-1 and shall incorporate thermal or overload protection as part of the appliance.

22.7.2 The following types of motor-overload protection are examples of motors that comply with the requirement in 22.7.1:

a) A thermally protected motor complying with CSA C22.2 No. 77 and UL 1004-3;

b) An impedance-protected motor complying with the applicable requirements for locked-rotor protection in CSA C22.2 No. 77 and UL 1004-2. An impedance-protected motor that is subjected to restricted ventilation or to an external source of heat shall be tested in the appliance to determine if it complies with the locked-rotor requirements;

c) An electronically protected motor complying with CSA C22.2 No. 77 and UL 1004-7;

d) Other protection that is shown by test to be equivalent to the protection specified in (a) or (b), as specified in 22.7.6; or

e) A motor with locked-rotor protection only, intended to move air only by means of an air-moving fan that is integrally attached, keyed, or otherwise fixed to the motor shaft.

22.7.3 With reference to 22.7.2(b), the locked-rotor test may be conducted in a test oven set to represent the ambient temperature at the motor location within the appliance during normal operation of the appliance.

22.7.4 If a motor referred to in 22.7.2 is positively and reliably controlled by an automatic timer or the like so that operation of the motor is limited to a shorter interval, the test may be terminated at the conclusion of such interval. If an electronic control operates to end the test or limit the motor temperatures, the control shall be evaluated as electronic protection per 22.7.2(c) or the test shall be repeated with the electronic control defeated.

22.7.5 The protection provided in accordance with the requirements in 22.7.1 to 22.7.4 shall accomplish the intended result at each setting of the speed-control device of a multispeed motor.

22.7.6 With reference to 22.7.2(d), a motor protected by a protective device other than as specified in 22.7.2 (a) to (b) shall be subjected to the performance requirements of CSA C22.2 No. 77 and UL 1004-3 to determine if the device provides adequate protection.

22.8 Receptacles

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

22.9 Seals and diaphragms

22.9.1 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.

22.9.2 The test procedure for investigating a component as required by 22.9.1 shall depend upon the material of which it is composed, its size and shape, the mode of application in the appliance, and other factors. The test procedure may include visual inspection for determination of cracks, deformation, and the like, after artificial ageing, as well as comparison of hardness, tensile strength, and elongation before and after artificial ageing.

22.9.3 With reference to 22.9.1 and 22.9.2, a noncomposite material, when tested to compare its tensile strength and elongation before and after artificial ageing, shall be acceptable if these properties are found to be not less than the minimum corresponding values specified in UL 157. The maximum operating temperature specified in UL 157 corresponds to the temperature of the component during the heating test.

22.9.4 Materials exposed to dishwashing detergents shall be subjected to the detergent/cleaner exposure test conditions of UL 157.

22.10 Switches

22.10.1 General

22.10.1.1 Switches shall comply with the following, as applicable:

a) CSA C22.2 No. 55;

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

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

22.10.1.2 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.

22.10.1.3 Switches shall be acceptable for the application and shall have a current and voltage rating not less than that of the maximum load they control in the appliance. For switches that comply with CAN/CSA-C22.2 No. 61058-1 and UL 61058-1, see 22.10.1.6.

Note: See 22.11 for requirements relating to controls with a switching function.

22.10.1.4 A cord-connected appliance having a motor rated more than 249 W (output) shall be provided with a switch to control the motor circuit. The switch shall not be connected in the grounded conductor of the supply circuit unless it also results in the opening of all ungrounded supply conductors to the motor.

22.10.1.5 Switching devices of the single-pole type that control the power supply to the appliance or to components shall not be connected in the grounded conductor of the supply circuit if the device could introduce a risk of fire, electric shock, or injury to persons when short circuited. (See 17.3.2 and 18.6.)

22.10.1.6 Switches that comply with CAN/CSA-C22.2 No. 61058-1 and UL 61058-1 shall be rated as specified in 22.10.1.7 – 22.10.1.9.

22.10.1.7 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; and

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

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

a) Power switches: 6,000 cycles;

b) Power switches provided with series electronics shall be subjected to an additional 1,000 cycles of operation with the electronics bypassed;

c) Switches other than power switches, such as speed selector switches, that might be switched under electrical load: 1,000 cycles; and

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

1) Switches not intended for operation without 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 CAN/CSA-C22.2 No. 61058-1 and UL 61058-1.

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

22.10.2 Overload test

22.10.2.1 A switch or other device that controls a motor, and that has not been investigated and found to be acceptable for the purpose, shall be tested as described in 22.10.2.2. There shall be no electrical or mechanical breakdown or malfunction of the device nor welding or undue pitting or burning of the contacts. The fuse in the grounding connection shall not open.

22.10.2.2 The rotor of the motor shall be locked. During the test, exposed non-current-carrying metal parts of the appliance shall be connected to ground through a 3 A plug fuse, and the connection shall be such that any single-pole current-rupturing device is in an ungrounded conductor of the supply circuit. The switch or other device shall be operated for 50 cycles at a rate of not more than 10 cycles/min. With the concurrence of those concerned, a faster rate of operation may be employed.

22.10.3 Endurance test

22.10.3.1 A switch or other device that controls a solenoid, a relay coil, or the like, and that has not been investigated and found to be acceptable for the purpose, shall be tested as described in 22.10.3.2. There shall be no electrical or mechanical breakdown or malfunction of the device nor welding or undue pitting or burning of the contacts. During the test, exposed non-current-carrying metal parts of the appliance shall be connected to ground through a 3 A plug fuse, and the connection shall be such that any single-pole current-rupturing device is in an ungrounded conductor of the supply circuit.

22.10.3.2 The appliance shall be connected to a supply circuit of rated frequency and 110 percent of the test voltage specified in 5.1.1. The load on the device under test shall be the same as that which it is intended to control during a normal cycle. The device shall be operated for 50 cycles at a rate of not more than 10 cycles/min. With the concurrence of those concerned, a faster rate of operation may be employed.

22.11 Controls

22.11.1 General

22.11.1.1 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 control standards with respect to a risk of fire, electric shock, and injury to persons.

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

22.11.2 Operating controls

22.11.2.1 Except as specified in Table 22.1 and Table 22.2, an operating control shall comply with:

a) CSA C22.2 No. 156, CSA C22.2 No. 24, or the requirements for Class A control functions as specified in CAN/CSA-E60730-1; and

b) UL 873 or the requirements for Class A control functions as specified in UL 60730-1.

Alternatively, an operating control shall comply with the electronic circuit requirements specified in Annex D.

Table 22.1
Leakage Current Detection Device Correlation Table for a Grounded Sheathed Heater Without Barrier Between the Sheath and Supporting Surface

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.
Declared Trip Current and Response Time	100 mA maximum 10 seconds maximum Deviation and Drift: +0 %
Operating Ambient	Determined via Heating Test, Section 12, of the appliance
Action	Type 2 (2.B.E or 2.Y (if any re-closings occur within 10 seconds maximum)
Endurance and Thermal Cycling Test	Manual reset[1] or non-resettable device 3,000 cycles for manual, non-self-resetting devices 100,000 cycles for relay contacts also operating during the normal operating cycle of the dishwasher
Overvoltage Category	Overvoltage Category II
Pollution Degree	See 28.4
Enclosure Flammability	Minimum V-1, except as indicated in 30.3
EMC Immunity	Tested as an Operating, Type 2 control (Table H.13DV)
Control Class	Class B
[1] Any intentional action would be acceptable as a manual reset including cycling power, a push button reset, or a sequence of key presses on the user interface.	

Table 22.2
Leakage Current Detection Device Correlation Table for an Ungrounded Sheathed Heater With a Barrier Between the Sheath and Supporting Surface

Information	Operating control requirement
Declared Trip Current and Response Time	100 mA maximum 10 seconds maximum
Operating Ambient	Determined via Heating Test, Section 12, of the appliance
Action	Type 1 (1.B.E or 1.Y (if any re-closings occur within 10 seconds maximum))
Endurance and Thermal Cycling Test	Manual reset[1] or non-resettable device 3,000 cycles for manual, non-self resetting devices 100,000 cycles for relay contacts also operating during the normal operating cycle of the dishwasher
Pollution Degree	See 28.4
Enclosure Flammability	Minimum V-1, except as indicated in 30.3
Control Class	Class A
[1] Any intentional action would be acceptable as a manual reset including cycling power, a push button reset, or a sequence of key presses on the user interface.	

22.11.2.2 The cycle selection control, water level detection (15.7.2), temperature-regulating devices, and any control not relied upon to provide a required safety function shall be considered and shall be tested and evaluated as operating controls.

22.11.2.3 The minimum test parameters for the evaluation of an operating control for use in a household dishwasher conforming to CAN/CSA-E60730-1 and UL 60730-1 are specified in Table 22.3.

Table 22.3
Operating Control Correlation Table

Information	Operating control requirement
FMEA	Conduct a failure-mode and effect analysis (FMEA) to identify components the failure of which might result in a risk of fire or electric shock.
Operating ambient	Determined via Heating Test, Section 12, of the appliance
Endurance Testing (for electro-mechanical switching devices)	Except as indicated in 22.11.4.1 and 22.11.7.3: a) 30,000 cycles for automatic, self-resetting temperature-regulating controls b) 6,000 cycles for manual, non-self-resetting temperature-regulating controls c) 6,000 cycles for relays and automatic self-resetting operating controls
Overvoltage Category	Overvoltage Category II
Pollution Degree	See 28.4
Enclosure Flammability	Minimum V-1, except as indicated in 30.3

22.11.3 Protective controls

22.11.3.1 A control that performs a safety-related (protective) function shall comply with:

a) CSA C22.2 No. 24, CSA C22.2 No. 156, or the requirements for Class B control functions as specified in CAN/CSA-E60730-1; and

b) UL 873 or the requirements for Class B control functions as specified in UL 60730-1.

Alternatively, a protective control shall comply with the electronic circuit requirements specified in Annex D.

22.11.3.2 A thermal-link shall comply with the requirements of:

a) CSA C22.2 No. 60691; and

b) UL 60691.

22.11.3.3 Electronic protective controls shall also be evaluated for functional safety (reliability) in accordance with the following:

a) the requirements for Class B control functions as specified in CAN/CSA-E60730-1 or CSA C22.2 No. 0.8; and

b) UL 991 and UL 1998, or the requirements for Class B control functions as specified in UL 60730-1.

Alternatively, an electronic protective control shall comply with the electronic circuit requirements specified in Annex D.

22.11.3.4 Electronic motor protection shall be evaluated in accordance with 22.7.2(c), or the electronic circuit requirements specified in Annex D.

Note: In the application of the Annex D requirements, see D1.8:

a) Thermal motor protectors in direct contact with motor windings and intended for direct control of the motor supply are outside the scope of Annex D even if they incorporate one or more electronic components.

b) Electronic circuits that provide thermal motor protection but only have a thermal sensor in direct contact with motor windings are within the scope of Annex D.

c) Electromechanical thermal motor protectors in direct contact with the motor windings where the protector is connected to electronic circuits that provide the motor load control are within the scope of Annex D.

22.11.3.5 Electronic protective controls not relying on software as a protective component shall comply with the requirements specified in 22.11.3.3, except for UL 1998 and Clause H.11.12 of 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 17.2.

22.11.3.6 The door interlock [18.6.2(b)], door lock [18.6.2(a)], presence detection control (18.7.2), motor overload protection (22.7), temperature-limiting devices, combined temperature-regulating and -limiting devices, and any control relied upon for compliance with the Abnormal Operation testing of Section 17 shall be considered and shall be tested and evaluated as protective controls.

22.11.3.7 The test parameters and conditions used in the investigation of the electronic protective control as specified by 22.11.3.3 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.

22.11.3.8 The minimum test parameters for the evaluation of a protective control for use in a household dishwasher conforming to CAN/CSA-E60730-1 and UL 60730-1 are specified in Table 17.2.

22.11.4 Temperature-regulating and -limiting devices

22.11.4.1 The number of cycles required for Endurance Testing specified in Table 22.3 for automatic, self-resetting temperature-regulating devices shall not apply if, with the control defeated, no temperature higher than the limits given in Table 12.1 is attained in a heating test (see Section 12) of the appliance.

22.11.4.2 The number of cycles required for Endurance Testing specified in Table 17.2 for temperature-limiting devices and combined temperature-regulating and -limiting devices may be reduced to 30,000 cycles, if with the control defeated, the appliance complies with all testing required by this standard.

22.11.4.3 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 (42.8 °F) or 5 percent, whichever is greater; and

b) Drift from the temperatures measured in the as -received condition by more than either 6 °C (42.8 °F) or 5 percent, whichever is greater, after being subjected to the specified number of cycles per Table 17.2 and, for electronic protective controls, the environmental stress tests of UL 991 or Clause H.26 of CSA-E60730-1 and UL 60730-1.

Note: If the manufacturer declares a tighter tolerance, the deviation and drift shall remain within the manufacturer's declared values.

22.11.4.4 A positive temperature coefficient temperature (PTC) sensing thermistor and a negative temperature coefficient (NTC) temperature sensing thermistor, performing as a Temperature-Regulating Device, Temperature-Limiting Device or combined temperature-regulating and -limiting device shall comply with:

a) Annex J of CSA E60730-1 and CSA E60730-2-9; and

b) Annex J of UL 60730-1 and UL 60730-2-9 or UL 1434.

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

22.11.4.5 When a thermistor is used as a sensor or as part of a thermal management function of a control, it shall be investigated as part of the control (e.g., a thermistor used in conjunction with an electronic control to perform the same function as a thermostat).

22.11.5 Cycle selection controls

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

a) CSA C22.2 No. 177 or CAN/CSA-E730-2-7; or CAN/CSA-E730-2-7 and UL 60730-2-7; or

b) The relevant requirements of Annex D.

22.11.5.2 A cycle selection control incorporating electronic timing or switching circuits shall comply with the requirements specified in 22.11.2.1.

22.11.6 Door/drawer interlock or lock

22.11.6.1 If a door-actuated switch is employed to directly disconnect power to the motor and heating element, it shall withstand the Endurance Test as specified in 22.11.6.4 without malfunction and shall comply with:

a) CSA C22.2 No. 55;

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 CAN/CSA-C22.2 No. 61058-1 and UL 61058-1, see 22.10.1.6 and 22.11.6.4.

22.11.6.2 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 22.11.3.

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

22.11.6.4 The number of cycles required for Endurance Testing specified in Table 17.2 for the door interlock shall be 30,000 cycles of operation. For the first 20,000 cycles, the interlock circuitry shall be de-energized. For the remaining 10,000 cycles, the interlock circuitry shall be energized so as to represent the maximum load encountered during intended operation of the appliance, unless the interlock switch employed has been investigated and found acceptable for 10,000 cycles of electrical operation. The test shall be conducted at a rate of 12 cycles/minute. The interlock shall be operated so that maximum wear on parts will occur.

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

22.11.7 Water level detection controls

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

a) CSA C22.2 No. 55 or CAN/CSA-C22.2 No. 61058-1; and

b) UL 61058-1 or UL 60730-2-15.

Alternatively, a switch employed as a part of a water level detection mechanism shall comply with the electronic circuit requirements specified in Annex D.

22.11.7.2 If a pressure or flow switch is employed as part of a water level detection mechanism, it shall comply with:

a) CSA C22.2 No. 14 or CAN/CSA-E730-2-6; and

b) UL 508, UL 60730-2-6, or UL 60730-2-18.

Alternatively, a pressure of flow switch employed as a part of a water level detection mechanism shall comply with the electronic circuit requirements specified in Annex D.

22.11.7.3 The number of cycles required for Endurance Testing specified in Table 22.3 for a water level detection control required for compliance with 15.3 or 15.7.2 shall be 6000 cycles.

22.11.8 Leakage current detection devices

22.11.8.1 A leakage current detection device provided in accordance with 20.2.3 shall check leakage current to the outer metal sheath of the heating assembly at least one time per wash cycle.

22.11.8.2 The minimum test parameters for the evaluation of a leakage current detection device to CAN/CSA-E60730-1 and UL 60730-1 shall be specified as follows:

a) Table 22.1 for constructions with heater sheaths that are grounded without a barrier as specified in 20.2.2(c); or

b) Table 22.2 for constructions with heater sheaths that are grounded with a barrier as specified in 20.2.2(c); or

c) Table 22.2 for constructions with heater sheaths that are ungrounded.

22.12 Connecting hoses

22.12.1 Connecting hoses shall not contact any uninsulated current-carrying part. A connecting hose, such as a rubber hose that is used for a water inlet or drain, that is moved during the normal use of the appliance (e.g., by being extended or retracted) shall be so located or guarded that it will not contact any internal wiring or any other component if such motion results in a risk of fire or electric shock.

22.13 Transformers and power supplies

22.13.1 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 22.13.2 through 22.13.5.

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

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

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

22.13.5 Power supplies other than Class 2 shall comply with CSA C22.2 No. 107.1 and UL 1012.

22.14 Overcurrent protection

22.14.1 Fuses shall comply with CSA C22.2 No. 248.1, UL 248-1, and the applicable Part of the CSA C22.2 No. 4248.1 and UL 248 series for the specific fuse type.

22.14.2 Fuseholders shall comply with CSA C22.2 No. 39 or CSA C22.2 No. 4248.1 and UL 4248-1 and the applicable Part of the CSA C22.2 No. 4248 and UL 4248 series for the specific fuseholder type.

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

22.15 Electrically operated valves

22.15.1 Electrically operated valves shall comply with:

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

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

22.16 Terminals and connectors

22.16.1 Terminals and connectors shall comply with:

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

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

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

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

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

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

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

22.17 Pumps

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

22.17.2 Polymeric parts of pumps subjected to wash water, detergent or rinse agent shall also be subjected to the Immersion Test, 30.8.

22.18 Insulating devices

22.18.1 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 standard, as applicable:

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

b) UL 635 for insulating bushings.

22.18.2 Tests specified in this standard (e.g., Strain Relief Test) could still need to be performed to confirm the combination of the insulating bushing and the supporting part are suitable.

22.19 Adhesives used to secure parts

22.19.1 An adhesive relied upon to reduce the risk of fire, electric shock, or injury to persons shall comply with the requirements for adhesives in UL 746C.

22.19.2 The requirement in 22.19.1 also applies to an adhesive used to secure a conductive part, that could, 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.

22.20 Equipment protective devices

22.20.1 An equipment ground fault protection device (EGFPD) provided for compliance with 20.2.3 shall comply with:

a) CSA C22.2 No. 144; and

b) UL 1053, and the appropriate requirements of UL 943.

22.20.2 An equipment leakage current interrupter (ELCI) provided for compliance with 20.2.3 shall comply with CSA C22.2 No. 144 and UL 943.

22.20.3 The test and reset buttons of the equipment protective device, if provided, shall be located where accessible to the user without the use of tools and the instructions specified in 8.4.4 shall be provided.

22.21 Circuit interrupters with fire extinguishing agent (CIFEA) devices

22.21.1 A circuit interrupter with fire extinguishing agent (CIFEA) provided for compliance with 17.5 (Hot Coil Ignition Test) shall comply with:

a) The Outline of Investigation for Circuit Interrupters with Fire Extinguishing Agent for Use in Electrical Appliances and Components, UL 60692; and

b) Be evaluated in the end-use application to determine that the CIFEA does not adversely interfere with the safe use of the appliance under normal operating conditions; and

c) If the CIFEA operates during abnormal operating conditions, the results of the expelled fire extinguishing agents shall be investigated to determine if any other hazards are introduced.

Note: The acceptability of a CIFEA in a dishwasher appliance depends upon its acceptability for continued use under the conditions that prevail in actual service. Compliance of a CIFEA to the requirements in UL 60692 only evaluates the electrical and thermal attributes of the device.

22.21.2 To determine compliance with 22.21.1(b), the CIFEA shall not operate during the Heating Test, nor shall the CIFEA introduce conditions that may increase the risk of fire, electric shock, or injury to persons.

22.21.3 To determine compliance with 22.21.1(c), if the CIFEA operates during abnormal operating conditions, the appliance shall be evaluated to determine if there are electric circuits and appliance functions still operable after the CIFEA actuates that may increase the risk of fire, electric shock, or injury to persons.

23 Supply Connection and External Flexible Cords

23.1 Permanently connected appliances

23.1.1 Electrical boxes and the associated bushings, fittings, and raceways of the types specified in the Wiring Methods section of the Canadian Electrical Code and the National Electrical Code for Wiring Methods and Materials, and that comply with the relevant CSA and UL Standards and 22.1, shall be 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.

23.1.2 An appliance intended to be fastened or secured in position or permanently connected to a water supply and a drain line shall be provided with wiring terminals or leads for the connection of power-supply conductors and shall have provision for connection to a wiring system.

23.1.3 A terminal box or compartment in which power-supply connections are to be made shall be located so that the connections could be readily inspected after the appliance has been installed as intended.

23.1.4 To comply with the requirement in 23.1.3, the terminal box of a permanently connected appliance shall be located so that it will be accessible without moving the appliance after installation.

23.1.5 A terminal or splice compartment shall be complete and shall enclose all field wiring terminals and all splices to be made in the field unless the appliance enclosure is otherwise complete – that is, unless all sides and a complete bottom are provided when the appliance is shipped from the factory. Ventilating openings shall not be located in the bottom or sides of the terminal compartment.

23.1.6 A terminal compartment intended for connection of a supply raceway shall be attached to the appliance such that the raceway is prevented from turning.

23.1.7 A permanently connected appliance shall be provided with the following:

a) Wiring terminals for the connection of conductors having an ampacity suitable for the appliance; or

b) Leads for such a connection.

23.1.8 An appliance equipped with terminals or leads for field connection of power-supply conductors shall be provided with a terminal or lead for connection of an equipment-bonding conductor. The length of the lead is specified in 24.10.

23.1.9 Sheet metal to which a wiring system is to be connected in the field shall have a thickness not less than 0.81 mm (0.03 in) if uncoated steel, not less than 0.86 mm (0.034 in) if galvanized steel, and not less than 1.14 mm (0.04 in) if nonferrous.

23.1.10 Polymeric parts to which a wiring system is to be connected in the field shall meet the enclosure requirements in Section 30 and shall have strength equivalent to a thickness not less than 0.81 mm (0.03 in) of sheet steel or meet the requirements of 23.1.11.

23.1.11 A 670 N (150.62 lb-f) force shall be applied to the conduit connection from any angle that the construction of the appliance permits. The part shall not be acceptable if, at the point of connection of the conductors, there is movement of the wires that indicates stress on the connections.

23.1.12 If the appliance is provided with a terminal block for connection of conductors, the terminal block shall be suitably rated for field wiring and have a flammability classification in accordance with 30.3.8 and 30.3.9 or be tested in accordance with 17.5, Hot coil ignition test.

23.1.13 The terminal box or compartment shall be evaluated for fire containment as specified in 17.5. The wire shall be wrapped around one of the twist type connectors or across the terminal block, and as a result of the test, there shall be no charred, burnt, or broken fibers of cheesecloth.

23.2 Cord-connected appliances

23.2.1 A power-supply cord shall comply with CSA C22.2 No. 21 and UL 817.

23.2.2 Flexible cords and cables shall comply with CSA C22.2 No. 49 and UL 62. Flexible cords or cables shall be considered to fulfill this requirement when preassembled into a power-supply cord complying with 23.2.1.

23.2.3 Attachment plugs and appliance couplers shall comply with CSA C22.2 No. 42 and UL 498. Attachment plugs and appliance couplers shall be considered to fulfill this requirement when preassembled into a power-supply cord complying with 23.2.1.

23.2.4 The power-supply cord of an appliance provided with a means for grounding shall include an equipment-bonding conductor and shall terminate in a grounding-type attachment plug.

23.2.5 The power-supply cord shall be attached permanently to the appliance or shall be in the form of a separate cord supplied as part of a power-supply cord kit with means for connection to the appliance. The power-supply cord kit shall comply with 23.6.

23.2.6 The ampacity of the cord and the current rating of the fittings shall not be less than the current rating of the appliance.

23.2.7 For an appliance rated more than 15 A, the current rating of the attachment plug shall not be less than 125 percent of the current rating of the appliance.

23.2.8 A 20 A plug shall be acceptable for an appliance rated not more than 4,000 W at 240 V. The attachment plug shall be acceptable for use at a voltage equal to the rated voltage of the appliance.

23.2.9 If the appliance can be adapted for use on two or more voltages by field alteration of internal connections, the attachment plug shall be rated for the voltage for which the appliance is connected when shipped from the factory (see 7.2.20).

23.2.10 An appliance intended for use with a detachable cord set shall not be provided with terminal pins that will accommodate a standard flat iron or appliance plug.

23.2.11 For a portable, floor-supported appliance:

a) The flexible cord shall be Type S, SJT, or the equivalent; and

b) The length of flexible cord shall be not less than:

1) 1.5 m (4.92 ft) measured from the face of the attachment plug to the point of entry into the appliance, if that point is 0.8 m (2.62 ft) or more above the floor; or

2) 1.5 m (4.92 ft) plus the distance between the point of cord entry and a point 0.8 m (2.62 ft) above the floor, vertically above the point of the cord entry, if that point is less than 0.8 m (2.62 ft) above the floor.

23.2.12 For a portable, counter-supported appliance:

a) The flexible cord shall be Type S, SJT, SPT-3, or the equivalent; and

b) The length of flexible cord shall be not less than 1.5 m (4.92 ft), measured from the face of the attachment plug to the point of entry into the appliance.

23.2.13 For a cord-connected built-in appliance:

a) The flexible cord shall be Type S, SJT, SPT-3, or the equivalent; and

b) The length of the flexible cord shall be 0.9 – 2.0 m (2.95 – 6.5 ft), measured from the face of the attachment plug to the plane of the rear of the appliance.

23.2.14 A power-supply cord for an outdoor use dishwasher shall be recognized for outdoor use. Such cords are identified by the letter “W” following the cord type designation marked on the jacket. A cord that is marked “Outdoor” in addition to the letter “W” shall be used only on dishwashers that have been found acceptable for outdoor use.

23.2.15 The power-supply cord of an undercounter appliance shall:

a) Be attached to the appliance in such a way that it can readily be removed in the field to permit permanent connection to the power supply; and

b) Not be attached to a movable component of the appliance, such as a drawer.

23.2.16 For a cord-connected undercounter appliance, the manufacturer shall furnish an edge protector for installation in the opening specified in 8.3.3(b) or provide instructions for how to obtain the edge protector from the manufacture when installing the dishwasher with metal cabinets. The edge protector shall be:

a) Of such dimensions that it will serve as a complete bushing around the opening, but shall not be shorter than 152 mm (5.98 in);

b) Sufficiently flexible to permit installation in the opening;

c) Of such shape that it will protect the power-supply cord from abrasion; and

d) Resistant to ageing.

23.3 Push-back relief

23.3.1 General

23.3.1.1 Means shall be provided to prevent a flexible cord being pushed into the enclosure of a dishwasher through the cord-entry hole when such displacement results in a risk of the following:

a) Subjecting the cord to mechanical damage;

b) Exposing the cord to a temperature higher than that for which it is rated;

c) Reducing spacings, such as to a metal strain-relief clamp, below the minimum required values; or

d) Damaging internal connections or components.

23.3.2 Push-back relief test

23.3.2.1 An appliance shall be tested as specified in 23.3.2.2. As a result of the test, the conditions specified in 23.3.1.1 (a) – (d) shall not occur.

23.3.2.2 The attached flexible cord shall be held 25.4 mm (1 in) from the point where the cord emerges from the enclosure of the dishwasher and shall then be pushed back into the dishwasher. If an integral cord guard is provided, the push-back force shall be applied 25.4 mm (1 in) from the end of the cord guard. The cord shall be pushed back into the dishwasher in 25.4 mm (1 in) increments until the cord buckles or the force to push the cord into the dishwasher exceeds 26.7 N (6 lb-f). The cord within the dishwasher shall be manipulated to determine compliance.

23.4 Strain relief

23.4.1 General

23.4.1.1 Strain relief shall be provided to prevent mechanical stress on the flexible cord from being transmitted to terminals, splices, or interior wiring.

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

23.4.1.3 A strain-relief clamp shall be constructed so as not to damage the cord.

23.4.2 Strain relief test

23.4.2.1 When tested as described in 23.4.2.2, a strain-relief means provided on a flexible cord shall withstand for 1 min, without displacement, a direct pull of 155 N (34.8 lb-f) applied to the cord, with the connections within the appliance disconnected.

23.4.2.2 A 16 kg (35.27 lb) weight shall be suspended on the cord and supported by the appliance so that the strain relief will be stressed from any angle that the construction of the appliance permits. The strain relief shall not be acceptable if, at the point of disconnection of the conductors, there is movement of the cord that indicates that stress would have resulted on the connections.

23.5 Cord reels

23.5.1 A cord reel employed in an appliance shall:

a) Comply with the requirements in UL 355; or

b) Be subjected to the test described in 23.5.2. There shall be no malfunction of the cord reel or damage to the cord as a result of this test. After the test, the appliance shall comply with the electric strength requirements in Section 16 (see also 17.4).

23.5.2 The cord reel shall be subjected to 9,000 cycles of operation. The full length of the cord minus a 152 mm (5.98 in) section at each end shall be unreeled during each cycle. Each cycle shall consist of unreeling the specified length of cord and then allowing it to recoil on the reel automatically. The test shall be conducted at a rate of 12 cycles/min. The power-supply cord shall not be connected to a source of supply during this test. The cord shall be unreeled in a manner that will result in maximum wear on both the cord and the cord reel.

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

23.6 Power-supply cord kits for use with undercounter or built-in dishwashers

23.6.1 A power-supply cord kit intended for the installation of an undercounter or built-in dishwasher shall include the following:

a) A power-supply cord, edge protector or instructions that comply with 23.2.16, push-back relief that complies with 23.3, and strain relief means that comply with 23.4;

b) A part or model number marked on the power-supply cord kit package, or in the kit installation instructions;

c) Installation instructions; and

d) Grounding instructions in accordance with 8.2.4(a).

23.7 Bushings

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

23.7.2 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, fiber, or other material that has been investigated and found to be acceptable for the application, the opening in which the bushing is placed shall be smooth and free from burrs, fins, projections, sharp edges, and the like that could result in abrasion of the cord.

24 Terminals for External Conductors

24.1 A terminal intended solely for connection of an equipment-bonding conductor shall be capable of securing a conductor of the size acceptable for the application.

24.2 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 shall be acceptable only for appliances requiring 12 AWG (3.3 mm^2) or smaller supply conductors.

24.3 A wiring terminal shall be provided 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. A wire-binding screw may be employed at a wiring terminal intended to accommodate a 10 AWG (5.3 mm^2) or smaller conductor if upturned lugs or the equivalent are provided to hold the wire in position.

24.4 A wiring terminal shall be provided with a means of reducing the likelihood of turning.

24.5 A wire-binding screw shall thread into metal.

24.6 A wire-binding screw at a wiring terminal shall not be smaller than No. 10 (M5). A No. 8 (M4) screw may be used at a terminal intended only for the connection of a 14 AWG (2.1 mm^2) conductor.

24.7 A terminal plate tapped for a wire-binding screw shall be of metal not less than 1.27 mm (0.05 in) thick and shall provide not less than two full threads in the metal.

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

24.9 Upturned lugs or a cupped washer shall be capable of retaining a conductor of the size specified in 24.2, but not smaller than 14 AWG (2.1 mm^2), under the head of the screw or the washer.

24.10 The free length of a lead inside an outlet box or wiring compartment shall be 152 mm (5.98 in) or more if the lead is intended for field connection to an external circuit.

24.11 An appliance constructed so that it could be adapted upon installation for either of two 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 could be made during field installation, without the necessity of changing or disrupting internal wiring or connections other than at the terminal block.

24.12 A terminal for connection of the grounded conductor of a supply circuit shall be of, or plated with, a silver-colored 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.

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

25 Provision for Grounding

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

25.1 General

25.1.1 In an appliance intended to be permanently connected to the power supply, all exposed non-current-carrying metal parts that could become energized and all non-current-carrying metal parts within the enclosure that are exposed to contact during any servicing operation and that could become energized shall be conductively connected to the equipment-bonding terminal or lead (see 25.4).

25.1.2 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 to connect the equipment to ground.

25.1.3 A portable appliance provided with a system of double insulation that complies with the requirements for double-insulated appliances in accordance with CSA C22.2 No. 0.1 and UL 1097 does not need to comply with 25.1.2.

25.1.4 Except as specified in 25.1.5, the bonding conductor of a flexible power-supply cord shall be:

a) Bare or be provided with insulation having an outer surface that is green with or without one or more yellow stripes;

b) Connected to the grounding blade of an attachment plug of the grounding type; and

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

25.1.5 With reference to 25.1.4, 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 under the following conditions:

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 (0.13 in); and

2) Insulation resistance of not less than 50,000 ohms (see Section 14).

25.1.6 A non-current-carrying metal part within the enclosure shall not be required to be bonded to ground, if the appliance is marked in accordance with 7.2.11 to 7.2.14.

25.1.7 With reference to the requirements of 25.1.4(c), the connection shall be made by a means not likely to be removed during ordinary servicing that does not involve the power-supply cord. Solder alone shall not be used for making this connection.

25.1.8 With reference to the requirements in 25.1.1 and 25.1.4, the following non-current-carrying metal parts shall not be considered 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 of vulcanized fiber, varnished cloth, phenolic composition, or other moisture-resistant insulating material not less than 0.81 mm (0.03 in) thick and secured in place;

c) A panel, cover, or other metal part that does not enclose uninsulated current-carrying parts and that is electrically isolated from other electrical components; and

d) A door or the like that could only become energized through a grounded part.

25.1.9 Servicing, as specified in 25.1.1 and 25.1.4, shall be considered to include the repair of the appliance by a qualified service representative as well as by the user.

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

25.2 Bonding means

25.2.1 A bonding conductor shall be made of copper, copper alloy, or other material that has been investigated and found to be acceptable for use as an electrical conductor. A ferrous metal part in the grounding path shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means.

25.2.2 A bonding conductor shall:

a) Be protected from mechanical damage or be located within the enclosure; and

b) Not be secured by a removable fastener used for any purpose other than bonding for grounding, unless the bonding conductor is not likely to be omitted after removal and replacement of the fastener.

25.2.3 A bonding connection shall be by a positive means, such as by clamping, riveting, or a bolted or screwed connection, or by welding or soldering and brazing for materials having a softening or melting point of more than 454 °C (849.2 °F).

25.2.4 The bonding connection shall penetrate nonconductive coatings such as paint or vitreous enamel.

25.2.5 Among the factors that shall be taken into consideration when judging the acceptability of a clamping device are:

a) The effect of assembling and disassembling the appliance for servicing; and

b) The likelihood that the device will not be reassembled in its intended manner.

25.2.6 If the adequacy of a bonding connection cannot be determined by examination, it shall comply with the requirement in 25.2.11.

25.2.7 A bonding conductor shall have a cross-sectional area not less than that of the bonding conductor of the power-supply cord.

25.2.8 A bonding conductor:

a) May be smaller than specified in 25.2.7 or 25.2.9 if it complies with the requirement in 25.2.12; or

b) For a component or separate electrical enclosure, may be smaller than specified in 25.2.7 or 25.2.9, but shall not be smaller than the conductors supplying power to the component or components within the separate enclosure.

25.2.9 A bonding conductor intended to be permanently connected to the power supply shall not be smaller than the size specified in Table 25.1, except as provided in 25.2.8.

Table 25.1
Minimum Acceptable Size of Bonding Conductor on an Appliance Intended to be Permanently Connected to the Power Supply

Rating of branch-circuit overcurrent device to which appliance will be connected, A	Size of bonding conductor, AWG (mm^2 equivalent cross-sectional area)			
	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)

25.2.10 If more than one rating of the branch-circuit overcurrent-protective device is involved, the size of the bonding conductor shall be based on the rating of the overcurrent device intended to provide protection against ground fault for the component bonded by the conductor. For example, if a motor is individually protected by a branch-circuit overcurrent device of a lesser rating than other overcurrent devices used with the appliance, a bonding conductor for that motor shall be sized on the basis of the overcurrent device intended for protection of the motor under ground-fault conditions.

25.2.11 If necessary, the following test shall be used to determine the adequacy of a bonding connection: the connection shall not open when carrying a current of 200 percent of the rating of the branch-circuit overcurrent device for 4 min.

25.2.12 A bonding conductor having a cross-sectional area less than that of the bonding conductor of the power-supply cord and the bonding connections may be used if the connection does not open when carrying a current of 200 percent of the rating of the appropriate branch-circuit protective device for 4 min.

25.3 Continuity of grounding circuit

25.3.1 The resistance between the point of connection of the equipment-bonding means, at or within the appliance, and any point in the grounding circuit shall not be more than 0.1 Ω. The resistance shall be measured as specified in 25.3.2.

25.3.2 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 be included in this measurement.

25.4 Grounding terminals and leads

25.4.1 A wiring terminal or lead for attaching an equipment-bonding conductor shall be provided and shall comply with the requirements in Section 24.

25.4.2 A terminal for attaching an equipment-bonding conductor shall be such that the 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.

25.4.3 A wire-binding screw intended for the connection of an equipment-bonding conductor shall have a green head that is hexagonal, slotted, or both. A pressure terminal connector intended solely for the connection of such a conductor shall be marked in accordance with 7.2.22. The wire-binding screw or pressure terminal connector shall be located so that it does not require removal during normal servicing of the appliance. A sheet-metal screw shall not be used for connection of an equipment-bonding conductor.

Note: The ground screw may be provided with a secondary means of rotation.

25.4.4 A lead intended for attaching an equipment-bonding conductor shall not be smaller than the wire to which it is intended to be connected.

25.4.5 The surface of an insulated lead intended solely for the connection of an equipment-bonding conductor shall be green with or without one or more yellow stripes, and no other lead shall be so identified.

25.5 Heater sheaths

25.5.1 The metal sheath of a heater assembly that normally contacts water and could become energized shall not be required to be bonded to the grounding terminal of an appliance, if:

a) The appliance is marked in accordance with 7.2.11;

b) The appliance has means for preventing a user from accessing the metal sheath while energized, such as by means of an interlock switch(es) that simultaneously disconnects all circuit conductors (including neutrals) to the heater; and

c) For a heater that is energized during draining or pump-out, the appliance is subjected to the test described in 25.5.2.

25.5.2 With reference to 25.5.1(c), an appliance shall be tested as specified in 25.5.3 to 25.5.6. The leakage current shall not exceed 5.0 MIU when measured with the meter described in UL 101. (See Section 13.)

25.5.3 The appliance shall be connected to a power supply source as follows:

a) The power supply to the appliance shall be supplied through an isolating transformer of sufficient capacity to maintain the required supply voltage;

b) The supply source to the primary shall be protected by 30 A fuses; and

c) The ungrounded conductor(s) for the appliance shall be connected to one end of the secondary winding. The other end of the secondary winding shall be connected to:

1) The enclosure ground terminal;

2) The neutral conductor; and

3) One side of a leakage current meter.

25.5.4 Dishwashing detergent shall be added to the washing compartment, or to the detergent dispenser of the appliance if it is so equipped. If the detergent is added directly to the washing compartment, the amount shall be in accordance with the operating instructions for the appliance. If the appliance incorporates a detergent dispenser, the dispenser shall be filled with the detergent. The appliance shall be operated through one complete normal cycle as follows:

a) The heater assembly shall be altered so that the sheath is energized;

b) The connection of non-current-carrying metal parts to the appliance ground terminal shall not be disturbed, and any protective devices shall remain in the circuit;

c) The connecting hoses shall be made of nonconductive materials; and

d) The dishwasher water shall be discharged through the drain hose to a tank insulated from ground.

25.5.5 A copper pipe 19 mm (0.75 in) nominal in diameter (3/4 in trade size), and 150 mm (5.9 in) minimum in length shall be connected to the end of the drain hose of the appliance. With the appliance connected to a power-supply source as specified in 25.5.3 and operated as specified in 25.5.4, the leakage current shall be measured between the secondary winding specified in 25.5.4(c) and any point on the copper pipe. The leakage current shall be monitored continuously throughout the test.

25.5.6 An investigation of the construction of the appliance shall be made to determine how the leakage current is limited. The reliability of these features for the anticipated life of the appliance shall be determined.

26 Screws and Connections

26.1 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.

27 Creepage Distances, Clearances, and Distances through Insulation

27.1 Spacings between uninsulated current-carrying parts of opposite polarity, between uninsulated parts of low-voltage and line-voltage circuits, and between an uninsulated current-carrying part and a non-current-carrying metal part shall not be less than the values specified in Table 19.1. 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 current-carrying part, the construction shall be such that the acceptable minimum spacing is maintained. See also 28.7.

27.2 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.

27.3 The spacing requirements specified in 27.1 might 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 19.1. At closed-in points, such as the screw-and-washer construction of an insulated terminal mounted in metal, a spacing of not less than 1.2 mm (0.05 in) shall be acceptable.

27.4 Film-coated wire shall be regarded as an uninsulated current-carrying part when spacings are being considered.

27.5 At terminal screws and studs to which connection is to 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 19.1 when the connectors, eyelets, or the like are in such a position that minimum spacings exist between the following:

a) Current-carrying parts;

b) Current-carrying parts of opposite polarity; or

c) Current-carrying parts and non-current-carrying metal parts.

27.6 An insulating liner or barrier of vulcanized fiber or similar material employed in lieu of spacings shall:

a) Not be less than 0.81 mm (0.03 in) thick; and

b) Be located so, or of such material that, it will not be adversely affected by arcing.

27.7 For the liner or barrier specified in 27.6, fiber not less than 0.4 mm (0.02 in) thick may be used in conjunction with an air spacing of not less than 50 percent of the spacing required for air alone.

28 Alternative Spacings-Clearances and Creepage Distances

28.1 As an alternative to the spacing requirements specified in 27.1, spacings shall be in accordance with the requirements of CSA C22.2 No. 0.2 and UL 840, except:

a) Between field wiring terminals; and

b) Between uninsulated current-carrying parts and a metal enclosure.

28.2 Appliances shall be considered overvoltage category 2 as specified in CSA C22.2 No. 0.2 and UL 840.

28.3 Printed wiring boards constructed of Type 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 and CAN/CSA-C22.2 No. 0.17, shall be considered to have a minimum comparative tracking index of 100 as specified in CAN/CSA-C22.2 No. 0.17 and UL 746A.

28.4 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.

28.5 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.

28.6 An overvoltage control having exposed low-voltage outputs shall be provided with a mechanism to indicate the malfunction of the overvoltage-protective control or system where the control outputs:

a) Might be contacted during normal operation or user servicing; and

b) Have clearances between the low-voltage circuit and an overvoltage as specified in CSA C22.2 No. 0.2 and protected line-voltage circuits that have been evaluated in accordance with Clearance B requirements as specified in CSA C22.2 No. 0.2 and UL 840.

28.7 For a capacitor that is provided with an expansion mechanism to reduce the likelihood of expelling the dielectric medium, an additional spacing of at least 12.7 mm (0.5 in) shall be added to the spacings specified in this Sections 27 and 28 for capacitor parts that could move during the operation of the expansion mechanism.

29 Resistance to Corrosion

29.1 General

29.1.1 Iron and steel parts shall be provided with means of reducing 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 may 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.

29.2 Liquid containers

29.2.1 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. See 30.8 and 30.10 for evaluation of polymeric materials.

29.3 Outdoor use dishwashers (protected locations and outdoor locations)

29.3.1 Sheet steel water shields and enclosures exposed to the effects of weathering shall be protected against corrosion by the means specified in Table 29.1, or by other metallic or nonmetallic coatings that provide equivalent protection.

Note: These requirements do not apply to a metal part, such as a decorative grille, that is not required to determine compliance with this standard.

Table 29.1
Protection Against the Effects of Weathering

Type of cabinet and enclosure	Enclosure thickness 1.35 mm (0.053 in) and greater as specified by clause	Enclosure thickness less than 1.35 mm (0.053 in) as specified by clause
Outer cabinets which protect motors, wiring or enclosed current-carrying parts	29.3.2	29.3.3
Inside enclosures which protect current-carrying parts other than motors	29.3.2	29.3.3
Outer cabinets which are the sole enclosure of current-carrying parts	29.3.3	29.3.3

29.3.2 To comply with the requirements in 29.3.1, for an enclosure thickness 1.35 mm (0.053 in) and greater as described in Table 29.1, one of the following coatings shall be used:

a) Hot-dipped mill-galvanized sheet steel conforming with the Coating Designation G60 or A60 in Table 1 of ASTM A653/A653M with not less than 40 percent of the zinc on any side, based on the minimum single spot test requirement in the ASTM Specification. The weight of zinc coating may be determined by any recognized method; however, in case of question, the weight of coating shall be established in accordance with ASTM A90/A90M. An A60 (alloyed) coating shall also comply with 29.3.4;

b) A zinc coating, other than that provided on hot-dipped mill-galvanized sheet steel, uniformly applied to an average thickness of not less than 0.0104 mm (0.00041 in) on each surface with a

minimum thickness of 0.0086 mm (0.00034 in). The thickness of the coating shall be established by the Metallic-Coating Thickness Test, 29.4. An annealed coating shall also comply with 29.3.4;

c) Two coats of an organic finish of the epoxy or alkyd-resin type or other outdoor paint on both surfaces. Unless acceptability of the paint can be determined by consideration of its composition, corrosion tests are required; or

d) Other finishes, including paints, special metallic finishes, and combinations of the two may be accepted when comparisons with galvanized sheet steel (without annealing, wiping, or other surface treatment) that complies with Item (a) of 29.3.2 indicate they provide equivalent protection to mill-galvanized steel as noted in Item (a). Among the factors that are taken into consideration when judging the acceptability of such coating systems are exposure to salt spray, moist carbon dioxide-sulfur dioxide-air mixtures, and ultraviolet light and water. The exposures shall be in accordance with UL 1332.

29.3.3 To comply with 29.3.1, for an enclosure thickness less than 1.35 mm (0.053 in) as described in Table 29.1, one of the following coatings shall be used:

a) Hot-dipped mill-galvanized sheet steel conforming with the Coating Designation G90 in Table 1 of ASTM A653/A653M, with not less than 40 percent of the zinc on any side, based on the minimum single spot test requirements in that ASTM Specification. The weight of zinc coating may be determined by any recognized method; however, in case of question, the weight of coating shall be established in accordance with ASTM A90/A90M;

b) A zinc coating, other than that provided on hot-dipped mill-galvanized sheet steel, uniformly applied to an average thickness of not less than 0.0155 mm (0.00061 in) on each surface with a minimum thickness of 0.0137 mm (0.00054 in). The thickness of the coating shall be established by the Metallic-Coating Thickness Test of 29.4. An annealed coating shall also comply with 29.3.4,

c) A cadmium coating of not less than 0.025 mm (0.001 in) thick on both surfaces. The thickness of the coating shall be established in accordance with the Metallic-Coating Thickness Test of 29.4;

d) A zinc coating conforming with 29.3.2(a) or (b) with one coat of outdoor paint as specified in 29.3.2(c);

e) A cadmium coating of not less than 0.0191 mm (0.00075 in) thick on both surfaces with one coat of outdoor paint on both surfaces or not less than 0.013 mm (0.0005 in) thick on both surfaces with two coats of outdoor paint on both surfaces. The thickness of the cadmium coating shall be established in accordance with the Metallic-Coating Thickness Test of 29.4, and the paint shall be as specified in 29.3.2(c); or

f) Other finishes, including paints, special metallic finishes, and combinations of the two may be accepted when comparisons with galvanized sheet steel (without annealing, wiping, or other surface treatment) that complies with 29.3.3(a), indicate they provide equivalent protection to mill-galvanized steel as noted in (a). Among the factors that are taken into consideration when judging the acceptability of such coating systems are exposure to salt spray, moist carbon dioxide-sulfur dioxide-air mixtures, and ultraviolet light and water. The exposures shall be in accordance with UL 1332.

29.3.4 An annealed zinc coating that is bent or similarly formed after annealing shall be painted in the bent or formed area if the bending or forming process has damaged the zinc coating, as evidenced by flaking or cracking of the zinc coating at the outside radius of the bent or formed section visible at 25 power magnification.

29.3.5 With reference to the requirements of 29.3.4, simple sheared or cut edges and punched holes are not considered to be formed, but extruded and rolled edges and holes shall comply with 29.3.4.

29.3.6 Copper, bronze, brass containing not less than 80 percent copper, or stainless steel may be used without additional protection against corrosion. Sheet, extruded, or cast aluminum, die-cast zinc, and other metals shall be of a grade or alloy known to be resistant to atmospheric corrosion.

29.3.7 With respect to 29.1, for outdoor use dishwashers, hinges, bolts, and fasteners made of ferrous materials and securing water shields or enclosure parts together shall be protected against corrosion in accordance with 29.3.2, 29.3.3, 29.3.6, or 29.3.7.

29.4 Metallic coating thickness test

29.4.1 The solution to be used for this test shall be made from distilled water containing 200 grams per liter of chemically pure chromic acid, CrO^3, and 50 grams per liter of chemically pure concentrated sulfuric acid, H_2SO_4. The latter is equivalent to 27 milliliters per liter of chemically pure concentrated sulfuric acid, specific gravity 1.84 containing 96 percent of H_2SO_4.

29.4.2 The test solution shall be contained in a glass vessel, such as a separatory funnel, with the outlet equipped with a stopcock and a capillary tube of 0.64 mm (0.025 in) inside bore and 140 mm (5.5 in) long. The lower end of the capillary tube shall be tapered to form a tip, each drop from which shall be 0.05 milliliters. To preserve an effectively constant level, a small glass tube shall be inserted in the tip of the funnel through a rubber stopper and its position adjusted so that the rate of dropping is 100 ±5 drops per minute when the stopcock is open. An additional stopcock may be used in place of the glass tube to control the rate of dropping.

29.4.3 The sample and the test solution shall be kept in the test room long enough to acquire the temperature of the room, which shall be noted and recorded. The test shall be conducted at a room temperature of 21.1 to 32.2 °C (70 to 90 °F).

29.4.4 Each sample shall be thoroughly cleaned before testing. All grease, lacquer, paint, and other nonmetallic coatings shall be removed completely by means of an acceptable solvent. Samples then shall be thoroughly rinsed in water and dried with clean cheesecloth. Care should be exercised to avoid contact of the cleaned surface with the hands or any foreign material.

29.4.5 The sample to be tested shall be supported 17.8 – 25.4 mm (0.7 – 1 in) below the orifice so that the drops of solution strike the point to be tested and run off quickly. The surface to be tested shall be inclined 45 degrees from horizontal.

29.4.6 After cleaning, the sample to be tested shall be placed under the orifice. The stopcock shall be opened and the time, in seconds, shall be measured with a stopwatch until the dripping solution dissolves off the protective metallic coating and exposes the base metal. The initial appearance of the base metal is recognizable by the change in color at that point.

29.4.7 Each sample of a test lot shall be subjected to the test at three or more points, excluding cut, stenciled, and treaded surfaces, on the inside surface, and at the equal number of points on the outside surface, at points where the metallic coating might be expected to be the thinnest. On enclosures made from precoated sheets, the external corners that are subjected to the greatest deformation may have thin coatings.

29.4.8 To calculate the thickness of the coating being tested, the thickness factor appropriate for the temperature at which the test was conducted shall be selected from Table 29.2 and multiplied by the time, in seconds, required to initially expose base metal as determined in 29.4.6.

Table 29.2
Thickness of Coating Factors

Temperature		Thickness factors, 0.0003 mm (0.00001 in) per second	
°C	(°F)	Cadmium platings	Zinc platings
21.1	(70)	1.331	0.980
21.7	(71)	1.340	0.990
22.2	(72)	1.352	1.000
22.8	(73)	1.362	1.010
23.3	(74)	1.372	1.015
23.9	(75)	1.383	1.025
24.4	(76)	1.395	1.033
25.0	(77)	1.405	1.042
25.6	(78)	1.416	1.050
26.1	(79)	1.427	1.060
26.7	(80)	1.438	1.070
27.2	(81)	1.450	1.080
27.8	(82)	1.460	1.085
28.3	(83)	1.470	1.095
28.9	(84)	1.480	1.100
29.4	(85)	1.490	1.110
30.0	(86)	1.501	1.120
30.6	(87)	1.513	1.130
31.1	(88)	1.524	1.141
31.7	(89)	1.534	1.150
32.2	(90)	1.546	1.160

30 Resistance to Heat, Fire, and Cracking – Polymeric Materials

30.1 General

30.1.1 The requirements of Section 30 shall apply to polymeric materials, including thermoset materials, used as enclosures, functional polymeric parts including polymeric barriers, decorative parts, or liquid containers. These requirements shall apply only to a material used in such a way that deterioration or breakage of the part could result in a risk of fire, electric shock, or injury to persons. These requirements shall not apply to materials used as electrical insulation.

30.1.2 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.

30.1.3 The tests to be conducted shall be as specified in Table 30.1. Each test method and the conditions under which each test is to be conducted shall be as specified in this clause.

Table 30.1
Polymeric Materials Test Summary

Test[7]	Clause	Polymeric part[1]		
		Decorative	Enclosure[2, 9]	Functional[2]
Horizontal burning rate	30.2	X[13]	–	X[13]
Flammability	30.3	–	X	–
Flammability – large mass[7]	30.4	X	X	X
Impact	30.5	–	X	–
Cold impact[3]	30.6	–	X	X
Mould stress[4, 6]	30.7	–	X	X
Immersion[6, 10]	30.8	–	–	X
Thermal ageing[4, 6]	30.9	–	X	X
Long-term exposure[5, 6, 10]	30.10	–	–	X
Accelerated ageing[11]	30.14	–	–	X
Ultraviolet light exposure[12]	30.15	–	X	X
Water exposure and immersion[12]	30.16	–	X	X

Notes:

1) The X appearing in a column designates the applicable requirement.

2) Some parts can be both an enclosure and a functional part and shall be subjected to both sets of tests.

3) Cold impact is only required on polymeric water shields and enclosures for dishwashers intended for installation outdoors.

4) Moulded parts subjected to the thermal ageing test shall not be required to be subjected to the mould stress test.

5) The long-term exposure test shall be conducted on washing compartments only.

6) Moulded parts subjected to the endurance test of the long-term exposure test shall not be required to be subjected to the mould stress, immersion, and thermal ageing tests.

7) These requirements do not fully cover a plated plastic if loss of bond strength could result in a risk of fire or electric shock. A plated plastic part shall be the subject of a separate investigation.

8) The flammability – large mass test shall be conducted only on an external part having a dimension greater than 1.8 m (5.9 ft) or a total projected surface area greater than 0.9 m^2 (10 ft^2).

9) Refer to 23.1.10 for polymeric field wiring enclosure tests.

10) Immersion and long-term exposure testing shall not be required if the material recognition included subjecting it to dishwasher detergent and solutions that are typically used in fluid containing parts of dishwasher equipment.

11) Accelerated ageing is only required on gaskets and seals employed for compliance with the Rain Test of 15.8.

12) Ultraviolet light exposure and water exposure and immersion are only required on polymeric water shields and enclosures exposed to sunlight and the effects of weather, respectively, for dishwashers intended for installation outdoors.

13) The flammability requirements specified in 30.3.4 – 30.3.10 are applicable to parts that serve as electrical connectors, or are within 3 mm (0.118 in) of electrical connections or within the vertical cylinder described in 30.3.9.

30.2 Horizontal burning rate

30.2.1 The burning rate of a polymeric part shall be evaluated in accordance with CAN/CSA-C22.2 No. 0.17 and UL 94, and shall have a flammability rating of HB. The test specimens may be flat stock of the thickness of the end-use part or cut from the part.

30.3 Flammability

Note: See Figure 30.1, Figure 30.2 and Figure 3.1 for guidance in the application of 30.3.

Figure 30.1

Enclosure Flammability

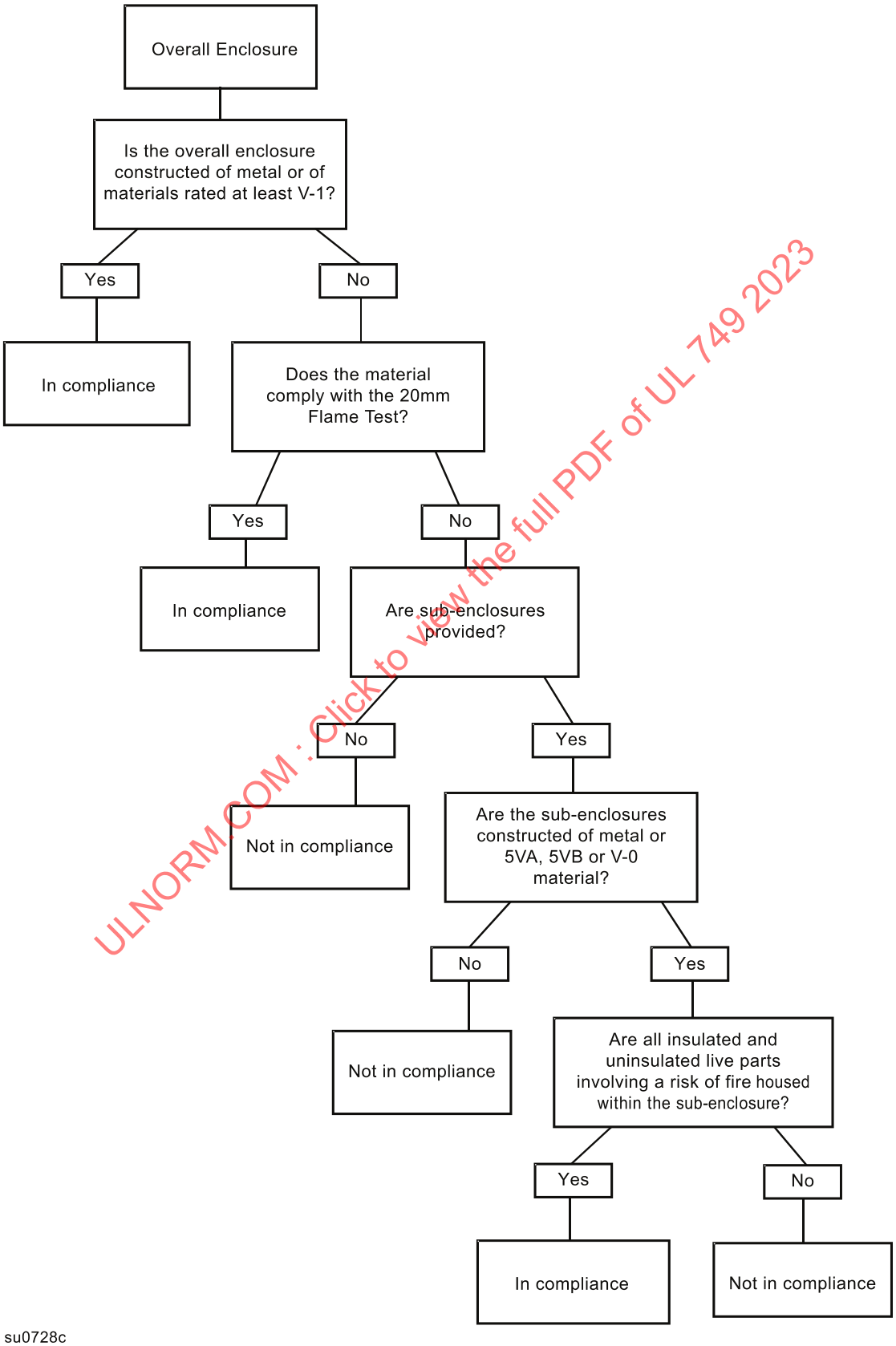


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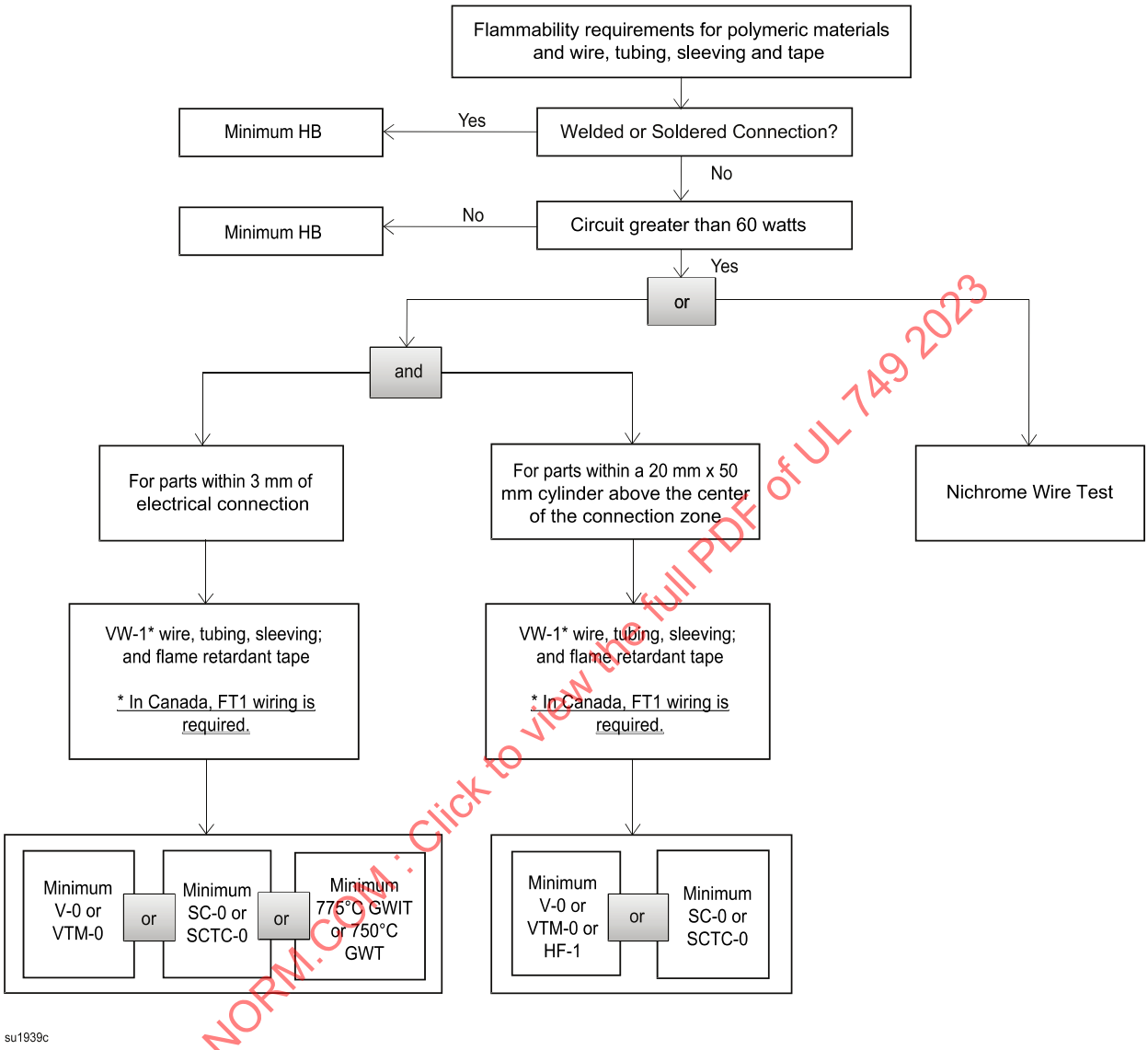
Figure 30.2

Flammability Requirements for Polymeric Materials, Wire, Tubing, Sleeving, and Tape



30.3.1 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 V-1 minimum.

Note: Materials not classified V-1 may be tested in accordance with the 20 mm flammability test described in UL 746C and CAN/CSA-C22.2 No. 0.17, using parts moulded from the polymeric material.

30.3.2 A flammability classification of HB used for the outer enclosure material is acceptable if:

a) A metal or polymeric material classified 5VA, 5VB, or V-0 is used as a sub-enclosure that houses all insulated or uninsulated live parts that involve a risk of fire; and

b) Live parts that involve a risk of fire are adequately housed within the sub-enclosure where accessibility shall be determined by application of the probe as shown in Figure 9.3.

30.3.3 The requirement in 30.3.2(b) shall not apply to connections within snap switches, lampholders with switching mechanisms, appliance inlets and outlets, receptacles, membrane switches, and special-use switches that have been found to be acceptable with respect to resistance to ignition, resistance to arcing, or overload and endurance testing in accordance with CSA C22.2 No. 111 and UL 20, CSA C22.2 No. 43 and UL 496, CSA C22.2 No. 42 and UL 498, UL 2557 and CSA C22.2 No. 55 and CAN/CSA-C22.2 No. 61058-1/UL 61058-1.

30.3.4 All electrical connections where the total circuit load is greater than 60 W during normal operation shall:

a) Comply with 30.3.7, 30.3.8, and 30.3.9; or

b) Be evaluated as specified in 17.5.

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 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.

30.3.5 Electrical connections within components are not required to comply with 30.3.4 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 30.3.4.

30.3.6 The requirements in 30.3.4 shall not apply to welded or soldered connections.

30.3.7 With reference to 30.3.4, components such as wire, tubing, sleeving, or tape that are located within 3 mm (0.18 in) of an electrical connection as shown in Figure 3.1 shall have a flammability classification as follows:

a) VW-1 for wire evaluated in accordance with CSA C22.2 No. 2556.

b) VW-1 for tubing and sleeving evaluated in accordance with 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 (176 °F), and UL 510A covers tape rated greater than 80 °C (176 °F).

30.3.8 With reference to 30.3.4, polymeric materials located within 3 mm (0.18 in) of an electrical connection as shown in Figure 3.1 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) A minimum glow wire ignition temperature (GWIT) of 775 °C (1427 °F) 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 (1382 °F) 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 is performed on the minimum specified flame rated material.

30.3.9 With reference to 30.3.4, all non-metallic combustible materials located within the envelope of a vertical cylinder having a diameter of 20 mm (0.787 in) and a height of 50 mm (2 in), 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 30.3, shall have a flammability classification as follows:

a) A minimum of V-0 or 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

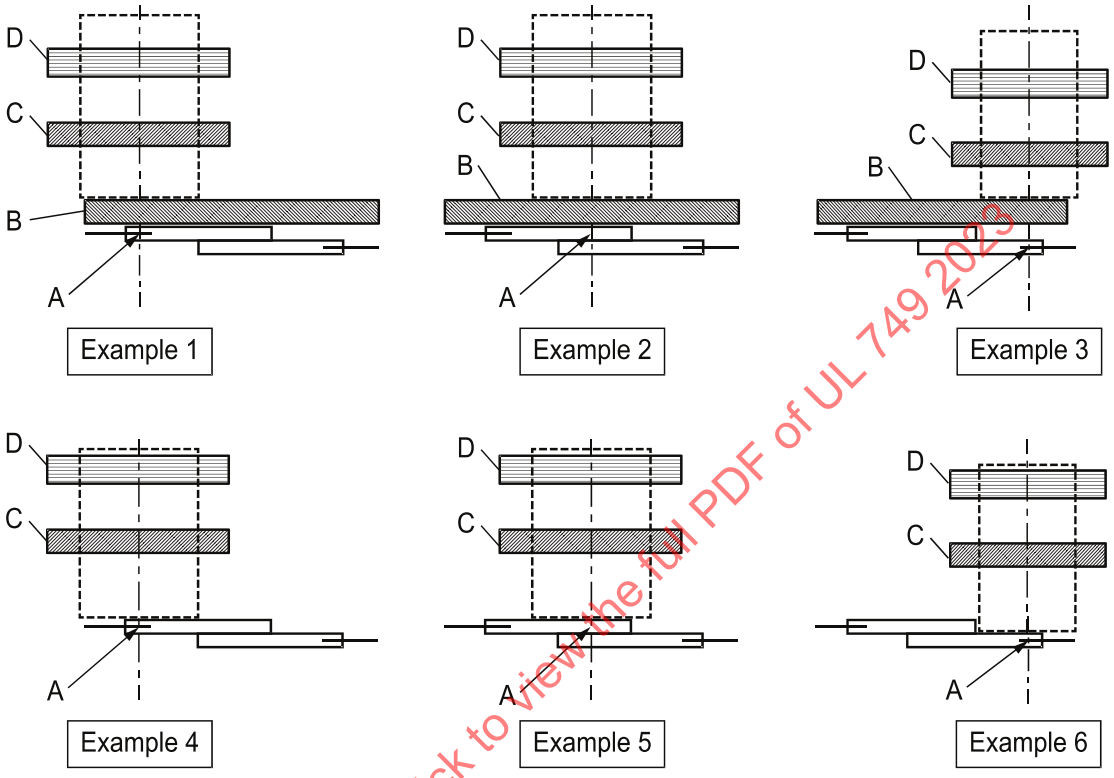
c) A minimum VW-1 and FT1 for wire, tubing, sleeving and tape in accordance with 30.3.7.

Note 1: Testing of alternate materials within the cylinder is not required when the test is performed on the minimum specified flame rated material.

Note 2: The requirement does not apply to parts having a mass not exceeding 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.

Figure 30.3

Placement of Flame Cylinder



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A Center of connection zone

B Polymeric material supporting current carrying connection (e.g., connector housing)

C Metallic or polymeric material

D Metallic or polymeric material

30.3.10 With reference to 30.3.9 and Figure 30.3, 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 30.3. 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 30.3. 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 the Hot Coil Ignition Test, 17.5.

30.4 Enclosure flammability – large mass consideration

30.4.1 An external part having a single linear dimension greater than 1.8 m (5.9 ft) or a projected surface area greater than 0.9 m^2 (9.7 ft^2) shall be treated as described in CAN/CSA-C22.2 No. 0.17, and:

a) UL 723; or

b) ASTM E162.

The flame-spread index of the part shall not exceed 200.

30.5 Impact test

30.5.1 A polymeric enclosure or the polymeric portion of an enclosure shall be tested as described in 30.5.2. As a result of the test:

a) Spacings shall not be reduced to less than those specified in Table 19.1;

b) Current-carrying parts or internal wiring shall not be exposed, as determined in accordance with Section 9; and

c) There shall be no damage that could result in a risk of fire, electric shock, or injury to persons. (See 18.5.3.)

30.5.2 Samples of a polymeric enclosure or the polymeric portion of an enclosure shall be subjected to the resistance to impact test described in UL 746C and CAN/CSA-C22.2 No. 0.17.

30.6 Cold impact

30.6.1 Polymeric water shields and enclosures of dishwashers intended for installation outdoors shall comply with the resistance of impact test at -35 ±2 °C (-31 ±3.6 °F) in CAN/CSA-C22.2 No. 0.17 and UL 746C.

30.7 Mould stress relief

30.7.1 A polymeric part shall be tested as specified in the mould stress relief test in UL 746C and CAN/CSA-C22.2 No. 0.17. As a result of this test:

a) Spacings shall not be reduced to less than those specified in Table 19.1;

b) Current-carrying parts or internal wiring shall not be exposed, as determined in accordance with Section 9;

c) There shall be no damage that could result in a risk of fire, electric shock, or injury to persons (see 18.5.3); and

d) A part exposed to liquid shall not crack or leak if such leakage could result in a risk of fire, electric shock, or injury to persons.

Note: This test may be waived if the part is required to be subjected to the thermal ageing test in 30.9.

30.8 Immersion

30.8.1 Three samples of a polymeric part shall be subjected to the tests specified in (a), (b), or (c) in accordance with Table 30.2. As a result of the test, the part shall show no cracking, leakage, or deterioration that could result in a risk of fire, electric shock, or injury to persons.

a) **Test No. 1**

Three samples of the polymeric part shall be immersed in a solution consisting of 25 g (0.88 oz) of dishwasher detergent and 50 mL (1.69 oz) of rinse agent per liter of water. The samples shall be immersed for 1,000 h at a temperature 10 °C (18 °F) above the temperature to which the part is subjected during normal operation, but not less than 70 °C (158 °F).

b) **Test No. 2**

Three samples of the polymeric part shall be immersed in a solution consisting of 25 g (0.88 oz) of dishwasher detergent per liter of water. If other solutions are to be investigated, they shall be 100 percent concentrations of the agent. The samples shall be immersed for 1,000 h at a temperature 10 °C (18 °F) above the temperature to which the part is subjected during normal operation, but not less than 70 °C (158 °F).

c) **Test No. 3**

Three samples of the complete assembly shall be immersed in a solution consisting of 25 g (0.88 oz) of dishwasher detergent and 50 mL (1.69 oz) of rinse agent per liter of water. The samples shall be immersed for 168 h at a temperature 10 °C (18 °F) above the temperature to which the part is subjected, but not less than 70 °C (158 °F).

Note: The immersion test may be waived for molded polymeric parts having different configurations if all of the following conditions are met:

a) The candidate polymeric part uses the same material grade as the originally tested polymeric part;

b) The candidate polymeric part has a minimum thickness not less than the originally tested polymeric part; and

c) The candidate polymeric part is subjected to an operating temperature not more than the originally tested polymeric part.

Table 30.2
Immersion Test

Group[a]	Description	Test No.[b]
A[c]	A part serving as a wash-water carrier, hose fitting, sump pump, or the like	1
B	A part, such as a dispenser, subjected to a concentrated solution	2
C	A part subjected to casual splashing of water or vapour, or a part subjected to wash water or vapour during intended operating conditions	3

[a] If a polymeric part falls into more than one test group, a separate sample shall be subjected to the test required for each group.

[b] A complete assembly, consisting of the part to be evaluated and the associated fittings, might have to be tested to evaluate resistance to liquid leakage.

[c] Tests for this group may be omitted if the long-term exposure test in 30.10 is conducted.

30.9 Thermal ageing

30.9.1 General

30.9.1.1 A polymeric material shall be resistant to thermal degradation at the maximum temperature to which it is exposed during normal use of the appliance.

30.9.2 Thermal aging test

30.9.2.1 Three specimens of a polymeric part shall be tested as specified in 30.9.2.2. As a result of the test, a part shall comply with the following:

a) Spacings shall not be reduced to less than those specified in Table 19.1;

b) Current-carrying parts or internal wiring shall not be exposed, as determined in accordance with Section 9;

c) A condition shall not be produced that could increase the risk of fire, electric shock, or injury to persons (see 18.5.3); and

d) A part exposed to liquids shall not crack or leak.

30.9.2.2 The specimens shall be placed in an air-circulating oven for 1,000 h at the temperature specified in Table 30.3. The parts shall be removed from the oven, cooled to room temperature, and examined to determine compliance with the requirements in 30.9.2.1.

Table 30.3
Temperatures for Oven Conditioning

Maximum operating temperature of polymeric enclosure part, °C	Oven temperature,	
	°C	(°F)
> 50 ≤ 75	85	(185)
> 75 ≤ 85	95	(203)
> 85 ≤ 95	105	(221)

30.9.2.3 A polymeric part shall be considered to comply with the requirements in 30.9.1.1 if the material has a temperature index, based on historical data or a long-term thermal ageing program, that indicates its acceptability for use at the temperature involved.

30.9.2.4 A polymeric part shall be considered to comply with the requirements in 30.9.1.1 if the maximum temperature to which the material is exposed during normal use of the appliance does not exceed 50 °C (122 °F)

30.10 Long-term exposure

30.10.1 A polymeric material, the deterioration of which could result in a risk of fire, electric shock, or injury to persons, shall be resistant to solutions to which it is exposed during normal use of the appliance. The material shall be evaluated by one of the following methods:

a) An endurance test conducted as described in 30.11 on three complete appliances; or

b) A tensile strength test as described in 30.12 and a tensile impact energy test as described in 30.13.

30.11 Endurance

30.11.1 Following the endurance test described in 30.11.2, an appliance shall be subjected to an impact test as described in 30.5, with an impact of 3.4 J (2.5 lb-ft). There shall be no cracking, leakage, or the like that could result in a risk of fire, electric shock, or injury to persons.

30.11.2 Three complete appliances shall each be subjected to 6,000 normal cycles. The appliance shall be connected to a supply circuit and to the water supply (see 5.9.1 to 5.9.3). During the wash period of each cycle, 25 g (0.88 oz) of detergent per liter of water shall be added to the wash water. If the appliance has a detergent or rinse agent dispenser, then the amount of detergent or rinse agent shall be the maximum amount that can be dispensed during an operating cycle.

30.12 Tensile strength

30.12.1 Thirty-five specimens of polymeric material used in a part of an appliance that is subject to wash water shall be tested as specified in 30.12.2 to 30.12.5. As a result of the test, the average tensile strength of the specimens shall be at least 50 percent of the as-received specimens for each condition.

30.12.2 Each specimen shall be approximately 203 mm by 76 mm (8 in by 3 in) and shall have a minimum thickness equal to the thickness of the polymeric material as used in the part. Alternatively, the polymeric material under test may be moulded to form the test specimens indicated in 30.12.5 having a thickness equal to the minimum thickness of the polymeric material as used in the part.

30.12.3 The average tensile strength of five as-received specimens shall be determined in accordance with 30.12.5.

30.12.4 Thirty specimens shall be immersed in a solution of water and 2.5 percent, by mass, dishwasher detergent at a temperature of 82 °C (179.6 °F). Ten specimens shall be conditioned for 30 days, ten specimens shall be conditioned for 60 days, and ten specimens shall be conditioned for 138 days.

30.12.5 The average tensile strength of the specimens shall be tested and measured in accordance with ASTM D638. The specimens shall be prepared after testing in accordance with the Type I requirements for samples in ASTM D638. The tensile strength shall then be measured on the prepared samples.

30.13 Tensile impact energy

30.13.1 Thirty-five specimens of polymeric material used in a part of an appliance that is subject to wash water shall be tested as specified in 30.13.2 to 30.13.5. As a result of the test, the average tensile impact energy of the specimens shall be at least 50 percent of the as-received specimens for each condition.

30.13.2 Each specimen shall be approximately 203 mm by 76 mm (8 in by 3 in) and shall have a minimum thickness equal to the thickness of the polymeric material as used in the part. Alternatively, the polymeric material under test may be moulded to form the test specimens indicated in 30.13.5 having a thickness equal to the minimum thickness of the polymeric material as used in the part.

Note: The results of tensile impact testing of standard specimens in the nominal 4 mm thickness may be considered representative of the testing of a reduced thickness provided the non-impact testing at the minimum thickness of the polymeric material as used in the part complies with the applicable requirements of Section 30.

30.13.3 The average tensile impact energy of five as-received specimens shall be determined in accordance with 30.13.5.

30.13.4 Thirty specimens shall be immersed in a solution of water and 2.5 percent, by mass, dishwasher detergent at a temperature of 82 °C (179.6 °F). Ten specimens shall be conditioned for 30 days, ten specimens shall be conditioned for 60 days, and ten specimens shall be conditioned for 138 days.

30.13.5 The average tensile impact energy of the specimens shall be tested and measured in accordance with ASTM D1822. The specimens shall be prepared after testing in accordance with the Type S requirements for samples in ASTM D1822. The tensile impact energy shall then be measured on the prepared samples.

30.14 Seal and gasket tests for outdoor use appliances

30.14.1 Gaskets and sealing compounds for use with electrical enclosures as determined during the Rain Test as specified in 15.8.4 shall have physical properties after 70 h of air oven ageing at 100 ±2 °C (212 ±3.6 °F) as indicated in Table 30.4.

Note: These requirements do not apply to foamed materials.

Table 30.4
Physical Properties of Gaskets and Sealing Compounds

	Before test	After test
Recovery – Maximum set when 25.4 mm (1 in) gauge marks are stretched to 63.5 mm (2-1/2 in) and held for 2 minutes and measured 2 minutes after release.	6.4 mm (1/4 in)	N/A
Elongation – Minimum increase in distance between 25.4 mm (1 in) gauge marks at break.	N/A	65 percent of original
Tensile Strength – Minimum force at breaking point.	N/A	75 percent of original

30.14.2 Foamed compounds shall not harden or otherwise deteriorate to a degree that will affect their sealing properties after being subjected to a 70-hour air oven test at 100 ±2 °C (212 ±3.6 °F).

30.14.3 A thermoplastic material shall not deform, melt, or otherwise deteriorate to a degree that will affect its sealing properties following exposure to air at a temperature of 87 °C (190 °F) for a period of 7 days.

30.14.4 With reference to 30.14.3, polyvinyl chloride gasket material shall have an ultimate tensile strength of not less than 8.3 MPa (1200 psig) and an ultimate elongation of not less than 250 percent prior to the exposure to the elevated air temperature. The minimum tensile strength shall be not less than 90 percent and the elongation not less than 75 percent of the original values following the exposure to the elevated air temperature.

30.14.5 Sealing compounds shall be applied to the surface they are intended to seal. A representative sample of the surface with the sealing compound applied shall be subjected to a test involving exposure to air at 87 °C (190 °F) for a period of 7 days. The sealing compound shall not melt, become brittle, or otherwise deteriorate to a degree that will affect its sealing properties as determined by comparing an aged sample to an unaged sample.

30.14.6 When gaskets are secured by adhesives, samples of the gasket adhesive and mounting surface shall be exposed to 87 °C (190 °F) air oven conditioning for 7 days; and immersion in distilled water for 3 days. The force required to peel the gasket from its mounting surface after exposure shall be not less than 50 percent of the value determined on “as-received” samples and in no case less than 350 N/m (2 lb per in) of gasket width.