UL 921

STANDARD FOR SAFETY

Commercial Dishwashers

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UL Standard for Safety for Commercial Dishwashers, UL 921

Eighth Edition, Dated January 30, 2020

Summary of Topics

This new edition of ANSI/UL 921 dated January 30, 2020 includes editorial cleanup and renumbering in addition to revisions to Commercial Dishwashers provided with a heat pump.

The requirements are substantially in accordance with Proposal(s) on this subject dated June 14, 2019 and September 13, 2019.

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CSA Group
CSA/ANSI Z83.21:20 • CSA C22.2 No. 168:20
Third Edition

Underwriters Laboratories Inc.
UL 921
Eighth Edition

Commercial Dishwashers

January 30, 2020

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Approved American National Standard

ANSI/UL 921-2020
CSA/ANSI Z83.21:20

Commitment for Amendments

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

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This 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 Eighth Edition. The most recent designation of ANSI/UL 921 as an American National Standard (ANSI) occurred on January 30, 2020. 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 921 on June 18, 1992. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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CONTENTS

ULNORM.COM : Click to view the full PDF of UL 921 2020

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CONSTRUCTION

PERFORMANCE

MARKINGS

SUPPLEMENT SB – (Normative) EVALUATION OF ELECTRONIC CIRCUITS

INTRODUCTION

CONSTRUCTION

PERFORMANCE

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PREFACE

This is the harmonized CSA Group and UL standard for Commercial Dishwashers. It is the Third edition of CSA/ANSI Z83.21 • CSA C22.2 No. 168, and the Eighth edition of UL 921. This edition of CSA/ANSI Z83.21 • CSA C22.2 No. 168 supersedes the previous editions published in 2005 and 2016. This edition of UL 921 supersedes the previous edition published in 2016.

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

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

This standard was reviewed by the Joint Technical Subcommittee on Gas Food Service Equipment under the jurisdiction of the Z21/83 Technical Committee on Performance and Installation of Gas Burning Appliances and Related Accessories and the CSA Strategic Steering Committee on Fuels and Appliances. It has been formally approved by the Z21/83 Technical Committee and the Interprovincial Gas Advisory Council.

This standard was also 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.

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Application of Standard

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

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

Level of Harmonization

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

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

Reasons for Differences From IEC

This standard provides requirements for commercial dishwashers 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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Commercial Dishwashers

1 Scope

1.1 This Standard covers commercial, freestanding, under-counter, and counter-insert dishwashers, utensil-washers, and glass washers using water as the principal cleaning medium, hereafter referred to as dishwashers. These dishwashers utilize steam, gas, or electric heaters for heating the water. Heated water is provided to a dishwasher by means of steam, gas, or electric heating systems integral to the appliance, or by means not integral to the dishwasher that is provided at the installation site.

1.2 This Standard is not intended to be used to evaluate the gas-fired water heating portions of the system that incorporate water containment vessels operating above atmospheric pressure.

For dishwashers that incorporate a gas-fired water heater with a pressurized water containment vessel operating above atmospheric pressure, the water heater portion of the system is covered by the requirements of ANSI Z21.10.3/CSA 4.3.

1.3 This Standard covers:

a) electric dishwashers rated 600 V or less, installed in accordance with the Canadian Electrical Code (CEC), Part I , CSA C22.1, and the National Electrical Code (NEC), NFPA 70; and

b) the gas-handling, gas-burning, and gas-control features of gas-fired dishwashers having inputs of 420 MJ (400,000 Btu per hour or less, limited to 3.45 kPa (0.5 psig) inlet pressure, installed in accordance with the National Fuel Gas Code, ANSI Z223.1/NFPA 54, the International Fuel Gas Code, ICC IFGC, or the Natural Gas and Propane Installation Code, CSA B149.1 for use with:

1) natural gas;

2) manufactured gas;

3) mixed gas;

4) propane gas;

5) liquefied petroleum gases; or

6) LP gas-air mixtures.

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1.4 These requirements cover dishwashers intended for use in commercial establishments, such as kitchens of restaurants and hospitals, where they are not intended to be accessible to the public.

2 General

2.1 Components

2.1.1 Except as indicated in Clauses 2.1.2, 2.1.3, and 2.1.4, a component of a product 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, except when contained in lamps.

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.

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

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

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

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

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

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

b) the component standard:

1) is compatible with the ampacity and overcurrent protection requirements in the Canadian Electrical Code (CEC), Part I and National Electrical Code, where appropriate;

2) considers long-term thermal properties of polymeric insulating materials in accordance with the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B; and

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

2.1.4 Components located in an EXTRA-LOW VOLTAGE CIRCUIT that are not relied upon to reduce the risk of electric shock, fire, or injury shall not require additional investigation.

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

a) not required for the application; and

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

2.1.6 A component not anticipated by the requirements of this end product standard, not specifically covered by the component standards specified in this Standard, and that involves a risk of fire, electric shock, or injury to persons shall be additionally investigated in accordance with the applicable CSA and UL standards, and shall comply with Clause 2.1.1 (b) – (e).

2.1.7 With respect to Clause 2.1.6, reference to construction and performance requirements in another CSA and UL end product standard is suitable where that standard anticipates normal and abnormal use conditions consistent with the application of commercial dishwashers.

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2.2 Units of measurement

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

2.3 Reference publications

2.3.1 Products covered by this standard shall comply with the reference installation codes and standards noted in this clause. For undated references to standards, such reference shall be considered to refer to the latest edition and all revisions to that edition up to the time when this standard was approved. For dated references to standards, such reference shall be considered to refer to the dated edition and all revisions published to that edition up to the time the standard was approved.

CSA Group Standards

CSA Component Acceptance Notice No. 5A

B149.1-15
Natural Gas and Propane Installation Code

C22.1-18
Canadian Electrical Code (CEC), Part I

CAN/CSA-C22.2 No. 0-10 (R2105)
General requirements – Canadian Electrical Code (CEC), Part II

C22.2 No. 0.2-16
Insulation coordination

C22.2 No. 0.8-12 (R2016)
Safety functions incorporating electronic technology

C22.2 No. 0.15-15
Adhesive Labels

CAN/CSA-C22.2 No. 0.17-00 (R2018)
Evaluation of properties of polymeric materials

C22.2 No. 5-16
Molded-case circuit breakers, molded-case switches and circuit-breaker enclosures

C22.2 No. 8-13
Electromagnetic interface (EMI) filters

C22.2 No. 14-18
Industrial Control Equipment

C22.2 No. 21-14
Cord sets and power-supply cords

CSA C22.2 No. 24-15
Temperature-indicating and regulating equipment

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C22.2 No. 38-18
Thermoset-insulated wires and cables

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

C22.2 No. 42-10 (R2015)
General use receptacles, attachment plugs, and similar wiring devices

C22.2 No. 43-17
Lampholders

C22.2 No. 49-14
Flexible cords and cables

C22.2 No. 55-15
Special use switches

C22.2 No. 65-18
Wire connectors

C22.2 No. 66-1(R2015)
Low voltage transformers - Part 1: General requirements

C22.2 No. 66-2 (R2015)
Low voltage transformers – Part 2: General purpose transformers

C22.2 No. 66-3 (R2015)
Low voltage transformers – Part 3: Class 2 and Class 3 transformers

C22.2 No. 74-16
Equipment for use with electric discharge lamps

C22.2 No. 75-17
Thermoplastic-insulated wires and cables

C22.2 No. 77-14
Motors with inherent overheating protection

C22.2 No. 100-14
Motors and generators

C22.2 No. 127-18
Equipment and lead wires

C22.2 No. 144.1-16
Ground-fault circuit-interrupters

C22.2 No. 153-14
Electrical quick-connect terminals

C22.2 No. 156-M1987 (R2013)
Solid-state speed controls

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

C22.2 No. 182.3-16
Special use attachment plugs, receptacles, and connectors

C22.2 No. 188-18
Splicing wire connectors

C22.2 No. 209-M1985 (R2013)
Thermal cut-offs

C22.2 No. 210-15
Appliance wiring material products

C22.2 No. 235-04 (R2017)
Supplementary protectors

C22.2 No. 236-15
Heating and cooling equipment

C22.2 No. 248.1-11 (R2016)
Standard for low-voltage fuses – Part 1: General requirements

CAN/CSA C22.2 No. 248.14-00 (R2015)
Standard for low-voltage fuses – Part 14: Supplemental fuses

C22.2 No. 250.4-14
Portable luminaires

C22.2 No. 2459-08 (R2017)
Insulated multi-pole splicing wire connectors

C22.2 No. 4248.1-17
Fuseholders

CAN/CSA-C22.2 No. 60335-2-34:17
Household and similar electrical appliances – Safety – Part 2-34: Particular requirements for motor-compressors

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

CAN/CSA-E60730-1
Automatic electrical controls for household and similar use – Part 1: General requirements

CAN/CSA-E60730-2 Series of Standards
Automatic electrical controls for household and similar use – Part 2: Particular requirements

CAN/CSA-E60730-2-9:15
Automatic electrical controls for household and similar use – Part 2-9: Particular requirements for temperature sensing controls

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CAN/CSA-C22.2 No. 60950-1-07 (R2016)
Electromagnetic interface (EMI) filters

ANSI Z21.20-2014/CAN/CSA 60730-2-5-14
Automatic electrical controls for household and similar use – Part 2: Particular requirements for automatic electrical burner control systems

CSA/AM ANSI Z21.15-2009/CSA 9.1-2009 (R2014)
Manually-Operated Gas Valves for Appliances Appliance Connector Valves, and Hose End Valves

CSA/AM ANSI Z21.18-2007/CSA 6.3-2007 (R2017)
Gas Appliance Pressure Regulators

CSA/AM ANSI Z21.20-2014/CAN/CSA-C22.2 No. 60730-2-5-14
Automatic Electrical Controls for Household and Similar Use – Part 2: Particular Requirements for Automatic Burner Ignition Systems and Components

CSA/AM ANSI Z21.21-2015/CSA 6.5-2015
Automatic Valves for Gas Appliances

CSA/AM ANSI Z21.35-2005/CSA 6.8-2005 (R2015)
Pilot Gas Filters

ANSI Z21.78-2010/CSA 6.20-2010 (R2015)
Combination gas controls for gas appliances

UL[1] Standards

UL 44
Standard for Thermoset-Insulated Wires and Cables

UL 62
Standard for Flexible Cords and Cables

UL 66
Standard for Fixture Wire

UL 83
Standard for Wires and Cables, Thermoplastic-Insulated

UL 244A
Standard for Solid-State Controls for Appliances

UL 248-1
Standard for Low-Voltage Fuses – Part 1: General Requirements

UL 248-14
Standard for Low-Voltage Fuses - Part 14: Supplemental Fuses

UL 310
Standard for Electrical Quick-Connect Terminals

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UL 353
Standard for Limit Controls

UL 372
Standard for Automatic Electrical Controls for Household and Similar Use – Part 2: Particular Requirements for Burner Ignition Systems and Components

UL 429
Standard for Electrically Operated Valves

UL 486A-486B
Standard for Wire Connectors

UL 486C
Standard for Splicing Wire Connectors

UL 486E
Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

UL 489
Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

UL 489A
Standard for Circuit Breakers for Use in Communications Equipment

UL 496
Standard for Lampholders

UL 498
Standard for Attachment Plugs and Receptacles

UL 508
Standard for Industrial Control Equipment

UL 723
Standard for Test for Surface Burning Characteristics of Building Materials

UL 746A
Standard for Polymeric Materials – Short Term Property Evaluations

UL 746B
Standard for Polymeric Materials – Long Term Property Evaluations

UL 746C
Standard for Polymeric Materials – Use in Electrical Equipment Evaluations

UL 746E
Standard for Polymeric Materials – Industrial Laminates, Filament Wound Tubing, Vulcanized Fibre, and Materials Used In Printed Wiring Boards

UL 758
Standard for Appliance Wiring Material

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UL 795
Standard for Commercial-Industrial Gas Heating Equipment

UL 796
Standard for Printed-Wiring Boards

UL 817
Standard for Cord Sets and Power-Supply Cords

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

UL 873
Standard for Temperature-Indicating and -Regulating Equipment

UL 935
Standard for Fluorescent-Lamp Ballasts

UL 943
Standard for Ground-Fault Circuit-Interrupters

UL 969
Standard for Marking and Labeling Systems

UL 1004-1
Standard for Rotating Electrical Machines – General Requirements

UL 1004-2
Standard for Impedance Protected Motors

UL 1004-3
Standard for Thermally Protected Motors

UL 1029
Standard for High-Intensity-Discharge Lamp Ballast

UL 1059
Standard for Terminal Blocks

UL 1077
Standard for Supplementary Protectors for Use in Electrical Equipment

UL 1411
Standard for Transformer and Motor Transformers for Use in Audio-, Radio-, and Television-Type Appliances

UL 1434
Standard for Thermistor-Type Devices

UL 1446
Standard for Systems of Insulating Materials – General

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UL 1557
Standard for Electrically Isolated Semiconductor Devices

UL 1577
Standard for Optical Isolators

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

UL 1995
Standard for Heating and Cooling Equipment

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

UL 2459
Standard for Insulated Multi-Pole Splicing Wire Connectors

UL 4248-1
Standard for Fuseholders – Part 1: General Requirements

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

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

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

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

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

UL 60335-1
Standard for Safety of Household and Similar Electrical Appliances, Part 1: General Requirements

UL 60335-2-34 (4th, 5th, and 6th Editions)
Standard for Household and Similar Electrical Appliances, Part 2: Particular Requirements for Motor-Compressors

UL 60384-14
Standard for Safety 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
Standard for Thermal-Links – Requirements and Application Guide

UL 60730-1
Standard for Automatic Electrical Controls – Part 1: General Requirements

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UL 60730-2-5
Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Burner Control Systems

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

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

IEC Standards

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

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

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

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

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

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

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

IEC 61000-4-13
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

ULC[2] Standards

CAN/ULC S102-2010
Standard for Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies

ANSI[3] Standards

ANSI/ASTM E230/E230M
Standardized Thermocouples

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ANSI Z21.23-2010 (R2015)
Standard for Gas Appliance Thermostats

ASME[4] Standards

ANSI/ASME B1.20.1-2013
Standard for Pipe Threads, General Purpose (Inch)

ANSI/ASME B36.10M-2015
Welded and Seamless Wrought Steel Pipe

ASTM[5] Standards

F1696-14
Standard Test Method for Energy Performance of Single-Rack, Door-Type Commercial Dishwashing Machines

F1704-12 (R2017)
Standard Test Method for Capture and Containment Performance of Commercial Kitchen Exhaust Ventilation Systems

F1920-15
Standard Test Method for Performance of Rack Conveyor, Commercial Dishwashing Machines

F2474-14
Standard Test Method for Heat Gain to Space Performance of Commercial Kitchen Ventilation/Appliance Systems

ICC[6] Standards

ICC IFGC-2018
International Fuel Gas Code

NFPA[7] Standards

ANSI Z223.1/NFPA 54-2015
National Fuel Gas Code

NFPA 70-2017
National Electrical Code (NEC)

ANSI/NFPA 96-2017
Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

ANSI/NFPA 211-2016
Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances

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2.4 General requirements

In Canada, general requirements as indicated in the Canadian Electrical Code, Part II, General Requirements, CSA C22.2 No. 0, are applicable.

3 Definitions

3.1 For the purpose of these requirements the following definitions apply.

3.2 **Automatic gas ignition system** – A system intended to ignite and reignite an appliance burner(s). Such systems are intended to:

a) automatically ignite gas at the main burner, or gas at the pilot burner so that the pilot ignites the main burner;

b) prove the presence of either the ignition source, the main burner flame, or both; and

c) automatically act to shut off the gas supply to the main burner or pilot burner and the main burner, when the supervised flame or ignition source is not proved.

3.3 **Automatically controlled dishwasher** – A dishwasher or a unit of a system for which energization of a motor, a solenoid, a magnet, or similar component occurs without manual intervention. Automatic control also occurs during any single predetermined cycle of operation, when automatic changing of the mechanical load reduces the speed of a motor so that starting-winding connections to the branch circuit are reestablished.

3.4 **Auxiliary control** – A control intended primarily for the regulation of time, temperature, pressure, or operations under conditions of normal operation, and that is not intended to address abnormal conditions such as overload or above maximum normal operating temperatures resulting from abnormal operation.

3.5 **Barrier** – A partition for the insulation or isolation of electric circuits, for the isolation of electric arcs, or for the isolation of moving parts or hot surfaces. In this respect, a barrier can serve as a portion of an enclosure and as a functional part.

3.6 **Continuous-duty motor** – A motor that, under any intended condition of use, is intended to operate unattended and under load for 3 hours or more.

3.7 **Control, operating** – Control, the operation of which starts or regulates the appliance during normal operation.

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3.8 **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.

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

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3.9 **Cord-connected dishwasher** – A dishwasher that is connected to the electrical supply by a power-supply cord or cord set.

3.10 **Extra-low voltage circuit** – A circuit having an open-circuit potential of not more than 30 V, ac or dc, or 42.4 V peak ac supplied by a primary battery, by a standard Class 2 transformer, or by a combination of a transformer and a fixed impedance that, as a unit, complies with all performance requirements for a Class 2 transformer. A circuit derived from a line-voltage circuit by connecting a resistance in series with the supply circuit as a means of limiting the voltage and current is not an extra-low voltage circuit.

3.11 **Factory-wired** – The installation of wiring or wiring harnesses on or in the equipment in the factory.

3.12 **Field-wired** – The wiring or wiring harnesses which are connected to the equipment in the field.

3.13 **Field wiring terminal** – A terminal to which a power supply or control connection is made in the field when the dishwasher is installed.

3.14 **Gas ignition device** – A device, either a pilot or an igniter, for igniting gas at a burner.

3.15 **Igniter** – A device that utilizes electrical energy to ignite gas at a pilot or main burner.

3.16 **Internal wiring** – Wiring that is interconnecting beyond the point where the power-supply cord of a cord-connected dishwasher enters the enclosure, or beyond the wiring terminals or leads for power-supply connection of a fixed dishwasher.

3.17 **Line-voltage circuit** – A circuit having a potential of not more than 600 V and having circuit characteristics in excess of those of a low-voltage circuit.

3.18 **Multi-flame pilot burner** – A pilot burner that produces a single flame with variation in contour under minimum pilot conditions.

3.19 **Operational maintenance** – Any operation, accessible without the use of tools, that can be performed by other than authorized maintenance personnel for the equipment. The following service functions which require the use of tools to perform are not considered operational maintenance:

a) resetting of overload devices and primary safety controls;

b) repeated adjustment of timers; and

c) replacement of fuses.

3.20 **Permanently connected dishwasher** – A dishwasher that is connected to the electrical supply by means of conduit, armored cable, or non-metallic sheathed cable.

3.21 **Pilot** – A gas flame utilized to ignite the gas at a main burner.

3.22 **Pressure-relief device** – A pressure-actuated valve or rupture member constructed to automatically relieve pressures above normal operating pressures.

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3.23 **Pressure-relief valve** – A pressure-actuated valve held closed by a spring or other means and constructed to automatically relieve pressure in excess of its setting.

3.24 **Recessed dishwasher** – A dishwasher that is intended:

a) to be supported by the floor;

b) to rest against a wall in the rear;

c) to rest against a wall, a cabinet, or another dishwasher on one side; and

d) to rest against a cabinet or another dishwasher on the other side.

Installation configurations include a countertop covering the dishwasher and the adjacent cabinets and appliances. A recessed dishwasher is not intended for permanent attachment to the building structure or to adjacent cabinets or dishwashers.

3.25 **Remotely controlled** – A dishwasher or a unit of a system that is out of sight of an operator who is at the device by which the dishwasher is started.

3.26 **Safety circuit** – A circuit connected to an interlock, limit control, safety pilot, or similar control (other than an operating or regulating control), the failure of which results in a risk of fire, electric shock, or injury to persons during operation of the equipment or burner in the event any part of the circuit (wiring or components) becomes grounded, open-circuited, or short-circuited. In the application of the Supplement SB, Electronic Circuit requirements, a safety circuit is considered to be a protective electronic circuit (PEC) – see SB3.6.

3.27 **Safety critical function (SCF)** – Control, protection, and monitoring functions which are being relied upon to reduce the risk of fire, electric shock, or injury to person hazards.

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3.28 **Single-flame pilot burner** – A pilot burner that produces a single flame with substantially uniform contour under minimum pilot conditions.

3.29 **Temperature controls** – Devices that respond with a change in temperature (thermostatic devices) may be one of the following types:

a) **Regulating** – Functions only to regulate the temperature of the dishwasher under intended conditions of use, and whose malfunction would not result in a risk of fire.

b) **Limiting** – Functions only under conditions that produce abnormal temperatures. The malfunction of such a device will result in a risk of fire.

3.30 **Wall-insert dishwasher** – A dishwasher that is intended to be permanently attached to the building structure and mounted in a wall or other vertical surface of a building or in a cabinet.

4 Construction Requirements Applicable To All Dishwashers

4.1 General

4.1.1 A dishwasher shall be constructed and assembled so that it has the strength and rigidity to resist the abuses to which it is subjected during intended use, without increasing the risk of fire, electric shock, or

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injury to persons due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other serious defects.

4.1.2 A dishwasher shall be constructed and assembled so that parts fit together tightly and bolts or other fasteners are drawn tightly to produce rigidity. Exposed edges and surfaces shall be smooth when the potential exists for contact with hands or other body parts during the operation and maintenance of the dishwasher.

4.1.3 A free-standing dishwasher shall be provided with a means to attach it to a floor or with other mounting means unless the dishwasher has stability such that it does not overturn under conditions of intended use. See Clause 7.22.1.

4.1.4 A dishwasher shall be provided with enclosures of material rated for the application that enclose all parts that involve, under any conditions of use, a risk of fire, electric shock, or injury to persons.

4.1.5 Side or back panels are not required for a dishwasher intended to be mounted in or under a counter and marked in accordance with Clause 14.17. See 4.4.5 and 4.9.3.

Note: Omitting a portion of the overall enclosure of a dishwasher intended to be installed in conjunction with other equipment complies with the requirement when:

a) the adjoining equipment completes the enclosure (see Clause 14.17); and

b) the installation instructions and marking provide the information required for proper installation.

4.1.6 Asbestos shall not be used in the construction of a dishwasher.

4.1.7 The effects of the following factors shall be determined for compliance with Clause 4.1.1:

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 is subjected under conditions of intended or unintended use.

All of these factors shall be evaluated with respect to thermal aging when a nonmetallic enclosure is being investigated to determine compliance.

4.1.8 A part fabricated from polymeric materials and that is subject to ignition by its operating environment shall have a flame spread rating of not more than 25 and a smoke developed rating of not more than 50, when tested as specified in the requirements of the Standard for Tests for Surface Burning Characteristics of Building Materials, UL 723, or the Standard for Method of Tests for Surface Burning Characteristics of Building Materials and Assemblies, CAN/ULC-S102.

4.1.9 A flame spread rating is not required for finishes and parts immersed in water, gaskets forming an air or water seal between metal parts, and miscellaneous small parts, such as drain fittings, insulating bushings, vibration mounts, wire ties, labels, and clamps having an exposed surface area not exceeding 161.29 cm^2 (25 in^2).

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4.1.10 A flame spread rating is not required for molded or formed polymeric-material components in such quantity that the total face surface area does not exceed 0.93 m^2 (10 ft^2). For this construction, the polymeric material shall have a flame spread rating of not more than 25 or shall comply with the requirements for a material classified 5V in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, and CAN/CSA-C22.2 No. 0.17, Evaluation of Properties of Polymeric Materials.

4.1.11 A cast- or sheet-metal section of an enclosure shall have a thickness not less than that specified in Table 3, Minimum thickness of enclosure materials.

4.1.12 Reinforcement as specified in Table 3, Minimum thickness of enclosure materials, is not required to consist of a complete frame for all edges. A large enough number of reinforcing members shall be employed to provide additional support for all surfaces.

4.1.13 Ventilation and other openings in the external enclosure of a dishwasher shall be constructed, located, or baffled so that:

a) the risk of water entering the enclosure as a result of spillage or splashing is reduced; and

b) electrical disturbances are contained within the enclosure.

4.1.14 An enclosure shall be constructed so that molten metal, burning insulation, flaming particles, or similar material does not fall onto combustible materials, including the surface on which the dishwasher is supported.

4.1.15 Compliance with Clause 4.1.14 requires that a switch, a relay, a solenoid, or similar component be completely enclosed, unless it is shown that malfunction or breakdown of the component does not result in a risk of fire, or there are no openings in the bottom of the enclosure. See Clause 7.15, Abnormal operation test, and Clause 7.16, Blocked plunger test.

4.1.16 Component terminals are not required to be enclosed.

4.1.17 Compliance with Clause 4.1.14 requires the use of a barrier:

a) under a motor unless:

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

2) the protection provided with the motor is such that no burning insulation or molten material falls onto the surface that supports the dishwasher when the motor is subjected to fault conditions of open main winding, open starting winding, and starting switch short-circuited;

3) the motor is provided with overload protection such that, regardless of the motor insulation system class rating:

i) the temperature of the motor windings does not exceed 125°C (257°F) under the maximum load under which the motor runs without causing the protector to cycle; and

ii) the temperature of the motor windings does not exceed 150°C (302°F) with the rotor of the motor locked; and

Note: A shaded-pole motor having a difference of 1 A or less between no-load and locked-rotor currents and having a 2:1 or smaller ratio between locked-rotor and no-load current, and that is provided with protection for locked-rotor conditions, complies with the requirement.

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4) the motor is impedance protected and the locked-rotor temperature of the winding of an open motor or the enclosure of a totally enclosed motor does not exceed 150°C (302°F) with the dishwasher otherwise operating normally;

b) under wire unless it is flame-retardant wire; and

c) under a combustion chamber or burner compartment.

4.1.18 The barrier specified in Clause 4.1.17 shall:

a) be horizontal or at such an angle that falling molten, burning, or flaming materials hitting the barrier do not rebound and fall on the supporting surface;

b) be located as illustrated in Figure 1, Location and extent of barrier;

c) have an area not less than that determined in accordance with Figure 1; and

d) be metal or constructed of a polymeric material that complies with Clause 4.1.7.

4.1.19 With reference to Clause 4.1.17, an opening that is intended for drainage or ventilation shall be such that molten metal, burning insulation, or similar material does not fall onto combustible material.

4.2 Field-attached accessories

4.2.1 An accessory intended for installation on, or connection to, a dishwasher to modify or supplement the functions of the dishwasher shall comply with Clauses 4.2.2 – 4.2.7.

4.2.2 A dishwasher having provisions for accessories to be attached in the field shall be constructed so that the use of the accessories does not introduce a risk of fire, electric shock, or injury to persons.

4.2.3 The installation of an accessory by the operator shall be an operation that is accomplished by receptacles and plug-in connectors.

4.2.4 The installation of an accessory by qualified personnel shall be an operation performed by use of wire connectors to a terminal block provided for the purpose.

4.2.5 The installation of an accessory shall be such that the field rearrangement of components or wiring, the cutting or splicing of wiring, or the soldering of connections is not required.

4.2.6 Each accessory shall be tested and trial-installed to determine whether:

a) the accessory can be installed;

b) the instructions are detailed and correct; and

c) use of the accessory does not result in a risk of fire, electric shock, or injury to persons.

4.2.7 A dishwasher that includes provisions for field connection of a detergent or chemical dispenser, or other accessory, shall be supplied with:

a) a circuit that provides a programmed signal to the dispenser or other accessory; and

b) a wiring diagram or other marking that gives the electrical rating and illustrates how connections to the circuit shall be made.

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4.3 Doors and covers

4.3.1 An overcurrent or overload-protective device shall not be accessible from outside the dishwasher without opening a door or a cover.

Note: The operating handle of a circuit breaker, the operating button of a manually-reset motor protector, or a similar part that projects outside the enclosure complies with the requirement.

4.3.2 A door or a cover of an enclosure that gives access to a fuse or overload-protective device that requires replacement shall be secured by being hinged or pivoted, or by sliding.

Note: A cover that is provided over a compartment that encloses current-carrying parts, is intended for access to replace or reset a burned out overload-heater element, fuse, or similar component, and that requires the use of tools for removal complies with the requirement.

4.3.3 A door or cover over a fuseholder shall fit tightly. Means shall be provided for holding the door or cover closed. The holding means shall be a captive screw or a latch operated by hand or by a hand tool such as a screwdriver.

Note: A snap latch complies where no live parts, other than fuse clips or screwshells, are accessible with the cover open.

4.4 Accessibility of current-carrying parts

4.4.1 The electrical parts of a dishwasher shall be so located or enclosed as to reduce the risk of persons unintentionally contacting uninsulated current-carrying parts.

4.4.2 When determining compliance with Clause 4.4.1, a part of the outer enclosure that can be removed by the user of the dishwasher, without the use of tools, shall be removed.

4.4.3 With reference to the requirement in Clause 4.4.1:

an opening complies with the requirement when a 19.1-mm (3/4-in) diameter rod cannot be inserted into the opening and when:

1) a probe as illustrated in Figure 2, Probe for uninsulated live part, does not touch any uninsulated live part when inserted, at any angle, through the opening; and

2) a probe as illustrated in Figure 3, Probe for film-coated wire, does not touch film-coated wire when inserted, at any angle, through the opening; and

b) for an opening that enables a 19.1-mm (3/4-in) diameter rod to be inserted, at any angle, the opening complies with the requirement only under the conditions described in Clause 4.4.4 and Figure 4, Opening in enclosure.

4.4.4 With reference to Figure 4, Opening in enclosure, for an opening to comply with the requirement, uninsulated current-carrying parts and film-coated wire, inside the enclosure shall be:

a) X mm (X in) or more from the perimeter of the opening; and

b) outside the volume generated by projecting the perimeter X mm (X in) normal to the plane.

The dimension X equals five times the diameter of the largest-diameter rod that can be inserted through the opening. In any case, X shall not be less than 102 mm (4 in). In evaluating an opening, any barrier located within the volume shall be ignored unless it intersects the boundaries of the volume in a continuous, closed line.

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4.4.5 Each electrical component of an under-counter dishwasher not provided with an overall enclosure – back, top, and sides – when shipped from the factory shall be enclosed, other than at its terminals.

4.4.6 With reference to Clause 4.4.5, an enclosure is not required for:

a) insulated wiring;

b) a solenoid, a solenoid valve, a relay, or a motor-starting relay whose malfunction or breakdown does not result in a risk of fire;

c) a motor protected in accordance with Clauses 4.1.17(a)(3) and 4.1.17(a)(4); or

d) a component more than 76.2 mm (3 in) from the back, top, and side surfaces of the smallest compartment that encloses the dishwasher.

4.4.7 The guarding and arrangement of a part shall be such that:

a) a strainer, a basket, or a similar part is easily installed and removed without a risk of injury to persons;

b) containers that must be removed, cleaned, and replaced are easily refilled by the operator; and

c) removal, replacement, and refilling of these containers and ingredients shall not result in damage to or contamination of wiring, electrical components, or other parts.

4.4.8 The part arrangement described in Clause 4.4.7 shall be such that the risk of spillage on current-carrying parts, including film-coated wire, is remote.

4.5 Corrosion protection

4.5.1 To reduce the risk of corrosion, an iron or steel part shall be enameled, galvanized, plated, or similarly treated.

4.5.2 The corrosion protection treatment is not required for:

a) a bearing, a balance weight, a lamination, or a minor part of iron or steel such as a washer or screw; or

b) an iron or steel part where corrosion of the part does not result in a risk of fire, electric shock, or injury to persons.

4.5.3 A reservoir for a cleaning agent or other additive – liquid or powder – shall be resistant to the corrosive and other deteriorating effects of the intended contents.

4.6 Mechanical assembly

4.6.1 A switch, a lampholder, an attachment-plug receptacle, a connector base (motor-attachment plug), or similar component shall be securely mounted and shall not rotate.

The means intended to inhibit rotation of the switch is not required when the switch complies with the following:

a) the switch has a plunger or push-type actuator that does not tend to rotate the switch when operated. A toggle switch does not comply with this requirement;

b) the risk of the switch loosening from its mounting means due to operation is remote;

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c) in the event switch rotation occurs, spacings are not reduced below the minimum required values; and

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

4.6.2 The means intended to inhibit rotation of a lampholder for a lamp that is not replaced, such as a neon pilot or indicator light in which the lamp is sealed in a nonremovable jewel, is not required when the means does not reduce spacings below the minimum required values.

4.6.3 Friction between surfaces shall not be used as the only means to reduce the risk of the rotation specified in Clause 4.6.1. For example, using a lock washer that is applied as intended to prohibit the rotation of a stem-mounted switch or other device having a single-hole mounting means complies with the requirement.

4.6.4 An uninsulated live part shall be secured to so that the part does not rotate or shift in position where such motion results in a reduction of spacings less than the required spacings.

4.6.5 Friction between surfaces shall not be used as the only means to reduce the risk of rotation specified in Clause 4.6.4. For example, using a lock washer to prohibit rotation of the components complies with this requirement.

4.7 Power-supply connections

4.7.1 Cord-connected dishwashers

4.7.1.1 A power-supply cord shall comply with CSA C22.2 No. 21 and UL 817.

4.7.1.2 Flexible cords and cables shall comply with CSA C22.2 No. 49 and UL 62. Flexible cords or cables are considered to fulfill this requirement when preassembled into a power-supply cord complying with Clause 4.7.1.1.

4.7.1.3 Attachment plugs and appliance couplers shall comply with CSA C22.2 No. 42 and UL 498. Attachment plugs and appliance couplers are considered to fulfill this requirement when preassembled into a power-supply cord complying with Clause 4.7.1.1.

4.7.1.4 A portable dishwasher shall be provided with a power-supply cord.

4.7.1.5 The power-supply cord shall be provided either permanently attached to the dishwasher or as a separate detachable cord set.

4.7.1.6 A dishwasher intended for use with a detachable cord set shall not be provided with terminal pins that accommodate a standard flatiron appliance receptacle.

4.7.1.7 A flexible cord used in a power-supply cord shall be Type S, SE, SO, SOO, ST, STO, or STOO. The length of the cord – measured from the face of the attachment plug to the point of entry into the dishwasher – shall not be less than 1.83 m (6 ft).

Note: For conditions of use, such as those of a counter-top glass washer, that indicate that a lighter cord is applicable, using a Type SJ, SJE, SJO, SJOO, SJT, SJTO, or SJTOO cord complies with the intent of the requirement.

4.7.1.8 The current rating of the flexible cord used in a power-supply cord for a dishwasher rated 15 A or less, and the current rating of cord fittings, shall not be less than the current rating of the dishwasher.

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4.7.1.9 For a dishwasher rated 15 A or less, the attachment plug shall:

a) have a voltage rating equal to the rated voltage of the dishwasher and a current rating not less than 125 percent of the current rating of the dishwasher; and

b) be a grounding type.

Note: The use of a 20-A attachment plug complies with the requirement when the dishwasher is rated not more than 4000 W at 240 V.

4.7.1.10 The attachment plug for a dishwasher that is adaptable for use on two or more different values of voltage by field alteration of internal connections shall have a voltage rating equal to the voltage for which the dishwasher is connected when shipped from the factory. See Clause 14.7.

4.7.1.11 Strain relief shall be provided for a permanently attached power-supply cord so that mechanical stress on the flexible cord is not transmitted to terminals, splices, or interior wiring. The strain relief shall comply with the requirements in Clause 7.23, Strain relief test.

4.7.1.12 For a knot in a flexible cord serving as strain relief, the surfaces that the knot contacts shall be smooth and free from projections, sharp edges, burrs, or fins.

4.7.1.13 The edges of an entry hole for a flexible cord, including a hole in a bushing, shall be smooth and free from projections, sharp edges, burrs, or fins.

4.7.1.14 The hole in the metal for an insulating bushing constructed of material other than ceramic, phenolic, or cold-molded composition, fiber, or other material rated for the application shall be smooth and free from projections, sharp edges, burrs, or fins.

4.7.1.15 Means shall be provided so that a flexible cord can not be pushed into an appliance through the cord-entry hole when such displacement results in a risk of:

a) subjecting the cord to mechanical damage;

b) exposing the cord to a temperature higher than that for which the cord 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.

To determine compliance, the cord shall be tested in accordance with Push-back relief test, Clause 7.24.

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4.7.2 Permanently connected dishwashers

4.7.2.1 A dishwasher intended to be fastened or secured in position or permanently connected to the water supply or drain line shall be provided with wiring terminals or leads for field connection to the power-supply conductors and means for connection of a permanent wiring system.

4.7.2.2 A compartment or outlet box provided for connections to the power-supply conductors shall be located so that:

a) during the making of electrical connections in the compartment or outlet box, internal wiring and electrical components are not exposed to mechanical abuse or stress; and

b) after the dishwasher has been installed as intended, the terminal compartment or outlet box is accessible without moving the dishwasher.

4.7.2.3 A dishwasher provided with an extension for the point of supply connection to an accessible location remote from the dishwasher shall be a maximum length of 1.83 m (6 ft).

4.7.2.4 A compartment or outlet box to which the permanent wiring system is attached shall be secured to the dishwasher so that the compartment or box does not rotate with respect to the dishwasher.

4.7.2.5 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 dishwasher enclosure is otherwise complete, that is, unless all sides and a complete bottom are provided when the dishwasher is shipped from the factory.

4.7.2.6 A dishwasher constructed so that it is adaptable upon installation to different supply voltages – for example, 120 V, 2-wire or 120/240 V, 3-wire – shall be provided with a means for making the connections during field installation without changing or disrupting internal wiring or connections other than at the point of field connection.

4.7.2.7 A dishwasher intended for connection to a grounded power-supply conductor shall have one terminal or lead identified for connection of the grounded conductor of the supply circuit when it employs:

a) an Edison-base screwshell lampholder;

b) a single-pole switch;

c) a single-pole automatic control; or

d) a ballast that is marked to specify the connection of a grounded circuit conductor.

4.7.2.8 The identified terminal or lead shall be connected to the screwshell of a lampholder and to the identified circuit conductor of a ballast when specified. The identified terminal or lead shall not be connected to a single-pole switch or a single-pole automatic control other than an auxiliary control complying with Clause 4.22.10.

4.7.2.9 A field-wiring terminal for connection of a grounded power-supply conductor shall be of, or plated with, a metal substantially white in color and shall be readily distinguishable from other terminals; or proper identification of that terminal shall be clearly shown in some other manner, such as on a wiring diagram adjacent to the terminal.

4.7.2.10 The surface of a lead intended for field connection of a grounded power-supply conductor shall be white or gray, and that lead shall be readily distinguishable from other leads.

4.7.2.11 The requirements in Clause 4.7.2.10 related to color coding do not apply to internal wiring.

4.7.2.12 For a lead intended to be spliced in the field to an external conductor:

a) the lead shall not be smaller than 18 AWG (0.82 mm^2);

b) the insulation shall not be less than 0.8 mm (1/32 in) thick; and

c) the free length of the lead inside an outlet box or wiring compartment shall not be less than 152 mm (6 in) unless the use of a lead 152 mm (6 in) or longer results in a risk of fire or electric shock.

4.7.2.13 A field-wiring terminal or lead shall be rated for the connection of conductors having an ampacity not less than:

a) the rating of the branch circuit marked on the dishwasher in accordance with Clause 14.4 or 14.13; or

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b) the current rating of the dishwasher when the dishwasher is not marked as indicated in (a).

4.7.2.14 The ratings of field-wiring terminals and leads of a dishwasher rated 100 A or less shall be based on the use of power-supply wires rated 60°C (140°F). For a dishwasher rated more than 100 A, the ratings shall be based on the use of power-supply conductors rated 75°C (167°F).

4.7.2.15 A field-wiring terminal shall be provided with a soldering lug, a pressure wire connector, or a wire-binding screw at a terminal intended to accommodate an 8 AWG (8.4 mm^2) or smaller conductor. The lug or connector shall be firmly bolted or held by a screw. For a wire-binding screw, upturned lugs or the equivalent shall be provided to hold the wire in position.

4.7.2.16 A field-wiring terminal shall not rotate.

4.7.2.17 A wire-binding screw shall thread into metal.

4.7.2.18 A wire-binding screw at a field-wiring terminal:

a) shall not be smaller than No. 10;

b) shall be a No. 8 screw at a terminal intended for the connection of a 14 AWG (2.1 mm^2) conductor; or

c) shall be a No. 6 screw for the connection of a 16 or 18 AWG (1.3 or 0.82 mm^2) control-circuit conductor.

4.7.2.19 A terminal plate tapped for a wire-binding screw, including an equipment-grounding screw, shall be of metal not less than 1.27 mm (0.050 in) thick and provide a minimum two threads' engagement in the metal, or not less than 0.76 mm (0.030 in) thick for tapped threads investigated and found to have the required mechanical strength.

4.7.2.20 Extrusion of the metal at a tapped hole to provide two full threads for the binding screw meets the intent of the requirement for two full threads specified in Clause 4.7.2.19.

4.7.2.21 An upturned lug or a cupped washer shall retain a conductor of the size specified in Clause 4.7.2.12 under the head of the screw or the washer.

4.8 Current-carrying parts

4.8.1 A current-carrying part shall be silver, silver alloy, copper, copper alloy, stainless steel, or other corrosion-resistant material. Unplated iron or unplated steel shall not be used as a current-carrying part.

4.8.2 Plated iron and plated steel may be used for a current-carrying part, if the part:

a) has a temperature during intended operation of more than 100°C (212°F);

b) is within a motor or associated governor; or

c) complies with Clause 2.1.1.

4.9 Internal wiring

4.9.1 The internal wiring and interconnecting wiring between parts of a dishwasher shall be enclosed or protected.

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4.9.2 Flexible cord may be used, and not required to be enclosed or protected, provided:

a) the cord is one of the types specified in Clause 4.7.1.7;

b) the cord complies with Strain relief test, Clause 7.23; and

c) the cord is routed and protected to reduce the risk of damage.

4.9.3 In an under-counter dishwasher shipped from the factory without back or side panels, internal wiring shall be located, cabled, routed, or secured so that wiring is not damaged prior to, and during, installation.

4.9.4 With reference to Clause 4.9.1, the required protection of insulated wiring exists when the wiring is investigated as though it were film-coated wire and the wiring complies with Clause 4.4.3(a)(2) and Figure 3, Probe for film coated wire. Internal wiring not so protected complies where it is secured within the enclosure so that the risk of damage to the wiring due to stress or mechanical abuse is remote.

4.9.5 Wiring employed for internal wiring shall be standard building wire or appliance wiring material rated for the application, and shall comply with Table 4, Characteristics of internal wiring.

4.9.6 Appliance wiring material having insulation not less than 0.4 mm (1/64 in) thick and without a braid or jacket in a circuit operating at not more than the rated voltage of the wiring shall be located within an individual, completely enclosed chassis that is not required to be opened for placement or normal field adjustment.

4.9.7 Unless it is investigated as an uninsulated current-carrying part, insulated internal wiring of a dishwasher, including a grounding conductor, shall consist of wire having insulation rated for the application. The following factors shall be used to determine the applicable wire to be used:

a) the temperature and voltage to which the wire is subjected;

b) exposure to oil, grease, cleaning fluid, or other substances having a degrading effect on the insulation;

c) exposure to moisture; and

d) other conditions of service to which the wire is subjected during intended use.

4.9.8 Internal wiring that is subjected to potential mechanical damage shall be in armored cable, conduit, or electrical metallic tubing or shall be otherwise protected.

4.9.9 Internal wiring shall be protected from sharp edges, including projections, screwheads, burrs, and fins.

4.9.10 A hole through which insulated wires pass in a sheet-metal wall within the overall enclosure shall be provided with a smooth, rounded bushing or shall have smooth surfaces, free of burrs, fins, projections, and sharp edges, upon which the wires bear so that the insulation is not abraded.

4.9.11 A splice or connection shall be mechanically secure and provide electrical continuity. A soldered connection shall be made mechanically secure before being soldered. Splices shall be located only in accessible junction boxes or control enclosures. For a soldered connection on a printed wiring board, the wire shall be passed through a hole in the printed wiring board before soldering.

4.9.12 A splice shall be provided with insulation equivalent to that of the wires being spliced. For splices involving 250 V or less, the use of insulation consisting of two layers of friction tape, of two layers of

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thermoplastic tape, or of one layer of friction tape on top of one layer of rubber tape complies with this requirement. The effects of factors such as dielectric properties and heat- and moisture-resistant characteristics shall be evaluated during the investigation to determine compliance of splice insulation consisting of coated-fabric, thermoplastic, or other tubing.

4.9.13 An insulated splicing device shall be used within the limits of its voltage and temperature ratings.

4.9.14 Thermoplastic tape used as an insulating means shall not be wrapped over a sharp edge.

4.9.15 Stranded internal wiring connected to a wire-binding screw shall be connected so that loose strands of the wire do not:

a) reduce spacings;

b) contact other current-carrying parts not always of the same polarity as the wire; and

c) contact dead-metal parts.

4.9.16 When the loosening of a screw or nut results in a risk of fire or electric shock, the screw or nut shall be provided with a means to reduce the risk of loosening. For example, where a wire-binding screw or nut can be loosened by vibration, providing a lock washer under the head of the screw or under the nut complies with the requirement.

4.9.17 An open-end spade lug shall be provided with additional means, such as upturned ends or similar construction, to hold the lug in place in the event that the wire-binding screw or nut becomes loosened. An open-end lug with a lock washer alone shall not be used.

4.9.18 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 applicable CSA and UL standards for other insulated conductor types specified in the Canadian Electrical Code (CEC), Part I, for Wiring Methods, and the National Electrical Code (NEC) for Wiring Methods and Materials.

4.9.19 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 multiple connectors for use in data, signal, control and power applications;

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

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

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

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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.

4.9.20 A fabricated part performing the function of a terminal block need not comply with CSA C22.2 No. 158 and UL 1059 if the part complies with the relevant terminal block requirements of Clause 4.7.2 (permanently connected dishwashers), Clause 4.8 (current-carrying parts), Clause 4.11 (insulating materials), and Clause 4.23 (spacings) of this end product standard. This requirement does not apply to protective conductor terminal blocks.

4.9.21 Female devices (such as receptacles, appliance couplers, and connectors) that are intended, or that can be used, to interrupt current in the end product shall be suitably rated for current interruption of the specific type of load, when evaluated with its mating plug or connector. For example, an appliance coupler that can be used to interrupt the current of a motor load shall have a suitable horsepower rating when tested with its mating plug.

4.10 Separation of circuits

4.10.1 Conductors of circuits operating at different potentials shall be reliably separated from each other unless each conductor is provided with insulation rated for the highest potential involved in the circuits.

4.10.2 An insulated conductor shall be retained so that it does not contact an uninsulated live part of a circuit operating at a different potential.

4.10.3 In a compartment intended for the field installation of conductors, and that contains provision for connection of Class 2 circuit conductors, and Class 1 power or lighting circuit conductors, a barrier shall be provided to separate the conductors of the different circuits, or the arrangement of the compartment shall be such that a minimum spacing of 6.4 mm (1/4 in) is maintained between all circuit conductors located in the compartment.

4.11 Insulating materials

4.11.1 An insulating washer, a bushing, or similar component, and a base or a support for the mounting of current-carrying parts shall be of a moisture-resistant material, such as porcelain, phenolic, or cold-molded composition, or other material that is rated for the application, and shall not be adversely affected by the temperatures to which it is subjected under conditions of intended use.

4.11.2 Polymeric materials used for the sole support of uninsulated live parts shall comply with the requirements for materials used as direct support of live parts in UL 746C and CAN/CSA-C22.2 No. 0.17.

4.11.3 Materials such as mica, some molded compounds, and certain refractory materials are typically usable as the only support of a current-carrying part. A material, such as magnesium oxide, shall not be used for direct contact or support of current-carrying parts unless the material is used in conjunction with other insulating materials or is so located and protected so that the current-carrying parts are not damaged and the material does not absorb moisture.

4.11.4 A thermoplastic or thermosetting material shall not be used for the direct contact or support of uninsulated current-carrying parts unless the material is rated with respect to mechanical strength and rigidity, resistance to heat, resistance to flame propagation, resistance to electrical arcing, dielectric strength, and other properties for the condition of use. The effects of all of these properties shall be evaluated with respect to the effects of thermal aging on thermoplastic materials.

4.11.5 A screw or other fastener used to mount or support small, fragile insulating parts shall not be so tight as to crack or break such parts with expansion and contraction.

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4.11.6 Vulcanized fiber, impregnated fiber, or similar materials shall not be used for the direct contact or support of uninsulated current-carrying parts where shrinkage, moisture absorption, or warpage results in a risk of fire or electric shock. Using vulcanized fiber as insulating material for a bushing, washer, separator, or barrier complies with this requirement.

4.12 Thermal insulation

4.12.1 Thermal insulation in direct contact with a current-carrying part shall be glass wool or equivalent material that is nonconductive, nonabsorbent, resistant to flame propagation, and has been shown by investigation to be rated for such use. Thermal insulation in contact with wiring shall be nonabsorbent and resistant to flame propagation.

4.12.2 Thermal insulation not in contact with a current-carrying part or wiring shall be material that has been shown by investigation to be rated for such use.

4.12.3 Thermal insulation shall not contact products of combustion or condensation unless the insulation is rated for such conditions of use.

4.12.4 The leading edges of thermal insulation and other surfaces shall be protected from damage. Locating the edges of thermal insulation against bulkheads or panel flanges to protect the leading edges complies with the intent of this requirement.

4.12.5 The body of the thermal insulation shall be secured in position by one of the following methods:

a) mechanical fasteners with a coverage of at least one fastener per square meter of exposed surface area, unless the insulation is retained in position under all test conditions by a lesser number of fasteners due to the inherent rigidity of the fasteners. Mechanical fasteners shall be bolts, metal clamps, wire rods, or the equivalent. The location of the mechanical fasteners shall not result in a reduction of electrical spacings below the required values or short-circuiting or grounding of uninsulated electrical components; or

b) an adhesive rated for use with the type of thermal insulation and the substrate to which it is attached. The adhesive shall secure the insulation at any temperature attained by the adhesive when the dishwasher is tested in accordance with the performance requirements of this standard.

4.13 Equipment grounding

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

4.13.1 General

4.13.1.1 All exposed dead-metal parts and all dead-metal parts within the enclosure that are exposed to contact during any user-servicing operation and that have the potential of becoming energized shall be conductively connected to the means for equipment bonding.

4.13.1.2 To determine whether a part has the potential to become energized, such factors as construction and the proximity of wiring shall be evaluated.

4.13.1.3 A dishwasher that is provided with means for separate connection to more than one power supply shall be provided with a separate means for equipment bonding for each power supply.

4.13.1.4 The grounded power-supply conductor (neutral) shall not be grounded at, or in conjunction with, the dishwasher.

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4.13.1.5 An equipment bonding connection means shall reliably penetrate a nonconductive coating, such as paint or vitreous enamel.

4.13.1.6 An equipment-grounding bonding means and separate individual conductors used for internal bonding purposes shall be located so that the probability of its removal during servicing of the dishwasher is remote.

4.13.1.7 A power-supply cord with an equipment bonding conductor connected to the frame or enclosure as an equipment bonding means for all cord-connected dishwashers complies with these requirements.

4.13.1.8 The equipment bonding conductor of a power-supply cord shall be attached to the grounding pin of an attachment plug, and shall be connected within the frame or enclosure by means of a screw. A sheet-metal screw shall not be used to secure an equipment bonding conductor. The screw shall not require removal during routine servicing not involving the power-supply cord.

4.13.2 Equipment-grounding terminals and leads

4.13.2.1 The free length of an equipment-grounding lead intended for connection to an equipment-grounding conductor shall be insulated – for example, shall have the end folded back and taped to the lead – unless the uninsulated end of the lead is located so that it does not contact current-carrying parts in the event that the lead is not used in the field.

4.13.2.2 An equipment-grounding terminal or lead shall be capable of connecting an equipment-grounding conductor that is:

a) sized in accordance with Clause 4.7.2.13; and

b) sized in accordance with the National Electrical Code, NFPA 70, and the Canadian Electrical Code (CEC), Part I, CSA C22.1.

The grounding terminal shall be located adjacent to the supply terminals or leads and shall be accessible for inspection and maintenance by removing a cover or the equivalent.

4.13.2.3 An equipment-grounding terminal or lead shall be conductively connected to the frame or enclosure by a positive means, such as by a bolted or screwed connection.

4.13.3 Equipment-grounding identification

4.13.3.1 The surface of the insulation of an equipment-grounding lead intended for connection to an equipment-grounding conductor shall be green with or without one or more yellow stripes, and no other lead shall be so identified.

4.13.3.2 A terminal intended for the connection of an equipment-grounding conductor shall be identified by:

a) use of a wire-binding screw with a green-colored head that is hexagonal or slotted, or both;

b) use of a threaded stud with a green-colored hexagonal nut;

c) use of a green-colored pressure terminal connector;

d) being marked "G," "GR," "GND," "Ground," "Grounding," or similar marking;

e) a marking on a wiring diagram provided on the product; or

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f) the grounding symbol shown in Figure 5, Grounding symbol, on or adjacent to the connector or on a wiring diagram provided on the product.

4.14 Lampholders

4.14.1 A lampholder shall be constructed or installed so that uninsulated current-carrying parts other than a screwshell are not exposed to contact by a person removing or replacing the lamp.

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.

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

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

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

4.14.5 An Edison-base lampholder used in the following shall be wired so that the screwshell will be connected to the terminal or lead that is intended for the connection of the grounded conductor of a supply circuit:

a) a permanently connected appliance; or

b) an appliance equipped with a polarized attachment plug.

4.15 Receptacles

4.15.1 A receptacle intended for general use shall be of the grounding type.

4.16 Capacitors

4.16.1 A capacitor provided as a part of a capacitor-type motor and a capacitor connected across the line, such as a power-factor correction capacitor, shall be housed within an enclosure or container. The enclosure or container shall reduce the risk of:

a) the capacitor plates being mechanically damaged; and

b) the emission of flame or molten material from the enclosure or container as a result of the capacitor malfunctioning or breaking down.

4.16.2 The capacitor construction shall comply with one of the following:

a) The enclosure or container shall be:

1) sheet steel having a thickness of not less than 0.51 mm (0.020 in) or shall be constructed to provide equivalent protection; or

2) a nonferrous enclosure complying with Clause 4.1.8 and Table 3, Minimum thickness of enclosure metal.

b) The individual container of a capacitor constructed of sheet metal less than 0.51 mm (0.020 in) thick or of material, other than metal, rated for the application shall be mounted in an enclosure that

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houses other parts of an appliance and where such box, case, or similar enclosure, is rated for the enclosure of current-carrying parts.

c) The individual enclosure of an electrolytic capacitor shall be provided with means for venting and constructed so that the capacitor is not mechanically damaged, and no minimum enclosure thicknesses is specified.

d) The individual enclosure of an electrolytic capacitor not provided with means for venting and with an opening more than 1.6 mm (1/16 in) wide between the capacitor enclosure and the motor is not required to comply with the requirement for enclosure thickness when it complies with Clause 7.17, Overvoltage for electrolytic capacitors test.

4.16.3 The voltage rating of a capacitor, other than a motor capacitor, shall not be less than the maximum steady-state voltage to which the capacitor is subjected during normal operation of the dishwasher.

4.16.4 A capacitor used for suppressing radio interference shall comply with the applicable requirements in Electromagnetic Interference (EMI) Filters, CSA C22.2 No. 8, and the Standard for Transient Voltage Surge Suppressors, UL 1449.

4.17 Overcurrent- or overload-protective devices

4.17.1 A fuseholder or circuit breaker shall be rated for the application. A plug fuseholder shall be Type S or Edison-base with a factory-installed nonremovable Type S adapter.

4.17.2 For a circuit breaker with a handle that operates vertically rather than rotationally or horizontally, the up position of the handle shall be the on position.

4.17.3 The screwshell of a plug-type fuseholder shall be connected toward the load.

4.17.4 A protective device, such as a fuse, the normal functioning of which requires renewal or replacement during operational maintenance, shall be constructed and installed so that no uninsulated live part other than the screwshell terminals or clips are exposed to contact by a person removing or replacing a fuse or other protective devices.

4.17.5 Where the operating handle of a circuit breaker and similar parts are intended to be accessible during operational maintenance, the accessibility of the part shall not result in the exposure of protected or enclosed current-carrying parts.

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

4.17.7 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.

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

4.17.9 Circuit breakers used in telecommunications circuitry shall comply with UL 489A.

4.17.10 Circuit breakers shall comply with UL 489 and CSA C22.2 No. 5.

4.17.11 Circuit breakers having integral ground fault circuit interrupter capability for protection against electrical shock shall additionally comply with UL 943 and CSA C22.2 No. 144.1.

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4.18 Overcurrent and overload protection for motors

4.18.1 A motor shall operate under the maximum normal load of the dishwasher as described in Clause 7.4.6 or 7.4.7 without resulting in a risk of fire, electric shock, or injury to persons.

4.18.2 A motor of one of the following types or installations shall have protection for motor-running overcurrent and locked rotor conditions:

a) an automatically- or remotely-controlled motor;

b) a permanently-connected, continuous-duty, manually-started motor; or

c) each motor of a motor group installation of two or more motors connected to a single branch circuit.

Note 1: A motor intended for moving air only by means of a fan or blower directly attached to the motor shaft and provided with protection for locked-rotor conditions is not required to have additional overload protection.

Note 2: A shaded-pole motor having a difference of 1 A or less between no-load and locked-rotor currents, and having a 2:1 or smaller ratio between locked-rotor and no-load current, and is provided with protection for locked-rotor conditions is not required to have additional overload protection.

4.18.3 The overload protection required in Clause 4.18.2 shall be one of the following:

a) thermal protection complying with Motors with Inherent Overheating Protection, CSA C22.2 No. 77, and the Standard for Thermally Protected Motors, UL 1004-3;

b) impedance protection complying with Motors with Inherent Overheating Protection, CSA C22.2 No. 77, and the Standard for Impedance Protected Motors, UL 1004-2, when tested as used in the application; or

c) other protection that is shown by tests to be equivalent to the protection described in (a).

4.18.4 With reference to Clause 4.18.3(c), the motor of a dishwasher having a device that is integral with the control of the dishwasher, is responsive to motor current, and is sized according to the Canadian Electrical Code (CEC), Part I, CSA C22.1, and the National Electrical Code, NFPA 70, has equivalent protection to the protection described in Clause 4.18.3(a).

4.18.5 With reference to Clause 4.18.3(c), an overcurrent device that is responsive to motor current and is rated to set to trip at not more than the percentage of the motor nameplate full-load current rating specified in Table 5 has equivalent protection. If the percentage protection specified in Column A of Table 5, does not correspond to an overload device of a standard size, the device of the next higher size may be used. However, the overload device of the next higher size shall protect against currents exceeding the percentage values specified in Column B of Table 5. For a multispeed motor, each winding connection shall be evaluated separately.

4.18.6 A fuse employed for motor-running overcurrent protection shall be located in each ungrounded conductor, and for a 3-wire, 3-phase, alternating-current motor, in each of the three phases. The fuse shall comply with Low-Voltage Fuses – Part 1: General Requirements, CSA C22.2 No. 248.1/UL 248-1, and Low-Voltage Fuses – Part 14: Supplemental Fuses, CAN/CSA-C22.2 No. 248.4/UL 248-14.

4.18.7 A device, other than one which is inherent in a motor, employed for motor-running overcurrent protection shall be located in each ungrounded conductor.

4.18.8 The functioning of a motor-protective device shall not result in a risk of fire, electric shock, or injury to persons.

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4.18.9 A fuse shall not be used as a motor-overload protective device unless the motor is protected by a time-delay fuse of the highest ampere rating accommodated by the fuseholder.

4.19 Overcurrent protection for transformers

4.19.1 A transformer shall be protected by overcurrent protection:

a) rated not more than 20 A for the primary or secondary;

b) rated at not more than 125 percent of the primary current when only the primary is protected; or

c) rated at not more than 250 percent of the primary current and 125 percent of the secondary current when both the primary and the secondary circuits are protected.

4.19.2 Overcurrent protection is not required for:

a) a transformer that is provided with overcurrent protection by means of the branch circuit to which the dishwasher is connected. The overcurrent protection of the branch circuit shall provide equal or better protection than the protection required by Clause 4.19.1 (a), (b), and (c); or

b) the primary of a transformer that complies with Clause 7.19, Transformer overcurrent protection test.

4.19.3 With reference to Clause 4.19.1 (b), the primary of the transformer shall be protected by an overcurrent device (or devices) located in the primary circuit, and rated or set as indicated below:

a) Where the rated primary current of a transformer is 9 A or more and 125 percent of the primary current does not correspond to a standard rating of a fuse or nonadjustable circuit breaker, the next higher standard rating protective device may be used.

b) Where the rated primary current is less than 9 A, use of an the overcurrent device shall be rated or set at not more than 167 percent of the primary current.

c) Where the rated primary current is less than 2 A, the overcurrent device shall be rated or set at not more than 300 percent of the primary current.

4.19.4 With reference to Clause 4.19.1(c), where both the primary and secondary are protected, and the rated secondary current of a transformer is 9 A or more and 125 percent of the secondary current does not correspond to a standard rating of a fuse or nonadjustable circuit breaker, the next higher standard rating protective device may be used.

4.20 Overcurrent protection for conductors

4.20.1 A dishwasher having a current rating more than 40 A shall be provided with internal overcurrent protection for the conductors of each internal circuit feeding two or more current-consuming components – such as motors, motor-control circuits, or electric heating elements – connected to any pair of power-supply terminals or leads.

4.20.2 With reference to Clause 4.20.1, internal overcurrent protection is not required:

a) for insulated conductors supplying motors or heating elements where the conductors have an ampacity, determined from Table 15, not less than one-third of the current rating of the protective device in the branch circuit to which the dishwasher is connected; and

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b) for insulated conductors supply control circuits where the conductors have an ampacity, determined from Table 15, at least one-fifth of the current rating of the protective device in the branch circuit to which the dishwasher is connected.

4.21 Switches

4.21.1 A switch shall comply with Special Use Switches, CSA C22.2 No. 55, or Switches for Appliances – Part 1: General Requirements, UL 61058-1/CAN/CSA C22.2 No. 61058-1 and shall have a current and voltage rating not less than the load that it controls when the dishwasher is operated normally.

4.21.2 A switching device that controls a motor shall comply with Clause 4.21.3 and have a horsepower rating not less than that of the motor it controls.

4.21.3 A switching device that controls a Design E motor rated more than 1492 W (2 hp) shall comply with Clause 7.18.1 unless:

a) The device is rated for the application.

b) A switching device that controls a Design E motor and that is not rated for the application has a Design B, C, or D horsepower rating that is 1.4 times the motor horsepower rating.

4.21.4 A switch shall be located or protected so that it is not exposed to mechanical damage during intended use.

4.21.5 A switch that controls an inductive load, such as a transformer or an electric discharge-lamp ballast, shall not have an ampere rating less than twice the rated full-load current of the load unless the switch is rated for the application or is investigated and complies with the requirements in this standard.

4.21.6 A switch that controls a medium-base lampholder of other than a pilot or indicating light shall have a tungsten rating.

4.21.7 A portable dishwasher employing a motor rated more than 249 W (1/3 hp) shall be provided with a motor-control switch for the motor.

4.22 Controls

4.22.1 General

4.22.1.1 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.

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

4.22.2 Protective controls and safety critical functions

4.22.2.1 An electronic control that manages a safety critical function shall comply with the requirements of:

a) The Evaluation of Electronic Circuits, Supplement SB; or

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b) The protective control requirements of CSA C22.2 No. 24, CSA C22.2 No. 156, or CAN/CSA-E60730; and

c) UL 244A, UL 873, UL 60691, or UL 60730-1.

4.22.2.2 Electronic controls that manage a safety critical function shall also be evaluated for reliability in accordance with:

a) The Evaluation of Electronic Circuits, Supplement SB; or

b) The protective control requirements of CAN/CSA-E60730 or CSA C22.2 No. 0.8, and

c) UL 60730-1.

4.22.2.3 Electronic controls that manage a safety critical function not relying on software shall comply with the requirements specified in Clause 4.22.2.2, except for Clause SB7.2 of the Supplement SB and Clause H.11.12 of CAN/CSA-E60730-1 and UL 60730-1. If software is relied upon to perform the safety critical function, the electronic control shall comply with the requirements specified in Clause 4.22.2.2, including the software requirements in Clause SB7.2 of Supplement SB, or the software requirements in Clause H.11.12 of CAN/CSA-E60730-1 and UL 60730-1 shall be considered Software Class B as indicated in Table 2.

4.22.2.4 The door interlock, door lock, motor overload protection, temperature-limiting devices, combination temperature-regulating and - limiting devices, and any control relied upon for compliance with the Abnormal operation testing of Clause 7.15 are considered to manage a safety critical function.

4.22.2.5 The minimum test parameters for the evaluation of a protective control for use in a commercial dishwasher conforming to CAN/CSA-E60730-1 and UL 60730-1 are specified in Table 2.

4.22.3 Operating controls

4.22.3.1 An operating control shall comply with the requirements in:

a) The Evaluation of Electronic Circuits, Supplement SB; or

b) CSA C22.2 No. 156, CSA C22.2 No. 24, or CAN/CSA-E60730-1 and the relevant part 2; and

c) UL 244A, UL 873, or UL 60730-1 and relevant Part 2.

4.22.3.2 The cycle selection control, water level detection, temperature-regulating devices, thermostat, and any control not relied upon to provide a required safety function are considered to be an operating control and are tested and evaluated as operating controls.

4.22.3.3 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 1.

4.22.4 A dishwasher employing a temperature-regulating control, the malfunction of which could result in a risk of fire, electric-shock, or injury to persons, shall be provided with a temperature-limiting control. The regulating control shall be shunted out of the circuit during the Abnormal operation test, Clause 7.15. The temperature-limiting control shall open, directly or indirectly, all ungrounded conductors of the circuit it controls, shall shut off all fuel to the pilot and main burners in a gas-fired dishwasher, or shall disconnect the steam supply in a steam-operated dishwasher. The temperature-limiting control shall be:

a) a thermal cutoff (see Clause 4.22.6);

b) a manually-reset control (see Clause 4.22.7); or

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c) an automatically-reset control (see Clause 4.22.8).

4.22.5 With reference to Clause 4.22.4(a), a thermal cutoff shall comply with Thermal Cut-Offs, CSA C22.2 No. 209, and the Standard for Thermal-Links (Thermal Cutoffs) for Use in Electrical Appliances and Components, UL 60691.

4.22.6 Temperature-regulating and limiting devices

4.22.6.1 A temperature-regulating control or thermostat shall comply with:

a) The electronic circuit requirements of Supplement SB; or

b) CSA C22.2 No. 24, ANSI Z21.20-2014/CAN/CSA-C22.2 No. 60730-2-5-14 or CAN/CSA-E60730-1 and the relevant part 2; and

c) UL 873, UL 353, ANSI Z21.23 or UL 60730-1 and the relevant part 2.

4.22.6.2 A temperature-limiting, or combination temperature-regulating and -limiting control shall comply with:

a) The electronic circuit requirements of Supplement SB; or

b) CSA C22.2 No. 24, ANSI Z21.20-2014/CAN/CSA-C22.2 No. 60730-2-5-14, or CAN/CSA-E60730-1 and the relevant part 2; and

c) UL 873, UL 353, ANSI Z21.23 or UL 60730-1 and the relevant part 2.

4.22.6.3 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 or 5 percent, whichever is greater; and

b) drift from the temperatures measured in the as-received condition by more than either 6°C or 5 percent, whichever is greater, after being subjected to the specified number of cycles in accordance with Table 2 and, for electronic protective controls, the environmental stress tests of Clause H.26 of Automatic electrical controls – Part 1: General requirements, CAN/CSA-E60730-1 or the Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1.

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

4.22.6.4 A temperature-sensing device such as a positive temperature coefficient (PTC) thermistor and a negative temperature coefficient (NTC) thermistor, performing as a temperature-regulating device, temperature-limiting device or combination temperature-regulating and -limiting device, shall comply with:

a) The electronic circuit requirements in Supplement SB; or

Note: When a thermistor is used as a sensor or as part of a thermal management function of a control, it is investigated as part of the control.

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

c) the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Temperature Sensing Controls, UL 60730-2-9 or the Standard for Thermistor-Type Devices, UL 1434.

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4.22.7 With reference to Clause 4.22.5 (b), for a manually-reset control that is reset from outside the dishwasher without using a tool to gain access to the reset mechanism, the control shall not be of the automatic-reclosing type; that is, when the control is held in the on or reset position and the device trips, the contact or contacts shall not automatically return to the closed position.

4.22.8 With reference to Clause 4.22.5 (c), an indicator light shall be provided in conjunction with the automatically-reset temperature-limiting control to alert the user that the temperature-regulating control is not operating normally. A light of the filament type shall have a minimum rated life of 20,000 continuous hours at the operating voltage and shall be connected in a circuit in which the increased voltage, incident to switching or any other operational characteristic of the dishwasher, does not exceed 120 percent of the rated voltage to provide the required life. In addition, the dishwasher shall be marked in accordance with Clause 14.20.

4.22.9 For a control used in conjunction with a magnetic contactor, relay, or other auxiliary components, the combination of the control and auxiliary components functioning as a unit shall be evaluated.

4.22.10 An auxiliary control shall disconnect all that it controls from all ungrounded conductors of the power-supply circuit, unless no current-carrying parts are exposed to unintentional contact.

4.22.11 A control thermal-sensing element or capillary tube shall not be subject to mechanical damage during intended use. For example, this may be accomplished either by their routing means or by separate protection.

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Table 1
Operating Control Correlation Table

(See 4.22.3.3)

Information	Operating Control Requirement
FEMA	Conduct a failure-mode and effect analysis (FMEA) to identify components the failure of which may result in a risk of fire or electric shock.
Operating Ambient	Determined via Normal temperature test, Clause 7.4, of the appliance
Endurance Testing	See Clause 8.3.
Overvoltage Category	Overvoltage Category II
Pollution Degree	See Clause 4.24.4

Table 2
Protective Control Correlation Table

(See Clause 4.22.2.3, 4.22.2.5, and 4.22.6.3)

Information	Protective Control Requirement
FEMA	Conduct a failure-mode and effect analysis (FMEA) identifying component failures which may result in a risk of fire, electric shock or injury and confirming the protective function continues to operate as intended.
Operating Ambient	Determined via the Normal temperature test, Clause 7.4, of the appliance
Endurance Testing	100,000 cycles (see Clauses 8.3.3 and 8.3.4)
Overvoltage Category	Overvoltage Category II
Pollution Degree	See Clause 4.24.4

Table 2 Continued on Next Page

Table 2 Continued

Information	Protective Control Requirement
Radio-Frequency Electromagnetic Field Immunity To Conducted Disturbances	Test Level 3
Radio-Frequency Electromagnetic Field Immunity To Radiated Electromagnetic Fields	Field Strength of 3 V/m
Fast Transient Bursts	Test Level 3 applied for 1 minute in each polarity
Surge Immunity	Installation Class 3
Electrostatic Discharge	Severity Level 3
Thermal Cycling	14 Days, Assumed temperature range: 10.0 +2 °C to the Operating Ambient
Software Class	Software Class B

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4.23 Spacings

4.23.1 Uninsulated current-carrying parts connected to different line- or extra-low voltage circuits shall be spaced from one another as though they were parts of opposite polarity in accordance with Clause 4.23.3, and the spacings shall be investigated on the basis of the highest voltage involved.

4.23.2 For an extra-low voltage circuit other than a safety circuit, the spacings are not specified. The spacings for an extra-low voltage safety circuit shall not be less than 0.8 mm (1/32 in) between uninsulated current-carrying parts and between an uninsulated current-carrying part and a dead-metal part where short-circuiting or grounding of such parts results in a risk of fire, electric shock, or injury to persons.

4.23.3 Other than as specified in Clause 4.23.4 and Clause 4.23.7, for an uninsulated live part not rigidly fixed in position by means other than friction between surfaces, the spacings in a dishwasher shall not be less than those specified in Table 6, Minimum spacings. For a movable dead-metal part in proximity to an uninsulated live part, the construction shall be such that the minimum spacings are maintained. The inherent spacings of a component such as a snap switch shall comply with the requirements for that component.

4.23.4 The spacings in a motor shall comply with Motors and Generators, CSA C22.2 No. 100, and the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1.

4.23.5 The spacings at terminal screws and studs to which connection is made in the field shall not be less than those specified in Table 6, Minimum spacings, when the connectors or lugs are in such position that minimum spacings exist when the terminals are turned 30 degrees (0.52 rad) toward each other, toward other uninsulated current-carrying parts of opposite polarity, or toward grounded dead-metal parts.

4.23.6 For an isolated dead-metal part interposed between, or in close proximity to:

a) current-carrying parts of opposite polarity;

b) a live part and an exposed dead-metal part; or

c) a dead-metal part that can be grounded,

the spacings between an isolated dead-metal part and any one of the other parts in (a) – (c), shall not be less than 1.2 mm (3/64 in). The total spacing between the isolated dead-metal part and any two of the other parts in (a) – (c) shall not be less than as specified in Table 6, Minimum spacings.

4.23.7 For an electric heating element, spacings through air or over the surface of insulating material not less than 1.6 mm (1/16 in) between uninsulated current-carrying parts of opposite polarity and between

uninsulated current-carrying parts and dead-metal parts shall be maintained at or near the end of the sheath of a heating element rated 300 V or less. When exact centering of a terminal pin is required to maintain the 1.6 mm spacing, a minimum of only 1.2 mm (3/64 in) is required. For an element rated more than 300 V, the spacing at the end of the sheath shall not be less than 6.4 mm (1/4 in).

4.23.8 A spacing of not less than 1.2 mm (3/64 in) between current-carrying parts of opposite polarity and between live parts and dead-metal parts of a heating element at or near the end of the sheath is required. See Figure 6, Spacings at closed-in voids.

4.23.9 For an electric heating element rated 300 V or less, a spacing not less than 1.2 mm (3/64 in) measured between a terminal pin and the sheath is required at a closed-in void, such as between an end seal and the element insulating material. See Figure 6.

4.23.10 For a thermostat, a spacing shall not be less than 0.8 mm (1/32 in) through air and 1.2 mm (3/64 in) over the surface of insulating material between uninsulated current-carrying parts of the same polarity on opposite sides of the switching mechanism, excluding the contact points, for constructions that permanently maintain the spacings.

4.23.11 An insulating lining or barrier of vulcanized fiber, impregnated fiber, or similar material employed where spacings are otherwise less than the minimum required values shall not be less than 0.8 mm (1/32 in) thick and shall be so located or of such material that it is not adversely affected by arcing, unless:

a) the use of an insulating material having a lesser thickness is rated for the condition of use; or

b) the material is used in conjunction with an air spacing of not less than 50 percent of the spacings required for air alone, using vulcanized fiber, impregnated fiber, or similar materials not less than 0.4 mm (1/64 in) thick.

4.23.12 The spacings on a printed wiring board shall comply with Solid-State Speed Controls, CSA C22.2 No. 156, and the Standard for Solid State Controls for Appliances, UL 244A. Compliance with Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1 and CAN/CSA-E60730-1, and/or the applicable Part 2 standard from the UL 60730 and CAN/CSA-E60730 series fulfills these requirements.

4.24 Alternative spacings-clearances and creepage distances

4.24.1 As an alternative to the spacing requirements specified in Spacings, Clause 4.23, spacings shall be in accordance with the requirements of Insulation Coordination, CSA C22.2 No. 0.2, and the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840, except:

a) between field wiring terminals, and

b) between uninsulated current-carrying parts and a metal enclosure.

4.24.2 Appliances shall be considered overvoltage category 2 as specified in Insulation Coordination, CSA C22.2 No. 0.2, and the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840.

4.24.3 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 the Standard for Polymeric Materials – Industrial Laminates, Filament Wound Tubing, Vulcanized Fibre, and Materials Used in Printed Wiring Boards, UL 746E, shall be considered to have a minimum comparative tracking index of 100 as specified in Evaluation of Properties of Polymeric Materials, CAN/CSA-C22.2 No. 0.17, and the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

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4.24.4 The internal microenvironment of the enclosure shall be considered pollution degree 2 as specified in Insulation Coordination, CSA C22.2 No. 0.2, and the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, 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 Insulation Coordination, CSA C22.2 No. 0.2, and Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, 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.

4.24.5 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 Insulation Coordination, CSA C22.2 No. 0.2, and the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840.

4.24.6 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) could be contacted during normal operation or user servicing; and

b) have clearances between the low-voltage circuit and an overvoltage as specified in Insulation Coordination, CSA C22.2 No. 0.2, and protected line voltage circuits that have been evaluated in accordance with Clearance B requirements as specified in Insulation Coordination, CSA C22.2 No. 0.2, and the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840.

4.25 Seals and gaskets

4.25.1 A gasket or seal, the failure of which could result in the wetting of current-carrying parts or film coated wire, shall be rated for the intended condition of use or shall comply with the Liquid containers, seals, and diaphragm tests, Clause 7.13.

4.26 Moisture condensation

4.26.1 In a dishwasher provided with a cold-water supply, uninsulated current-carrying parts and unprotected electrical components shall be located so that there is no collection of moisture on, or flooding of, such parts by condensed water vapor dripping from tanks, pipes, and similar areas prone to condensation.

5 Construction Requirements Unique To Gas-Fired Dishwashers

5.1 General

5.1.1 A burner compartment, a combustion chamber, and a flueway exposed to products of combustion shall be constructed of cast iron, sheet steel, or equivalent material. Sheet steel shall provide strength, rigidity, durability, resistance to corrosion, and other physical properties not less than those of American Iron and Steel Institute (AISI) C1010 hot-rolled sheet steel having a minimum thickness of 0.79 mm (0.031 in).

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5.1.2 An opening of such size that the interior and components within the burner compartment are accessible for cleaning shall be provided. The removal of the entire burner assembly, with or without the use of tools, to gain access to the burner compartment complies with the requirement.

5.1.3 Convenient means shall be provided for observing flames of:

a) all pilot burners;

b) an atmospheric type burner; and

c) burners of other than the atmospheric type provided with air adjustment means.

Removal of an access door or panel that does not require the use of a tool or does not affect the flame characteristics complies with the requirement. An outside opening provided only for observation of flames and having a minimum dimension exceeding 7.9 mm (5/16 in) shall be screened or covered with nonflammable transparent material.

5.1.4 A burner compartment and a combustion chamber shall be provided with a solid bottom or shall be constructed to provide a heat radiation barrier between the compartment or chamber and the floor below.

5.1.5 The flame adjustment means shall be mechanically secured so the adjustment cannot be unintentionally changed.

5.1.6 The dial of a thermostat that is adjustable by the operator shall be provided with temperature markings, a lettered or numbered scale, or pictorial representations of the operating temperatures. Markings other than temperature markings on a thermostat dial shall be identified in the manufacturer's operating or maintenance instructions with respect to the corresponding operating temperatures.

5.1.7 Where a cleanout panel in a flue-gas passageway is provided, flue-gas shall not leak through the mating joints of the panel.

5.1.8 A main burner or mixer tube shall be located and securely positioned so the burner does not twist, slide, or drop out of position while in service. Bolts, cotter pins, or screws within the combustion chamber shall not be used to comply with this requirement. The construction shall be such that the burner cannot be installed in other than the correct position.

5.1.9 A main burner or pilot device, or any assembly thereof, shall be removable for cleaning and replacement without disconnecting threaded joints of the manifold assembly other than those such as a union type, a flare fitting, or a compression fitting. The use of a tool or tool manipulation shall not be required in order to remove or replace a main burner, pilot device, or a main burner and pilot device assembly. A ribbon burner shall be constructed so the ribbon assembly is securely fixed in position.

5.1.10 The burner head shall be a single casting or shall be of an equally gastight and durable construction.

5.1.11 A burner shall be constructed of a corrosion-resistant material, or have a corrosion-resistant finish to resist corrosion by condensate. Steel with a coating, such as paint, that is rated for the temperature to which it is exposed, and cast iron are corrosion resistant.

5.1.12 A port shall be machined or otherwise accurately made.

5.1.13 A bolt hole shall not intersect a gasway unless provision is made to provide permanent gastightness.

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5.1.14 A joint in the pressure zone of a burner assembly shall be securely bolted, screwed, machined, welded, brazed, or of equivalent construction.

5.1.15 A flame spreader and a flame spreader support used with upshot-type burners shall be constructed so they cannot be incorrectly fitted together or shall be marked to indicate the correct method of assembly. When the flame spreader is removed for service or assembly, the flame-spreader shall not be attached to its support by a threaded joint or other fixed means, unless the support and spreader can be removed and replaced as a unit with the dishwasher installed as it is in service.

5.1.16 A flame spreader support used with upshot-type burners shall be constructed so the flame spreader cannot be supported at other than the correct distance above the burner.

5.1.17 A burner shall be constructed such that disintegrated flame spreader material does not fall into the burner port. The burner construction shall be such that disintegration of the ceramic material does not change the operating characteristics of the burner in a way that could result in a risk of fire or injury to persons.

5.1.18 Where an air shutter is used, there shall not be openings other than the adjustable openings through which primary air is entrained. Clearances, such as between air shutters and air mixer faces or around the orifice projection, shall not affect the flame characteristics when stopped by lint or other materials.

5.1.19 A means shall be provided to secure an air shutter in the intended position. Such means shall be conveniently accessible for adjustment with the burner in place and the dishwasher in operation.

5.1.20 A sheet-metal air shutter shall not be less than 0.645 mm (0.0254 in) thick. An air shutter less than 1.29 mm (0.051 in) thick shall have the outer edge turned at 90 degrees (1.57 rad) or be otherwise equally reinforced. An air shutter shall be constructed of a corrosion-resistance material or have a corrosion-resistant finish. Use of a cast-iron air shutter complies with this requirement.

5.1.21 For a dishwasher with an induced draft or power burner, the dishwasher construction shall be such that gas does not flow to the main burner in the event the blower providing the draft becomes inoperative.

5.1.22 With reference to Clause 5.1.21, the use of a centrifugal or sail switch, or equivalent device, meets the intent of the requirement. Where a centrifugal switch is used, the blower shall be secured to the shaft on which the centrifugal switch is located by means of keying, two setscrews with at least one on a flatted shaft, a locking-type setscrew on a flatted shaft, or the equivalent.

5.1.23 An orifice fitting, other than one used with a multiple injection tube burner, shall be accessible for adjustment and replacement. See Clause 18.1. The orifice fitting shall be securely positioned so that misalignment with the burner mixer does not occur.

5.1.24 A fixed orifice shall be provided and have a hex-shaped head.

5.1.25 A main burner orifice spud shall be threaded to its holder with not less than 3-1/2 full threads.

5.1.26 A main burner orifice spud shall be constructed of metal having a melting point not less than 788°C (1450°F).

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5.2 Manually-operated gas valves

5.2.1 A manually-operated gas valve shall comply with the applicable requirements in Manually-Operated Gas Valves for Appliances, Appliance Connector Valves, and Hose End Valves, ANSI Z21.15/CSA 9.1.

5.3 Automatic valves and safety shutoff valves

5.3.1 Automatic valves intended for operating duty, and safety shutoff valves shall comply with Automatic Valves for Gas Appliances, ANSI Z21.21/CSA 6.5, Combination Gas Controls for Gas Appliances, ANSI Z21.78/CSA 6.20, or the Standard for Electrically Operated Valves, UL 429.

5.4 Gas pressure regulators

5.4.1 A gas pressure regulator which controls the gas supply pressure to the main and pilot burner, when a pilot burner is provided, shall be supplied with each dishwasher.

5.4.2 A gas pressure regulator shall comply with Gas Appliance Regulators, ANSI Z21.18/CSA 6.3, and shall have a regulation capacity, as determined in accordance with ANSI Z21.18/CSA 6.3 or Combination Gas Controls for Gas Appliances, ANSI Z21.78/CSA 6.20, equal to or greater than the manufacturer's hourly Btu input rating for the dishwasher at normal inlet test pressure.

5.4.3 When a single pressure regulator is used to control the pressure of the gas to both the pilot and main burners, the regulator shall be of a type rated for both pilot and main burner load applications as designated by the following symbol adjacent to the regulator model number:

a) for an appliance having a pilot gas flow rate less than 3.93 cm^3/s and not less than 1.10 cm^3/s (less than 0.50 ft^3/hr and not less than 0.15 ft^3/hr) the symbol Ⓟ.

b) for an appliance having a pilot gas flow rate of 3.39 cm^3/s (0.50 ft^3/hr) or greater the symbol Ⓟ or ▽P.

5.4.4 A pressure regulator provided with a pilot gas safety valve shall comply with Automatic Valves for Gas Appliances, ANSI Z21.21/CSA 6.5, or Combination Gas Controls for Gas Appliances, ANSI Z21.78/CSA 6.20.

5.5 Ignition systems

5.5.1 Each main-burner assembly shall be provided with an automatic gas-ignition system that functions as specified in either (a) or (b):

a) The system provides for ignition of the main burner by means of a proved pilot. In the event the presence of the main burner flame is not proved, the automatic gas-ignition system shall provide for automatic shutoff of main burner gas. For a main burner intended for use with fuel gases having a specific gravity greater than 1.0, the automatic gas-ignition system shall also provide automatic shutoff of pilot burner gas.

b) The system provides for ignition of main burner gas by a direct ignition system. A direct ignition system shall only be used with a mechanical forced draft or induced draft burner. In the event the presence of the main burner flame is not proved, the automatic gas-ignition system shall provide for automatic shutoff of the main burner gas. In the event of main burner flame outage during an operating cycle, the automatic gas-ignition system shall provide for automatic shutoff of the main burner gas without reenergizing the direct ignition system or provide for reignition of the main

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burner gas by reenergizing the direct ignition system as specified in the Direct ignition systems test, Clause 9.9.

5.5.2 In addition to the automatic gas-ignition system functions specified in Clause 5.5.1, an automatic gas-ignition system having an interrupted ignition source shall provide for supervision of the main burner flame following the main burner flame establishing period. In the event that a main burner flame is not established within the main burner flame establishing period, the automatic gas-ignition system shall provide for automatic shutoff of the main burner gas.

5.5.3 A pilot-burner, safety shutoff device, and a direct-ignition system shall comply with the applicable requirements of Automatic Electrical Controls for Household and Similar Use – Part 2: Particular Requirements for Automatic Burner Ignition Systems and Components, ANSI Z21.20/CAN/CSA-C22.2 No. 60730-2-5, UL 60730-2-5, Combination Gas Controls for Gas Appliances, ANSI Z21.78/CSA 6.20, or the Standard for Primary Safety Controls for Gas- and Oil Fired Appliances, UL 372.

5.5.4 A pilot-burner body or orifice spud shall be constructed of a material having a melting point above 538°C (1000°F).

5.5.5 An automatic gas-ignition system that employs a relight pilot system shall act to reestablish ignition at the ignition device in 0.8 seconds or less following pilot flame outage, or a mechanical or electrical interlocking means shall be provided to automatically stop the flow of gas to the main burner when the relight pilot system is energized.

5.5.6 A frame or mounting bracket for an automatic gas-ignition device and a flame responsive element shall be constructed of metal having a melting point of not less than 788°C (1450°F).

5.5.7 A manually-lighted pilot burner shall be located to reduce the risk of injury to persons. A pilot burner ignition device or lighter rod that is required in order to reduce the risk of injury to persons shall be provided with a means for permanently attaching the burner ignition device or lighter rod to the dishwasher.

5.5.8 For a manually-lighted pilot burner, the main burner gas flow shall not rely on the operation of a manual valve that is not mechanically interlocked with the pilot gas control, on the thermostat, or on a separate switch. After the pilot has been established and the safety shutoff device remains in the position that controls main burner gas flow, an additional manual operation of the control shall be required to initiate gas flow to the main burner.

5.5.9 A pilot burner shall be located so the pilot burner flames are directly observable with the main burner off, and unless other means are available for checking operation, shall be observable with the main burner on.

5.5.10 An automatic gas-ignition system component shall be installed such that its operation and main burner ignition are not affected by falling scale or dirt during normal operation of the dishwasher.

5.5.11 The means for pilot gas flow adjustment shall be fully accessible for adjustment and servicing.

5.5.12 An automatic gas ignition device shall be positively positioned with respect to the main burner port.

5.5.13 Where the pilot burner supply line is connected to a horizontal line, the connection shall be made on the side or top of the horizontal line. Where a pilot gas supply line is connected to a vertical line, the connection shall be above the main burner gas supply line, unless a means to prohibit condensate from entering the pilot line is provided.

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5.5.14 The construction of a pilot gas adjustment device shall be such as to eliminate leakage. An adjustment screw, concealed by a gastight closure, complies with this requirement. A plug core-type pilot adjustment device shall be spring-loaded.

5.5.15 An electrode and electric igniter shall comply with Automatic Electrical Controls for Household and Similar Use – Part 2: Particular Requirements for Automatic Burner Ignition Systems and Components, ANSI Z21.20/CAN/CSA-C22.2 No. 60730-2-5, UL 60730-2-5, or the Standard for Commercial-Industrial Gas Heating Equipment, UL 795.

5.5.16 An electrode and electric igniter shall be constructed so that the electrode or bus bar is secured into position. This type of electrode shall not be mechanically adjusted.

5.5.17 Flexibility in the outer end of an electrode or electric igniter complies where the electrode or electric igniter is constructed to resist warping and unintentional dislocation.

5.5.18 An electrode and electric igniter shall be constructed and located so as to eliminate the collection of carbon or other materials, or the dislocation, distortion, or burning of parts as the result of normal conditions of heating or vibration of parts.

5.6 Pilot-gas filters

5.6.1 A pilot-gas filter that complies with Pilot Gas Filters, ANSI Z21.35/CSA 6.8, shall be provided for continuous pilots.

5.6.2 The rated capacities of a pilot-gas filter shall not be less than the rated capacities of the pilot burners with which they are used.

5.6.3 A pilot-gas filter shall be located on the upstream side of the pilot, pilot adjustment device, or other accessory in the pilot-gas supply line. This requirement does not apply to a plug-type pilot valve that is not used as a pilot adjustment device.

5.7 Gas supply line

5.7.1 The requirements in Clauses 5.7.2 – 5.7.4 apply only to the gas supply line within the dishwasher.

5.7.2 Threaded pipe connections shall comply with Pipe Threads, General Purpose (Inch), ANSI/ASME B1.20.1.

5.7.3 Steel pipe employed as gas conduit shall comply with Welded and Seamless Wrought Steel Pipe, ANSI/ASME B36.10M.

5.7.4 A tapped hole for a gas valve, pilot, lighter, or other branch supply line shall provide not less than 3-1/2 tapered pipe threads in accordance with the Standard for Pipe Threads, General Purpose (Inch), ANSI/ASME B1.20.1.

5.8 Semi-rigid tubing

5.8.1 Semi-rigid tubing employed as gas conduit shall have a wall thickness in accordance with Table 7, Minimum wall thickness for semi-rigid tubing.

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6 Reduction Of Risk Of Injury To Persons – Requirements Applicable To All Dishwashers

6.1 Enclosure and guards

6.1.1 A dishwasher shall be provided with protection that reduces the risk of injury to persons during normal operation.

6.1.2 A door of a dishwasher shall be provided with an interlock as specified in Clause 6.1.3 when opening the door during operation:

a) exposes a moving part such as a fan blade, blower wheel, pulley, or belt;

b) enables spraying or splashing of water or the escape of steam; or

c) exposes a heating element that results in a risk of injury to persons.

6.1.3 The interlock specified in Clause 6.1.2 shall disable the opening of the door during operation, or comply with the following when the door is opened:

a) remove the driving force from a moving part;

b) stop the spraying of water; and

c) de-energize any exposed heating element.

6.1.4 An interlock shall be such that it can not be:

a) inadvertently operated; or

b) defeated without:

1) damaging the dishwasher;

2) making or altering wiring connections; or

3) using a tool.

6.1.5 A moving part, such as the rotor of a motor, a chain, a pulley, a belt, or gear, shall be enclosed or guarded to reduce the risk of injury to persons.

6.1.6 With reference to Clause 6.1.5, the degree of protection required of the enclosure or guard is related to the construction and intended use of the dishwasher. The effects of the following factors shall be determined during the investigation of moving parts to determine compliance:

a) the degree of exposure;

b) the sharpness of the moving parts;

c) the potential for unintentional contact with the moving parts;

d) the speed of movement of the parts; and

e) the potential for fingers, arms, or clothing being drawn into the moving parts, such as at points where gears mesh, where a belt travels onto a pulley, or where moving parts close in a pinching or shearing action.

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6.2 Automatic restarting of motor

6.2.1 The automatic restarting of a motor by an automatically-reset protective device shall not result in a risk of injury to persons.

6.2.2 With reference to Clause 6.2.1, an interlock that complies with Clause 6.1.4 may be employed so that an automatically-reset protective device complies with Clause 6.2.1.

6.3 Parts subject to air or steam pressure

6.3.1 A pressure vessel having an inside diameter of more than 152 mm (6 in) and subjected to a pressure of more than 103 kPa (15 psig) shall be constructed, tested, and stamped in accordance with the applicable boiler and pressure vessel code symbol of the American Society of Mechanical Engineers (ASME) or bear a Canadian Registration Number (CRN) for a working pressure not less than the pressure determined in accordance with Clause 6.3.2.

6.3.2 A part or an assembly that is subject to air or steam pressure during normal or abnormal operation shall comply with the Hydrostatic pressure test, Clause 7.11. The test pressure shall be a pressure equal to the highest of the following that is applicable:

a) five times the pressure corresponding to the maximum setting of a pressure-reducing valve provided as part of the assembly, five times the marked maximum supply pressure from an external source, or five times the pressure setting of a pressure-relief device provided as part of the assembly, whichever is less;

b) five times the marked maximum supply pressure-relief device provided as part of the assembly;

c) five times the pressure setting of a pressure-relief device provided as part of the assembly;

d) five times the maximum pressure that can be developed by an air compressor that is part of the assembly, unless the pressure is limited by a pressure-relief device in accordance with (a); or

e) five times the working pressure marked on the part.

6.3.3 A test is shall not be conducted on a part or assembly when analysis of its material and dimensions indicate that it has the strength required for its intended purpose – for example, copper or steel pipe of standard sizes and thicknesses provided with standard fittings have been determined to have the required strength.

6.3.4 A pressure vessel conforming with the National Board of Boiler and Pressure Vessel Inspectors and bearing the American Society of Mechanical Engineers Code inspection symbol – other than the UM symbol – or bearing a Canadian Registration Number (CRN) and marked with a value of working pressure not less than that to which it is subject during normal or abnormal operation does not need to be tested. A vessel bearing the American Society of Mechanical Engineers Code UM symbol shall comply with the Hydrostatic Pressure Test, Clause 7.11.

6.4 Pressure-relief devices

6.4.1 A means for relieving pressure shall be provided for all parts in which there is a potential for pressure to be generated as a result of an external source of heat.

6.4.2 With reference to Clause 6.4.1, use of a pressure-relief device, a fusible plug, soldered joint, nonmetallic tubing, or other pressure-relief means complies with the requirement.

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6.4.3 There shall not be a shut-off valve between the pressure-relief means and the parts being protected.

6.4.4 A vessel having an inside diameter of more than 76.2 mm (3 in) and subject to air or steam pressure shall be protected by a pressure-relief device having a start-to-discharge pressure setting not higher than the marked working pressure of the vessel. The discharge rate of the device shall be such that the pressure is relieved and a risk of injury to persons is not introduced.

6.4.5 A pressure-relief device:

a) shall be connected as close as possible to the pressure vessel or parts of the system that the device is intended to protect;

b) shall be installed so that the device is accessible for inspection and repair, and is not readily rendered inoperative;

c) shall have its discharge opening located and directed so that:

1) the risk of scalding is reduced; and

2) operation of the device does not deposit moisture on uninsulated current-carrying parts or on insulation or components adversely affected by moisture; and

d) shall bear the code inspection symbol of the ASME or have a Canadian Registration Number (CRN) when the pressure vessel bears a similar symbol.

6.4.6 A pressure-relief device that has an adjustable setting shall be investigated at its maximum setting unless the adjusting means is sealed at a lower setting.

7 Performance Requirements Applicable To All Dishwashers

7.1 General

7.1.1 Unless otherwise indicated, a dishwasher shall be tested for operation:

a) at the factory-set open-tank water temperature when a fixed setpoint thermostat is provided; or

b) at an open tank water temperature corresponding to the highest dial setting when a user adjustable thermostat is provided.

See Clause 7.4.9.

7.1.2 All tests shall be performed with the dishwasher connected to a power-supply circuit of rated frequency and voltage as specified in Clause 7.1.3 and protected by a branch-circuit protective device sized in accordance with the National Electrical Code, NFPA 70, and the Canadian Electrical Code (CEC), Part I, CSA C22.1. See Clause 14.14.

7.1.3 The test voltage shall be the marked voltage rating of the dishwasher, or the highest voltage of a range of rated voltages, in accordance with Clause 12.1. For a single marked voltage falling within one of the ranges specified in Clause 12.1, the test voltage shall be the highest voltage of the range within which the single voltage rating is included.

7.2 Electrical input test

7.2.1 The input current to a dishwasher shall not be more than 110 percent of the rated value of current.

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7.2.2 To determine compliance with Clause 7.2.1, the input current shall be measured with the dishwasher at normal operating temperature under maximum normal-load conditions, and while connected to a supply voltage in accordance with Clause 7.3.1.

7.3 Starting current test

7.3.1 Unless marked in accordance with Clause 14.14, a cord-connected dishwasher shall start and operate normally on a circuit protected by a nontime-delay fuse as indicated in Clause 7.3.2.

7.3.2 The fuse specified in Clause 7.3.1 shall have a current rating equal to the rating of the branch circuit to which the dishwasher is normally connected.

7.3.3 A fuse of lesser rating shall be used when:

a) the manufacturer specifies that the dishwasher be protected by a fuse of a lesser rating; and

b) the dishwasher is marked in accordance with Clause 14.13.

7.3.4 To determine compliance with Clause 7.3.1, a dishwasher shall be started three times with the dishwasher at room temperature at the beginning of the test. The starting operation shall be under conditions representing the normal-operating cycle and load. Each motor shall attain full speed and then stop between successive starts. The fuse shall not open. An overload-protective or overcurrent device provided as part of the dishwasher shall not trip.

7.4 Normal temperature test

7.4.1 When tested under conditions described in Clauses 7.4 and 7.5:

a) a dishwasher and enclosing surfaces shall not attain a temperature at any point so as to constitute a risk of fire, to adversely affect any materials employed, or to exceed the temperatures specified in Table 8, Maximum temperatures;

b) an overload- or overcurrent-protective device shall not open the circuit during normal operation of the dishwasher; and

c) a motor-protective device shall not operate.

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7.4.2 For a component located adjacent to an integral heat source operating independently of ambient temperature, such as steam, or thermostatically-controlled hot water, no temperature on the component shall exceed the temperatures specified in Table 8, Maximum temperatures.

7.4.3 The temperatures specified in Table 8, Maximum temperatures, are based on an assumed ambient temperature of 25° C (77° F). However, for an observed temperature corrected to 25° C (77° F), testing performed within the range of 20 – 30°C (68 – 86°F) complies with the requirement.

7.4.4 An observed temperature shall be corrected by addition [when the ambient temperature is lower than 25° C (77° F)] or subtraction [when the ambient temperature is higher than 25° C (77° F)] of the difference between 25°C (77°F) and the ambient temperature.

7.4.5 For a corrected temperature exceeding the values specified in Table 8, Maximum temperatures, repeating the test at an ambient temperature closer to 25°C (77°F) meets the intent of Clause 7.4.4.

7.4.6 A dishwasher normally intended to be operated in cycles shall be so operated, with an interval of 3 min between the conclusion of 1 cycle and the beginning of the next cycle to represent the time required

for unloading and reloading the dishwasher. Operation shall be continued until the maximum temperatures in three successive cycles become constant.

7.4.7 A dishwasher that is intended to be operated with a noncycling load shall be operated until temperatures become constant.

7.4.8 With reference to Clauses 7.4.6, 7.4.7, and 7.4.11, a temperature is constant when three successive readings taken at intervals of 10 percent of the previously elapsed duration of the test indicate no change. In any case, the interval duration between readings shall not be less than 5 minutes.

7.4.9 The water temperature shall be as follows:

a) hot-inlet water shall be at a temperature of 71°C (160°F) or at the temperature specified by the manufacturer, whichever is higher;

Note: Inlet-water temperatures less than 71°C (160°F) comply with the requirement when a dishwasher intended for use with a chemical sanitizer is tested using the water temperature specified by the manufacturer, and the dishwasher is marked in accordance with Clause 14.16.

b) the recirculated water shall be at the highest temperature that results from setting the control thermostat at the highest temperature to which it can be adjusted when the thermostat adjusting means is accessible to the user or at the factory-adjusted temperature when the adjusting means is not accessible to the user;

c) final-rinse water shall be at a temperature not less than 82°C (180°F); and

Note: A final-rinse water temperature less than 82°C (180°F) complies with the requirement when a dishwasher intended for use with a chemical sanitizer is tested using the water temperature specified by the manufacturer, and the dishwasher is marked in accordance with Clause 14.16.

d) a dishwasher intended for a cold-water intake shall be connected to a cold-water inlet.

7.4.10 The maximum normal load on a pump motor shall be measured with the spray fittings in place and operating.

7.4.11 During the temperature test, all conveyor motors shall be operated, without a load, until temperatures become constant.

7.4.12 The outlet of the hose from all drain pumps shall be 914 mm (36 in) above the floor on which the dishwasher is installed.

7.4.13 With reference to Clause 4.2.7 (a), a circuit providing a programmed signal to a detergent dispenser or similar device shall be connected to a load with current equal to the marked rating of the circuit providing the signal.

7.5 Temperature measuring equipment and enclosure setup

7.5.1 Temperatures shall be measured by thermocouples consisting of wires not larger than 24 AWG (0.21 mm^2) and not smaller than 30 AWG (0.05 mm^2). When thermocouples are used in determining temperatures in electrical equipment, it is common practice to employ thermocouples consisting of 30 AWG (0.05 mm^2) iron and constantan wire and a temperature indicating or recording device type instrument. Such equipment shall be used whenever reference temperature measurements by thermocouples are required.

7.5.2 For a coil or winding, a thermocouple shall be used to determine the temperature:

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a) on the integrally applied insulation of a coil or winding without a wrap; or

b) on the outer surface of a wrap over a coil or winding that is not more than 0.8 mm (1/32 in) thick and consists of cotton, paper, rayon, or similar nonthermal insulation. This method shall not be used with a coil or winding using thermal insulation.

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

7.5.3 For a thermocouple-measured temperature of a motor coil as specified in items A1 through A8 of Table 8, Maximum temperatures, the thermocouple shall be mounted on the integrally applied insulation on the insulated wire.

7.5.4 The thermocouples and related instruments shall be accurate and calibrated in accordance with standard laboratory practice. The thermocouple wire shall conform with the requirements specified in the "Tolerances on Initial Values of EMF versus Temperature" tables in the Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples, ANSI/ASTM E230/E230M.

7.5.5 When a material temperature is being measured, a thermocouple junction and adjacent thermocouple lead wires shall be securely held in thermal contact with the surface of the material. In most cases, taping or cementing the thermocouple in place provides the required thermal contact. Where a metal surface is involved, brazing or soldering the thermocouple to the metal as a means to maintain thermal contact complies with the requirement.

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

$$T = \frac{R}{r}(k + t_1) - k$$

In which:

k is the constant 234.5 for copper or 225.0 for electrical conductor grade (EC) aluminum; values of the constant k for other conductor materials shall be determined;

R is the resistance of the coil at the end of the test in ohms;

r is the resistance of the coil at the beginning of the test in ohms;

T is the final temperature in °C; and

t_1 is the temperature of the coil in °C at the time resistance r is being measured.

7.5.7 nominal 19.1 mm (3/4 in) thick plywood, consisting of bottom, back, two sides, and top. For a dishwasher provided with a countertop, the top shall be omitted while conducting the test. The enclosing surfaces shall be brought into as intimate contact with the corresponding surface of the dishwasher as the dishwasher configuration enables. Temperatures shall be measured at points on each of the enclosing surfaces.

7.5.8 Unless it is obviously not intended for installation in an alcove, the test on a freestanding dishwasher shall be performed with the dishwasher mounted in an alcove as described in Clause 7.5.7.

7.5.9 A dishwasher intended to be installed in a corner shall be set 152 mm (6 in) from each side of a partial enclosure formed by two walls of nominal 19.1-mm (3/4-in) thick pine boards or plywood set at right

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angles and painted black. The side walls shall extend 457 mm (18 in) beyond the physical limits of the dishwasher. A clearance of at least 50.8 mm (2 in) shall be between the surface of any projecting part that extends out from the body of the dishwasher and the wall. When the part projects 102 mm (4 in) or less, the body of the dishwasher shall be located 152 mm (6 in) from the walls. When the part projects more than 102 mm (4 in), the body of the dishwasher shall be located as near to the walls as possible, subject to the 50.8-mm (2 in) clearance specified between the part and the wall. In any case, the dishwasher shall be located not less than 152 mm (6 in) from the walls. These clearances shall be decreased when manufacturer's installation instructions specify lesser clearances. Temperatures shall be measured at points on each of the enclosing surfaces.

7.5.10 The installation of a straight-through dishwasher shall be performed as described in Clause 7.5.9, except only a back wall shall be used instead of an alcove.

7.5.11 A thermocouple attached to a metal surface shall be soldered or brazed or secured under a screwhead.

7.5.12 A thermocouple attached to a surface other than wood or metal shall be cemented or taped in a manner that provides complete thermal contact with the surface.

7.5.13 Room ambient temperature shall be measured by a shielded thermocouple, centrally located 381 mm (15 in) in front of the dishwasher and 610 mm (24 in) above the floor of the test enclosure.

7.5.14 The floor of the enclosure for a gas-fired dishwasher shall be constructed of nominal 19.1-mm (3/4-in) plywood or 25.4-mm (1-in) white pine flooring painted black on the surface facing the bottom of the dishwasher. The extent of the floor shall be such that it underlies, and extends not less than 914 mm (3 ft) horizontally in every direction from, the bottom of the gas-burner section of the dishwasher.

7.5.15 The temperature of the flue gases of a gas-fired dishwasher exiting from the outlet of a draft hood of a dishwasher intended to be directly connected to a venting system, or the outlet of the dishwasher when equipped with an integral draft hood, shall be determined by a thermocouple grid located not more than 76.2 mm (3 in) downstream from the outlet.

7.5.16 A gas-fired dishwasher shall be fired at normal pressure and ±2 percent of rated input. When adjusting for rated input, adjusting the manifold pressure by ±10 percent of the manifold pressure rating complies with the requirement.

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7.6 Dielectric voltage-withstand test

7.6.1 A dishwasher shall withstand for 1 min without breakdown the application of a 60-Hz sinusoidal potential between current-carrying parts and dead-metal parts – or between current-carrying parts of opposite polarity of a radio-interference-elimination or arc-suppression capacitor – with the dishwasher at the maximum operating temperature reached in intended use. The test potential shall be:

a) 1000 V for a primary circuit rated 250 V or less and not having a motor rated more that 373 W (1/2 hp);

b) 1000 V plus twice-rated voltage for:

1) a primary circuit having a motor rated more than 373 W (1/2 hp); or

2) a primary circuit rated more than 250 V with or without a motor; and

c) for an extra-low voltage circuit, five hundred volts applied between low-voltage parts of opposite polarity and between extra-low voltage parts and dead-metal parts.

Note: For components that have been, as part of a separate investigation, found to comply with this test condition, the dielectric voltage-withstand test between extra-low voltage parts of opposite polarity is not required.

7.6.2 A dishwasher that employs one or more motors rated 373 W (1/2 hp) or less, as well as one or more motors rated more than 373 W (1/2 hp) , shall be tested as follows. The motor or motors as described in Clause 7.6.1 (a) shall be disconnected and subjected to the test potential specified in that item. The remainder of the dishwasher shall be tested in accordance with Clause 7.6.1(b).

7.6.3 For internal wiring or connections that are subject to motion during intended use of the dishwasher – for example, a wire connected 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.

7.6.4 To determine whether a dishwasher complies with the requirement in Clause 7.6.1, the test shall be performed using a 500 VA or larger transformer, the output voltage of which is sinusoidal and which is variable. The applied potential shall be increased from zero to the required test value and shall be held at that value for 1 minute. The increase in the applied potential shall be at a substantially uniform rate and as rapidly as is consistent with its value being correctly indicated by a voltmeter. A 500 VA or larger transformer is not required when the testing equipment has a voltmeter in the output circuit to directly indicate the applied test potential.

7.6.5 When higher than rated voltage is developed in a motor circuit through the use of capacitors, the rated voltage of the dishwasher shall be employed to determine the dielectric voltage-withstand test potential, unless the developed steady-state capacitor voltage exceeds 500 V, in which case the test potential for the parts affected shall be 1,000 V plus twice the developed voltage.

7.6.6 The arrangement of the test circuit shall be such that any occurrence of dielectric breakdown of the insulating material is indicated by a positive signal from the testing device. A visual inspection of the material shall not be used to detect dielectric breakdown of the insulating material.

7.7 Flexing test

7.7.1 A dishwasher in which the normal operation of movable parts mechanically affects the electrical wiring or other insulated current-carrying parts, including a supply-cord reel, shall operate in the intended manner without electrical or mechanical breakdown for the number of cycles indicated in Clause 7.7.2 while connected to a supply circuit of maximum rated voltage. For a dishwasher incorporating an interlock switch that de-energizes the electrical wiring or uninsulated live part when flexed, conducting the test without energizing the sample complies with the requirement. After the test, the dishwasher shall comply with Dielectric voltage-withstand test, Clause 7.6.

7.7.2 The number of cycles of flexing shall be:

a) fifty, where flexing occurs only during installation or inspection of electrical field-wiring connections;

b) six thousand, where flexing occurs only during regularly prescribed servicing, such as lubrication, cleaning out traps, resetting of protectors, or replacement of fuses; and

c) one hundred thousand, where flexing occurs during a routine operation, such as recharging a detergent reservoir, cleaning out a foreign-matter trap, or opening or closing a loading door.

7.7.3 To determine whether a dishwasher complies with Clause 7.7.1, the mechanical arrangement shall be such that the movable member operates at a rate of 12 cycles per minute. The movable member shall be operated so that it reaches the actual limits of travel in both directions during each cycle. When requested by the manufacturer, increasing the cycling rate complies with this requirement.

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7.7.4 The test on a supply-cord reel normally shall be performed with the supply cord not connected to the power-supply receptacle. Unreeling of the cord shall be arranged so that there is a maximum tendency to abrade the cord insulation and to wear parts in contact with the cord. A length of 760 mm (30 in) or more of the cord shall be unreeled during the test, and recoiled on the reel automatically. Disengaging the latching mechanism to facilitate conducting the test meets the intent of this requirement. During the test, the tension on the cord shall be applied in the same direction as the direction applied when the dishwasher is being used as intended.

7.8 Insulation resistance following humidity conditioning test

7.8.1 A dishwasher or part of a dishwasher employing insulating material that has the potential to be adversely affected by moisture under conditions of normal operation shall have an insulation resistance of 50,000 Ω or more between current-carrying parts and exposed dead-metal parts after exposure for 24 hours to moist air having a relative humidity of 80 – 90 percent at a temperature of 3 – 34°C (86 – 93°F). See Clause 4.11.2.

7.8.2 Typically, insulation resistance is measured by a high-resistance voltmeter using a 250-V direct-current potential. However, the use of other resistance-measuring equipment providing equivalent results complies with the requirements.

7.9 Water exposure tests

7.9.1 Water spillage test

7.9.1.1 After a dishwasher has been tested in accordance with Clause 7.9.1.2 for a countertop or an under-counter type:

a) there shall not be water in a compartment that houses field-installed wiring;

b) there shall not be wetting of any uninsulated live part elsewhere in the dishwasher;

c) the insulation resistance shall not be less than 50,000 Ω; and

d) the dishwasher shall comply with Dielectric voltage-withstand test, Clause 7.6.

7.9.1.2 A countertop or an under-counter dishwasher shall be leveled, and one pint of water shall be poured from a height of 152 mm (6 in) above the area being tested.

7.9.2 Water spray test

7.9.2.1 After a dishwasher, other than a countertop or under countertop type, has been tested in accordance with Clauses 7.9.2.2 – 7.9.2.5 for any other type:

a) there shall not be water in a compartment that houses field-installed wiring;

b) there shall not be wetting of any uninsulated live part elsewhere in the dishwasher;

c) the insulation resistance shall not be less than 50,000 Ω; and

d) the dishwasher shall comply with Dielectric voltage-withstand test, Clause 7.6.

7.9.2.2 The dishwasher, at room temperature, shall be set up in the intended manner with feed and discharge tables in place. The test shall be performed with the side panels removed for side panels of the enclosure that are:

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a) removable without the use of tools, unless the dishwasher is marked in accordance with Clause 14.19; or

b) provided as additional equipment by the manufacturer.

7.9.2.3 An opening that is closed after installation by a water line, a steam line, a drain line, an electric conduit, or similar part or structure shall be closed to simulate normal conditions of use.

7.9.2.4 A hose having the free end fitted with a nozzle as illustrated in Figure 7, Nozzle, shall be connected to a water supply capable of maintaining a flow rate of 19 L/min (5 gal/min) as measured at the outlet orifice of the nozzle. The water shall be directed as specified in (a) and (b) at the portion of the enclosure containing electrical components. The nozzle shall not be brought closer than 3.05 m (10 ft) horizontally from any part of the dishwasher. The water from the hose shall be sprayed from all sides and at any angle:

a) against the surface that supports the dishwasher; and

b) under the dishwasher at points where the enclosure does not extend to the floor.

7.9.2.5 Wetting shall be continued until ultimate results are attained. Typically, one minute of wetting at each area establishes the effectiveness of the enclosure to exclude water at that point.

7.10 Flooding of current-carrying parts test

7.10.1 When tested as specified in Clauses 7.10.2 – 7.10.8, wetting of any uninsulated live part or film-coated wire shall not result from:

a) a malfunction of a timer switch or a float- or pressure-operated switch; or

b) the deterioration or damage of a boot, diaphragm, or other liquid seal of elastomeric or similar material.

The dielectric voltage-withstand test and insulation resistance tests shall be performed following the test, as well as a visual examination to determine whether or not parts have become wet or contaminated as a result of the overflow conditions. Only one malfunction shall be simulated at a time.

7.10.2 In a test to determine compliance of a dishwasher with the requirement in Clause 7.10.1(b) with respect to deterioration or damage of a boot or diaphragm due to flexing, such a component shall be removed completely, and the dishwasher shall be operated through one complete cycle of normal operation or shall be tested as described in Clauses 7.10.6 and 7.10.7.

Note: When it is shown that an alternate test determines that the material is rated for the application, compliance with Clauses 7.10.2 – 7.10.8 is not required. See Clause 7.13.2.

7.10.3 For other than a boot or other flexed part, or for a dishwasher involving construction that does not lend itself to the test described in Clauses 7.10.6 and 7.10.7, the part – gasket, seal, hose, diaphragm, boot, or similar part – shall be removed completely and the dishwasher operated through 1 cycle of operation. The dishwasher complies with Clause 7.10.1 when there is no wetting of electrical parts by the water discharged through the opening resulting from the removal of the part.

Note: When it is shown that an alternate test determines that the material is rated for the application, the test in Clauses 7.10.2 – 7.10.8 is not required. See Clause 7.13.2.

7.10.4 With reference to Clause 7.10.2, infrequent motion of small amplitude, such as that experienced during normal operation by a diaphragm covering a pressure-sensitive switch, does not constitute flexing.

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7.10.5 For an elastomeric part that is not flexed and is subjected to hot soapy water, the material shall be investigated to determine whether it is rated for the intended conditions, and whether deterioration of the part results in a risk of fire or electric shock. The investigation shall include evaluation of the effects of heat, air pressure, soap and detergent solutions, and other factors contributing to the deterioration of the elastomeric part.

7.10.6 The dishwasher shall be leveled prior to the test and the boot or diaphragm shall be removed. Water shall be placed in the vessel as described in Clause 7.10.7 and maintained during the test at a level the same as that of the maximum level of the water in the dishwasher during intended operation. The free end of the flexible tube, pointed in any direction, shall be held at points within the volume enclosed by the outer surface of the boot when the latter is in its normal position.

7.10.7 With reference to Clause 7.10.6, the vessel shall be flat-bottomed and of any convenient dimension. A tube of rubber or similar flexible material shall be attached to the bottom of the vessel. The inside diameter of the tube shall be 9.5 mm (3/8 in), and its length shall be that which is required for the test. Water shall flow into the tube through a circular orifice, with a diameter of 1.6 mm (1/16 in), located in the bottom of the vessel.

7.10.8 With reference to Clause 7.10.1 (a), elastomeric barriers, diaphragms, seals, and similar components throughout the dishwasher shall not be removed when the test is being performed to simulate the malfunction of a timer switch, or of a float- or pressure-operated switch.

7.11 Hydrostatic pressure test

7.11.1 With reference to Clauses 6.3.1 and 6.3.2, a part or assembly shall not rupture or leak when tested in accordance with Clause 7.11.2.

Note: Leakage or rupture at a gasket during the test complies with the requirement unless it occurs at a pressure 40 percent or less of the required test value.

7.11.2 Two samples shall be tested at the pressure specified in Clause 6.3.2. Each sample shall be filled with water so as to exclude air and shall be connected to a hydraulic pump. The pressure shall be raised gradually to the specified test value and shall be held at that value for 1 minute.

7.12 Reservoir overflow test

7.12.1 Liquid or powder overflowing from an auxiliary reservoir, such as a cleaning-agent reservoir or a reservoir for a rinse additive, shall not wet or contaminate uninsulated current-carrying parts or film-coated wire, and shall not wet or contaminate electrical insulation that is adversely affected by the liquid or powder normally used in the reservoir. A reservoir that is intended to contain an agent or additives that are potentially damaging to heated surfaces due to decomposition shall confine the cleaning agent or additive so that heated surfaces are not contacted.

7.12.2 For a reservoir as described in Clause 7.12.1 that is intended to contain a liquid, water shall be poured into the reservoir through an orifice 9.5 mm (3/8 in) in diameter. The reservoir shall be filled to the level marked by the manufacturer. Or, when a maximum-fill level mark is not provided by the manufacturer, the reservoir shall be filled to maximum capacity. Additional water, equal to 50 percent of the marked volume or 50 percent of the maximum fill-volume of the reservoir shall then be poured into the reservoir. In any case, no more than 950 mL (4 cups) of additional water shall be poured into the reservoir. The water shall be added to produce, as directly as possible, overflowing of the area where the parts specified in Clause 7.12.1 are located.

7.12.3 For a reservoir as described in Clause 7.12.1 that is intended to contain a powder, powder shall be poured into the reservoir. The reservoir shall be filled to the level marked by the manufacturer. Or, when

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a maximum fill-level mark is not provided by the manufacturer, the reservoir shall be filled to its maximum capacity. Additional powder, equal to 50 percent of the marked volume or 50 percent of the maximum fill-volume of the reservoir, as applicable, shall then be poured into the reservoir. In any case, no more than 950 mL (4 cups) of additional powder shall be poured into the reservoir. The powder shall be added to produce, as directly as possible, overflowing at the area where the parts specified in Clause 7.12.1 are located.

7.13 Liquid containers, seals, and diaphragms tests

7.13.1 Where the deterioration of a liquid container, seal, diaphragm, or similar component results in a risk of fire or electric shock, the container, seal, or similar component shall be resistant to deterioration from the liquid intended to be used in contact with that component.

7.13.2 To determine compliance with Clause 7.13.1, the component shall be investigated with respect to the material of which the component is made, the size and shape of the component, the mode of application in the dishwasher, and other factors. Where applicable, the investigation shall include visual inspection for cracks, deformation, and similar damage or deterioration after artificial aging, as well as comparison of hardness, tensile strength, and elongation before and after artificial aging.

7.13.3 With reference to Clauses 7.13.1 and 7.13.2, a component of elastomeric material, when tested to compare its tensile strength and elongation before and after artificial aging, complies when these properties comply with the minimum values specified in Table 9, Artificial aging tests.

7.14 Limited short-circuit test (motor protection)

7.14.1 Unless rated for the application, an overload-, overcurrent-, or a thermal-protective device employed in a dishwasher required to have group motor protection in accordance with Clause 4.18.2(c) shall withstand the test described in Clauses 7.14.2 and 7.14.3 without introducing a risk of fire or electric shock when protected by a fuse having a current rating in accordance with Clause 7.14.2. The capacity of the circuit shall be in accordance with Table 10, Current for limited short-circuit test. See Clause 14.4.

Note: The short-circuit test is not required for the following conditions:

a) when a thermally-protected motor or a separately enclosed overload- or overcurrent-protective device is enclosed in accordance with Clause 4.1.14;

b) when an assembly is constructed so that it is determined that flame and molten metal are confined within the enclosure specified in (a); and

c) when there is no combustible material, other than electrical insulation, within the enclosure specified in (a).

7.14.2 The current rating of the fuse specified in Clause 7.14.1 shall be 400 percent of the current rating of the highest rated motor in the dishwasher plus the sum of the current ratings of all other loads in the dishwasher. When the sum does not equal a standard fuse rating, a fuse of the next lower standard fuse rating shall be used. Where a fuse of a lower rating is used for the test, the following conditions apply:

a) the dishwasher shall start and operate normally without opening the fuse; and

b) the fuse rating shall not be less than the rating of the supply-circuit overcurrent-protective device required in accordance with Clause 14.4 or 14.13.

7.14.3 In applying Table 10, Current for limited short-circuit test, the horsepower rating shall be computed by adding the currents of all loads other than motors, the full-load current ratings of motors so rated, and the corresponding full-load current ratings of horsepower-rated motors. The total computed current then shall be used to determine the applicable horsepower rating range in Table 10. When all the components of a dishwasher consist of motors rated in horsepower, the horsepower rating shall be the

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sum of the individual horsepower ratings. For a dishwasher intended to be connected to two or more individual branch circuits, these conditions apply to each individual internal circuit of the dishwasher.

7.15 Abnormal operation test

7.15.1 A dishwasher, when operated continuously under the abnormal conditions described in Clauses 7.15.2 and 7.15.3, shall comply with the following:

a) there shall not be emission of flame or molten metal, other than molten solder;

b) there shall not be glowing or flaming of the combustible material on which a dishwasher is placed, or is in proximity to;

c) there shall not be indication of flame or glowing embers either before or after the loading door is opened;

d) the fuse in the grounding connection shall not open; and

e) the dishwasher shall comply with the requirement in Clause 7.6.1 in a repeated Dielectric voltage-withstand test, following the Abnormal-operation test.

7.15.2 A dishwasher shall be operated under abnormal conditions such as the malfunction of an air-circulating fan or temperature-regulating control, interruption of the water supply, malfunction of a thermostat controlling an automatic gas shutoff system, or similar malfunction. Other than shunting the temperature-regulating control, only one condition of malfunction shall be imposed at a time. Before the start of the test, the dishwasher shall be operated through one complete cycle of normal operation, and dead-metal parts of the dishwasher shall be connected to ground through a 3 A nontime-delay fuse.

7.15.3 The test shall be continued until ultimate results are attained. When a timer is provided, the test shall continue for not longer than the maximum interval of the timer.

7.16 Blocked plunger test

7.16.1 Unless previously investigated for unenclosed use, an unenclosed relay, a solenoid, or similar component – including a solenoid valve and a motor-starting relay – as specified in Clause 4.1.15 shall not emit flame or molten metal, other than solder, nor shall it result in glowing or flaming of the cheesecloth or tissue paper when tested in accordance with Clause 7.16.2.

7.16.2 To determine whether a component complies with Clause 7.16.1, the component shall be tested as follows:

a) the plunger of a solenoid, a solenoid valve, or a relay shall be blocked in the normally open position. A motor-starting relay shall be operated with the contacts blocked in the normally open position or the closed position, whichever results in more current through the relay coil. The motor and other components of the dishwasher shall remain connected;

b) the component shall be:

1) supported on a softwood surface covered with a double layer of white tissue paper;

2) covered with a double layer of bleached cheesecloth; and

3) energized at the test voltage specified in Clause 7.1.3;

c) the power-supply circuit shall include a fuse of the maximum current rating of the branch circuit to which the dishwasher is normally connected. The fuse shall not be less than 20 A; and

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d) the test shall be continued for 7 h unless burnout occurs sooner.

Note: For a component controlled by an automatic timer, protector, or similar device rated for the application, and the operation of the component is therefore limited to a shorter interval, termination of the test at the conclusion of such interval complies with the intent of the requirement.

7.17 Overvoltage for electrolytic capacitors test

7.17.1 With reference to Clause 4.16.2 (d), an electrolytic capacitor shall be tested as described in Clause 7.17.2. The cotton shall not ignite as a result of the test.

7.17.2 Three samples of the capacitor, mounted as intended and with cotton placed around openings in the enclosure, shall be subjected to such overvoltage as to cause breakdown or malfunction.

7.18 Overload on switches test

7.18.1 A switch or other device that controls a motor, a solenoid, a relay coil, or similar component and that is not rated for the load it controls shall be subjected to the applicable overload tests described in Clauses 7.18.2 and 7.18.3 or 7.18.4. Each test shall consist of 50 cycles of operation. There shall not be electrical or mechanical malfunction or breakdown of the device or undue burning or pitting of the contacts as a result of the test, and the fuse in the grounding connection shall not open.

7.18.2 For the tests described in Clause 7.18.3 or 7.18.4, the dishwasher shall be connected to a grounded, supply circuit of rated frequency, and exposed dead-metal parts of the dishwasher shall be connected to ground through a 3 A nontime-delay fuse. The connection shall be such that any single-pole, current-interrupting device is located in the ungrounded conductor of the supply circuit. The switch or control device shall be operated at a rate of not more than 10 cycles per minute. Employing a faster rate of operation complies with the requirement when requested by the manufacturer.

7.18.3 In a test to determine whether a switch or other control device that controls a motor complies with the requirement in Clause 7.18.1, the rotor of the motor shall be locked in position and the dishwasher shall be connected to a grounded, supply circuit of rated voltage.

7.18.4 In a test to determine whether a switch or other control device that controls a solenoid, a relay coil, or similar component complies with Clause 7.18.1, the dishwasher shall be connected to a supply circuit of 110 percent of maximum rated voltage. The load on the device being tested shall be the load that it is intended to control when the dishwasher is being used as intended.

7.19 Transformer overcurrent protection test

7.19.1 With reference to Clause 4.19.2 (b), there shall not be emission of flame or molten metal from a dishwasher enclosure when a transformer not provided with the primary overcurrent protection is tested under the conditions described in Clause 7.19.2 and 7.19.3.

7.19.2 The load connected to the output terminals shall be:

a) a resistance so that three times the rated full-load current of the transformer is drawn from the secondary winding. When the transformer is unable to deliver three times rated current from the secondary, the test shall be performed with the output terminals of the transformer short-circuited;

b) the locked rotor current of a motor that is intended to be used with the transformer; or

c) a resistance equal to the load imposed on the transformer by the coil of any solenoid, relay, or similar component under a blocked-plunger or -armature condition. When more than one device is provided, the largest device shall be connected to the output terminals with the armature or plunger

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blocked in the position resulting in maximum current with the remaining devices operating as intended; the remaining devices shall be connected such that maximum current flow is achieved based on normal operation and control.

7.19.3 The transformer shall be operated continuously at the test voltage specified in Clause 7.1.3 and at rated frequency with the transformer enclosure or core grounded. The supply circuit for which the transformer is tested shall be protected by fuses rated not less than that required for the transformer circuit in the dishwasher. Fuses accessible in accordance with Clause 4.17.4 shall be replaced with dummy fuses. Inaccessible fuses shall not be replaced in the circuit. Operation shall be continued until constant temperatures (see Clause 7.4.9) are attained, as measured by a thermocouple on the transformer coil or until burnout of the transformer, whichever occurs first.

7.20 Transformer burnout test

7.20.1 For a power transformer employed as specified in Clause 4.22.2, the transformer shall be placed on a layer of bleached cheesecloth. A 3 A nontime-delay fuse shall be connected from the core of the transformer to ground. Each secondary winding of the transformer shall be short-circuited one at a time for 7 hours or until ultimate results occur. Each secondary winding of the power transformer shall be tested. A separate sample of the transformer shall be used for each secondary winding to be tested. The transformer shall be protected by the current-limiting device provided by the transformer circuit in the dishwasher. The results comply with the requirement when:

a) the fuse in the grounding connection does not open;

b) each transformer withstands the Dielectric voltage-withstand test, Clause 7.6, for 1 minute between the primary and each secondary winding, between the transformer core and primary winding, and between the transformer core and each secondary winding;

c) there is no ignition of the cheesecloth; and

d) the transformer circuit fuse or current-limiting device opens, and there is no indication of an increased risk of fire, electric shock, or injury to persons.

Note: Performing this test with the transformer and the current-limiting device installed in the dishwasher complies with the requirement. The layer of cheesecloth is not required to be placed under the transformer during the test.

7.21 Door interlock endurance test

7.21.1 With reference to the requirements in Clause 6.1.2 – 6.1.4, an electrical component of an interlock assembly, such as a switch or solenoid, shall withstand 100,000 cycles of operation without mechanical or electrical malfunction. The endurance test shall be performed at a rate of 6 through 12 cycles per minute. The interlock shall be energized during the test.

7.22 Loading door/drawer moment load test

7.22.1 The stability of a free-standing, front-loading dishwasher, mounted as it is intended to be used, shall be tested by applying, or suspending, a 22.9-kg (50-lb) weight to the center of the outer edge of the loading door, or the loading drawer when it is in its outermost position, whichever results in the larger upsetting moment. No dishes or water shall be in the dishwasher. Casters or legs, when provided, shall be turned or adjusted to result in the least stability. The dishwasher shall not overturn.

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7.23 Strain relief test

7.23.1 The strain-relief means provided on an attached flexible cord, when tested in accordance with Clause 7.23.2, shall withstand for 1 minute, without displacement, a direct pull force of 35 lb (156 N) applied to the cord.

7.23.2 The connections within the dishwasher shall be disconnected. A 35-lb (16-kg) weight shall be suspended on the cord and supported by the dishwasher so that the strain-relief means is stressed from all angles available due to the construction of the dishwasher. At the point of disconnection of the conductors, there shall not be movement of the cord as to indicate stress on the connections.

7.24 Push-back relief test

7.24.1 To determine compliance with Clause 4.7.1.15 a dishwasher shall be tested in accordance with Clause 7.24.2 without occurrence of any of the conditions specified in Clause 4.7.1.15 (a) – (d).

7.24.2 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. 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 lbf). The cord within the dishwasher shall be manipulated to determine compliance. When 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.

8 Performance Requirements Unique To Electrically-Heated Dishwashers

8.1 Automatic temperature control tests

8.1.1 When an automatic temperature control is tested as described in Clause 8.2 and 8.3:

a) there shall not be electrical or mechanical malfunction of the control;

b) there shall not be undue burning, pitting, or welding of the contacts; and

c) the fuse in the grounding connection shall not open.

8.2 Overvoltage test

8.2.1 The overvoltage test on an automatic temperature control shall be performed with the connections made so that there is a difference of potential equal to the full test voltage between current-carrying parts of the control mechanism and the enclosure and other dead-metal parts of the dishwasher. The enclosure shall be connected to ground through a 3 A nontime-delay fuse. The dishwasher shall be connected to a supply circuit having a voltage equal to 120 percent of the maximum rated voltage of the dishwasher and the control operated for 50 cycles of operation.

8.3 Endurance test

8.3.1 For the endurance test described in Clause 8.3.2 – 8.3.4, the dishwasher shall be connected to a supply circuit having a voltage equal to the maximum rated voltage of the dishwasher. The enclosure of the dishwasher shall be connected to ground through a 3 A nontime-delay fuse.

8.3.2 A temperature-regulating control and each contactor or similar device that is part of a temperature-regulating control circuit shall be subjected to 100,000 cycles of making and breaking the load that it normally controls.

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Note: For a control that when shunted out of the circuit in accordance with Clause 7.15.2 does not result in a risk of fire or electric shock, subjection to 6000 cycles for the test meets the intent of the requirement.

8.3.3 An automatically-reset temperature-limiting control or a combination temperature-regulating and -limiting control shall be subjected to 100,000 cycles of making and breaking the load that it normally controls.

8.3.4 A manually-reset temperature-limiting thermostat shall be subjected to 1000 cycles of operation making and breaking the load that it normally controls, and 5000 cycles of no-load operation.

9 Performance Requirements Unique To Gas-Fired Dishwashers

9.1 General

9.1.1 A part or fitting used as a gas conduit shall not sag, distort, melt, or show leakage of gas during the performance of the tests specified in Clause 9, Performance requirements unique to gas-fired dishwashers.

9.1.2 The finish of a jacket and other exposed parts shall be durable and uniformly applied and shall not show undue discoloration or deterioration after being subjected to the tests in Clause 9, Performance requirements unique to gas-fired dishwashers.

9.1.3 For the tests specified in Clause 9.4, Normal operation – combustion test, and Clause 9.10, Flue gas temperature for draft hood appliances test, the dishwasher shall be installed in an alcove as specified in Clauses 7.5.9 and 7.5.14.

9.1.4 For a dishwasher intended for installation with a vent connector and chimney arrangement in accordance with the Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances, ANSI/NFPA 211, the dishwasher shall be tested with either a single-wall galvanized vent connector or a rated Type B vent connector, at the option of the manufacturer. When a single-wall vent connector is used, it shall have a clearance of 152 mm (6 in) between its surface and the walls and ceiling of the test enclosure, an opening having a diameter 102 mm (4 in) larger than the diameter of the vent connector shall be provided, and the vent connector shall be centered in the opening. The 50.8-mm (2-in) annulus thus formed shall be sealed on the outer surface. When a Type B vent connector is used, the clearance from its surface to the walls and ceiling of the enclosure shall comply with the requirements for that component. At its point of passage through the enclosure, the annulus shall be sealed as specified for single-wall vent connectors.

9.1.5 A dishwasher with a vertical flue outlet shall be tested with vent arrangement Style I as shown in Figure 8, Enclosure types and clearance nomenclature for alcove and closet installation tests for dishwashers, unless otherwise specified in the manufacturer's installation instructions. A dishwasher with a horizontal flue outlet shall be tested with vent arrangement Style II as shown in Figure 8, unless otherwise specified in the manufacturer's installation instructions.

9.1.6 For a gas-appliance pressure regulator with a vent limiter, the limiter shall be in place during the tests.

9.1.7 While performing the tests in Clause 9, Performance requirements unique to gas-fired dishwashers, and Clause 11, Manufacturing and production tests unique to gas-fired dishwashers, the means to vent flue gases shall be inherent to the construction of a dishwasher. For a dishwasher intended to be installed with a commercial cooking or kitchen hood complying with the Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations, NFPA 96, the dishwasher shall not be connected to a vent connector for the test.

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9.1.8 A dishwasher provided with a draft hood shall be tested with the hood in place during all tests, unless otherwise specified.

9.1.9 For a dishwasher with controls that provide automatic multi-rate control of the input rating, and for a dishwasher with an automatic-modulating controls which provides for turning on of the main burner gas at a reduced rate, shall also be tested at the minimum input rating for the tests in Clauses 9.7 and 9.8.

9.1.10 A dishwasher having an automatic-modulating control which acts to reduce the input rating after ignition of the main burner shall also be tested at the minimum input rating and comply with Clauses 9.7.1.1 and 9.7.3.1.

9.1.11 For a dishwasher intended for installation with a vent connector and chimney arrangement in accordance with the Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances, ANSI/NFPA 211, and intended for installation under a commercial kitchen hood in accordance with the Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations, ANSI/NFPA 96, tests shall be performed with and without any vent connector or venting arrangement connected to the dishwasher.

9.2 Test gases

9.2.1 In performing the tests specified in Clause 9.4 – 9.10, the dishwasher shall be tested with the gases for which the equipment is rated. (See Table 11, Inlet test pressures.) The input air-fuel ratio and other operating conditions shall be in accordance with the manufacturer's instructions.

9.3 Test pressures and burner adjustments test

9.3.1 In performing the tests specified in Clause 9.3 – 9.7, unless otherwise stated, the test for each type of gas specified shall consist of a series of three test conditions: one at the normal inlet test pressure condition, one at a reduced inlet test pressure condition, and one at an increased inlet test pressure condition, as specified in Table 11, Inlet test pressures.

9.3.2 When the manifold pressure at the increased inlet test pressure condition is not greater than the manifold pressure at the normal inlet test pressure condition, tests at the increased inlet test pressure condition are not required. However, tests at the normal inlet test pressure condition shall be performed whenever tests at the increased inlet test pressure condition are specified.

9.3.3 The inlet test pressures specified in Clause 9.3.1 shall be the pressure immediately ahead of all controls. The regulator outlet pressure at normal inlet test pressure shall be the rated pressure specified in accordance with Clause 15.2(e).

9.3.4 A burner shall be adjusted to the burner's hourly Btu rating at normal inlet test pressure, unless otherwise specified. A burner shall be adjusted to the manufacturer's hourly Btu rating ±2 percent, 15 minutes after being placed in operation from an ambient temperature start. The manifold pressure shall be within ±10 percent of that printed on the rating plate. Primary air shall be set to give a complete and solid flame. No readjustment of hourly Btu input or primary air shall be made during a series of tests with any one test gas.

9.3.5 The minimum input rating for test purposes, on a dishwasher provided with controls which reduce the input rating by automatic means, shall be 87 percent of the minimum input rating specified by the manufacturer. The manufacturer's specified minimum input rating shall not be less than 20 percent of the manufacturer's specified normal input rating.

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9.4 Normal operation – combustion test

9.4.1 A dishwasher shall not produce carbon monoxide in excess of 0.04 percent in an air-free sample of the products of combustion when the dishwasher is tested in a room with a normal oxygen supply.

9.4.2 The dishwasher shall be installed as specified in Clauses 7.5.9 and 7.5.14. The dishwasher shall be filled and supplied with water at a temperature in accordance with Clause 7.4.9. The main burners shall be fired and caused to run continuously to maintain a tank temperature within ±8°C (±15°F) of the set point of the thermostat.

9.4.3 At the end of 15 minutes of operation at normal inlet test pressure and rated Btu input, a sample of the flue gases shall be obtained at a point immediately preceding the discharge of the gases from the flue outlet of the dishwasher. When the method of obtaining the flue gas sample is not practical, using another equivalent method to obtain the sample is acceptable with the agreement of all parties involved. Additional samples shall be taken at 5 minute intervals as follows:

a) with the dishwasher operating at increased inlet test pressure; and

Note: When there is no subsequent increase in manifold test pressure going from normal inlet gas pressure to increased inlet gas pressure, this portion of the test is not required.

b) with the dishwasher operating at reduced inlet test pressure.

9.4.4 The flue-gas samples shall be analyzed for carbon dioxide and carbon monoxide. The samples shall be obtained before the control functions to reduce the gas rate or shut off the gas fuel to the burner.

9.5 Undervoltage combustion test

9.5.1 A burner assembly or device shall, when tested at a voltage of 85 percent of minimum rated voltage for alternating current or 80 percent of minimum rated voltage for direct current, operate such that:

a) gas at the main burner is ignited as intended during the five ignition trials;

b) flames do not flash outside the device being fired nor damage parts;

c) combustion is complete and stable;

d) the concentration of carbon monoxide does not exceed 0.04 percent in an air-free sample of the products of combustion at normal inlet gas test pressure; and

e) the burner assembly operates without interruption.

9.6 Combustion air failure test

9.6.1 A mechanical-draft burner assembly or device shall not operate in a manner that results in a risk of fire or injury to persons during interruption and on restoration of the combustion air supply as specified in Clause 9.6.2. The fuel supply shall be shut off due to the inherent function of the burner assembly or by action of a control within the specified time limits for the control. The burner assembly shall require manual restart to fire the burner assembly upon restoration of the air supply, or an automatically-lighted burner assembly shall restart upon restoration of the air supply and automatic reignition shall be attained as intended.

9.6.2 To determine compliance with Clause 9.6.1, the test shall be performed under normal operating conditions as specified in Clause 9.4, Normal operation – combustion test. While the burner assembly or device is being fired at any operating rate, the fan supplying air for combustion shall be stopped by

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disconnecting the fan motor only from the electrical circuit, by disconnecting any flexible coupling, or by removing any belt required to drive the fan.

9.7 Burner operating characteristics test

9.7.1 Determination of general operating characteristics test

9.7.1.1 When tested in accordance with Clause 9.7.1.2 – 9.7.1.8, a pilot or main burner flame:

a) shall not flash back outside the combustion space during this or any of the other tests specified in this section; and

b) shall carry across all ports and burn at all ports when the main burner gas is ignited.

9.7.1.2 The tests shall be performed at the inlet test pressures specified under Clause 9.3.1.

9.7.1.3 A dishwasher provided with controls which reduce the input rate by automatic means shall also be tested when adjusted as specified in Clause 9.3.5.

9.7.1.4 Starting with the dishwasher at room temperature and inlet water at a temperature in accordance with Clause 7.4.9, with the burner cold, at least 5 successive ignition tests shall be performed with the main burner gas flow maintained for 30 seconds and interrupted for 30 seconds for each cycle.

9.7.1.5 The dishwasher shall then be operated for a period of 15 minutes at normal inlet test pressure with the burner hot. At least five successive ignition tests shall be performed with the main burner gas flow maintained for 30 seconds and interrupted for 30 seconds for each test.

9.7.1.6 For a dishwasher equipped with other than snap-action main-burner gas controls, this test shall be repeated with the gas rate to the main burner adjusted to deliver 1/3 of normal input rate. On dishwashers equipped with automatic multi-rate or automatic-modulating controls that provide for ignition and operation at a reduced rate, and that act to reduce the input rate after ignition of the main burner gas, this test shall be performed with the gas rate to the main burner adjusted to deliver 1/3 of maximum input rate.

9.7.1.7 In the event the control system shuts off the main burner gas before the gas rate is adjusted to deliver 1/3 the normal or maximum input rate as applicable, the test shall be performed at the lowest input rate at which a burner is operated by the control system. In any case, a burner shall not be operated by the control system at less than 87 percent of the minimum input rate on dishwashers which have automatic multi-rate or automatic-modulating controls that provide for ignition and operation at a reduced rate and that act to reduce the input rate after ignition of the main burner gas.

9.7.1.8 For any dishwasher, including those equipped with automatic multi-rate or automatic-modulating controls that provide for ignition and operation at a reduced rate and act to reduce the input rate after ignition of the main burner gas, the test shall be repeated at 87 percent of the minimum input rate.

9.7.2 Determination of flashback at mixer faces test

9.7.2.1 When tested in accordance with Clause 9.7.2.2 – 9.7.2.4, a burner shall not expel gas through air openings in mixer faces.

9.7.2.2 With the dishwasher operating at the inlet test pressure specified in Clause 9.3.1 and at the input rate specified in Clause 9.3.5, a flame shall be applied to the mixer face in such a manner that any gas expelled from the mixer head is ignited.

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9.7.2.3 For a dishwasher equipped with other than snap-action main burner gas controls, this test shall be repeated with the gas rate to the main burner adjusted to deliver 1/3 the normal input rate. On dishwashers equipped with automatic multi-rate or automatic-modulating controls that provide for ignition and operation at a reduced rate, and that act to reduce the input rate after ignition of the main burner gas, this test shall be performed with the gas rate to the main burner adjusted to deliver 1/3 of maximum input rate.

9.7.2.4 For all dishwashers including those equipped with automatic multi-rate or automatic-modulating controls that provide for ignition and operation at a reduced rate, and that act to reduce the input rate after ignition of the main burner gas, the test shall be repeated at 87 percent of the minimum input rate.

9.7.3 Determination of carbon deposits test

9.7.3.1 A burner or pilot shall not deposit carbon during any of the tests specified in Clause 9.7.1.1 – 9.7.2.4. Yellow-tipped flames that do not deposit carbon comply with this requirement.

9.7.3.2 At the completion of each test in this section, the combustion chamber shall be examined for evidence of carbon.

9.8 Pilot ignition systems test

9.8.1 Determination of general operating characteristics test

9.8.1.1 When tested in accordance with Clause 9.8.1.2 – 9.8.1.7, the pilot shall ignite the gas at the main burner after gas reaches the main burner port and shall not remain extinguished when the gas to the main burner is turned on or off in a normal manner, either manually or by means of automatic devices. This requirement does not apply to intermittent type pilots when the gas to the main burner is turned off.

9.8.1.2 This test shall be performed over the range of inlet test pressures specified in Clause 9.3.1 for each type of gas specified for the test. When testing with natural gas, a 995-Pa (4.0-in water column) inlet test pressure adjustment shall be included with the test.

9.8.1.3 The pilot burner, main burner, and automatic igniter shall be adjusted according to the manufacturer's instructions, and then the gas shall be turned off at the main burner.

9.8.1.4 Before timing the ignition, all gas piping shall be filled with gas.

9.8.1.5 Gas shall be admitted to the main burner by turning on fully, in a continuous movement, any manual means provided for main burner ignition. The period of time between the instant gas is admitted to the main burner and ignition of the gas shall be recorded.

9.8.1.6 Not less than 25 successive ignition tests shall be performed with the main burner gas flow maintained for 30 seconds and interrupted for 30 seconds for each test. The results do not comply when the presence of the ignition source is not proved after gas reaches the main burner port in any one instance, or when there is continued extinction of the pilot.

9.8.1.7 These tests shall be repeated using any automatic means provided for controlling main burner gas flow.

9.8.2 Determination of ignition time test

9.8.2.1 The time after the initiation of gas flow to prove the ignition source shall not be greater than the ignition means flame-establishing period specified in Table 12, Maximum safety control timings, when the

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dishwasher is operated at normal inlet test pressure. For purposes of this test, the primary-safety control manufacturer's specified maximum flame-establishing period shall be used.

9.8.2.2 When an interrupted ignition source is provided, the time required for the main burner flame to be proved from the initiation of main burner gas flow shall not exceed the main burner flame-establishing period specified in Table 12, Maximum safety control timings, when the dishwasher is operated at normal inlet test pressure. For purposes of this test, the primary-safety control manufacturer's specified maximum main burner flame-establishing period for the automatic gas ignition system shall be used.

9.8.3 Determination of flame failure response time test

9.8.3.1 When tested in accordance with Clause 9.8.3.2 – 9.8.3.5, the time required for the automatic gas ignition system to shut off the gas supply following loss of supervised flame shall not exceed the flame failure response time and the valve closing time specified in Table 12, Maximum safety control timings. For this test, the primary-safety control manufacturer's specified maximum flame failure response time shall be used.

9.8.3.2 A user adjustable thermostat shall be set at its maximum temperature setting.

9.8.3.3 With the inlet water at a temperature in accordance with Clause 7.4.9, the main burner gas shall be ignited and shall burn for 1 hour at normal inlet test pressure, or until the thermostat reduces the main gas supply or functions to shut off all gas fuel to the burner.

9.8.3.4 The tank water temperature shall be maintained during the test at a setting that allows the burners to operate continuously. All gas shall then be turned off and the gas flow to a continuous or intermittent pilot immediately reestablished. An interrupted pilot having a separate sensing device from that for the main burner flame shall be tested by turning off all gas after the pilot has been proved and before the main burner gas is ignited. The gas flow to the interrupted pilot shall be immediately reestablished. The gas shall not ignite.

9.8.3.5 When the automatic gas ignition system is constructed to shut off the pilot gas supply also, the time and conditions specified in Clause 9.8.3.1 and Table 12, Maximum safety control timings, shall apply.

9.8.4 Pilot supervision test

9.8.4.1 When tested in accordance with Clause 9.8.4.2 – 9.8.4.3, the pilot shall ignite the gas at the main burner when the gas supply to the pilot is reduced to a point where the flame is just enough to keep the valve of the automatic gas ignition system open, or just above the point of flame extinction, whichever represents the higher pilot gas rate. A pilot which becomes extinguished after having completed main burner ignition complies with this requirement. A pilot that becomes extinguished when the main burner gas is turned on and before igniting the main burner complies with the requirement when additional tests are made at increasing pilot rates and it is determined that no condition exists where the pilot remains lighted without igniting the main burner gas.

9.8.4.2 The primary-safety control manufacturer's specified maximum flame failure response time shall be used for the test.

9.8.4.3 To determine compliance with Clauses 9.8.4.1 and 9.8.4.2, the tests in (a) – (c) shall be performed at normal inlet test pressure based on the specified pilot types. For each test condition, the pilot shall ignite the gas within 4 seconds from the time gas reaches the main burner without flame flashout or damage to the dishwasher:

a) for a single-flame pilot burner, the pilot gas supply shall be reduced to an amount just enough to keep the valve of the automatic gas ignition system open, or just above the point of flame

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extinction, whichever represents the higher pilot gas rate. For this test, a flame is equivalent to a substantially uniform contour flame when the flame deviates from uniform contour due to a flame baffle or channel;

b) for a multiflame pilot burner, all the pilot flame ports other than those for heating the thermal element shall be blocked, and the pilot gas supply shall be reduced to an amount just enough to keep the valve of the automatic gas ignition system open, or just above the point of flame extinction, whichever represents the higher pilot gas rate;

c) for a pilot burner and thermal element assembly that supply electrical energy to an automatic control system, the tests under (a) and (b) shall be performed with the pilot adjusted to the minimum size (pull-in voltage) required to open the valve, when the thermal element is the only source of electric power for operation of the system, and shall be based on the performance of the system when only the thermal element and valve are present. System components other than the valve shall be excluded during this test. When a multiflame pilot burner is provided, the tests in (b) shall be performed at increased pilot input ratings; and

d) for a recycling pilot burner (gas ignited) that operates every time the main gas burner is turned on or off, either manually or by automatic controls, the gas supply to the ignition flame shall be adjusted so that the gas provided is just enough to ignite the gas at the thermal heating ports. When an escapement pilot is used in the control system, the escapement pilot shall be disconnected before applying this test.

9.8.5 Determination of pilot ignition system with voltage variations test

9.8.5.1 Under the conditions of voltage variation and inlet test pressure specified in Clause 9.8.5.2, an automatic pilot ignition system shall ignite the pilot burner gas within 30 seconds after gas reaches the pilot burner port.

9.8.5.2 Tests shall be performed 10 times for each of the following voltage conditions at normal inlet test pressure:

a) the dishwasher shall be tested at undervoltage, which is the voltage adjusted to 85 percent of the dishwasher rating plate voltage; and

b) the dishwasher shall be tested at overvoltage, which is voltage adjusted to 110 percent of the dishwasher rating plate voltage.

9.8.6 Determination of delayed pilot ignition on pilots with automatic shutoff test

9.8.6.1 When tested in accordance with Clause 9.8.6.2 – 9.8.6.7, a pilot equipped with an automatic igniter shall not result in flame flashout or damage to the dishwasher. For this test, the primary-safety control manufacturer's specified maximum flame failure response time, in combination with the primary-safety control manufacturer's specified minimum recycle time, shall be used.

9.8.6.2 The pilot ignition means shall be rendered inoperative. Main burner gas flow shall be shut off.

9.8.6.3 A dishwasher shall be tested with one or more sampling tubes to measure the gas-to-air ratio at various points in the dishwasher. The sampling tube or tubes shall be connected to a gas-air analyzer coupled to a chart-type single-point indicating or recording device in order to produce a constant trace of the gas-to-air ratio at the sample point. This connection shall be maintained until the system has been completely evaluated. The gas-to-air ratio trace shall be developed with the dishwasher both hot and cold, and with all test gases for which the dishwasher is tested.

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9.8.6.4 Unburned pilot gas shall flow into the dishwasher for a time equivalent to the primary-safety control manufacturer's specified maximum flame failure response time. Immediately following shutoff of the gas supply, an ignition cycle shall be initiated and continued until the pilot igniter is energized, as determined by the primary-safety control manufacturer's specified minimum recycle time.

9.8.6.5 For a gas-to-air ratio above the lower explosive limit, additional ignition tests shall be performed between the time of energization of the ignition means and when the atmosphere within the dishwasher returns to below the lower explosive limit to determine that the automatic igniter does not result in flame flashout or damage to the dishwasher.

9.8.6.6 A dishwasher with a control system that does not provide complete gas shutoff, and a purge period of 5 minutes or longer, shall be tested as specified in Clause 9.8.6.1 – 9.8.6.7. The purge period shall be 4-1/2 minutes with the pilot gas flowing during the period.

9.8.6.7 With reference to Clause 9.8.6.6, a dishwasher with a control system that provides complete gas shutoff and a purge period of 5 minutes or longer complies with the requirement.

9.8.7 Determination of delayed pilot ignition on pilots without automatic shutoff test

9.8.7.1 When tested in accordance with Clause 9.8.7.2 – 9.8.7.5, a pilot not provided with automatic shutoff when the presence of the ignition source is not proved shall not result in flame flashout or damage to the dishwasher.

9.8.7.2 A pilot ignition means shall be rendered inoperative. Main burner gas flow shall be shut off.

9.8.7.3 The test shall be performed in a draft-free environment.

9.8.7.4 A dishwasher shall be tested with one or more sampling tubes to measure the gas-to-air ratio at various points in the dishwasher. The sampling tube or tubes shall be connected to a gas-to-air analyzer coupled to a chart-type single-point indicating or recording device in order to produce a constant trace of the gas-to-air ratio at the sample point. This connection shall be maintained until the system has been completely evaluated. The gas-to-air ratio trace shall be developed with the dishwasher both hot and cold, and with all test gases for which the dishwasher is tested.

9.8.7.5 Unburned pilot gas shall flow into the dishwasher until equilibrium of the gas-to-air ratio is attained. A dishwasher complies with Clause 9.8.7.1 when the gas-to-air ratio at the time at which the pilot igniter energizes is not greater than the lower explosive limit. For a ratio above the lower explosive limit, additional ignition tests shall be performed at any time for up to 1 hour of pilot gas flow to determine that the unsupervised pilot system does not result in flame flashout or damage to the dishwasher.

9.8.8 Determination of delayed pilot ignition on systems with runner-type pilot burner

9.8.8.1 When tested in accordance with Clauses 9.8.8.2 and 9.8.8.3, flames shall travel freely to all pilot burner ports when the gas is ignited at any one port.

9.8.8.2 The gas rate to the pilot shall be adjusted at normal inlet test pressure to the manufacturer's hourly Btu input rating, and the pilot gas shall be ignited. The pilot gas pressure shall then be reduced to a point at which the amount of gas being consumed is such that the safety shutoff device remains in the position that is required during service to turn on the gas supply.

9.8.8.3 The pilot flames shall then be extinguished at the point of pilot flame proving, and the gas from the ports which serve to prove pilot flame (that is, to heat the thermal element of the safety shutoff device) shall be immediately reignited. The flames shall travel freely to all other ports on the pilot runner burner.

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9.8.9 Determination of automatic gas ignition system component temperature test

9.8.9.1 The temperatures measured on an automatic gas ignition system component shall not be greater than those temperatures for which the component is rated.

9.8.9.2 To determine compliance with Clause 9.8.9.1, thermocouples shall be peened, brazed, or secured to the following locations as applicable to the component being investigated:

a) pilot burner tip;

b) pilot burner orifice fittings;

c) electric igniter;

d) flame sensor;

e) surfaces of the hot and cold junction of thermoelectric types;

f) valve body;

g) electric switch;

h) contact mechanism; or

i) magnetic assembly.

9.8.9.3 The main burner and pilot burner shall be operated at normal inlet test pressure until equilibrium pilot temperatures have been attained. The temperatures at the points specified in Clause 9.8.9.2 shall then be measured to determine compliance with Clause 9.8.9.1.

9.9 Direct ignition systems tests

9.9.1 Determination of general operating characteristics test

9.9.1.1 The ignition system shall ignite the gas at the main burner immediately after gas reaches the main burner port when operated at dishwasher rating plate voltage.

9.9.1.2 This test shall be performed at the inlet test pressures specified under Clause 9.3.1. While maintaining dishwasher rating plate voltage to the dishwasher, the ignition system shall be placed in operation and ignition observed.

9.9.1.3 The procedure described in Clause 9.9.1.2 shall be performed 25 times, and for each performance, ignition shall occur immediately after gas reaches the main burner port.

9.9.2 Determination of operating characteristics under varied voltage conditions

9.9.2.1 Under the conditions of voltage variation and inlet test pressure specified in Clause 9.9.2.2, the direct ignition system shall ignite main burner gas within 4 seconds after gas reaches the main burner port.

9.9.2.2 Tests shall be performed under the following voltage conditions at normal inlet test pressure. Ignition cycles shall be performed 25 times:

a) the dishwasher shall be tested at undervoltage, which is the voltage adjusted to 85 percent of the dishwasher rating plate voltage; and

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b) the dishwasher shall be tested at overvoltage, which is voltage adjusted to 110 percent of the dishwasher rating plate voltage.

9.9.3 Determination of flame failure response timing test

9.9.3.1 When tested in accordance with Clauses 9.9.3.2 and 9.9.3.3, the time required for the main burner gas supply to be shut off in the event of flame outage during an operational cycle shall not exceed the direct ignition flame failure response timing specified in Table 12, Maximum safety control timings. For purposes of this test, the primary-safety control manufacturer's specified maximum flame failure response time, maximum flame failure reignition time, and minimum recycle time shall be used.

9.9.3.2 The dishwasher shall be tested at equilibrium temperatures while operating at normal inlet test pressure.

9.9.3.3 In the event the ignition means reactivates, the means shall be reenergized in not more than 0.8 seconds following flame outage, and the ignition means shall reignite the main burner gas without flame flashout or damage to the dishwasher. For dishwashers where all air for combustion is supplied by mechanical means, reactivation of the ignition means after a purge (recycle time) period that provides time for a minimum of four air changes of the combustion chamber and flue passages complies with Clause 9.9.3.1. For this test, the primary-safety control manufacturer's specified maximum flame failure response time, maximum flame failure reignition time, and minimum recycle time shall be used.

9.9.4 Determination of delayed main burner ignition test

9.9.4.1 The construction of the dishwasher and the arrangement of the ignition system shall be such that the dishwasher vents without flame flashout or damage, in the event of a delay in ignition of the main burner gas that is produced by foreign debris, electrical shorting of the ignition means, or similar events.

9.9.4.2 For this test, the primary-safety control manufacturer's specified maximum lockout time shall be used. For systems which deactivate the ignition means prior to the end of the lockout time, the test shall be performed using the primary-safety control manufacturer's specified maximum ignition activation period time.

9.9.4.3 With the dishwasher at room temperature, the dishwasher shall be placed into operation at normal inlet test pressure with the ignition means defeated for varying intervals of time up to the primary-safety control manufacturer's maximum specified lockout time or maximum specified ignition activation period, whichever is shorter. For recycling systems, attempts to ignite shall be made for varying intervals of time for each cycle throughout the total operating sequence up to lockout.

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9.10 Flue gas temperature for draft hood appliances test

9.10.1 When tested in accordance with Clause 9.10.2 – 9.10.4, the average temperature of the flue gases shall not exceed 266.5°C (480°F) above room temperature.

Note: For a dishwasher having unconventional venting means supplied with the dishwasher by the manufacturer, the dishwasher complies with Clause 9.10.1 when the flue gas temperature rise is 266.5°C (480°F) or less, or the construction of the dishwasher is such that the risk of fire is not increased when the dishwasher is installed in accordance with the manufacturer's instructions.

9.10.2 This test shall be performed at normal inlet test pressure. The flow of water through the dishwasher shall be regulated so that the burners operate continuously. The dishwasher tank temperature shall be maintained at a temperature below the set point of the thermostat. A sample of the flue gases shall be secured ahead of the draft hood and analyzed for carbon dioxide. See Clause 9.10.4.

9.10.3 The draft hood relief opening shall then be blocked. A 610-mm (2-ft) long vent pipe shall be attached vertically to the outlet of a vertically discharging draft hood. For a draft hood that discharges horizontally, an elbow and a 610-mm (2-ft) vent pipe shall be used. The draft hood, elbow, and vent pipe shall be insulated to reduce heat loss with 25.4 mm (1 in) of fiberglass insulation. To determine the average temperature across the transverse of the stack, a grid of thermocouples in parallel shall be installed in the vent pipe in a plane 457 mm (18 in) from the inlet. The thermocouples shall be positioned in the grid so each thermocouple measures an equal area of the vent pipe. The length of all thermocouple leads shall be equal before paralleling. The outlet of the vent pipe shall be equipped with an adjustable restrictor.

9.10.4 The blockage for the draft hood relief opening shall be removed and the vent pipe outlet shall be restricted until the carbon dioxide concentration in a sample of the flue gases is the same as determined under conditions specified in Clause 9.10.2. The average temperature of the flue gases shall be determined.

10 Manufacturing And Production Tests Unique To Electrically-Heated Dishwashers

10.1 Production line dielectric voltage-withstand test

10.1.1 When tested in accordance with Clause 10.1.2 – 10.1.10, a dishwasher shall withstand without electrical breakdown, as a routine production-line test, the application of a potential in accordance with either condition A or condition B of Table 13, Production-line test conditions, at a frequency within the range of 40 – 70 Hz:

a) between the primary wiring, including connected components, and accessible dead-metal parts that are able to become energized under fault conditions; and

b) between primary wiring and accessible extra-low voltage – 42.4 V peak or less – metal parts, including terminals.

For a dishwasher that has provisions for connection to more than one primary supply, the test shall be performed with all primary circuits connected together. The test potential shall be the maximum potential corresponding to the highest voltage as specified in Table 13, Production-line test conditions.

10.1.2 Testing the dishwasher in either a heated or unheated condition meets the intent of Clause 10.1.1.

10.1.3 The test shall be performed with the dishwasher fully assembled. The dishwasher shall not be unwired or modified for the test. A part such as a snap cover or a friction-fit knob that interferes with performance of the test shall be removed.

10.1.4 For a dishwasher employing a solid-state component that is not relied upon to reduce the risk of electric shock and that is damaged by the dielectric potential, the test shall be performed before the component is electrically connected. A random sampling of each day's production shall be tested. The circuitry shall be rearranged for the test to reduce the potential of solid-state component damage while retaining representative dielectric stress of the circuit.

Note: Performing the test before final assembly meets the intent of the requirement when the subassembly is representative of the completed dishwasher.

10.1.5 The test equipment shall include a transformer having a sinusoidal output, a means of indicating the test potential, an audible or visual indicator of electrical breakdown, and either a manually-reset device to restore the equipment after electrical breakdown, or a feature that automatically rejects a unit after electrical breakdown.

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10.1.6 For test equipment with a transformer output of less than 500 VA, a voltmeter shall be provided in the output circuit to directly indicate the test potential.

10.1.7 For test equipment with a transformer output of 500 VA or larger, the test potential shall be indicated:

a) by a voltmeter in the primary circuit or in a tertiary-winding circuit;

b) by a switch marked to indicate the test potential; or

c) by a marking in a visible location to indicate the test potential for equipment having a single test-potential output.

10.1.8 With reference to Clause 10.1.7 (b) and (c), where marking is used without an indicating voltmeter, the equipment shall include a positive means, such as an indicator lamp, to indicate that the manually reset device has been reset following a dielectric breakdown.

10.1.9 The use of test equipment, other than that described in Clause 10.1.5 – 10.1.8, meets the intent of Clause 10.1.1 where the equipment is found to accomplish the intended factory control.

10.1.10 With the primary switch and other switching devices in the on-position so that all of the primary circuit is tested, both sides of the primary circuit – all ungrounded conductors for a multiple phase primary circuit – of the dishwasher shall be individually connected to one terminal of the test equipment or collectively connected together and connected to one terminal of the test equipment, and the second test-equipment terminal shall be connected to the part specified in Clause 10.1.1.

10.1.11 A dishwasher having circuitry not subject to unintended secondary-voltage build-up in case of electrical breakdown during the test shall be tested:

a) with a single-pole primary switch, when provided, in the off-position; or

b) with only one side of the primary circuit connected to the test equipment when the primary switch is in the on-position, or when a primary switch is not used.

10.2 Production line grounding continuity test

10.2.1 A dishwasher that has a power-supply cord shall be tested as a routine production-line test, to determine that grounding continuity exists between the grounding-pin of the attachment plug and the accessible dead-metal parts of the dishwasher that have the potential to become energized.

10.2.2 Only a single test is required to be performed where the accessible metal specified for the test is conductively connected by construction to all other accessible metal.

10.2.3 An indicating device, such as an ohmmeter, a battery-and-buzzer combination, or similar indicator shall be used for the test.

11 Manufacturing And Production Tests Unique To Gas-Fired Dishwashers

11.1 The manufacturer shall check, inspect, and test the components and the assemblies of each dishwasher by test firing each burner and manifold and control assembly for proper burner and gas valve operation. The gastightness of the manifold and control assembly shall be verified. This test shall be performed on completely assembled dishwashers, when practicable.

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12 Rating Requirements Applicable To All Dishwashers

12.1 A dishwasher shall be rated in volts and frequency and in amperes, watts, or kilowatts. See Clause 12.2. The rating shall include the number of phases where the dishwasher is intended for connection to a polyphase circuit. The frequency shall be expressed in one of the following terms: hertz, Hz, cycles per second, cps, cycles/second, or c/s. A dishwasher intended for connection to a 3-wire, single-phase power supply shall be marked “3 w” or “3 wire.” The voltage rating shall be in accordance with an applicable single voltage or range of voltages, such as: 110 – 120, 200, 208, 220 – 240, 254 – 277, 440 – 480, 550, 575, or 600.

12.2 A permanently wired dishwasher having a motor load more than 1/8 hp (93.3 W) shall have a dual rating, with each element identified. One element of the rating shall be that of the motor load in amperes. The other element shall be the rating of the total load other than the motor load – heater load, lighting load, or similar loads – in amperes, watts, or kilowatts.

Note: A dishwasher rated with a single total load rating and marked in accordance with Clause 14.4(a) complies with the requirement.

12.3 For a dishwasher intended for connection to two different branch circuits, Clauses 12.1 and 12.2 apply to each individual circuit.

12.4 In accordance with Clause 12.2, when a dishwasher is required to have a dual rating and is controlled so that the motor load and the load other than the motor load are never connected simultaneously, additionally marking the dishwasher to indicate the maximum load that shall be connected at one time complies with the requirement.

12.5 A dishwasher rated in accordance with Clause 12.2 shall include 15 A in the other than motor load portion of the rating for each attachment-plug receptacle provided as part of the dishwasher and intended for use as a general-use receptacle. A receptacle that is accessible only when the enclosure of the dishwasher is open is not a general-use receptacle.

13 Marking Requirements Applicable To All Dishwashers

13.1 A pressure-sensitive label secured by adhesive, or a pressure-sensitive label exposed to water, detergent solution, or other agents due to its location, shall comply with Adhesive Labels, CAN/CSA C22.2 No. 0.15, or the Standard for Marking and Labeling Systems, UL 969.

13.2 A marking that is required to be permanent shall be molded, die-stamped, paint-stenciled, stamped, or etched metal that is permanently secured, or indelibly stamped, on a pressure-sensitive label secured by adhesive.

14 Marking Requirements Unique To Electrically-Heated Dishwashers

14.1 The markings described in Clauses 14.2 – 14.7, 14.10 – 14.14, and 14.16 – 14.20 shall be permanent, and shall not be on a readily removable part.

14.2 Each dishwasher shall be provided with a name plate, or a combination of adjacent plates, of material rated for the application and located so that the required information is plain, legible, and readily visible after the appliance is installed in the intended manner. The removal of a front panel that does not require special tools for removal for viewing the information complies with the requirement. The following shall appear on the plate or plates:

a) the manufacturer's name, trade name, trademark, or other descriptive marking by which the organization responsible for the appliance is identified;

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b) a distinctive catalog number or the equivalent; and

c) the electrical rating including the voltage and frequency expressed in one of the following terms: hertz, Hz, cycles-per-second, cps, cycles/second, or c/s.

14.3 A heating element rated more than 1 A and intended to be replaceable in the field shall be marked with a rating in volts and amperes or in volts and watts, the manufacturer's part number, or other equivalent means of identification.

14.4 A permanently-connected dishwasher having one motor and other loads or more than one motor with or without other loads shall be permanently marked, in a location that is visible when connections to the power-supply circuit are made and inspected, with:

a) the minimum supply-circuit conductor ampacity in accordance with Clause 14.5, and the maximum rating and type – for example, a nontime-delay fuse or a dual-element time-delay fuse – of supply-circuit overcurrent-protective device. The rating of the supply-circuit overcurrent-protective device shall not exceed the rating of the fuse employed in the short-circuit test described in Clause 7.14.2; or

b) the abbreviated wiring diagram or chart required by Clauses 14.9.

14.5 With reference to Clause 14.4(a), the minimum supply-circuit conductor ampacity for a dishwasher shall not be less than the sum of the following:

a) one hundred and twenty-five percent of the full-load current rating of the highest rated motor;

b) the full-load currents of all other motors; and

c) the currents of all other loads.

14.6 The minimum supply-circuit conductor ampacity for a dishwasher required to have a dual-rating in accordance with Clause 12.2 and marked in accordance with Clause 12.4 shall not be less than the ampacity of the maximum load connected at one time.

14.7 Where a dishwasher is readily adapted upon installation for connection to a supply circuit of either of two different voltages, complete instructions for making the connections for the different voltages shall be included in the permanent marking of the dishwasher or shown on a circuit diagram affixed to the dishwasher. The instructions shall include identification of the terminals that are applicable to the two different voltages.

14.8 A noncompulsory component intended to be field assembled to a completed dishwashing system shall be marked in such a manner as to identify it as a noncompulsory part of the system. See Clauses 4.1.5, 14.17, and 14.18.

14.9 With reference to Clause 14.4(b), the rating of each motor, and any other loads other than a pilot-duty load, shall be provided in an abbreviated diagram or chart on the dishwasher. The rating shall include:

a) the ampere or ampere and horsepower rating of a motor; and

b) electric heating element rating in volts and in amperes or watts.

14.9.1 Where fuse replacement is operational maintenance, the diagram or chart shall show the location of each connection that needs to be made in the field.

Note: An internal fuse that is not intended to be replaced during operational maintenance is not required to be shown on the diagram. See Clause 3.19.

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14.10 A dishwasher having provision for connection to multiple power supplies shall be marked with the word “CAUTION” and the following or equivalent: “This Dishwasher Has More Than One Power-Supply Connection Point. Disconnect All Power Supplies Before Servicing.” The marking shall be on the outside of the dishwasher, where readily visible after installation of the dishwasher, and at each point where a power-supply connection shall be made.

14.11 When, during the temperature test, the temperature on a field-installed lead or on any part within the wiring compartment that can be contacted by a lead is more than 60°C (140°F), the dishwasher shall be marked at or near the point where field connections shall be made, and so located that the marking is readily visible during installation, with the following or the equivalent: “For Supply Connections, Use Wires Rated For At Least ... °C (...°F).” The temperature value to be used in the marking shall be in accordance with Table 14, Outlet-box marking. The marking on a tag or label located as specified meets the intent of this requirement.

14.12 A dishwasher having field-wiring terminals shall be marked:

a) “Use Copper Conductors Only,” where the terminal is rated for connection to copper wire;

b) “Use Aluminum Conductors Only,” where the terminal is rated for connection to aluminum wire;

c) “Use Copper-Clad Aluminum, or Copper Conductors,” where the terminal is rated only for connection to either copper or copper-clad aluminum wire; and

d) “Use Copper or Aluminum Conductors” or “Use Copper, Copper-Clad Aluminum, or Aluminum Conductors,” where the terminal is rated only for connection to either copper or aluminum wire.

14.13 Unless marked in accordance with Clause 14.4, a dishwasher that is intended to be protected by a branch-circuit fuse having a current rating less than the maximum rating of the branch-circuit fuse to which the dishwasher is properly connected shall be clearly and permanently marked, in a location that is visible after the dishwasher has been installed as intended, with a statement indicating the rating of the branch-circuit to which the dishwasher is intended to be connected, and the maximum ampere rating of the overcurrent-protective device to be used in that branch-circuit. See Clauses 7.3.1, 7.3.2, and 7.14.2.

14.14 With reference to Clauses 7.1.2 and 7.3.1, a dishwasher that does not start and attain normal running speed when connected to a circuit protected by nontime-delay fuses shall be plainly marked with the words: “When connected to a circuit protected by fuses, use time-delay fuses with this dishwasher,” or an equivalent wording.

14.15 Each connection point for an external supply of steam, or air, shall be provided with a paper label or tag marked with the maximum pressure limitation, such as: “Steam ____ psi maximum.”

14.16 With reference to Clause 7.4.9 (a) and (c), the rating plate of a dishwasher intended for use with a chemical-sanitizing additive shall include the following marking or the equivalent: “Do Not Connect To Hot-Water Supply Exceeding A Temperature Of ...°C (... °F)” when the manufacturer specifies an inlet-water temperature less than 70°C (160°F). The temperature value shall be the manufacturer's specified water temperature for the dishwasher.

Note: This requirement does not apply to a dishwasher that complies with the temperature requirements when tested using the water temperatures specified in Clause 7.4.9 (a) and (c).

14.17 With reference to Clause 4.1.5, a dishwasher which is shipped from the factory without the back and both sides of the enclosure mounted in place shall be marked with the following or equivalent statement: “Not Provided With Complete Enclosure. Enclosure For Sides And Back Shall Be Provided At The Time Of Installation.” The marking shall be in a location that is visible when connections to the power-supply circuit are made and shall be provided in instructions packed with the dishwasher.

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14.18 A dishwasher that has plug-in provisions (see Clause 4.2.1 – 4.2.7) for the installation of a specific electrical accessory shall be marked with the name and model number of the accessory. Instructions for the installation of the accessory shall be marked on the accessory or in literature supplied with the accessory. See Clauses 12.5 and 4.15.1 for general-use receptacles.

14.19 Where side panels of a dishwasher are removable without the use of tools and when tests are performed with the panels in place as described in Clause 7.9.2.2(a), the dishwasher shall be marked: "Make Sure The Side Panels Are In Place When Cleaning The Dishwasher And Surrounding Areas," or with an equivalent marking. A single location for the marking complies with the requirement when it is permanently visible to the user.

14.20 A dishwasher that employs an indicator light in accordance with Clause 4.22.8 shall be provided with a permanent marking located adjacent to the light that identifies the function of the light. The marking shall consist of the signal word "WARNING" and the following or the equivalent: "In The Event This Light Goes On, Turn Off Dishwasher Or Disconnect It From The Power Supply And Have It Serviced By A Qualified Technician." The word "WARNING" shall be in letters not less than 2.4 mm (3/32 in) high.

15 Marking Requirements Unique To Gas-Fired Dishwashers

15.1 An electrical diagram shall be provided and shall include all circuits within the dishwasher. The electrical diagram shall be attached to the dishwasher on a label in a location where the label is accessible during servicing of the electrical components.

Note: Millivolt circuits for thermocouples that are only connected to a single component, such as a gas valve, are not required to be included in the diagram.

15.2 Each dishwasher shall be provided with a name plate, or a combination of adjacent plates, of material rated for the application and located so that the required information is plain, legible, and readily visible after the appliance is installed in the intended manner. The removal of a front panel that does not require special tools for removal for viewing the information complies with the requirement. The following shall appear on the plate or plates:

a) the manufacturer's name, trade name, trademark, or other descriptive marking by which the organization responsible for the appliance is identified;

b) a distinctive catalog number or the equivalent;

c) the electrical rating, including the voltage and frequency expressed in one of the following terms: hertz, Hz, cycles-per-second, cps, cycles/second, or c/s;

d) the manufacturer's hourly Btu input rating of each burner or group of burners operating as a unit for each gas for which the dishwasher is equipped;

e) the manufacturer's normal dishwasher manifold gas pressure in inches water column for each gas for which the dishwasher is equipped. For a point of pressure measurement other than a plugged tapping, the point shall also be identified on the name plate; and

f) gases for which the dishwasher is equipped.

15.3 Dishwasher installation clearances, as applicable, shall be clearly marked on the name plate, or on a separate permanent plate adjacent to the name plate. For clearances that are not all the same or for a dishwasher intended for installation in locations where the materials used do not ignite or burn only, clearance distances for the back, right side, left side, front, and top of the dishwasher shall be marked on the plate. For a vent installed adjacent to such construction, a clearance distance shall be marked on the plate. For a connector installed adjacent to combustible construction, a clearance distance shall be marked on the plate.

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Note 1: When clearances for the two specified locations construction are equal, indicating the equal clearances on the marking complies with the requirement.

Note 2: A zero clearance is not required to be indicated.

15.4 On a dishwasher not intended for use on combustible floors, one of the following shall be marked, as applicable: “For Use Only On Floors that Do Not Ignite or Burn” or “For Use In Locations Where Materials Do Not Ignite or Burn.”

16 Installation Instructions Applicable to All Dishwashers

16.1 Each dishwasher shall be accompanied by printed instructions stated in clearly understandable language, which separately cover dishwasher installation and user operation and maintenance. These instructions shall be included in an installation manual, an operator's manual, or both.

16.2 A dishwasher that requires exhaust air to be vented for proper operation shall be provided with explicit instructions specifying:

a) how the dishwasher shall be vented; and

b) that the exhaust air shall not be vented into a wall, a ceiling, or a concealed space of a building.

The venting instructions shall be included in the installation instruction manual, or marked on the dishwasher in a location that is visible when the exhaust system is being installed.

17 Installation Instruction Requirements Unique to Electrically-Heated Dishwashers

17.1 The instructions specified in Clause 16.1 shall specify that the dishwasher shall be installed in accordance with local codes, or in the absence of local codes, installed in accordance with the applicable requirements in the National Electrical Code, NFPA 70, Canadian Electrical Code (CEC), Part I, CSA C22.1, and Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations, NFPA 96.

18 Installation Instruction Requirements Unique To Gas-Fired Dishwashers

18.1 With reference to Clause 5.1.23, the instructions shall include the following or the equivalent: “In the event an orifice fitting shall be adjusted or replaced, have it serviced by qualified personnel.”

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Table 3
Minimum thickness of enclosure metal

(See 4.1.11, 4.1.12, 4.16.2.)

Material	Reinforced surfaces[a]		Surfaces to which a wiring system shall be connected in the field		Large unreinforced flat surfaces	
	mm	(in)	mm	(in)	mm	(in)
Die-cast metal	1.2	(3/64)	6.4[b]	(1/4)	2.0	(5/64)
Cast malleable iron	1.6	(1/16)	6.4[b]	(1/4)	2.4	(3/32)
Other cast metal	2.4	(3/32)	6.4[b]	(1/4)	3.2	(1/8)
Uncoated sheet steel	0.66	(0.026)	0.81	(0.032)	0.66	(0.026)

Table 3 Continued on Next Page

Table 3 Continued

Material	Reinforced surfaces[a]		Surfaces to which a wiring system shall be connected in the field		Large unreinforced flat surfaces	
	mm	(in)	mm	(in)	mm	(in)
Galvanized sheet metal	0.74	(0.029)	0.86	(0.034)	0.66	(0.026)
Nonferrous sheet metal	0.91	(0.036)	1.14	(0.045)	0.91	(0.036)

[a] Reinforced by curving, ribbing or similar methods. Also includes small, flat, unreinforced surfaces and surfaces of a shape or size that provides equivalent mechanical strength to the reinforced surfaces.

[b] Not less 3.2 mm (1/8 in) at an untapped hole.

Table 4
Characteristics of internal wiring

(See 4.9.5.)

Insulation	Nominal thickness of Insulation		Braid or jacket required	Nominal thickness of braid or jacket	
	mm	(in)		mm	(in)
Thermoplastic	0.8	(1/32)	No	–	–
Neoprene	0.4	(1/64[a])	Yes	0.4	(1/64[a])
Rubber	0.8	(1/32[b])	Yes	0.8	(1/64[b])

[a] See the Note to 4.9.4.

[b] For heat-resistant rubber, other than a silicone type, the insulation thickness shall not be less than 1.2 mm (3/64 in) and no braid is required.

Table 5
Maximum rating or setting of overcurrent-protective device

(See 4.18.5.)

Type of motor	Ampere rating of device as a percentage of motor full-load current rating	
	A	B
Motor with marked service factor of 1.15 or more	125	140
Motor with marked temperature rise of 40°C or less	125	140
Any other motor	115	130

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Table 6
Minimum spacings

(See 4.23.3, 4.23.5, and 4.23.6.)

Location		Potential involved, Volts					
		0 – 150		151 – 300		301 – 600	
		mm	(in)	mm	(in)	mm	(in)
Between an uninsulated live part and an uninsulated part of opposite polarity, an uninsulated grounded part other than the enclosure, or an exposed metal part	Through air or oil	3.2[a]	(1/8)	6.4	(1/4)	9.5	(3/8)
	Over surface	6.4	(1/4)	9.5[b]	(3/8)	12.7[c]	(1/2)
Between an uninsulated live part and the walls of a metal enclosure, including fittings for conduit or armored cabled[d]	Through air and over surface	12.7[b]	(1/2)	12.7[b]	(1/2)	12.7[c]	(1/2)

[a] The spacing between wiring terminals of opposite polarity and the spacing between a wiring terminal and a grounded dead-metal part shall not be less than 6.4 mm (1/4 in) where there is a risk of short-circuiting or grounding of such terminals as a result of projecting strands of wire.

[b] For a motor terminal box used for field-wiring connections, a spacing shall not be less than 6.4 mm (1/4 in).

[c] For a motor terminal box used for field-wiring connections, a spacing shall not be less than 9.5 mm (3/8 in).

[d] A metal piece attached to the enclosure is part of the enclosure when deformation of the enclosure reduces spacings between the metal piece and uninsulated current-carrying parts.

Table 7
Minimum wall thickness for semi-rigid tubing

(See 5.8.1.)

Outside diameter		Minimum wall thickness	
mm	(in)	mm	(in)
3.2	(1/8)	0.51	(0.020)
4.8	(3/16)	0.64	(0.025)
6.4	(1/4)	0.74	(0.029)
7.9	(5/16)	0.74	(0.029)
9.5	(3/8)	0.81	(0.032)
11.1	(7/16)	0.81	(0.032)
12.7	(1/2)	0.97	(0.038)
14.3	(9/16)	0.97	(0.038)
15.9	(5/8)	0.97	(0.038)
19.1	(3/4)	1.14	(0.045)
22.2	(7/8)	1.14	(0.045)

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Table 8
Maximum temperatures

(See 7.4.1 – 7.4.3, 7.4.5, and 7.5.3.)

Materials and components	°C	(°F)
A. Motors and transformers:		
1. Class 105(A) insulation systems in coil windings of an a-c motor having a diameter of 178 mm (7 in) or less, not including a universal motor[a]:		
a) In an open motor:		
Thermocouple or Resistance method	100	(212)
b) In a totally enclosed motor:		
Thermocouple or Resistance method	105	(221)
2. Class 105(A) insulation systems in coil windings of an a-c motor having a diameter of more than 178 mm (7 in), of a d-c motor, and of a universal motor[a]:		
a) In an open motor:		
Thermocouple method	90	(194)
Resistance method	100	(212)
b) In a totally enclosed motor:		
Thermocouple method	95	(194)
Resistance method	105	(221)
3. Class 130(B) insulation systems in coil windings of an a-c motor having a diameter of 178 mm (7 in) or less, not including a universal motor[a]:		
a) In an open motor:		
Thermocouple or Resistance method	120	(248)
b) In a totally enclosed motor:		
Thermocouple or Resistance method	125	(257)
4. Class 130(B) insulation systems in coil windings of an a-c motor having a diameter of more than 178 mm (7 in), of a d-c motor, and of a universal motor[a]:		
a) In an open motor:		
Thermocouple or	110	(230)
Resistance method	120	(248)
b) In a totally enclosed motor:		
Thermocouple or	115	(239)
Resistance method	125	(257)
5. Class 155(F) insulation systems in coil windings of an a-c motor having a diameter of 178 mm (7 in) or less, not including a universal motor[a]:		
a) In an open motor:		
Thermocouple method or Resistance method	145	(293)
b) In a totally enclosed motor:		
Thermocouple method or Resistance method	150	(302)
6. Class 155(F) insulation in coil windings of an a-c motor having a frame diameter of more than 178 mm (7 in) and of a d-c motor, and a universal motor[a]:		
a) In an open motor:		
Thermocouple method or	135	(275)
Resistance method	145	(293)

Table 8 Continued on Next Page

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Table 8 Continued

Materials and components	°C	(°F)
b) In a totally enclosed motor:		
Thermocouple method or	140	(284)
Resistance method	150	(302)
7. Class 180(H) insulation in coil windings of an a-c motor having a frame diameter of 178 mm (7 in) or less – not including a universal motor – and on a vibrator coil[a]:		
a) In an open motor:		
Thermocouple method or Resistance method	160	(320)
b) In a totally enclosed motor:		
Thermocouple method or Resistance method	165	(324)
8. Class 180(H) insulation in coil windings of an a-c motor having a frame diameter of more than 178 mm (7 in), of a d-c motor, and a universal motor[a]:		
a) In an open motor:		
Thermocouple method	150	(302)
Resistance method	160	(320)
b) In a totally enclosed motor:		
Thermocouple method	155	(311)
Resistance method	165	(329)
9. Coil windings of a transformer:		
a) Class 105(A) insulation systems:		
Thermocouple method	90	(194)
Resistance method	100	(212)
b) Class 130(B) insulation systems:		
Thermocouple method	110	(230)
Resistance method	120	(248)
B. Components:		
1. Capacitors:		
a) Electrolytic[b]	65	(149)
b) Other types[c]	90	(194)
2. Fuses:		
a) Classes G, J, L, T, and CC:		
Tube	125	(257)
Ferrule or blade	110	(230)
b) Other types	90	(194)
3. Relays, solenoids, and coils (other than motors and transformers) with[a]:		
a) Class 105(A) insulation systems:		
Thermocouple method	90	(194)
Resistance method	110	(230)
b) Class 130(B) insulation systems:		
Thermocouple method	110	(230)
Resistance method	130	(266)
c) Class 155(F) insulation systems:		

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Table 8 Continued on Next Page

Table 8 Continued

Materials and components	°C	(°F)
Thermocouple method	125	(257)
Resistance method	160	(320)
C. Conductors:		
1. Rubber- or thermoplastic-insulated wires and cords	60	(140)
2. Copper conductors:		
a) bare or insulated, without tinning, nickel coating, or silver plating	200	(392)
b) termination in a pressure terminal connector, unless both are tinned, nickel coated, or silver plated	150	(302)
D. Electrical insulation – general:		
1. Fiber used as electrical insulation	90	(194)
2. Phenolic composition used as electrical insulation:		
a) Laminated	125	(257)
b) Molded	150	(302)
3. Varnished-cloth insulation	85	(185)
E. Surfaces:		
1. A surface upon which an dishwasher is placed or mounted in service, and surfaces that are adjacent to the dishwasher when it is so placed or mounted.	90	(194)
2. Any point within a terminal box or wiring compartment of a permanently connected dishwasher in which power supply conductors are connected, including such conductors themselves, unless the dishwasher is marked in accordance with Clause 14.11.	60	(140)
3. Wood or other combustible material, including the inside surface of the test enclosure and the surface supporting the dishwasher.	90	(194)
4. Exterior surfaces of access door handles, drain valve handles, control knobs, and other surfaces normally contacted by the user:		
a) Metallic parts	90	(194)
b) Nonmetallic parts	110	(230)
5. Top working surface of a tabletop, under-counter, or similarly installed dishwasher[d]	55	(131)

NOTE – The maximum acceptable temperature of any component or material not specifically identified in this table shall not be greater than the maximum temperature rating of the component or material.

[a] At a point on the surface of a coil where the temperature is affected by an external source of heat, a temperature measured by means of a thermocouple that is more than the temperature specified by:

1) 5°C (9°F) for item A(1)(a),
2) 15°C (27°F) for item A(2)(a),
3) 10°C (18°F) for item A(3)(a),
4) 20°C (36°F) for item A(4)(a), and
5) 15°C (27°F) for item B(3)(a),

complies with the requirement when the temperature measured by the change-of-resistance method is not more than that specified in the table.

[b] For an electrolytic capacitor that is physically integral with or attached to a motor, the maximum temperature on insulating material integral with the capacitor enclosure shall not be more than 90°C (194°F).

[c] A capacitor that operates at a temperature more than 90°C (194°F) shall be investigated on the basis of its marked temperature limit.

[d] The backsplash or other exterior surface of an under-counter or similarly installed dishwasher subject only to incidental contact during use, shall not be more than 90°C (194°F).

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Table 9
Artificial-aging tests

(See 7.13.3.)

Temperature on component during normal temperature test		Artificial-aging procedure	Minimum percent of original	
°C	(°F)		Tensile strength	Elongation
60 or less	(140 or less)	Immersion for 168 h at 70 ±1°C (158.0 ±1.8°F) in the liquid to which the component is exposed	50	50
60 or less	(140 or less)	Air oven for 70 h at 100 ±1C° (212 ±1.8°F)	60	60
More than 60	(More than 140)	Immersion for 168 h in a boiling solution of commercial dishwashing detergent – 25 g/L of water[a]	50	50
61 – 75	(142 – 167)	Air oven for 168 h at 100 ±1°C (212 ±1.8°F)	60	60
76 – 90	(169 – 194)	Air oven for 168 h at 121 ±1°C (249.8 ±1.8°F)	60	60
91 – 105	(196 – 221)	Air oven for 168 h at 136 ±1°C (276.8 ±1.8°F)	60	60

[a] For a part not subjected to a detergent solution, the applicable agent to which the part is exposed shall be substituted for this test.

Table 10
Current for limited short-circuit test

(See 7.14.1 and 7.14.3.)

Horsepower (kW) rating	Capacity of circuit in amperes	
	0 – 250 V	251 – 600 V
1 (0.746) or less	1000	1000
More than 1 (0.746) – not more than 3 (2.24)	2000	5000
More than 3 (2.24) – not more than 7-1/2 (5.60)	3500	5000
More than 7-1/2 (5.60)	5000	5000

Table 11
Inlet test pressures

(See 9.2.1 and 9.3.1.)

Test gas			Test pressure					
Type	Nominal heating value Btu/ft^3	Nominal specific gravity, (air = 1.0)	Reduced kPa (in w.c)		Normal kPa (in w.c)		Increased kPa (in w.c)	
Natural	1075	(0.65)	0.87	(3.5)	1.74	(7.0)	2.61	(10.5)
Manufactured	535	(0.38)	0.75	(3.0)	1.49	(6.0)	2.24	(9.0)
Mixed	800	(0.50)	0.75	(3.0)	1.49	(6.0)	2.24	(9.0)
n-Butane	3200	(2.00)	1.99	(8.0)	3.23	(13.0)	3.23	(13.0)
Propane (HD-5)	2500	(1.55)	1.99	(8.0)	2.74	(11.0)	3.23	(13.0)

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Table 12
Maximum safety control timings

(See 9.8.2.1, 9.8.2.2, 9.8.3.1, 9.8.3.5, and 9.9.3.1.)

Inputs in W (million Btu per hour)	
Input per individual combustion chamber	**117,228 (0.4)[a] or less**
Total input	**732,678 (2.5) or less**
	Times in second
Continuous ignition:	
Flame-establishing period	120
Flame failure response time	180
Flame failure reignition time	0.8
Valve closing time	b
Intermittent ignition:	
Flame-establishing period	90[c]
Flame failure response time[d]	180
Flame failure reignition time[e]	0.8
Valve closing time	b
Interrupted ignition:	
Ignition means flame-establishing period	90[c]
Main burner flame-establishing period	90
Flame failure response time[d]	180
Flame failure reignition time[e]	0.8
Valve closing time	b
Direct ignition:	
Flame-establishing period	60
Flame failure response time	90
Flame failure reignition time	0.8
Valve closing time	b

[a] For a pilot with an automatic relight system, 15 seconds complies with the requirement.

[b] Included in flame failure response time.

[c] Includes main gas valve opening time.

[d] Applicable to both main burner and pilot flame failure.

[e] Applicable to pilot flame failure reignition only.

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Table 13
Production-line test conditions

(See 10.1.1.)

Primary circuit rating	Condition A		Condition B	
	Potential, volts	Time, seconds	Potential, volts	Time, seconds
105 – 250 V with or without a motor rated 373 W (1/2 hp) or less	1000	60	1200	1
105 – 250 V with motor rated more than 373 W (1/2 hp)	1000+2V[a]	60	1200+2.4V[a]	1
251 – 600 V	1000+2V[a]	60	1200+2.4V[a]	1

[a] Maximum rated voltage in accordance with Clause 7.1.3.

Table 14
Outlet-box marking

(See 14.11.)

Temperature[a] attained in terminal box or compartment during temperature test		Temperature marking	
°C	(°F)	°C	(°F)
61 – 75	(142 – 167)	75	(167)
76 – 90	(169 – 194)	90	(194)

[a] Corrected to an ambient temperature of 25°C (77°F)

Table 15
Conductor ampacities for determination of internal overcurrent protection

(See 4.20.2)

Size AWG	Minimum temperature rating of conductor					
	60°C (140°F)	75°C (167°F)	90°C (140°F)	60°C (140°F)	75°C (167°F)	90°C (140°F)
	Copper			Aluminum or copper-clad aluminum		
22	–	–	10	–	–	–
20	–	–	13	–	–	–
18	–	–	18	–	–	–
16	–	–	24	–	–	–
14	25	30	35	–	–	–
12	30	35	40	25	30	35
10	40	50	55	35	40	40
8	60	70	80	45	55	60
6	80	95	105	60	75	80
4	105	125	140	80	100	110
3	120	145	165	95	115	130
2	140	170	190	110	135	150
1	165	195	220	130	155	175

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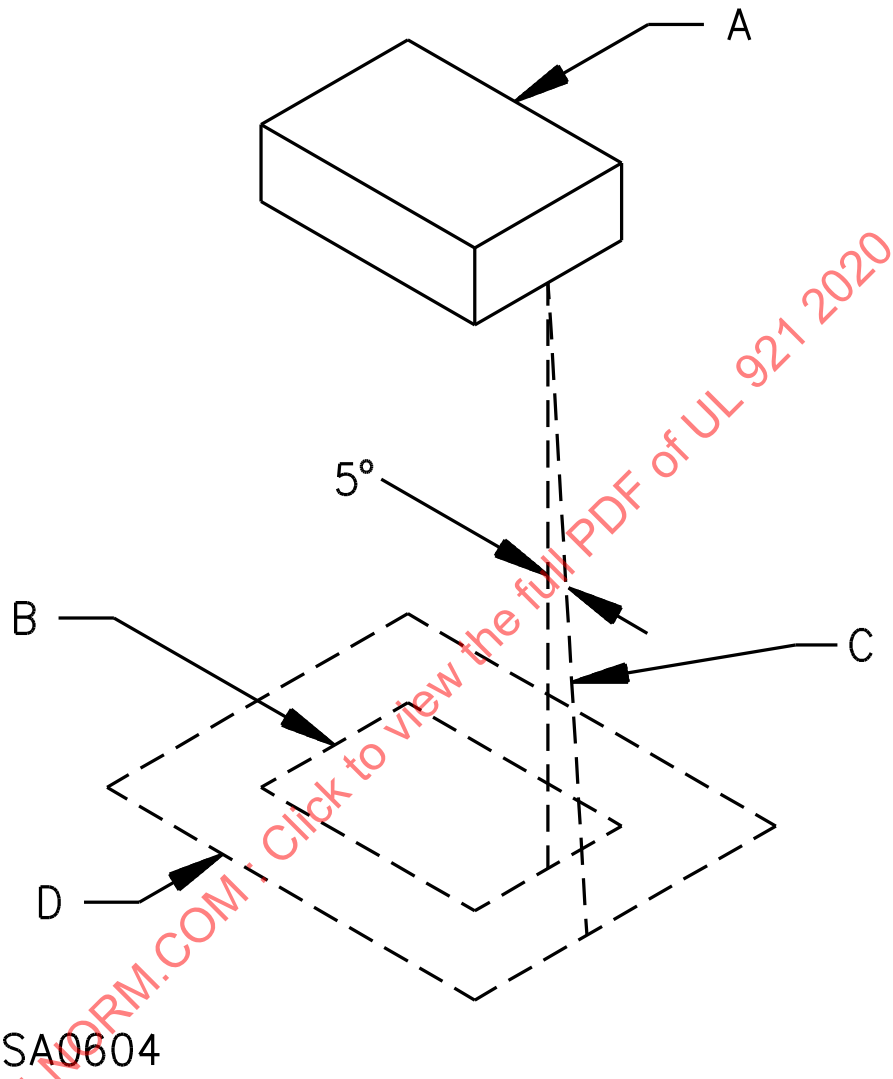
Figure 1

Location and extent of barrier

(See 4.1.18.)



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NOTES –

A – Region to be shielded by barrier. This consists of the entire component when it is not otherwise shielded and consists 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. The line is always:

1) Tangent to the component;

2) 5 degrees (0.09 rad) 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.