

**Underwriters Laboratories Inc.®**A not-for-profit organization dedicated to public safety
and committed to quality service**June 13, 1994****Revision pages for****Standard for****Commercial Electric Dishwashers****UL 921, Fourth Edition**

Attached to this transmittal notice is a revision of the Fourth edition of UL 921.

A CHANGE ON A PAGE DATED JUNE 13, 1994 IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE
AFFECTED ITEM, PRECEDED AND FOLLOWED BY AN ASTERISK.

THESE NEW AND REVISED REQUIREMENTS ARE NOW IN EFFECT.

The new and revised requirements are substantially in accordance with UL's bulletin on this subject dated
August 9, 1993. The bulletin is now obsolete and may be discarded.

Revised and/or additional pages may be issued from time to time.

With the inclusion of the accompanying material, the standard consists of pages dated as shown in the
following checklist:

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UL 921

Standard for

Commercial Electric Dishwashers

First Edition – March, 1970

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Fourth Edition

August 7, 1992

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Revisions of this standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest published set of revision pages.

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FOREWORD

A. This Standard contains a description of the basic test method(s) for evaluating products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. This test method(s) is based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. It is subject to revision as further experience and investigation may show is necessary or desirable.

B. The consistent and uniform production of the product so that it will perform in the manner indicated by the coverage is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which performs in a specified manner will not necessarily be judged to be eligible for coverage if, when examined and tested, it is found to have other features which impair the significance associated with such performance.

D. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

E. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements cover commercial freestanding, under-counter, and counter-insert dishwashers and glass-washers for use with water as the principal cleaning medium. These requirements cover dishwashers rated 600 volts or less, employing no universal motor rated more than 250 volts, for use in ordinary locations in accordance with the National Electrical Code, NFPA 70.

1.2 A commercial dishwasher may be provided with immersion-type electric heaters for heating water in open tanks. A dishwasher that utilizes some other source of energy – such as gas or steam – in addition to electric energy will be investigated under these requirements and under such additional requirements as are applicable to the dishwasher under consideration. Storage-tank water heaters and electric boilers are not covered by these requirements.

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

1.4 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involve a risk of fire, electric shock, or injury to persons, shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the acceptable level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard cannot be judged to comply with this standard. Where considered appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

1.4 revised June 13, 1994

2 Glossary

2.1 For the purpose of this standard the following definitions apply.

2.2 **AUTOMATICALLY CONTROLLED** – A dishwasher or a unit of a system for which energization of a motor, a solenoid, a magnet, or the like will occur without manual intervention, or during any single predetermined cycle of operation, automatic changing of the mechanical load can reduce the speed of a motor sufficiently to reestablish starting-winding connections to the branch circuit.

2.3 **CONTINUOUS-DUTY MOTORS** – A motor that, under any normal condition of use, can operate unattended and under load for 3 hours or more.

2.4 **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.

2.5 **SAFETY CIRCUIT** – A primary or secondary circuit that is relied upon to reduce a risk of fire, electric shock, or injury to persons.

2.6 **TEMPERATURE-LIMITING CONTROL** – A control that functions only under conditions that produce abnormal temperatures.

2.7 **TEMPERATURE-REGULATING CONTROL** – A control that functions to regulate the temperature of the dishwasher under normal conditions of use.

3 General

3.1 Components

3.1.1 Except as indicated in 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 generally used in the appliances covered by this standard.

3.1.2 A component need not comply with a specific requirement that:

- a) Involves a feature or characteristic not needed in the application of the component in the appliance 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 recognized rating established for the intended conditions of use.

3.1.4 Specific components are recognized as being incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits and shall be used only under those specific conditions for which they have been recognized.

3.2 Units of measurement

3.2.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

3.3 Undated references

3.3.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

CONSTRUCTION

4 General

4.1 A dishwasher shall employ materials that are acceptable for the particular use.

5 Frame and Enclosure

5.1 General

5.1.1 A dishwasher shall be formed and assembled so that it will have the strength and rigidity necessary to resist the abuses to which it is likely to be subjected, 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.

5.1.2 A dishwasher shall be provided with enclosures of material acceptable for the application that will house all parts that may result in a fire, electric shock, or injury to persons under any condition of use.

Exception No. 1: Side and back panels of a dishwasher intended to be mounted in or under a counter may be omitted from a dishwasher marked in accordance with 54.2.17. See 6.5 and 11.8.

Exception No. 2: A portion of an overall enclosure may be omitted from a dishwasher intended to be installed in conjunction with other equipment so that the latter will complete the enclosure, if installation instructions and marking provide the information necessary for proper installation. See 54.2.5, 54.2.12, and 54.2.17.

5.1.3 An enclosure consisting of individual components, outer cabinets, and combinations of the two is taken into consideration in applying the requirement in 5.1.2.

5.1.4 Among the factors taken into consideration when the acceptability of an enclosure is being investigated are its:

- 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 may be subjected under conditions of normal or abnormal use, and
- g) For a nonmetallic enclosure, (a) – (f) are to be considered with respect to thermal aging.

5.1.4 revised June 13, 1994

5.1.5 A cast- or sheet-metal section of an enclosure shall have a thickness not less than that specified in Table 5.1 and 5.1.6.

Table 5.1
Minimum acceptable thickness of enclosure metal

Material	Reinforced surfaces^a, Inch (mm)	Surfaces to which a wiring system is to be connected in the field, Inch (mm)	Relatively large unreinforced flat surfaces, Inch (mm)
Die-cast metal	3/64 (1.2)	1/4 (6.4) ^b	5/64 (2.0)
Cast malleable iron	1/16 (1.6)	1/4 (6.4) ^b	3/32 (2.4)
Other cast metal	3/32 (2.4)	1/4 (6.4) ^b	1/8 (3.2)
Uncoated sheet steel	0.026 (0.66)	0.032 (0.81)	0.026 (0.66)
Galvanized sheet steel	0.029 (0.74)	0.034 (0.86)	0.029 (0.74)
Nonferrous sheet metal	0.036 (0.91)	0.045 (1.14)	0.036 (0.91)
^a Includes small, flat, unreinforced surfaces and surfaces of a shape or size that provides mechanical strength.			
^b Not less 1/8 inch (3.2 mm) at an untapped hole.			

Table 5.1 revised June 13, 1994

5.1.6 The thickness of an enclosure where the face of an attachment-plug receptacle projects through it shall not be less than:

- a) For ferrous metal, 0.030 inch (0.76 mm); or
- b) For nonferrous metal, 0.040 inch (1.02 mm); or
- c) For insulating material, 0.10 inch (2.5 mm).

Exception: An enclosure of insulating material may be thinner if formed or reinforced so as to provide equivalent mechanical strength.

5.1.7 Reinforcement as specified in Table 5.1 need not consist of a complete frame for all edges but a sufficient number of reinforcing members shall be employed to provide additional support for all surfaces.

5.1.8 An enclosure shall prevent molten metal, burning insulation, flaming particles, or the like from falling on combustible materials, including the surface upon which a dishwasher is supported.

5.1.9 The requirement in 5.1.8 necessitates that a switch, a relay, a solenoid, or the like be completely enclosed, excepting the terminals unless it can be shown that malfunction or breakdown of the component would not result in a risk of fire, or unless there are no openings in the bottom of the enclosure. See Blocked Solenoid Test, Section 44.

5.1.9 revised June 13, 1994

5.1.10 The requirement in 5.1.8 necessitates the use of a barrier of noncombustible material:

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 to the surface that supports the dishwasher when the motor is energized under each of the fault conditions of open main winding, open starting winding, and starting switch short-circuited;
- 3) The motor is provided with a thermal protector that will prevent the temperature of the motor windings from exceeding 125°C (257°F) under the maximum load under which the motor will run without causing the protector to cycle and from exceeding 150°C (302°F) with the rotor of the motor locked; or

Exception: The thermal protector need only provide acceptable locked-rotor protection for a shaded-pole motor as described in Exception No. 2 to 19.2.

- 4) The motor is impedance protected and the locked-rotor temperature of its winding does not exceed 150°C (302°F) with the dishwasher otherwise operating normally.

b) Under wire, unless it is flame-retardant, such as neoprene- or thermoplastic-insulated wire.

5.1.11 The barrier mentioned in 5.1.10 shall be horizontal, shall be located as illustrated in Figure 5.1, and shall have an area not less than that described in that illustration. Openings for drainage, ventilation, and the like, that do not permit molten metal, burning insulation, or the like to fall on combustible material may be employed in a barrier.

Table 54.1
Outlet-box marking

Temperature ^a attained during test in terminal box or compartment, °C (°F)	Temperature marking, °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 54.1 revised June 13, 1994

54.2.9 An appliances having field-wiring terminals shall be marked:

- a) "Use Copper Conductors Only," if the terminal is acceptable only for connection to copper wire.
- b) "Use Aluminum Conductors Only," if the terminal is acceptable only for connection to aluminum wire.
- c) "Use Copper or Aluminum Conductors" or "Use Copper, Copper-Clad Aluminum, or Aluminum Conductors," if the terminal is acceptable only for connection to either copper or aluminum wire.
- d) "Use Copper-Clad Aluminum, or Copper Conductors," if the terminal is acceptable only for connection to either copper or copper-clad aluminum wire.

54.2.9 effective August 31, 1993

54.2.10 Unless marked in accordance with 54.2.1, 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 can properly be connected shall be clearly and permanently marked, in a location that will be 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 33.1, 33.2, and 42.2.

54.2.11 A dishwasher that will not start and attain normal running speed when connected to a circuit protected by a quick-acting – not a time-delay-fuse as described in the exception to 33.1 shall be plainly marked with the words: "If connected to a circuit protected by fuses, use time-delay fuses with this dishwasher," or an equivalent wording.

54.2.12 The manufacturer shall provide all instructions, including wiring diagrams and other pertinent data, necessary for proper assembly, installation, operation, and maintenance of the dishwasher.

54.2.13 A dishwasher for which it is necessary that exhaust air be vented for proper operation shall be provided with explicit instructions specifying:

- a) How the dishwasher should be vented; and
- b) That the exhaust air should not be vented into a wall, a ceiling, or a concealed space of a building.

54.2.14 The instructions described in 54.2.13 may be included in the installation-instruction book, or marked on the dishwasher in a location that will be visible when the exhaust system is being installed.

54.2.15 Each connection point for an external supply of steam, air, or the like shall be provided with a paper sticker or tag that is marked with the maximum pressure limitation, such as: "Steam ____ psi maximum."

54.2.16 The rating plate of a dishwasher intended for use with a chemical sanitizing additive shall include the following cautionary marking or the equivalent: "Do not connect to hot-water supply exceeding a temperature of ...°F (...°C)" if the manufacturer recommends an inlet-water temperature less than 82°C (180°F)." The temperature value shall be the manufacturer's recommended water temperature for the dishwasher.

54.2.17 A dishwasher that is shipped from the factory without the back and both sides of the enclosure mounted in place shall be marked in a location that the marking will be visible when connections to the power-supply circuit are made: "Not provided with complete enclosure. Enclosure for sides and back to be provided at time of installation," or equivalent information shall be provided in instructions packed with the dishwasher.

54.3 User servicing

54.3.1 A dishwasher that has plug-in provisions (see 25.1 – 25.7) for the installation of a specific electrical accessory shall be marked plainly with the name and model number of the accessory. Instructions for the installation of the accessory shall be marked on the accessory or shall be included in literature supplied with the accessory. See 21.1 and 53.5 for general-use receptacles.

54.3.2 A dishwasher that needs cleaning or similar servicing by the user, including replacement of a fusible link or resetting a manually reset limit control, involving the exposure of any normally enclosed or guarded uninsulated live part to unintentional contact shall be plainly marked with a warning that such servicing should be done with the dishwasher disconnected from the power-supply circuit.

54.3.3 If side panels of a dishwasher can be removed without the use of tools and if tests are conducted with the panels in place as described in 38.3, the dishwasher shall be plainly marked: "Have side panels in place when cleaning machine and surrounding areas," or with an equivalent marking. One location for the marking is adequate if it is permanently visible to the user.

54.4 Operation information

54.4.1 A dishwasher that employs an indicator light in accordance with 22.3.4 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: "If light goes on, turn off appliance or disconnect from power supply and have it serviced by a qualified technician." The word "WARNING" shall be in letters not less than 3/32 inch (2.4 mm) high.

GAS-FIRED DISHWASHERS

55 Scope

55.1 These requirements cover only the gas-handling, gas-burning, and gas-control features of gas-fired commercial dishwashers having inputs of 400,000 Btu (420 MJ) per hour or less.

55A Glossary

55A.1 For the purpose of these requirements the following definitions apply.

55A.1 added June 13, 1994

55A.2 **AUTOMATIC GAS IGNITION SYSTEM** – A system intended to automatically ignite gas at the main burner or at the pilot burner, and shut-off the gas supply to the main burner and the pilot burner, if provided, when the flame is not ignited. The system may incorporate the ignition means and flame detection device in separate or integral controls.

55A.2 added June 13, 1994

55A.3 **FLAME-ESTABLISHING PERIOD** – The period of time between initiation of gas flow and proof of the supervised flame or between the proof of supervised flame and initiation of gas flow. This may be applicable to proof of ignition source, proof of main burner flame, or both.

55A.3 added June 13, 1994

55A.4 **IGNITER** – A device that utilizes electrical energy to ignite gas at a pilot burner or at a main burner.

55A.4 added June 13, 1994

55A.5 **IGNITION DEVICE** – A device for igniting gas at a burner. It may be a pilot or an igniter.

55A.5 added June 13, 1994

55A.6 **MULTI-FLAME PILOT BURNERS** – Pilot burners that produce a single flame with variation in contour under minimum pilot conditions.

55A.6 added June 13, 1994

55A.7 **PILOT** – A small gas flame utilized to ignite the gas at a main burner.

55A.7 added June 13, 1994

55A.8 **SINGLE-FLAME PILOT BURNERS** – Pilot burners that produce a single flame with substantially uniform contour under minimum pilot conditions.

55A.8 added June 13, 1994

56 Construction

56.1 Fuel system

56.1.1 A gas-fired commercial dishwasher shall be constructed of materials acceptable for the purpose and of sufficient strength and durability to provide reliable service of the parts and the assembly for an extended period of service.

56.1.2 Fuel-confining parts shall be made of material having a melting point – solidus temperature – of not less than 510°C (950°F) and a tensile strength of not less than 10,000 pounds per square inch (68.9 MPa) at 204°C (400°F). Such parts shall not sag, distort, melt, oxidize, or show leakage of fuel during any of the tests specified in Sections 57 – 62.

56.1.3 Each burner, mixer, valve, pressure, regulator, piping, tubing, fitting, thermostatic operator, electric safety valve, and primary safety control shall be acceptable for the application.

56.1.4 An air shutter shall be readily adjustable to any desired setting and shall be provided with means for preventing unintentional change in setting. A sheet-metal air shutter shall not be less than 0.026 inch (0.66 mm) thick. A sheet-metal air shutter having a thickness less than 0.053 inch (1.35 mm) shall have the outer edge turned at right angles or shall be otherwise reinforced.

56.1.5 An air shutter shall be protected against sticking or corroding in position. Screws or bolts used for attaching or adjustment shall be of corrosion-resistant materials.

56.1.6 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 be such as to 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 0.031 inch (0.79 mm).

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

56.1.8 A main-burner assembly intended to operate at a manifold pressure of less than 6 inches (152 mm) water column when firing natural gas or of less than 10 inches (254 mm) water column when firing liquefied petroleum gas (LP-gas) shall be equipped with a pressure regulator.

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

a) Provide for ignition of the main burner by means of a proved pilot. If the presence of the ignition source is not proved, the automatic gas ignition system shall provide for automatic shutoff of main burner gas and the pilot burner gas, except if the appliance is intended for use with fuel gases having a specific gravity greater than 1.0, and is equipped with an automatic relight pilot system.

b) Provide 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. If the presence of the main burner flame is not proved, the automatic gas ignition system shall provide for automatic shutoff of 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 main burner gas without reenergizing the direct ignition system or provide for reignition of main burner gas by reenergizing the direct ignition system as specified in 60A.2.2, 60A.3.1, and 60A.3.2.

56.1.9 revised June 13, 1994

56.1.10 In addition to the automatic gas ignition system functions specified in 56.1.9(a), an automatic gas ignition system having an interrupted ignition source shall provide for supervision of the main burner flame only following the main burner flame establishing period. If the presence of the main burner flame is not proved within the flame establishing period, the automatic gas ignition system shall provide for automatic shutoff of main burner gas.

56.1.10 revised June 13, 1994

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

56.1.10.1 added June 13, 1994

56.1.11 A pilot shall ignite the main burner or burners without creating a risk of fire or injury to persons. A pilot burner and a pilot-flame-sensing device shall be supported so that their position relative to each other and to the main burner or burners will remain fixed.

56.1.12 A pilot burner that is not automatically lighted shall be placed so that it can be lighted manually without creating a risk of fire or injury to persons.

56.1.13 The control system shall be such that gas cannot be admitted to any main burner while the pilot is being lighted, either manually or automatically, and until the primary safety control will remain in its normal open position.

56.2 Venting

56.2.1 A dishwasher constructed or intended to be connected directly to a venting system shall be equipped with an integral draft hood or shall be furnished with a separate draft hood that may be readily attached when the dishwasher is installed. The flue-gas outlet of the dishwasher – or of the draft hood, if furnished separately – shall be of a size and shape that permits direct, ready connection of standard-trade-size round or oval vent pipe.

57 Test Conditions

57.1 The dishwasher is to be located in a room that is free from drafts. It is to be connected for tests to a gas-supply line not less than 3/4 inch nominal size and of the shortest practical length to minimize pressure drop in the lines. The gas-supply line is to include a meter located near the machine, a manual-shutoff valve, and a line-pressure regulator of the adjustable type.

57.2 Gas pressure is to be measured by a water manometer connected at the inlet to the dishwasher or at the inlet to the dishwasher pressure regulator, if provided. The pressure at the outlet of the pressure regulator, if provided, is to be adjusted as recommended by the manufacturer. This adjustment is not to be changed during any of the tests unless otherwise specified.

57.3 The dishwasher is to be fired with each kind of gas specified on its nameplate. A dishwasher intended for use with liquefied petroleum gases is to be tested with butane only, except that if the dishwasher is:

- a) Equipped with separate burners or other equipment for propane and butane gases, tests on the butane equipment are to be conducted with butane and on the propane equipment with propane, or
- b) Intended for use with propane gas only, tests are to be conducted with propane only.

57.4 Primary air adjustments are to be made after 15 minutes of operation at normal gas pressure. No change in adjustments is to be made subsequently for tests at other pressure or inputs. The burner input is to be the manufacturer's specified Btu rating plus or minus 2 percent.

57.5 Unless otherwise specified, each test is to be conducted:

- a) At normal pressure,
- b) At reduced pressure, and
- c) At increased pressure.

A change in the rated gas input at a test pressure above or below the normal pressure is not to be corrected.

Exception: If a pressure regulator is provided and if the manifold pressure at the increased test pressure is not more than the manifold pressure at normal test pressure, the tests at the increased test pressure need not be performed. However, tests at normal test pressure are to be conducted whenever tests at the increased test pressure only are specified.

57.6 Inlet test pressures are to be as specified in Table 57.1; and test gases are to have the approximate characteristics specified.

57.6 revised June 13, 1994

Table 57.1
Inlet test pressures and approximate gas characteristics

Gas	Heating value Btu per cu ft (MJ/m ³)	Specific gravity	Inlet test pressure — per inches (mm) water column		
			Reduced	Normal	Increased
Natural	1000 (38)	0.60	3.5 (89)	7.0 (178)	10.5 (266)
LP (propane)	2500 (94)	1.53	8 (203)	11 (279)	13.0 (330)

Table 57.1 revised June 13, 1994

58 Burner and Pilot Operating Characteristics

58.1 Btu input

58.1.1 Main burner and pilot burner flames shall comply with 58.1.2, 58.1.3 and 58.1.5 under the following conditions. Observations are to be made of each ignition and extinction of the main burner and pilot burner with the main burner both hot and cold:

- a) Upon immediate ignition at all rated Btu inputs, and at normal, reduced, and increased inlet pressures;
- b) For the main burner — at a gas rate one-third the full supply at normal inlet test pressure;

Exception: Dishwashers equipped with snap-action main burner controls, need not comply with the tests at one-third the full supply.

- c) If the appliance is equipped with automatic multirate or automatic modulating controls that provide for ignition and operation at a reduced input rating, the main burner is to be turned on and off at 87 percent of the lowest input Btu rating; and

- d) If the appliance is equipped with automatic modulating controls that act to reduce the input rating after ignition of the main burner gas, the main burner is to be adjusted to 87 percent of the lowest input Btu rating.

58.1 revised and relocated as 58.1.1 June 13, 1994

58.1.2 A burner and pilot arrangement shall be such that the gas is effectively ignited without flashback, delayed ignition, igniting at the orifice, flashing outside the combustion space, or damage to the appliance. The flames shall carry across all ports and burn at all ports of the burner. Main burner flames shall be approximately uniform in length over the entire burner. The main burner shall ignite and extinguish without extinguishing a continuous pilot.

58.3 revised and relocated as 58.1.2 June 13, 1994

58.1.3 Burners shall not expel gas through air openings in mixer faces.

58.5 revised and relocated as 58.1.3 June 13, 1994

58.1.4 To determine whether a dishwasher complies with the requirement in 58.1.3, a flame is to be played on the burner mixer face in such a manner that any air-gas mixture escaping from the mixer faces will be ignited.

58.6 revised and relocated as 58.1.4 June 13, 1994

58.1.5 The pilot shall not deposit carbon during any of the tests described in 58.1.1 and 58.1.4.

58.8 revised and relocated as 58.1.5 June 13, 1994

58.2 Reduced voltage

58.2.1 A dishwasher is to be adjusted to fire at normal inlet gas pressure at rated input. The voltage to the appliance is to be adjusted to 85 percent of rated voltage. Under the reduced voltage conditions specified, a dishwasher equipped with an automatic (non-manual) gas pilot ignition system shall ignite the pilot burner within 30 seconds after gas reaches the pilot burner ports and shall ignite the main gas burner without flame flashback or damage to the appliance. At least 10 ignition attempts of the pilot and main burner shall be made.

58.2.1 added June 13, 1994

58.3 Flame establishing period

58.3.1 The time from initiation of gas flow to proof of a supervised flame shall not exceed the ignition means flame establishing periods specified in Table 58.1.

58.3.1 added June 13, 1994

Table 58.1
Ignition means flame establishing period

Type of automatic gas ignition system	Maximum timing seconds
Continuous ignition	120
Intermittent ignition	90
Interrupted ignition	90
Direct ignition	60

Table 58.1 added June 13, 1994

58.3.2 When an interrupted or intermittent pilot is used, the time required for the main burner flame to be proved from initiation of main gas flow shall not exceed 90 seconds.

58.3.2 added June 13, 1994

58.3.3 The time required for the automatic gas ignition system to shut off the main gas supply following loss of supervised flame shall not exceed 180 seconds.

58.3.3 added June 13, 1994

58.3.4 The time required for an automatic gas ignition system with automatic return of ignition of the pilot upon flame failure conditions, to provide reignition of the pilot upon loss of supervised flame shall not exceed 0.8 seconds.

58.3.4 added June 13, 1994

59 Test on Automatic Pilot Igniters

Section 59 deleted June 13, 1994

59A Tests on Piloted Ignition Systems

59A.1 Continuous pilot ignition test

59A.1.1 A continuous pilot when tested in accordance with 59A.1.2 – 59A.1.4, shall effect ignition of gas at the main burner after gas reaches the main burner port. The continuous pilot shall not become extinguished and remain extinguished when the gas to the main burner is turned on or off in a normal manner, either manually as specified in 59A.1.3, or automatically as specified in 59A.1.4. Ignition of the main burner shall be obtained without flashback, delayed ignition, igniting at the orifice, flashing outside of the combustion space, damage to the appliance or continued extinction of the pilot.

59A.1.1 added June 13, 1994

59A.1.2 The tests described in 59A.1.3 and 59A.1.4 are to be conducted at reduced, normal and increased inlet pressures. The pilot burner, main burner and automatic igniter, if provided, are to be adjusted according to the manufacturers instructions, and all gas piping is to be filled with gas.

59A.1.2 added June 13, 1994

59A.1.3 Gas is to be admitted to the main burner by fully turning-on, in a continuous movement, any manual means provided for main burner ignition. At least 25 successive ignition tests shall be conducted with the main burner gas flow maintained for 30 seconds and interrupted for 30 seconds for each cycle.

59A.1.3 added June 13, 1994

59A.1.4 After completion of the tests specified in 59A.1.3, the tests are to be repeated using any automatic means provided for controlling main burner gas flow.

59A.1.4 added June 13, 1994

59A.2 Minimum pilot input test

59A.2.1 A pilot, tested as specified in 59A.2.2 with a reduced gas supply, shall comply with (a) or (b):

- a) A continuous, intermittent, or interrupted pilot shall effect ignition of the gas at the main burner within 4 seconds from the time gas is admitted to the main burner without flame flashback or damage to the appliance. Continuous pilots shall not extinguish after completing ignition of the main burner; and
- b) An automatically ignited gas pilot shall be ignited within 30 seconds after gas reaches the pilot gas burner ports.

Exception: A continuous pilot reduced to the minimum pilot gas input condition specified in 59A.2.2, may extinguish after having completed acceptable main burner ignition.

59A.2.1 added June 13, 1994

59A.2.2 The appliance is to be initially adjusted to operate at rated input at normal inlet pressure. The appliance is then to be started in the normal manner and one of the following test conditions is to be applied depending upon the type of pilot used.

- a) For a single-flame pilot burner, the pilot gas supply is to be reduced by manual means to a point where the pilot flame is just sufficient to keep the main burner gas valve controlled by the automatic gas ignition system open, or just above the point of flame extinction, whichever represents the higher pilot gas rate.
- b) For a multi-flame pilot burner, all pilot flame ports except those providing the means for proving the pilot flame at the combustion detector are to be blocked. The pilot gas supply is then to be reduced by manual means as described in (a).

59A.2.2 added June 13, 1994

59A.2.3 After completion of these tests at the minimum pilot condition, additional attempted ignitions of the main burner shall be made at increasing pilot input rates back to the pilot input rate specified by the manufacturer.

59A.2.3 added June 13, 1994

60 Tests on Automatic Pilots

Section 60 deleted June 13, 1994

60A Tests on Direct Ignition Systems**60A.1 Ignition tests**

60A.1.1 When subjected to the conditions specified in 60A.1.2, an automatic gas ignition system employing direct ignition of the main burner shall be such that ignition is effected at the main burner within 4 seconds after gas reaches the main burner ports, without flashback, igniting at the orifice, flashing outside the combustion space or damage to the appliance.

60A.1.1 added June 13, 1994

60A.1.2 To determine compliance with 60A.1.1, the ignition system shall be placed in operation under each specified condition in (a) and (b) for at least 25 ignition attempts of the main burner. Observations are to be made of each ignition and extinction of the main burner with the main burner both hot and cold.

- a) At all rated Btu inputs, at reduced, normal and increased inlet pressures, at rated voltage to the appliance.
- b) At all rated Btu inputs, at reduced, normal and increased inlet pressures, at 85 percent of rated voltage to the appliance.

60A.1.2 added June 13, 1994

60A.2 Flame outage test

60A.2.1 In the event of main burner flame outage during an operating cycle (flame failure), all fuel to the main burner shall be automatically shut off within 90 seconds except as noted in 60A.2.2 and 60A.2.3. Compliance with this requirement shall be determined with the burner operating at equilibrium conditions at rated input and normal inlet pressure.

60A.2.1 added June 13, 1994

60A.2.2 If the automatic gas ignition system is intended to attempt reignition of the main burner after main burner flame outage during an operating cycle (flame failure), the ignition means shall be reactivated within 0.8 seconds following flame outage except as noted in 60A.2.3. Reignition of the main burner shall be made without flame flashback or damage to the appliance. For determining compliance with this requirement, the burner is to be operated in a continuous manner at rated input and normal pressure until equilibrium conditions are obtained.

60A.2.2 added June 13, 1994

60A.2.3 On a burner where combustion air is supplied by mechanical means, the ignition system may be reactivated after a combustion air purge period of not less than 30 seconds.

60A.2.3 added June 13, 1994

60A.3 Delay of ignition test

60A.3.1 The construction of the burner and arrangement of the automatic gas ignition system shall be such that in the event of a delay in ignition of the main burner gas, the appliance will vent itself of unburned gas fuel without excessive flame flashback or damage to the appliance.

60A.3.1 added June 13, 1994

60A.3.2 The burner shall be arranged for operation at rated input at normal inlet pressure. When at room temperature, the appliance shall be placed in operation with the ignition means temporarily circumvented for varying intervals up to and including the maximum trial timing for main burner ignition of the automatic gas ignition system. The resulting ignition in each trial shall be observed for compliance to 60A.3.1.

60A.3.2 added June 13, 1994

61 Combustion Test

61.1 A dishwasher shall not produce a concentration of carbon monoxide in excess of 0.01 percent produced in a 1000 cubic-foot (28 m³) room with four air changes occurring during the combustion of an amount of gas liberating 60,000 Btu (63 MJ).

61.2 The dishwasher is to be adjusted to its rated input at normal test pressure. When operated for 15

minutes starting with all parts of the dishwasher at room temperature, the adjustment is to be within plus or minus 2 percent of the manufacturer's specified Btu input rating. Primary air is to be set at a good flame at this adjustment, and neither the input nor the primary air adjustment is to be changed thereafter.

61.3 After adjustment in accordance with 61.2, the dishwasher is to be fired until steady-state conditions have been established. Samples of the flue gases are to be obtained. The dishwasher is then to be fired at reduced pressure until steady-state conditions have been established. Samples of flue gases are to be obtained.

61.4 Analysis of the flue gases is to be reduced to an air-free basis and the carbon monoxide (CO) concentration in a 1000-cubic-foot (28 m³) room calculated using the equation:

$$C_r = \frac{C_a V}{4 \times 1000} (1 - e^{-1/4}) 60$$

in which

C_r is the concentration of CO in room atmosphere, percent;

C_a is the CO in air-free products of combustion, percent;

V is the volume of combustion products per 1000 Btu exclusive of water vapor, cubic feet; and

e is the Naperian logarithmic base, 2.7183.

This equation may be simplified to read

$$C_r = 0.0147 C_a V$$

61A Undervoltage Combustion Test

61A.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) Ignition of the main burner flame is effected as intended during the five ignition trials;
- b) Flames do not flash outside the device being fired nor damage appliance parts;
- c) Combustion is complete and stable;
- d) The concentration of carbon monoxide does not exceed the limit specified in 61.1, as calculated by the method described in 61.4; and
- e) The burner assembly operates without interruption.

61A.1 added June 13, 1994

61A.2 The initial conditions for the test are to be as for the Combustion Test, Section 61. The test may be conducted during the course of the combustion test. The voltage of the power supply to the burner assembly or device is to be regulated to maintain the minimum voltage specified. The burner assembly is to be ignited, and fired at high fire in the intended manner until steady-state conditions are attained.

61A.2 added June 13, 1994

61B Power Interruption Test

61B.1 A power operated burner assembly or device shall not operate in a manner likely to result in a risk of fire or injury to persons upon interruption of the power supply. The gas to the main burner shall be shut off within 5 seconds after the power supply is interrupted. Upon restoration of the power supply, the burner assembly or device shall require manual restart or shall resume intended operation automatically.

61B.1 added June 13, 1994

61B.2 The initial conditions for test to determine compliance with 61B.1 are to be as for the Combustion Test, Section 61. The test may be conducted during the course of the combustion test. While the burner assembly or device is being fired at any operating rate, the power supply is to be interrupted. The power is then to be restored after being interrupted for any period of time.

61B.2 added June 13, 1994

61C Combustion Air Failure Test

61C.1 A mechanical-draft burner assembly or device shall not operate in a manner likely to result in a risk of fire or injury to persons during interruption and upon restoration of the combustion air supply as specified in 61C.2. The fuel shall 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.

61C.1 added June 13, 1994

61C.2 The initial conditions for the test to determine compliance with 61C.1 are to be as for the Combustion Test, Section 61. The test may be conducted during the course of the combustion test. While the burner assembly or device is being fired at any operating rate, the fan supplying air for combustion is to be stopped by disconnecting the fan motor only from the electrical circuit, by disconnecting any flexible coupling, or by removing any belt needed to drive the fan.

61C.2 added June 13, 1994

62 Temperature Test

62.1 When tested as described in 62.2 – 62.12.

a) No part shall attain a temperature sufficient to damage required protection against corrosion, adversely affect operation of safety controls, impair the value of required thermal or electrical insulation, or cause creeping, distortion, sagging, or similar damage that may cause the dishwasher to become a risk of fire, electric shock, or injury to persons;

b) The temperature rise above room temperature on the walls and floor of the test enclosure shall not exceed 65°C (117°F);

- c) The temperature of flue gases exiting from the outlet of a draft hood, or the dishwasher outlet when equipped with an integral draft hood shall not be more than 222°C (440°F) above room temperature; and
- d) Temperature rise on other materials and parts shall not exceed the limits for such materials or parts.

62.2 For the temperature test a dishwasher intended to be installed in a corner is to be set 6 inches (152 mm) from each side of a partial enclosure formed by two walls of nominal 3/4-inch plywood set at right angles and finished in dull black. A clearance of at least 2 inches (51 mm) is to be allowed between the surface of a flue collar or other projecting part that extends out from the body of the dishwasher and the wall. If the collar or part projects 4 inches (102 mm) or less, the body of the dishwasher is to be located 6 inches from the walls. If it projects more than 4 inches, the body of the dishwasher is to be located as near to the walls as possible, subject to the 2 inches clearance specified above, but not less than 6 inches. The above clearances are to be decreased if the manufacturer recommends installation of the dishwasher nearer the wall than the clearance specified.

62.3 The temperature test on a straight-through dishwasher is to be conducted as described in 62.2, except that only a back wall is to be used instead of an alcove.

62.4 The floor is to be constructed of nominal 1-inch white pine flooring covered with one thickness of building paper and then by nominal 3/4-inch plywood, unfinished or finished with a clear sealer. The extent of the floor is to be such that it will underlie, and extend not less than 3 feet (914 mm) in every direction from the bottom of the gas-burner section of the machine.

62.5 Unless otherwise indicated, temperatures are to be determined by a potentiometer and bead-type thermocouples made of wires not larger than No. 24 AWG (0.21 mm²).

62.6 Thermocouples are to be placed on surfaces of the test enclosure at various locations as may be required to observe maximum temperatures during tests. Thermocouples are to be attached to other pertinent materials and parts likely to be adversely affected while the appliance is operating. Temperatures of electrical conductors are to be measured on surfaces of the conductor insulation and also on the enclosure surfaces that the conductors are likely to touch.

62.7 Thermocouples are to be secured to wood surfaces by staples over insulated portions of the wire and with the top or junction depressed flush with and held in good thermal contact with the surface by pressure-sensitive tape, except that, at points where the appliance contacts a wood surface, the thermocouples are to be applied to surfaces of the appliances.

62.8 Thermocouples attached to metal surfaces are to be soldered or brazed or may be secured under a screwhead.

62.9 Thermocouples attached to surfaces other than wood or metal are to be cemented or taped in a manner that provides good thermal contact with the surface.

62.10 Room temperature is to be measured by a shielded thermocouple placed centrally 15 inches (381 mm) in front of the dishwasher and 24 inches (610 mm) above the floor of the test enclosure.

62.11 The temperature of the flue gases 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 if equipped with an integral draft hood, is to be determined by a thermocouple grid located not more than 3 inches (76 mm) downstream from the outlet.

62.12 The dishwasher is to be fired at normal pressure and rated input. Firing of the dishwasher is to be continued until equilibrium temperatures are attained as evidenced by no change in the total temperature rise for three consecutive readings taken 15 minutes apart.

MARKING

63 Details

63.1 The dishwasher shall be marked with:

- a) The Btu input rate and the type of gas that it is equipped to burn. See 63.4 – 63.6.
- b) The minimum clearances to adjacent combustible material to be provided when the dishwasher is installed.
- c) The main burner assembly manifold pressure, if less than 6 inches (152 mm) water column for natural gas or less than 10 inches (254 mm) water column for LP-gas.

63.2 The marking shall be of the degree of permanence required by 54.1.2.

63.3 If the marking described in 63.1 is on a pressure sensitive label or a label secured by cement or adhesive, the label shall comply with the requirements in Section 49, Permanence of Marking Test.

63.4 A dishwasher intended for use with liquefied petroleum gases only, shall be marked "LP Gas" or "Liquefied Petroleum Gas."

63.5 A dishwasher equipped with separate burners or other equipment for propane and butane gases, shall be marked "Butane" or "Propane," as appropriate for the equipment the dishwasher is factory-equipped to burn.

63.6 A dishwasher intended for use with propane gas only, shall be marked "Propane."

APPENDIX A

Standards for Components

Standard under which components of the products covered by this standard are investigated include the following:

Title of Standard – UL Standard Designation

Attachment Plugs and Receptacles – UL 498
Cabinets and Boxes – UL 50
Conduit, Flexible Metal – UL 1
Conduit, Liquid-Tight Flexible Steel – UL 360
Cord Sets and Power-Supply Cords – UL 817
Electric Motors – UL 1004
Fittings for Conduit and Outlet Boxes – UL 514B
Fuseholders – UL 512
Fuses for Supplementary Overcurrent Protection – UL 198G
Fuses, Plug – UL 198F
Industrial Control Equipment – UL 508
Outlet Boxes, Metallic – UL 514A
Outlet Boxes, Nonmetallic, Flush-Device Boxes, and Covers – UL 514C
Polymeric Materials – Fabricated Parts – UL 746D
Polymeric Materials – Long Term Property Evaluations – UL 746B
Polymeric Materials – Short Term Property Evaluations – UL 746A
Polymeric Materials – Use in Electrical Equipment Evaluations – UL 746C
Printed-Wiring Boards – UL 796
Switches, Clock-Operated – UL 917
Switches, General-Use Snap – UL 20
Switches, Special-Use – UL 1054
Terminal Blocks – UL 1059
Tests for Flammability of Plastic Materials for Parts in Devices and Appliances – UL 94
Thermal Cutoffs for Use in Electrical Appliances and Components – UL 1020
Thermal Protectors for Electric Motors – UL 547
Time-Indicating and -Recording Appliances – UL 863
Transformers, Specialty – UL 506
Tubing, Electrical Metallic – UL 797
Tubing, Extruded Insulating – UL 224
Valves, Electrically Operated – UL 429
Wires and Cables, Thermoplastic Insulated – UL 83

UL 921

● Commercial Electric Dishwashers

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August 7, 1992

Standard for

Commercial Electric Dishwashers

UL 921, Fourth Edition

Accompanying this transmittal notice is a copy of the fourth edition of UL 921.

A CHANGE IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM.

THIS EDITION OF THE STANDARD IS NOW IN EFFECT EXCEPT FOR THOSE PARAGRAPHS, SECTIONS, TABLES, AND FIGURES HAVING FUTURE EFFECTIVE DATES AS INDICATED IN THE SMALL PRINT NOTES FOLLOWING THE AFFECTED ITEMS.

THE CURRENT REQUIREMENTS IN EFFECT FOR THE REQUIREMENTS HAVING FUTURE EFFECTIVE DATES ARE LOCATED IN THE BACK OF THE STANDARD.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this standard unless the applicant specifically requests that the product be judged under the current requirements. However, should the applicant elect this option, it should be noted that compliance with all the requirements in this standard will be required as a condition of continued Listing and Follow-Up Services after the effective date and understanding of this should be signified in writing.

The requirements in this standard are substantially in accordance with UL's bulletin on this subject dated March 11, 1991, except for the proposed revisions to the requirements for gas-fired dishwashers which have not been included. This bulletin is now obsolete and may be discarded.

Revised and/or additional pages may be issued from time to time.

Subscribers to UL's services in the area covered by this standard will receive these revised and/or additional pages automatically. Others may receive such pages by subscribing to UL's subscription service for revisions. See UL's CATALOG OF STANDARDS FOR SAFETY for a description of the revision subscription service, the cost of the service for this standard, and ordering information.