



UL 749

STANDARD FOR SAFETY Household Dishwashers

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UL Standard for Safety for Household Dishwashers, UL 749

Tenth Edition, Dated March 16, 2017

Summary of Topics

This new edition of ANSI/UL 749 is being issued to incorporate several substantive changes.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated November 20, 2015, October 7, 2016, and January 19, 2017.

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Canadian Standards Association
CSA-C22.2 No. 167-17
Seventh Edition



Underwriters Laboratories Inc.
UL 749
Tenth Edition

Household Dishwashers

March 16, 2017



ANSI/UL 749-2017

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

The most recent designation of ANSI/UL 749 as an American National Standard (ANSI) occurred on March 16, 2017. ANSI approval for a standard does not include the Cover Page, Transmittal Pages and Title Page.

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 UL at any time. Proposals should be submitted via a Proposal Request in UL’s On-Line Collaborative Standards Development System (CSDS) at <https://csds.ul.com>.

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CONTENTS

Preface	8
1 Scope	9
2 Reference Publications	9
3 Definitions	20
4 General Requirements	23
5 General Conditions for the Tests	24
5.1 Voltage and frequency	24
5.2 Cheesecloth for heating and abnormal tests	25
5.3 Test temperature	25
5.4 Thermocouples	25
5.5 Dishwashing detergent	25
5.6 Rinse agent	26
5.7 Place setting	26
5.8 High-sudsing detergent	26
5.9 Water temperature	26
6 Classification	26
7 Marking	26
7.1 General	26
7.2 Appliance markings	28
8 Instructions	31
8.1 General	31
8.2 Instructions pertaining to a risk of fire, electric shock, or injury to persons	32
8.3 Installation instructions	34
8.4 Operating instructions	35
8.5 User-maintenance instructions	36
9 Protection Against Accessibility to Current-Carrying Parts	36
9.1 General	36
9.2 Enclosures for other than built-in appliances	36
9.3 Enclosures for built-in appliances	38
9.4 All dishwashers	38
10 Starting of Motor-Operated Appliances	38
11 Power Input and Current	39
12 Heating	39
13 Leakage Current	40
14 Insulation Resistance	40
15 Moisture Resistance	41
15.1 General	41
15.2 Humidity conditioning	42
15.3 Liquid overflowing from an auxiliary reservoir	42
15.4 Oversudsing	43
15.5 Liquid spillage – all appliances	43
15.6 Liquid spillage – portable appliances	44
15.7 Wetting of electrical components	45
15.8 Rain test	46
15.9 Hose rupture test	47
15.10 Liquid leaking from an auxiliary reservoir	48
16 Electric Strength	49
17 Abnormal Operation	49
17.1 Burnout test on components	49

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Documents

Document Sharing Hub

17.2	Stopped timer	50
17.3	Cord reels	51
17.4	Nichrome wire test	52
18	Stability and Mechanical Hazards	54
18.1	General	54
18.2	Stability	54
18.3	Sharp edges	54
18.4	Automatic restarting of the motor	55
18.5	Moving parts	55
18.6	Guards, interlocks, and the like	56
18.7	Unintentional operation	56
19	Mechanical Strength	57
19.1	General	57
19.2	Frame and enclosure	57
20	Construction	58
20.1	Current-carrying parts	58
20.2	Bottom openings	59
20.3	Electrical insulation	61
20.4	Sound and thermal insulation	62
20.5	Plumbing requirements	62
21	Internal Wiring	62
21.1	General	62
21.2	Splices and connections	64
21.3	Separation of circuits	65
21.4	Barriers	65
21.5	Endurance test	66
22	Components	66
22.1	General	66
22.2	Mechanical assembly	68
22.3	Capacitors	68
22.4	Field-attached or optional accessories	69
22.5	Heating elements	70
22.6	Lampholders	71
22.7	Motors	71
22.8	Receptacles	72
22.9	Seals and diaphragms	72
22.10	Switches	73
22.11	Controls	74
22.12	Connecting hoses	78
22.13	Transformers and power supplies	79
22.14	Overcurrent protection	79
22.15	Electrically operated valves	79
22.16	Terminals and connectors	79
22.17	Pumps	80
22.18	Insulating devices	80
22.19	Adhesives used to secure parts	80
22.20	Equipment protective devices	81
23	Supply Connection and External Flexible Cords	81
23.1	Permanently connected appliances	81
23.2	Cord-connected appliances	82
23.3	Push-back relief	84
23.4	Strain relief	85
23.5	Cord reels	85

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Documents

Document Sharing Hub

23.6	Power-supply cord kits for use with undercounter or built-in dishwashers	86
23.7	Bushings	86
24	Terminals for External Conductors	86
25	Provision for Grounding	87
25.1	General	87
25.2	Bonding means	89
25.3	Continuity of grounding circuit	90
25.4	Grounding terminals and leads	90
25.5	Heater sheaths	91
26	Screws and Connections	92
27	Creepage Distances, Clearances, and Distances through Insulation	92
28	Alternative Spacings-Clearances and Creepage Distances	93
29	Resistance to Corrosion	94
29.1	General	94
29.2	Liquid containers	94
29.3	Outdoor use dishwashers (protected locations and outdoor locations)	95
29.4	Metallic coating thickness test	97
30	Resistance to Heat, Fire, and Cracking – Polymeric Materials	97
30.1	General	97
30.2	Horizontal burning rate	98
30.3	Flammability	98
30.4	Enclosure flammability – large mass consideration	100
30.5	Impact test	101
30.6	Cold impact	101
30.7	Mould stress relief	101
30.8	Immersion	102
30.9	Thermal ageing	102
30.10	Long-term exposure	103
30.11	Endurance	104
30.12	Tensile strength	104
30.13	Tensile impact energy	105
30.14	Seal and gasket tests for outdoor use appliances	105
30.15	Ultraviolet light exposure	106
30.16	Water exposure and immersion	106
31	Manufacturing and Production Tests	106
31.1	Grounding continuity test	106
31.2	Electric strength test	107
TABLES		108
FIGURES		114

SUPPLEMENT SA - Plumbing Requirements for Household Dishwashers (Normative)

SA1	Scope	127
SA2	Glossary	127
SA3	General Requirements	127
SA4	Test Procedures	128
SA4.1	General	128
SA4.2	Initial cycle	128
SA4.3	Preparation and test	129

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Documents

Document Sharing Hub

SUPPLEMENT SB - Safety of Smart Enabled Dishwashers

SB1 Scope	131
SB2 General	131
SB2.1 Controls	131
SB2.2 Separation of circuits	132
SB2.3 Communication and display devices	133
SB2.4 Communication conductors and cables	133
SB2.5 Communication connectors	133
SB2.6 Smart enabled or remote operation	134
SB3 Functional Safety	134
SB4 Resistance to Electro Magnetic Phenomena (Immunity)	135
SB5 Markings and Instructions	136

SUPPLEMENT SC - Ozone Generating Dishwashers

SC1 Scope	137
SC2 General	137
SC2.1 Ozone test	137
SC2.2 Equipment specifications	138
SC2.3 Test conditions	138
SC3 Marking and Instructions	138
SC4 Polymeric Materials Exposed to Ozone	138
SC5 Seals and Diaphragms	139
SC6 Protection Against Injury to Persons	139

SUPPLEMENT SD - ALTERNATIVE ELECTRONIC CIRCUIT REQUIREMENTS

SD1 Scope	141
SD2 General	141
SD3 Glossary	142
SD4 Creepage Distances, Clearances, and Distances Through Insulation	143
SD5 Control Functions	143
SD5.1 Protective electronic circuits/controls	143
SD5.2 Operating controls or circuits that perform safety critical functions	144
SD6 Evaluation of the Different Types of Control Circuits	144
SD6.1 All types of circuits	144
SD7 Protective Electronic Circuits	144
SD8 Operating Controls or Circuits that Perform Safety Critical Functions	145
SD9 General Conditions for the Tests	146
SD9.1 Details	146
SD9.2 Intentionally weak parts	146
SD9.3 Test results determined by overcurrent protection operation	147
SD10 Low-Power Circuits	147
SD10.1 Low-power circuit determination	147
SD10.2 Low-power circuit fire tests	149
SD11 Abnormal Operation and Fault Tests	149
SD12 Programmable Component Reduced Supply Voltage Test	151
SD13 Electromagnetic Compatibility (EMC) Requirements – Immunity	151

SD14 Manufacturing and Production Line Testing	153
SD15 Markings	153

Annex A (informative) Translations

A1 French Translations	154
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Preface

This is the harmonized CSA Group and UL Standard for Household Dishwashers. It is the seventh edition of CAN/CSA-C22.2 No. 167, and the tenth edition of UL 749. This edition of CSA C22.2 No. 167 supersedes the previous edition published in 2013. This edition of UL 749 supersedes the previous edition published in 2013.

The major differences between this edition and the previous edition include the addition of requirements for DC Electric Test Voltages, Smart Enabled Appliances, Dishwasher Ignition Containment, Ozone Generating Dishwashers, Dishwasher Rinse Agent Exposure, Plumbing for Household Dishwashers, Dishwasher Heating Element Test and Nichrome Wire Test.

This harmonized Standard was prepared by CSA Group and Underwriters Laboratories Inc. (UL).

The efforts and support of the Technical Harmonization Committee for Household Dishwashers and the Association of Home Appliance Manufacturers (AHAM) are gratefully acknowledged.

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

This Standard was reviewed by the CSA Subcommittee on Household Dishwashers, under the jurisdiction of the 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.

This standard has been approved by the American National Standards Institute (ANSI) as an American National Standard.

Application of Standard

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

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

Level of harmonization

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

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

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 the Canadian Electrical Code (CEC), Part I, C22.1, General Requirements – Canadian Electrical Code (CEC), Part II, C22.2, 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 Supplement SB.

1.4 This Standard applies to household dishwashers generating ozone during normal operation. See Supplement SC.

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 Reference Publications

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

CSA Group Standards

B64 Series-11

Backflow preventers and vacuum breakers

B64.1.1-11

Atmospheric Vacuum Breakers (AVB)

C22.1-15

Canadian Electrical Code, Part I

C22.2 No. 0-10 (R2015)

General Requirements – Canadian Electrical Code (CEC), Part II

C22.2 No. 0.1-M1985 (R2013)

General Requirements for Double-Insulated Equipment

C22.2 No. 0.2-93 (R2008)

Insulation Coordination

C22.2 No. 0.3-09 (R2014)

Test Methods For Electrical Wires and Cables

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

C22.2 No. 0.15-15
Adhesive Labels

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

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

C22.2 No. 14-13
Industrial Control Equipment

CAN/CSA-C22.2 No. 18.1-13
Metallic Outlet Boxes

C22.2 No. 18.2-06 (R2011)
Nonmetallic Outlet Boxes

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

CAN/CSA-C22.2 No. 18.5-13
Positioning Devices

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

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

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

C22.2 No. 39-13
Fuseholder Assemblies

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

CAN/CSA-C22.2 No. 42.1-13
Cover Plates for Flush-Mounted Wiring Device

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

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

C22.2 No. 55-15
Special Use Switches

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CAN/CSA-C22.2 No. 65-13
Wire Connectors

C22.2 No. 66.2-06 (R2011)
Low Voltage Transformers – Part 2: General Purpose Transformers

C22.2 No. 66.3-06 (R2011)
Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers

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

CAN/CSA-C22.2 No. 74-96 (R2015)
Equipment for Use with Electric Discharge Lamps

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

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

C22.2 No. 100-14
Motors and Generators

C22.2 No. 107.1-01 (R2011)
General Use Power Supplies

CAN/CSA-C22.2 No. 108-14
Liquid Pumps

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

C22.2 No. 127-09 (R2014)
Equipment and Lead Wires

C22.2 No. 139-13
Electrically Operated Valves

C22.2 No. 144-M91 (R2011)
Ground Fault Circuit Interrupters

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

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

C22.2 No. 158-10
Terminal Blocks

C22.2 No. 168-16
Commercial Dishwashers

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C22.2 No. 177-13

Clock-Operated Switches

C22.2 No. 182.3-M1987 (R2014)

Special Use Attachment Plugs, Receptacles, and Connectors

C22.2 No. 188-13

Splicing Wire Connectors

C22.2 No. 190-14

Capacitors for Power Factor Correction

C22.2 No. 197-M1983 (R2013)

PVC Insulating Tape

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

Extruded Insulating Tubing

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

Coated Electrical Sleeving

C22.2 No. 210-15

Appliance Wiring Material Products

CAN/CSA-C22.2 No. 223-M91 (R2013)

Power Supplies with Extra-Low-Voltage Class 2 Outputs

C22.2 No. 235-04 (R2013)

Supplementary Protectors

C22.2 No. 248.1-11

Low-Voltage Fuses - Part 1: General Requirements

C22.2 No. 250.4-14

Portable Luminaires

C22.2 No. 2459-08 (R2013)

Insulated Multi-pole Splicing Wire Connectors

CAN/CSA-C22.2 No. 4248.1-07 (R2012)

Fuseholders – Part 1: General Requirements

CAN/CSA-C22.2 No. 61058-1-09 (R2014)

Switches for Appliances - Part 1: General Requirements

CAN/CSA-C22.2 No. 60950-1-07 (R2012)

Information Technology Equipment - Safety - Part 1: General Requirements

CAN/CSA-E730-2-6-94 (R2013)

Automatic Electrical Controls for Household and Similar Use – Part 2: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements

CAN/CSA-E730-2-7-94 (R2013)

Automatic Electrical Controls for Household and Similar Use – Part 2: Particular Requirements for Timers and Time Switches

CAN/CSA-E60384-14-14

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

CAN/CSA-E60730-1-13

Automatic Electrical Controls for Household and Similar Use – Part 1: General Requirements

CAN/CSA-E60730-2-8-01 (R2011)

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

CAN/CSA-E60730-2-9-15

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

UL Standards

UL 20

General-Use Snap Switches

UL 44

Thermoset-Insulated Wires and Cables

UL 62

Flexible Cords and Cables

UL 66

Fixture Wire

UL 83

Thermoplastic-Insulated Wires and Cables

UL 94

Test for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 101

Leakage Current For Appliances

UL 157

Gaskets and Seals

UL 224

Extruded Insulating Tubing

UL 244A

Solid-State Controls for Appliances

UL 248-1

Low-Voltage Fuses - Part 1: General Requirements

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Electrical Quick-Connect Terminals

UL 355

Cord Reels

UL 429

Electrically Operated Valves

UL 486A-486B

Wire Connectors

UL 486C

Splicing Wire Connectors

UL 486E

Equipment Wiring Terminals For Use With Aluminum And/Or Copper Conductors

UL 496

Lampholders

UL 498

Attachment Plugs and Receptacles

UL 508

Industrial Control Equipment

UL 510

Polyvinyl Chloride, Polyethylene And Rubber Insulating Tape

UL 514A

Metallic Outlet Boxes

UL 514B

Conduit, Tubing, and Cable Fittings

UL 514C

Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

UL 514D

Cover Plates for Flush-Mounted Wiring Devices

UL 635

Insulating Bushings

UL 723

Tests for Surface Burning Characteristics of Building Materials

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Polymeric Materials – Short Term Property Evaluations

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Polymeric Materials - Long Term Property Evaluations

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Polymeric Materials – Use in Electrical Equipment Evaluations

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Polymeric Materials – Industrial Laminates, Filament Wound Tubing, Vulcanized Fiber, and Materials Used in Printed Wiring Boards

UL 758

Appliance Wiring Material

UL 778

Motor-Operated Water Pumps

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 917

Clock-Operated Switches

UL 921

Commercial Dishwashers

UL 935

Fluorescent-Lamp Ballasts

UL 943

Ground Fault Circuit Interrupters

UL 969

Marking and Labeling Systems

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Tests for Safety-Related Controls Employing Solid-State Devices

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Rotating Electrical Machines – General Requirements

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Impedance Protected Motors

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Electronically Protected Motors

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Power Units Other Than Class 2

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High-Intensity-Discharge Lamp Ballast

UL 1030
Sheathed Heating Elements

UL 1053
Ground Fault Sensing and Relaying Equipment

UL 1054
Special-Use Switches

UL 1059
Terminal Blocks

UL 1077
Supplementary Protectors for Use in Electrical Equipment

UL 1097
Double Insulation Systems for Use in Electrical Equipment

UL 1283
Electromagnetic Interference Filters

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

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Positioning Devices

UL 1577
Optical Isolators

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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 2459

Insulated Multi-Pole Splicing Wire Connectors

UL 2557

Outline for Membrane Switches

UL 4248-1

Fuseholders - Part 1: General Requirements

UL 5085-2

Low Voltage Transformers, Part 2: General Purpose Transformers

UL 5085-3

Low Voltage Transformers, Part 3: Class 2 and Class 3 Transformers

UL 8750

Light Emitting Diode (LED) Equipment For Use In Lighting Products

UL 60065

Standard for Audio, Video and Similar Electronic Apparatus - Safety Requirements

UL 60335-1

Safety of Household and Similar Electrical Appliances, Part 1: General Requirements

UL 60384-14

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

UL 60691

Thermal-Links – Requirements and Application Guide

UL 60730-1

Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements

UL 60730-2-6

Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements

UL 60730-2-7

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

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UL 60730-2-9

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

UL 60730-2-16A

Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Water Level Controls of the Float Type for Household and Similar Applications

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

AHAM¹ Standards**ANSI/AHAM DW-1**

Dishwashers

ASSE² Standards**ASSE 1001**

Performance Requirements for Atmospheric Type Vacuum Breakers

ASTM³ Standards**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 D 638

Standard Test Method for Tensile Properties of Plastics

ASTM D 1822

Standard Test Method for Tensile-Impact Energy to Break Plastics and Electrical Insulating Materials

ASTM E 162

Standard Test 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

IEC⁴

IEC 60127-1-06

Miniature fuses – Part 1: Definitions for miniature fuses and general requirements for miniature fuse-links

IEC 60695-2-11

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

IEC 60695-2-12

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

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

NFPA⁶ Standards

NFPA 70

National Electrical Code

¹ Association of Home Appliance Manufacturers

² American Society of Sanitary Engineering

³ American Society for Testing and Materials

⁴ International Electrotechnical Commission

⁵ Instrumentation, Systems, and Automation Society

⁶ National Fire Protection Association

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 Clauses 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, Clause 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 may otherwise present a risk of electric shock or injury to persons; and
- b) retard propagation of flame initiated by electrical disturbances that may occur within the product.

3.15 FIELD WIRING TERMINAL – A terminal to which a wire may 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 and a height of 50 mm, 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 12.

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, 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.

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

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:

- a) 15 V rms;
- b) 21.2 Vac peak; or
- c) 30 V continuous dc.

Note: Either a Low-Voltage Circuit, or the secondary circuit of a Class 2 circuit do 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 within 5 seconds

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

3.29 TEMPERATURE-LIMITING DEVICE – A device that functions:

- a) only under conditions that produce abnormal temperatures; and
- b) that is not intended to function during normal operation of the appliance.

3.30 TEMPERATURE-REGULATING DEVICE – A device that:

- a) regulates temperature; and
- b) functions during normal operation of the appliance.

3.31 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.

3.32 WITHIN 3MM – Falling within the dotted boundary formed by the cylinder with hemispherical ends, as shown in Figure 11.

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 CAN/CSA-C22.2 No. 0.

5 General Conditions for the Tests

5.1 Voltage and frequency

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

- a) 120 V for an appliance rated from 110 to 120 V;
- b) 240 V for an appliance rated from 220 to 240 V; or
- c) The maximum rated voltage of the appliance for an appliance rated other than as specified in (a) or (b).

5.1.2 The test voltage (V_t) used during the heating tests of Clause 12 and the abnormal operation tests of Clause 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 Clause 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 Clause 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 Clause 5.1.2 through a separate circuit, the rest of the appliance shall be supplied at the voltage specified in Clause 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/m² (lbs-/ft²) 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 mm²). The thermocouple wire shall conform with the requirements for special thermocouples as specified in the Initial Calibration Tolerances for Thermocouples table in the Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples, ASTM E230/E230M.

5.4.2 When thermocouples are used in the determination of temperatures in connection with the heating of electrical devices, it is common practice to employ thermocouples consisting of 30 AWG (0.05 mm²) iron and constantan wires and a potentiometer-type indicating instrument. Such equipment shall be used whenever reference temperature measurements by thermocouples are necessary.

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 Dishwashers, AHAM DW-1, or any other powdered dishwashing detergent having similar properties.

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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 Dishwashers, AHAM DW-1.

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 $60 \pm 2^{\circ}\text{C}$ ($140 \pm 3.6^{\circ}\text{F}$).

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 Clause 8.3.5, testing shall be repeated with the appliance connected to a cold-water supply with a nominal temperature of $15 \pm 5^{\circ}\text{C}$ ($59 \pm 9^{\circ}\text{F}$), 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 Clause 8.3.5, testing shall be repeated with the appliance connected to a hot-water supply with a nominal temperature of $50 \pm 2^{\circ}\text{C}$ ($122 \pm 3.6^{\circ}\text{F}$), 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 may introduce a risk of fire or electric shock (see Clause 15.5).

7 Marking

Advisory Note: *In Canada, there are two official languages, English and French. Annex A provides 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 Adhesive Labels, CSA C22.2 No. 0.15, and Marking and Labeling Systems, UL 969. If adhesive labels will be exposed to detergents or rinse agents, they shall also comply with Clauses 7.1.2 and 7.1.3.

7.1.2 After being conditioned as described in Clause 7.1.3, an adhesive label, immediately following removal from each test medium, and after being exposed to room temperature for 24 hours 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 Clause 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 $23 \pm 2^{\circ}\text{C}$ ($73.4 \pm 3.6^{\circ}\text{F}$), 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 $23 \pm 2^{\circ}\text{C}$ ($73.4 \pm 3.6^{\circ}\text{F}$).

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 Clause 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)."

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7.2.7 The marking specified in Clause 7.2.6 shall include both °C and °F. The temperature rating of the conductors required by the heating test (see Clause 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 Clause 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 Clause 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 Clause 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 Clauses 25.1.5 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 Clause 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 Clause 7.2.11, at the approach to the ungrounded parts, shall be required.

7.2.14 If the marking specified in Clause 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 may 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 its side panels or back omitted 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 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 it complies with the requirements for double-insulated appliances in accordance with General Requirements for Double-Insulated Equipment, CSA C22.2 No. 0.1, and Double Insulation Systems for Use in Electrical Equipment, UL 1097.

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 Clause 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,” “Grounding,” with the grounding symbol illustrated in Figure 1, or a similar marking, or by a marking on the wiring diagram provided on the appliance.

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

8.1 General

8.1.1 Instructions providing information equivalent to the marking required by Clause 7.2.17 shall be packed with an appliance that is shipped from the factory with its side panels or back omitted.

8.1.2 An appliance that may 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 Clause 8.2;
- b) Installation as specified in Clause 8.3;
- c) Operation as specified in Clause 8.4; and
- d) If applicable, user maintenance as specified in Clause 8.5.

8.1.4 The instructions required by Clause 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 Clauses 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 Clause 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 Clause 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 Clauses 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 Clauses 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 Clause 8.2.3, and the statement "SAVE THESE INSTRUCTIONS" or the equivalent shall either precede or follow the list (see Clause 8.1.7).

8.2.3 The instructions required by Clause 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 Clause 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.

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- 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 may 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 Clause 8.2.3 (see Clause 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.

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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 Clause 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 Clauses 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 Clause 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 Clause 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 Clause 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 Clause 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 may 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, Clause 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 Clauses 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 3 from touching insulated internal wiring, other than as specified in Clause 9.4.5; and
- b) Figure 4 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 Clauses 27 and 28.

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 Clauses 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 1.

9.2.8 Where an opening in an enclosure has a minor dimension (see Clause 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 2; and

2) Film-coated wire shall not be contacted by the probe illustrated in Figure 3; 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 1, to reduce the likelihood of electric shock resulting from unintentional contact with such a part or wire.

9.2.9 An accessible motor with an integral enclosure that has an opening with a minor dimension (see Clause 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 3; 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 1.

9.2.10 With reference to the requirements in Clauses 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 Clause 9.2.9, an accessible motor is a motor that:

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

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

9.3 Enclosures for built-in appliances

9.3.1 Except as specified in Clause 9.1.2, enclosures of built-in dishwashers shall prevent access to internal current-carrying parts as specified in Clause 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 Clause 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 2 shall not touch uninsulated current-carrying parts that may 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 3 shall not touch insulated internal wiring, other than as specified in Clause 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 Clause 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 Figures 2 and 3 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 4 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 Clauses 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 Clause 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 Clause 7.2.8.

10.3 To determine if an appliance complies with the requirements in Clause 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 Clause 11.3, the input current to an appliance rated in accordance with Clause 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 Clause 11.3, an appliance rated in accordance with Clause 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 Clause 12.10. 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 Clauses 12.2 to 12.10 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 2.

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

12.3 All temperatures in Table 2 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 temperature shall be considered to be constant when three successive readings taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 5 min intervals, indicate no change.

12.5 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.

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

12.7 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.

12.8 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.

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

12.10 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 Clause 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 the Standard for Leakage Current for Appliances, UL 101 and Clause 13.2.

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.

14 Insulation Resistance

14.1 Following the moisture resistance tests of Clause 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 Clause 14.2. In addition, when evaluating the resilient motor mounting as specified in Clause 25.1.4, the insulation resistance shall be measured as specified in Clause 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 5. The insulation resistance shall be calculated by the formula:

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

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 5.

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 Clause 15; and
- b) the duration of a test may be shortened.

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

15.1.3 The salt-water test solution for the tests of Clauses 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 may become moist during conditions of normal operation of the appliance introducing a risk of fire or electric shock shall be conditioned as specified in Clause 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 Clause 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 $32 \pm 2^\circ\text{C}$ ($89.6 \pm 3.6^\circ\text{F}$) 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 may 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 Clause 15.7.1.5) of any electric component that is likely to occur while being conditioned as specified in Clause 15.3.2;
 - 2) Comply with the abnormal leakage current requirements of 5 MIU in Clause 13 while being conditioned as specified in Clause 15.3.2; and
 - 3) Comply with the electric strength requirements in Clause 16 after being conditioned as specified in Clause 15.3.2; and
- b) A permanently connected appliance shall:
 - 1) Show no obvious wetting (see Clause 15.7.1.5) of any electric component that is likely to occur while being conditioned as specified in Clause 15.3.2;
 - 2) Comply with the electric strength requirements in Clause 16 after being conditioned as specified in Clause 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 Clause 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 Clauses 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 Clause 15.3.1(a), but shall be operated as specified in Clause 15.4.3.
- b) A permanently connected appliance shall comply with the requirements in Clause 15.3.1(b), but shall be operated as specified in Clause 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 Clause 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 Clause 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 Clauses 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 Clause 15.3.1(a), but shall be conditioned as specified in Clauses 15.5.4 and 15.5.5.
- b) A permanently connected appliance shall comply with the requirements in Clause 15.3.1(b), but shall be conditioned as specified in Clauses 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 Clause 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 Clause 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 Clause 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 Clause 15.3.1(a), but shall be conditioned as specified in Clause 15.6.2.
- b) A permanently connected appliance shall comply with the requirements in Clause 15.3.1(b), but shall be conditioned as specified in Clause 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 Clauses 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 Clause 15.3.1(a), but shall be operated as specified in Clauses 15.7.1.3 and 15.7.1.4.
- b) A permanently connected appliance shall comply with the requirements in Clause 15.3.1(b), but shall be operated as specified in Clauses 15.7.1.3 and 15.7.1.4.

15.7.1.2 The requirements in Clause 15.7.1.1 and Clauses 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 Clauses 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 Clause 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 Clause 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 Clause 22.9 is considered to comply with this requirement.

15.7.1.4 The vessel specified in Clause 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 may wet the component by chance shall not be considered obvious wetting.