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CSA C22.2 No. 168-2005
(Reaffirmed 2011)

American National Standard/
CSA Standard for
Commercial Dishwashers



CSA America, Inc.
ANSI Z83.21-2005
First Edition



Canadian Standards Association
CSA C22.2 No.168-2005
First Edition



Underwriters Laboratories Inc.
UL 921

Commercial Dishwashers



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July 18, 2005
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IGAC

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Preface

This is the common ANSI/CSA America, CSA, and UL standard for Commercial Dishwashers. It contains requirements for both electric and gas-fuelled commercial dishwashers. It is the first edition of ANSI Z83.21, the second edition of CSA C22.2 No. 168, and the sixth edition of UL 921. This edition of CSA C22.2 No. 168 supersedes the previous edition published in 1981, and it also replaces CGA 1.12. This edition of UL 921 supersedes the previous edition.

The Canadian Standards Association (CSA), CSA America, Inc. and Underwriters Laboratories Inc. (UL) prepared this common standard.

This standard was reviewed by:

- The Joint Z83/CSA Technical Advisory Group (TAG) on Standards for Food Service Equipment, under the jurisdiction of the Z21/83 Committee on Performance and Installation of Gas Burning Appliances and Related Accessories and the CSA Technical Committee on Gas Appliances and Related Accessories, and
- The CSA Subcommittee on 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.

The standard has been formally approved by the CSA Technical Committees and the Z21/83 Committee.

The first edition of the harmonized ANSI/CSA/UL standard for commercial dishwashers was approved by the American National Standards Institute (ANSI) as an American National Standard on July 18, 2005, and by the Interprovincial Gas Advisory Council on July 11, 2005.

Safe and satisfactory operation of commercial dishwashers depends to a great extent upon their proper installation, use and maintenance. They should be installed, as applicable, in accordance with the *National Fuel Gas Code*, ANSI/NFPA 54/Z223.1; the *Natural Gas and Propane Installation Code*, CAN/CSA-B149.1; and the *Canadian Electrical Code, Part I*, CSA C22.1.

This publication represents a basic standard for safe operation, substantial and durable construction, and acceptable performance. There are risks of injury to persons inherent in appliances that, if completely eliminated, would defeat the utility of the appliance. The provisions in this standard are intended to help reduce such risks while retaining the normal operation of the appliance.

Nothing in this standard is to be considered in any way as indicating a measure of quality beyond compliance with the provisions it contains. It is designed to allow compliance of commercial dishwashers, the safety, construction, and performance of which may exceed the various provisions specified herein. In its preparation, recognition has been given to possibilities of improvement through ingenuity of design. As progress takes place, revisions may become necessary. When they are believed desirable, recommendations or suggestions should be forwarded to CSA America, Standards Division, 8501 East Pleasant Valley Road, Cleveland, Ohio 44131, or the Chairs of the CSA Technical Committee on Gas Appliances and Related Accessories and the CSA Technical Committee on Consumer and Commercial Products, 5060 Spectrum Way, Suite 100, Mississauga, Ontario, Canada L4W 5N6.

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.

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Level of harmonization

This standard is published as an identical standard for CSA 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.

CSA effective date

The effective date for CSA International will be announced through *CSA Informs* or a CSA certification notice.

UL effective date

As of January 31, 2006 all products Listed or Recognized by UL must comply with the requirements in this standard except for clauses, figures, and tables in the following list, which are effective January 30, 2009.

Clauses 5.1–5.8, 9.1–9.10, 11, 15, 16, 18, Figure 8, and Tables 5, 9, 10

Between January 31, 2006 and January 30, 2009, new product submittals to UL may be evaluated under all requirements in this standard or, if requested in writing, evaluated under presently effective requirements only. A UL effective date is one established by Underwriters Laboratories Inc. and is not part of the ANSI approved standard.

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The Canadian Standards Association (CSA), under whose auspices this National Standard has been produced, was chartered in 1919 and accredited by the Standards Council of Canada to the National Standards system in 1973. It is a not-for-profit, nonstatutory, voluntary membership association engaged in standards development and certification activities.

CSA standards reflect a national consensus of producers and users — including manufacturers, consumers, retailers, unions and professional organizations, and governmental agencies. The standards are used widely by industry and commerce and often adopted by municipal, provincial, and federal governments in their regulations, particularly in the fields of health, safety, building and construction, and the environment.

Individuals, companies, and associations across Canada indicate their support for CSA's standards development by volunteering their time and skills to CSA Committee work and supporting the Association's objectives through sustaining memberships. The more than 7000 committee volunteers and the 2000 sustaining memberships together form CSA's total membership from which its Directors are chosen. Sustaining memberships represent a major source of income for CSA's standards development activities.

The Association offers certification and testing services in support of and as an extension to its standards development activities. To ensure the integrity of its certification process, the Association regularly and continually audits and inspects products that bear the CSA Mark.

In addition to its head office and laboratory complex in Toronto, CSA has regional branch offices in major centres across Canada and inspection and testing agencies in eight countries. Since 1919, the Association has developed the necessary expertise to meet its corporate mission: CSA is an independent service organization whose mission is to provide an open and effective forum for activities facilitating the exchange of goods and services through the use of standards, certification and related services to meet national and international needs.

L'Association canadienne de normalisation (CSA), sous les auspices de laquelle cette Norme nationale a été préparée, a reçu ses lettres patentes en 1919 et son accréditation au sein du Système de Normes nationales par le Conseil canadien des normes en 1973. Association d'affiliation libre, sans but lucratif ni pouvoir de réglementation, elle se consacre à l'élaboration de normes et à la certification.

Les normes CSA reflètent le consensus de producteurs et d'utilisateurs de partout au pays, au nombre desquels se trouvent des fabricants, des consommateurs, des détaillants et des représentants de syndicats, de corps professionnels et d'agences gouvernementales. L'utilisation des normes CSA est très répandue dans l'industrie et le commerce, et leur adoption à divers ordres de législation, tant municipal et provincial que fédéral, est chose courante, particulièrement dans les domaines de la santé, de la sécurité, du bâtiment, de la construction et de l'environnement.

Les Canadiens d'un bout à l'autre du pays témoignent de leur appui au travail de normalisation mené par la CSA en participant bénévolement aux travaux des comités de la CSA et en appuyant ses objectifs par leurs cotisations de membres de soutien. Les quelque 7000 volontaires faisant partie des comités et les 2000 membres de soutien constituent l'ensemble des membres de la CSA parmi lesquels ses administrateurs sont choisis. Les cotisations des membres de soutien représentent une source importante de revenu pour les services de soutien à la normalisation volontaire.

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Outre son siège social et ses laboratoires à Toronto, la CSA possède des bureaux régionaux dans des centres vitaux partout au Canada, de même que des agences d'inspection et d'essai dans huit pays. Depuis 1919, l'Association a parfait les connaissances techniques qui lui permettent de remplir sa mission d'entreprise, à savoir la CSA est un organisme de services indépendant dont la mission est d'offrir une tribune libre et efficace pour la réalisation d'activités facilitant l'échange de biens et de services par l'intermédiaire de services de normalisation, de certification et autres, pour répondre aux besoins de nos clients, tant à l'échelle nationale qu'internationale.

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The American National Standards Institute (ANSI), Inc. is the nationally recognized coordinator of voluntary standards development in the United States through which voluntary organizations, representing virtually every technical discipline and every facet of trade and commerce, organized labor and consumer interests, establish and improve the some 10,000 national consensus standards currently approved as American National Standards.

ANSI provides that the interests of the public may have appropriate participation and representation in standardization activity, and cooperates with departments and agencies of U.S. Federal, state and local governments in achieving compatibility between government codes and standards and the voluntary standards of industry and commerce.

ANSI represents the interests of the United States in international nontreaty organizations such as the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). The Institute maintains close ties with regional organizations such as the Pacific Area Standards Congress (PASC) and the Pan American Standards Commission (COPANT). As such, ANSI coordinates the activities involved in the U.S. participation in these groups.

ANSI approval of standards is intended to verify that the principles of openness and due process have been followed in the approval procedure and that a consensus of those directly and materially affected by the standards has been achieved. ANSI coordination is intended to assist the voluntary system to ensure that national standards needs are identified and met with a set of standards that are without conflict or unnecessary duplication in their requirements.

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History Of The Development Of The Standard For Commercial Dishwashers

(This History is informative and is not part of the standard.)

With the onset of the Free Trade Agreement between the United States and Canada on January 2, 1988, significant attention was given to the harmonization of the United States and Canadian safety standards, addressing gas-fired equipment for residential, commercial, and industrial equipment.

It was believed that the elimination of the differences between the standards would help avoid potential trade barriers and provide an atmosphere in which North American manufacturers could market more freely in the United States and Canada. The harmonization of these standards was also seen as a preliminary step toward harmonization with international standards, which was to become a necessity as Europe moved toward its goal to form the Economic Community (EC) by the early 1990s.

A Z83/CGA Joint Subcommittee on Standards for Gas Food Service Equipment was established, based on membership of the Z83 Subcommittee on Standards for Gas Food Service Equipment and the CGA 1.8, 1.12 & 1.15 Commercial Cooking Appliance Committee.

At its June 1991 meeting, the Joint Gas Food Service Equipment Subcommittee established a working group to develop a harmonized standard for commercial gas dishwashers.

At its August 1992 meeting, the Joint Gas Food Service Equipment Subcommittee requested that Underwriters Laboratories (UL) and the Canadian Gas Association (CGA) work together to harmonize their dishwasher standards. UL and CGA agreed to develop a plan for a harmonized commercial dishwasher standard. It was requested that the Joint Subcommittee provide assistance to process a proposed harmonized commercial dishwasher standard through the American National Standards Institute (ANSI).

At its March/April 1993 meeting, the Joint Gas Food Service Equipment Subcommittee agreed to endorse the concept of a single harmonized commercial dishwasher standard developed by AGA, CGA, and UL. The Joint Subcommittee established a working group to develop recommendations for consideration, including whether the harmonized standards should include coverage for both gas and electric dishwashers.

Several drafts of the proposed harmonized commercial dishwasher standard were discussed by the Z83/CSA Joint Subcommittee and a final draft was distributed for review and comment in May 2002.

At its July 2002 meeting, the draft commercial dishwasher standard was reconsidered and revised in light of comments received and the draft standard was recommended to the Z21/83 Committee and the CSA Technical Committees for consideration.

It was also agreed that since this standard also covered requirements for electric commercial dishwashers and replaced an existing Part II *Canadian Electrical Code* Standard, it would be issued as a new edition of that standard (CSA C22.2 No. 168).

This is the first combined electrical and gas standard to be published by CSA.

The draft harmonized commercial dishwasher standard was approved by the Z21/83 Committee and the CSA Technical Committee on Gas Appliances and Related Accessories by letter ballots dated August 1, 2003 and April 15, 2005, respectively. The CSA Technical Committee on Consumer and Commercial Product approved the draft standard by letter ballot dated April 26, 2005.

The American National Standards Institute (ANSI) approved the first edition of the harmonized Z83/CSA/UL Standard for Commercial Dishwashers on July 18, 2005; and it was also approved by the Interprovincial Gas Advisory Council on July 11, 2005.

The following identifies the designation and year of the harmonized standard:

ANSI Z83.21-2005 • CSA C22.2 No. 168-05 • UL 921-2005

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NOTE

This standard contains SI (Metric) equivalents to the yard/pound quantities, the purpose being to allow the standard to be used in SI (Metric) units. (Standard for use of the International System of Units (SI): The Modern Metric System, IEEE/ASTM SI 10 or Metric Practice Guide, CAN/CSA Z234.1 are used as a guide in making metric conversion from yard/pound quantities.) If a value for a measurement and an equivalent value in other units, the first stated is to be regarded as the requirement. The given equivalent value may be approximate. If a value for a measurement and an equivalent value in other units, are both specified as a quoted marking requirement, the first stated unit, or both shall be provided.

American National Standard/ CSA Standard for 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 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 covers:

- a. Electric dishwashers rated 600V or less, installed in accordance with the *Canadian Electrical Code (CEC)*, Part 1, *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 400,000 Btu/hr (420 MJ/hr) or less, limited to 0.5 psig (3.45 kPa) inlet pressure, installed in accordance with the *National Fuel Gas Code*, *ANSI Z223.2/NFPA 54*, or the *Natural Gas and Propane Installation Code*, *CAN/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.

1.3

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. Definitions

2.1

For the purpose of these requirements the following definitions apply.

2.2

Accessible, Readily – Capable of being reached easily and quickly without the use of tools for operation, adjustment and inspection.

2.3

Air-Circulating Blower - A complete blower assembly, including the blower wheel or fan, the blower housing, and the motor used to provide the means for circulating the air.

2.4

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.

2.5

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.

2.6

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

2.7

Barrier - A partition for the insulation or isolation of electric circuits, for the isolation of electric arcs, or for the isolation of moving parts or hot surfaces. In this respect, a barrier is able to serve as a portion of an enclosure and as a functional part.

2.8

Continuous-Duty Motor - A motor that, under any intended condition of use, is intended to operate unattended and under load for 3 h or more.

2.9

Cord-Connected Dishwasher - A dishwasher that is connected to the electrical supply by a power supply cord or cord set.

2.10

Factory-Wired - The installation of wiring or wiring harnesses on or in the equipment in the factory.

2.11

Field-Wired - The wiring or wiring harnesses which are connected to the equipment in the field.

2.12

Field Wiring Terminal - A terminal to which a power supply or control connection is made in the field when the dishwasher is installed.

2.13

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

2.14

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.

2.15

Gas Ignition Device - A device, either a pilot or an igniter, for igniting gas at a burner.

2.16

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.

2.17

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.

2.18

Multi-Flame Pilot Burner - A pilot burner that produces a single flame with variation in contour under minimum pilot conditions.

2.19

Operational Maintenance – Any operation, accessible without the use of tools, that is able to 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.

2.20

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

2.21

Pilot - A gas flame utilized to ignite the gas at a main burner.

2.22

Pressure-Relief Device - A pressure-actuated valve or rupture member constructed to automatically relieve pressures above normal operating pressures.

2.23

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.

2.24

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.

2.25

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.

2.26

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.

2.27

Single-Flame Pilot Burner - A pilot burner that produces a single flame with substantially uniform contour under minimum pilot conditions.

2.28

Temperature-Limiting Control - A control that functions only under conditions that produce abnormal temperatures.

2.29

Temperature-Regulating Control - A control that functions to regulate the temperature of the dishwasher under normal conditions of use.

2.30

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.

3. General

3.1

Components

3.1.1

Other than indicated in Clause 3.1.2, a component of an appliance covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components used in the appliances covered by this standard.

3.1.2

A component is not required to comply with a specific requirement that:

- a. Involves a feature or characteristic not required in the application of the component in the product covered by this standard; or
- b. Is superseded by a requirement in this standard.

3.1.3

A component shall be used in accordance with its rating established for the intended conditions of use.

3.1.4

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 shall be used only under those specific conditions.

3.2

Units of measurement

3.2.1

The values given in SI (metric) units are mandatory. Any other values given are for information only.

3.3

Reference publications

3.3.1

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

CSA¹ Standards

CSA C22.1-2002, Canadian Electrical Code (CEC), Part I

CAN/CSA C22.2 No. 0.15-2001, Standard for Adhesive Labels

CSA C22.2 No. 8-M 1986, Standard for Electromagnetic Interface (EMI) Filters

CSA C22.2 No. 14-1995, Standard for Industrial Control Equipment

CSA C22.2 No. 24-M1993 (R2003), Standard for Temperature-Indicating and Regulating Equipment

CSA C22.2 No. 55-M1986 (R2003), Standard for Special Use Switches

CSA C22.2 No. 77-1995 (R2004), Standard for Motors with Inherent Overheating Protection

CSA C22.2 No. 100-2004, Standard for Motors and Generators

CAN/CSA B149.1-2005, Natural Gas and Propane Installation Code

CSA C22.2 No. 156-M1987 (R2004), Standard for Solid-State Speed Controls

CAN/CSA C22.2 No. 199-M1989 (R2004), Combustion Safety Controls and Solid-State Igniters for Gas-and Oil-Burning Equipment

CSA C22.2 No. 209-M1985 (R1999), Standard for Thermal Cut-Offs

CAN/CSA C22.2 No. 223-M1991 (R1999), Standard for Power Supplies with Extra-Low-Voltage Class 2 Outputs

CSA C22.2 No.248-1-00, Standard for Low-Voltage Fuses-Part1: General Requirements

CSA C22.2 No. 248-14-00, Standard for Low Voltage Fuses-Part 14: Supplemental Fuses

UL² Standards

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

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 353, Standard for Limit Controls

UL 372, Standard for Primary Safety Controls for Gas- and Oil-Fired Dishwashers

UL 429, Standard for Electrically Operated Valves

UL 508, Standard for Industrial Control Equipment

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

UL 795, Standard for Commercial-Industrial Gas Heating Equipment

UL 873, Standard for Temperature-Indicating and -Regulating Equipment

UL 969, Standard for Marking and Labeling Systems

UL 1004, Standard for Electric Motors

UL 1054, Standard for Special-Use Switches

UL 1449, Standard for Transient Voltage Surge Suppressors

UL 1585, Standard for Class 2 and Class 3 Transformers

UL 2111, Standard for Overheating Protection for Motors

UL 60691, Standard for Thermal-Links (Thermal Cutoffs) for Use in Electrical Appliances and Components

ULC³ Standards

CAN/ULC S102-2003, Standard for Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

ANSI⁴ Standards

ANSI/ISA MC96.1-1982, Standard for Temperature-Measurement Thermocouples

ANSI Z21.15-1997, (R2003)/CGA 9.1-M97, Standard for Manually-Operated Gas Valves for Appliances, Appliance Connector Valves, and Hose End Valves

ANSI Z21.18-2000/CGA 6.3-2000, Standard for Gas Appliance Pressure Regulators

ANSI Z21.20-2005, Standard for Automatic Gas Ignition Systems and Components

ANSI Z21.21-2000/CSA 6.5-2000, Standard for Automatic Valves for Gas Dishwashers

ANSI Z21.22-1999/CSA 4.4-M99, Standard for Relief Valves for Hot Water Supply Systems

ANSI Z21.23-2000, Standard for Gas Appliance Thermostats

ANSI Z21.35-2005/CSA 6.8-2005, Standard for Pilot Gas Filters

ANSI Z21.78-2000/CGA 6.20-2000, Combination Gas Controls for Gas Appliances

ASME⁵ Standards

ANSI/ASME B36.10-M2000, Requirement for Welded and Seamless Wrought Steel Pipe

ANSI/ASME B1.20.1-1983, Standard for Pipe Threads, General Purpose (Inch)

NFPA⁶ Standards

ANSI Z223.1/NFPA 54-2002, National Fuel Gas Code

NFPA 70-2002, National Electrical Code (NEC)

ANSI/NFPA 96-2001, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

ANSI/NFPA 211-2003, Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances

¹ Canadian Standards Association (CSA America, Inc.)

² Underwriters Laboratories Inc.

³ Underwriters Laboratories of Canada

⁴ American National Standards Institute

⁵ American Society of Mechanical Engineers

⁶ National Fire Protection Association

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 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.

- Exceptions:*
1. *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 14.16. See Clauses 4.4.5 and 4.9.2.*
 2. *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 14.16); and*
 - b. *the installation instructions and marking provide the information required for proper installation.*

4.1.5

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

4.1.6

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.

4.1.7

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 UL 723, *Standard for Tests for Surface Burning Characteristics of Building Materials*; or CAN/ULC-S102, *Standard for Method of Test for Surface Burning Characteristics of Building Materials and Assemblies*.

- Exceptions:*
1. *A flame spread rating is not required for finishes and parts immersed in water.*
 2. *A flame spread rating is not required for gaskets forming an air or water seal between metal parts.*

3. *A flame spread rating is not required for 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 cm² (25 in²).*
4. *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 m² (10 ft²). 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 UL 94, Standard Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.*

4.1.8

A cast- or sheet-metal section of an enclosure shall have a thickness not less than that specified in Table I, Minimum Thickness of Enclosure Metal.

4.1.9

Reinforcement as specified in Table I, Minimum Thickness of Enclosure Metal, 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.

4.1.10

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.

4.1.11

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.

4.1.12

Compliance with Clause 4.1.11 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 Abnormal Operation Test, Clause 7.15, and Blocked Plunger Test, Clause 7.16.

Exception: Component terminals are not required to be enclosed.

4.1.13

Compliance with Clause 4.1.11 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 that, regardless of the motor insulation system class rating:
 - (a) 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
 - (b) The temperature of the motor windings does not exceed 150°C (302°F) with the rotor of the motor locked;

Exception: A motor with overload protection that provides the level of locked-rotor protection for a shaded-pole motor as described in Exception No. 2 to Clause 4.18.2 complies with the requirement.

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.

4.1.14

The barrier specified in Clause 4.1.13 shall:

- a. Be horizontal or at such an angle that falling molten, burning, or flaming materials hitting the barrier does 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.

4.1.15

With reference to Clause 4.1.13, 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 through 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 is able to 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.

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.

Exception: The operating handle of a circuit breaker, the operating button of a manually-reset motor protector, or 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.

Exception: 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.

Exception: 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 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 is able to 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:

- a. An opening complies with the requirement when a 19.1 mm ($\frac{3}{4}$ in) diameter rod is not able to 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.
- b. For an opening that enables a 19.1 mm ($\frac{3}{4}$ 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 in (X mm) or more from the perimeter of the opening; and
- b. Outside the volume generated by projecting the perimeter X in (X mm) normal to the plane.

The dimension X equals five times the diameter of the largest-diameter rod that is able to 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.

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.

- Exceptions:*
1. *An enclosure is not required for insulated wiring.*
 2. *An enclosure is not required for a solenoid, a solenoid valve, a relay, or a motor-starting relay whose malfunction or breakdown does not result in a risk of fire.*
 3. *An enclosure is not required for a motor protected in accordance with Clause 4.1.13-a3, and Clause 4.1.13-a4.*

4. *An enclosure is not required for a component more than 76.2 mm (3 in) from the back, top, and side surfaces of the smallest compartment that encloses the dishwasher.*

4.4.6

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.

4.4.7

The part arrangement described in Clause 4.4.6 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.

- Exceptions:*
1. *The corrosion protection treatment is not required for a bearing, a balance weight, a lamination, or a minor part of iron or steel such as a washer or screw.*
 2. *The corrosion protection treatment is not required for an iron or steel part where corrosion of the part does not result in a risk of fire, electric shock, or injury to persons.*

4.5.2

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.

- Exceptions:*
1. *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;*
 - 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.*
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.*

4.6.2

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.

4.6.3

An uninsulated live part shall be secured 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.

4.6.4

Friction between surfaces shall not be used as the only means to reduce the risk of rotation specified in Clause 4.6.3. 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 portable dishwasher shall be provided with a power-supply cord.

4.7.1.2

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

4.7.1.3

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

4.7.1.4

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).

Exception: 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.

4.7.1.5

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.

4.7.1.6

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.

Exception: 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.

4.7.1.7

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 [14.6](#).

4.7.1.8

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 Strain Relief Test, Clause [7.23](#).

4.7.1.9

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.

4.7.1.10

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.

4.7.1.11

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.

4.7.1.12

Means shall be provided so that a flexible cord is not able to 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; or
- 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 the Push-Back Relief Test, Clause [7.24](#).

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.

Exception: A dishwasher provided with an extension 1.83 m (6 ft) maximum in length to extend the point of supply connection to an accessible location remote from the dishwasher complies with the requirement.

4.7.2.3

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.

4.7.2.4

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.

4.7.2.5

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.

4.7.2.6

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.

4.7.2.7

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 4.22.8.

4.7.2.8

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.

4.7.2.9

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.

4.7.2.10

The requirements in Clause 4.7.2.9 related to color coding do not apply to internal wiring.

4.7.2.11

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

- a. The lead shall not be smaller than No. 18 AWG (0.82 mm²);
- 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.

4.7.2.12

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 Clause 14.12; or
- b. The current rating of the dishwasher when the dishwasher is not marked as indicated in -a.

4.7.2.13

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).

4.7.2.14

A field-wiring terminal shall be provided with a soldering lug or with a pressure wire connector. The lug or connector shall be firmly bolted or held by a screw.

Exception: The use of a wire-binding screw at a terminal intended to accommodate a No. 8 AWG (8.4 mm²) or smaller conductor complies with the requirement. Upturned lugs or the equivalent shall be provided to hold the wire in position.

4.7.2.15

A field-wiring terminal shall not rotate.

4.7.2.16

A wire-binding screw shall thread into metal.

4.7.2.17

A wire-binding screw at a field-wiring terminal shall not be smaller than No. 10.

- Exceptions:*
1. *Using a No. 8 screw at a terminal intended for the connection of a No. 14 AWG (2.1 mm²) conductor complies with the requirement.*
 2. *Using a No. 6 screw for the connection of a No. 16 or 18 AWG (1.3 or 0.82 mm²) control-circuit conductor complies with the requirement.*

4.7.2.18

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. There shall not be less than two full threads in the metal.

Exception: A plate not less than 0.030 in (0.76 mm) thick is able to be used for tapped threads investigated and found to have the required mechanical strength.

4.7.2.19

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 4.7.2.18.

4.7.2.20

An upturned lug or a cupped washer shall retain a conductor of the size specified in Clause 4.7.2.11 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. Iron or steel shall not be used as a current-carrying part.

Exception: A plated iron or steel part used as a current-carrying part complies with the requirement:

- a. *When the temperature of the part during intended operation is more than 100°C (212°F);*
- b. *Where the part is within a motor or associated governor; or*
- c. *Where the part complies with Clause 3.1.1.*

4.9

Internal wiring

4.9.1

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

Exception: Flexible cord is not required to be enclosed or protected:

- a. When the cord is one of the types specified in Clause 4.7.1.4 and the Exception to Clause 4.7.1.4;
- b. When the cord complies with Strain Relief Test, Clause 7.23; and