



Household Electric Dishwashers

AHAM DW-1- 2019



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PREFACE

The Association of Home Appliance Manufacturers develops standards in accordance with AHAM's "Policy and Procedures Governing Technical Standards" which states:

"AHAM Standards shall be in the best interest, mutually, of consumers who use appliances, the industries which provide and service appliances, and other interested parties. They shall relate to actual use conditions and be technically and scientifically sound."

Use or observance of AHAM standards is voluntary.

This standard contains:

Test procedures that may be applied to any brand or model of household electric dishwashers. Results of tests in accordance with this standard may be publicly stated.

Recommended levels of performance which are considered important to include but which, necessarily, are recommendations only.

With regard to safety, AHAM recommends that all appliance products -- both major and portable -- manufactured or marketed in the United States be submitted to a Nationally Recognized Testing Laboratory (NRTL¹) for inspection and listing in conformance with the safety standards and procedures followed by such laboratories. The relevant standard for dishwashers is ANSI/UL 749, CAN/CSA C22.2 No. 167 "Standard for Safety, Household Dishwashers," latest edition.

AHAM welcomes comments and suggestions regarding this standard. Any standard may be reviewed and improved as needed. All standards must be updated or reconfirmed at least every five years. Any interested party, at any time, may request a change in an AHAM standard. Such request should be addressed to AHAM's president, and should be accompanied by a statement of reason for the request and a suggested alternate proposal.

¹ The Occupational Safety and Health Administration (OSHA) recognizes laboratories that have the necessary qualifications to perform safety testing and certification of specific products covered within a scope of recognition as Nationally Recognized Testing Laboratories (NRTL).

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1. PURPOSE

This standard establishes uniform, repeatable procedures or standard methods for measuring specified product characteristics of household electric **dishwashers**.

The standard methods provide means to compare and evaluate different brands and models of household electric **dishwashers** regarding characteristics significant to product use.

The standard methods and the recommended levels of performance are not intended to inhibit improvement and innovation in product testing, design or performance.

2. SCOPE

2.1 This standard only applies to **automatic** and **non-automatic** household **dishwashers** as defined in 3.2.3.

2.2 This standard includes definitions, methods for testing and evaluating **dishwasher** cleaning performance, a reference to testing for safety and methods of testing and recommended levels for inlet and drain tubing of household electric **dishwashers** of the types indicated. The standard also includes recommendations for the **dishwasher** drain connection to a food waste disposer, inlet and drain tubing tests, references to energy and water consumption measurement methods, and safety.

This standard does not specify test methods for determining energy consumption, water consumption, drying performance, or sound levels or noise for **dishwashers**.

3. DEFINITIONS

3.1 Dishwasher. A machine which washes, rinses, and (when drying process is included) dries dishware, glassware, **flatware** and cooking utensils by chemical, mechanical, and/or thermal means.

3.2 Dishwasher Types

3.2.1 Installation

3.2.1.1 Built-In. A **built-in dishwasher** is a **dishwasher** which is permanently connected to the household water supply lines and may be installed to the electrical supply either permanently or with a power cord.

3.2.1.2 Portable. A **portable dishwasher** is a **dishwasher** which is not permanently connected to the household water and electric supply lines. It may be mounted on wheels and easily moved from one place to another in normal use.

This definition includes **dishwashers** intended to be used on a countertop or table.

3.2.1.3 Convertible. A **convertible dishwasher** is a **portable dishwasher** which has been specifically designed so that, with modifications, it may be “converted” or changed readily to be permanently installed, placed and used as any other **built-in dishwasher**.

3.2.1.4 Free-Standing. A **free-standing dishwasher** is a **dishwasher** of the **built-in** or **convertible** type provided with a top and side enclosure, installed as a free-standing unit instead of under the kitchen work surface or countertop, and may or may not be

permanently connected to the household water and electric supply.

3.2.2 Loading

3.2.2.1 A front opening dishwasher is a type of a **dishwasher** with a front door or drawer opening through which the machine is loaded or unloaded.

3.2.2.2 A top opening dishwasher is a type of **dishwasher** with a top cover or lid that is raised to provide an opening through which the machine is loaded or unloaded.

3.2.3 Operation

3.2.3.1 An automatic dishwasher is one in which, after one setting of controls, performs a complete cycle and stops without further attention by the user.

3.2.3.2 A non-automatic dishwasher is one which requires some manual operation or resetting of the controls during the **cycle** in order to complete a **cycle**.

3.2.4 Size Classification

3.2.4.1 Standard. A **dishwasher** with a capacity of **8 place settings** or more.

3.2.4.2 Compact. A **dishwasher** with a capacity of less than **8 place settings**.

3.3 Dishwasher Capacity (also referred to as the “**table setting** capacity” of the household electric dishwasher). The number of **place settings** and **serving pieces** that may be placed in a **dishwasher** in accordance with 5.2.

3.4 Place Setting. The dishware, glassware and **flatware** for one person. It consists of the items shown in Table 1 (See Appendix C).

Table 1 – Place setting
(See Appendix A for sources.)

Item	Company / Designation
<u>Dishware</u>	
1 cup – 7 fl oz (207 ml)	Arzberg # 1382 00001 4732
1 saucer - 5.5 in (14.0 cm)	Arzberg # 1382 00001 4731
1 dinner plate - 10 in (25.4 cm)	Corelle® # 5256294
1 bread and butter plate - 6.7 in (17.0 cm)	Corelle® # 5256286
1 fruit bowl - 10 oz (296 ml)	Corelle® # 5256297
<u>Glassware - Clear, No Pattern</u>	
1 ice tea glass - 12.5 fl oz (355 ml)	Libbey # 551HT
<u>Flatware</u>	
1 knife - solid handle	WMF # 12.0803.6047
1 dinner fork	WMF # 12.1905.6040
1 salad fork	WMF # 12.1964.6040
2 teaspoons	WMF # 12.1910.6040

Table 2 – Serving pieces
(See Appendix A for sources.)

Item	Company / Designation
<u>Serving Dishware</u>	
1 serving platter (oval) – 9 ½ in by 7 ½ in (24.1 cm by 19.1 cm)	Corelle® # 6011655
<i>OR ALTERNATE</i> 1 serving platter (round) – 8 ½ in (21.6 cm)	Corelle® # 5256290
2 serving bowls – 1 qt (950ml)	Corelle® # 5256304
<u>Serving Flatware</u>	
1 serving cold meat fork	WMF # 12.1902.6040
2 serving spoons	WMF # 12.1904.6040

3.5 Serving pieces. The dishware and **flatware** used for serving food, as shown in Table 2. Amount shown is for one **dishwasher table setting** (See Appendix C).

NOTE: Regarding 3.4 and 3.5: If it is found that **place settings** and **serving pieces** specified are not available, the user can contact AHAM (info@aham.org) for further assistance in identifying suitable alternatives.

3.6 Table Setting. A **table setting** is the total of all **place settings** plus the **serving pieces**. (See 3.4, 3.5 and Appendix C.)

3.7 Load. The **load** of the **dishwasher** is defined as the dishware, glassware, **flatware**, and **serving pieces** as shown in Appendix C.

3.8 Flatware. Implements used in preparing, serving and eating food, e.g., knives, forks, spoons, ladles, etc. as shown in Table 1 and 2.

3.9 Flatware Holder. Container for holding **flatware** in a **dishwasher**.

3.10 Rack. Support for holding dishware and glassware in a **dishwasher**.

3.11 Test Run. Single **cycle** performance assessment.

3.12 Test Series. Set of **test runs** which are collectively used to assess the performance. A minimum of three **test runs** constitutes a **test series**.

3.13 Cycle. A sequence of operations of a **dishwasher** which performs a complete dishwashing function. This may include any combination of washing, rinsing, or drying operations.

3.14 Normal Cycle. The **cycle** type, including options, recommended in the manufacturer's instructions for daily, regular, or typical use with a full **load** of normally soiled dishes.

3.15 Detergent. A cleaning agent manufactured for use in household electric **dishwashers** to aid in the removal of food soils by chemical means.

3.16 Rinse Agent. A chemical agent usually added to the last rinse water in a **dishwasher** which reduces the surface tension of water droplets, causing improved drainage from glassware, dishware and **flatware** to reduce water spotting and improve drying performance.

3.17 Dispenser

3.17.1 Automatic. A device activated automatically, usually by electrical or mechanical means, which injects or dispenses measured amounts of **detergent**, **rinse agent**, etc., one or more times, into the washing or rinsing solution at predetermined intervals throughout the **dishwasher cycle**.

3.17.2 Non-Automatic. A device, usually a fixed cup or cavity on the **dishwasher** door, cover or dish **rack** which injects or dispenses a previously measured amount of **detergent**, **rinse agent**, etc., into the washing solution at the beginning of the **dishwasher cycle**. The **dispenser** is emptied when the **dishwasher** door or cover is closed, or requires water circulation to flush the **detergent** from the **dispenser**.

3.18 Etching. A permanent change to surfaces resulting in cloudiness, opacity, or dulling.

3.19 Filming. A non-permanent change to surfaces resulting in cloudiness, opacity, or dulling.

3.20 Air Gap

3.20.1 Inlet Air Gap. A break in the inlet water flow to a **dishwasher** which, by venting to the atmosphere, prevents reverse flow from the **dishwasher** to the house water supply.

3.20.2 Drain Air Gap. A break in the drain plumbing which, by venting to the atmosphere, prevents reverse flow from the house drain plumbing to the **dishwasher**.

3.21 Coupler. A device used to connect a **portable dishwasher** inlet hose to a faucet. It may also position the drain line from the **dishwasher** over the sink bowl.

3.22 Drain Methods

3.22.1 Gravity. Discharge water from the **dishwasher** is drained by **gravity** flow.

3.22.2 Pump. A motor operated **pump** is used to remove the discharge water under pressure from the **dishwasher**.

3.23 Water Fill Control System

3.23.1 Time Control. A fill system in which the amount of water used by the **dishwasher** is controlled by a valve that is (usually with a flow control device) open for a pre-determined time interval.

3.23.2 Sensor Control. A fill system in which the amount of water used by the **dishwasher** is controlled by a sensor.

3.24 Heating Element

3.24.1 Open Type. A resistance material, or an assembly including such material used to generate heat electrically, designed to be used in air only.

3.24.2 Sheathed Type. Same as air type **heating element** except that construction is such that it is enclosed when immersed in water. Immersion heaters can be designed to operate in water only, or in both air and water in various parts of **dishwasher cycle**.

3.25 Interlock Switch. A switch in an electrical circuit of a **dishwasher** which opens or disconnects a supply or control circuit when the **dishwasher** is either unlatched or opened.

3.26 Vent. An opening or passage between the inside of the **dishwasher** and atmosphere to permit pressure equalization during washing and to permit ventilation during drying.

3.27 Water Spot, Water Streak, and Rack Contact Mark. An area of dried deposit resulting from evaporated water left on the surface of the glass.

4. GENERAL CONDITIONS FOR MEASUREMENTS

Conduct measurements under the following conditions:

4.1 Detergent. Use Cascade® with the Grease Fighting Power of Dawn® powder national formula. The **detergent** shall be stored in a cool and dry atmosphere. It shall be used within nine months after production as identified by the date code on the product packaging. **Detergent** from the same date code shall be used for a given **test series** (refer to Appendix D regarding determination of date code). Before use, the **detergent** shall be homogenized by gently rotating the box to ensure uniform distribution of contents.

The quantity of detergent for one **test run** shall be 1.8 grams per **place setting** in the main compartment of the **detergent dispenser** and 1.8 grams per **place setting** in the pre-wash compartment of the **detergent dispenser** or other pre-wash location as recommended by the manufacturer. If the **detergent dispenser** does not include a pre-wash cup and if no recommendation for pre-wash **detergent** location is given by the manufacturer, the pre-wash **detergent** shall be placed on the inner door near the **detergent dispenser**.

4.2 Rinse Agent. Use Finish® Jet Dry® liquid, original unscented. For **dishwashers** with an adjustable automatic **dispenser**, the setting shall be as shipped from the manufacturer. If the **dishwasher** is not equipped with a **rinse agent dispenser** and the manufacturer does not recommend using a **rinse agent**, no **rinse agent** shall be used.

4.3 Machine Pre-Conditioning and Conditioning. Install **dishwasher** in accordance with the manufacturer's instructions.

4.3.1 Machine Pre-Conditioning. A **dishwasher** shall be pre-conditioned prior to starting a **test series**. The **dishwasher** is to be clean and free of all residues at the start of each **test series**. To ensure cleanliness of a **dishwasher** interior, run at least two **cycles** using **dishwasher detergent**, **rinse agent** and water, per Sections 4.1, 4.2 and 4.8. This **cycle** shall be the **normal cycle** or a **cycle** described by the manufacturer as one intended to clean heavily soiled dishes. Filters and/or strainers shall be cleaned before starting a **test series**, and between **test series**, using cleaning technique(s) as described by the manufacturer's instructions.

4.3.2 Machine Conditioning during Test Series. After each **test run**, the **dishwasher** shall be operated through a clean-up operation using the **normal cycle** as described in Section 3.14. This clean-up cycle shall be run without dishes but with **detergent**, **rinse agent**, and water per Sections 4.1, 4.2, and 4.8. Filters and / or strainers shall not be cleaned between **test runs**.

4.4 Load Conditioning, Preparation, and Storage. The dishware shall be free from cracks or other damage with the glaze in good condition. Glassware shall be free of scratches. **Flatware** shall be free of pits and scratches.

4.4.1 Load Pre-Conditioning. New dishware, glassware, and **flatware** shall be thoroughly cleaned. Pre-condition new **load** items or **load** items from storage before use. One recommended approach is to machine wash new **load** items in a **dishwasher** (not the test machine) using the **normal cycle** with **dishwasher detergent** per Section 4.1, and machine dry the **load**. Use of **rinse agent** per Section 4.2 is optional during this cycle. Hand washing and drying may be used as long as no **detergent** residue remains.

4.4.2 Load Conditioning during Test Series. Before each **test run**, the **load** shall be conditioned by machine washing in another **dishwasher** (not the test machine) so that each item would achieve a score of 0 if assessed per Section 5.10 (excluding 5.10.1.2 and 5.10.1.3). One recommended approach is to use the **normal cycle** with **dishwasher detergent** per Section 4.1, and machine dry the **load**. Use of **rinse agent** per Section 4.2 is optional during this **cycle**.

4.4.3 Preparation. **Load** items shall be dry and at room ambient temperature before soiling.

4.4.4 Storage. Store **load** items in such a manner to prevent scratching and damage.

4.5 Electrical Supply

4.5.1 Frequency. Manufacturer's rated frequency $\pm 1\%$.

4.5.2 Voltage. Operate **dishwasher** at 120, 208 or 240 volts $\pm 2\%$ as intended by the manufacturer.

4.6 Test Cycle. Use the **normal cycle** as described in Section 3.14. Record **cycle** and options used per 5.11.

4.7 Room Ambient. Temperature is to be $75^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ($24^{\circ}\text{C} \pm 3^{\circ}\text{C}$) with a relative humidity (RH) of $35\% \pm 15\%$ throughout the soiling application and air dry period (refer to Section 5).

4.8 Water Supply

4.8.1 Temperature. For a **dishwasher** that is intended to be connected to the hot water supply, the input water temperature shall be maintained at $120^{\circ}\text{F} \pm 2^{\circ}\text{F}$ ($49^{\circ}\text{C} \pm 1^{\circ}\text{C}$). For a **dishwasher** that is intended to be connected to the cold water supply, the input water temperature shall be maintained at $50^{\circ}\text{F} \pm 2^{\circ}\text{F}$ ($10^{\circ}\text{C} \pm 1^{\circ}\text{C}$). These temperatures shall be maintained during each **dishwasher** fill through the test **cycle** and shall be measured at least every 4 seconds. These temperatures shall be maintained up until the connection point described below.

For **dishwashers** that include a water supply line (i.e. the water inlet hose is supplied by the manufacturer), the volume of the water pipe between the measurement device for temperature and the connection point to the water inlet hose of the test **dishwasher** shall not exceed 8.5 fl oz (250 ml). For **dishwashers** that do not include a water supply line (i.e. the water inlet hose is not supplied by the manufacturer), the volume of the water pipe between the measurement device for temperature and the connection point to the water inlet supply valve of the test **dishwasher** shall not exceed 13.53 fl oz (400 ml). If the temperature is measured in the circulation loop, the volume of the spur taking the water from the circulation loop shall not exceed 8.5 fl oz (250 ml) for **dishwashers** that include a water supply line, or shall not exceed 13.53 fl oz (400 ml) for **dishwashers** that do not include a water supply line. If a bypass to ensure water supply temperature

is installed, at each connection to the water inlet hose(s), or water inlet supply valve, of the **dishwasher**, the bypass shall be opened before starting tests until the water inlet temperature is in the required range.

4.8.2 Water Pressure. Maintain the pressure of the water supply at 35.0 ± 2.5 pound per square inch (2.41 ± 0.17 bar) during each **dishwasher** fill during the test **cycle**. Water pressure is best measured at the height level of the **dishwasher** water inlet valve. For convenience, floor level may be used as a reference point. Water pressure shall be measured no greater than 70 inches (177.8 cm) above the floor level and shall be achieved within 5 seconds of opening the water supply valve and then measured at a frequency not to exceed once every 5 seconds.

NOTE: *Height level affects water pressure measurement. For every 12 inches (30.5 cm) that water pressure is measured above floor level, an additional 0.43 psig (0.03 bar) of water pressure is experienced by the dishwasher water inlet valve.*

4.8.3 Hardness. Maintain the hardness of the water supply between 0 and 85 parts per million (ppm) of CaCO_3 . Where necessary a cation exchange water softener may be used to maintain water hardness at this level. Conduct water hardness measurements no less than once a week across a test series.

4.8.4 The actual water and electrical supply conditions maintained during the **test runs** shall be reported. If water supply or electrical supply conditions are outside of the specified tolerance range, the **test run** should be considered invalid.

5. DISHWASHER CLEANING PERFORMANCE EVALUATION METHOD AND PROCEDURE

5.1 Dishwasher Cleaning Performance - General. Execute a **test series** on each **dishwasher** in order to minimize the effect of variables due to soiling, dishwashing, scoring or other general condition variables.

5.2 Load. The test **load** is to consist of 8 **place settings** minimum plus **serving pieces** for a **standard dishwasher**. For **compact dishwashers**, the test **load** is to consist of 4 **place settings** minimum plus **serving pieces**, except where the rated capacity is lower than 4 **place settings**. Refer to Appendix C for test **load** quantities. Prepare all test **load** items as indicated in 4.4 before soiling which is to be done in accordance with 5.7 Application Method.

5.3 Soil Preparation Utensils Needed

- (1) One 1 qt or 1 L saucepan with cover
- (2) One bowl for egg yolks
- (3) Several sets of measuring spoons
- (4) Several bristle brushes
- (5) Several flexible spatulas
- (6) Two measuring cups, 2 cup (473 ml) capacity
- (7) One can opener
- (8) One stopwatch
- (9) One 1 qt or 1 L sealed storage container
- (10) One aluminum clad stainless skillet, or equivalent
- (11) One drip coffee maker (minimum 4 cups)
- (12) One paper coffee filter
- (13) One round wire mask divided in fourths (optional)
- (14) One round wire mask divided in halves (optional)

5.4 Soiling Ingredients

The soiling ingredients sufficient for a ten **place setting load** are shown in Table 3. Adjust as necessary for fewer or more **place settings**. All references to teaspoon, tablespoon, and cup are to be level measurements.

Table 3 – Soiling ingredients

	<u>Item</u>	<u>Quantity</u>	<u>Description</u>
1)	Eggs	Typically 4-6 (50 g minimum weight each)	Fresh, Grade A, Large
2)	Corn	6 teaspoons (30 ml)	Green Giant™ Cream Style
3)	Oatmeal	1 package	Quaker Oats™ Instant, Regular Flavor (12 individual packages)
4)	Potatoes	2/3 cup (158 ml)	Hungry Jack™ Instant Mashed
5)	Ground Beef	1 lb (454 g)	Round steak with all visible fat removed; mix together 75% (by weight) round steak with 25% kidney suet; grind together twice
6)	Preserves	10 teaspoons (49 ml)	Smuckers™ Red Raspberry (with seeds)
7)	Coffee Grounds	4 tablespoons (59 ml)	Folgers™ Classic Roast Decaf
8)	Coffee	Prepared using coffee grounds prescribed above	Folgers™ Classic Roast Decaf
9)	Peanut Butter	2 ½ teaspoons (12 ml)	JIF™ Creamy
10)	Tomato Juice	1 cup (237 ml)	Campbell's™
Additional Ingredients Used in Soil Preparation			
11)	Milk	1/3 cup (59 ml)	Carnation™ Nonfat Dry
12)	Vegetable Oil Spread (Margarine)	1 tablespoon (15 ml)	Fleischmann's™ Original Stick (9 g of fat per 14 g serving) not whipped
13)	Salt	1/4 teaspoon (1 ml)	Morton™ Iodized
14)	Tomato Paste	12 oz can (355 ml)	Contadina™

5.5 Soiling Agent Preparation

All soil items shall be brought to ambient temperature before application except as noted below. For those items that are refrigerated, a container with the food item may be placed in a water bath of 100-110°F (38-43°C) water.

Exception: The eggs, oatmeal, coffee and potatoes should not be brought to ambient temperature before application.

Use the following procedure to prepare the soiling materials:

1) Eggs

Remove eggs from the refrigerator. For each egg, crack the shell. Separate the yolk from the white by placing the yolk in hand and placing under a gentle stream of water to separate. Gently dry hands on towel, puncture yolk membrane and discard yolk membrane. Place egg yolk in small container and stir well. Repeat procedure for remaining eggs.

The egg yolk will be applied to the dinner plates, the forks, and the serving fork.

2) Cream Style Corn

Stir contents of the can approximately 5 times to ensure consistency before application.

The cream style corn will be applied to the bread & butter plates, some of the fruit bowls, one serving spoon, one serving bowl, and some of the teaspoons.

Place the remaining corn in a tightly covered container and store in the refrigerator until ready to use. The stored corn may be used for up to one week.

3) Oatmeal

In a 2 cup (473 ml) measuring cup, add ½ cup (118 ml) boiling water to a one-serving package of Quaker Oats™ Instant Oatmeal. Stir 25 times.

Add 2 tablespoons (29 ml) of reconstituted Carnation Nonfat Dry Milk to the oatmeal mixture. Stir 25 additional times.

Let stand for 1 minute; then use immediately.

The oatmeal will be applied to the bread & butter plates, some of the fruit bowls, and some of the spoons.

4) Instant Mashed Potatoes

Prepare 1 cup (237 ml) (2 servings) of Hungry Jack™ Instant Mashed Potatoes.

In a 1 qt (946 ml) saucepan, combine 2/3 cup (158 ml) water, 1 tablespoon (15 ml) vegetable oil spread, and ¼ teaspoon (1 ml) salt. Bring to a rolling boil and then remove from heat.

With a fork, stir into the mixture 1/3 cup (79 ml) reconstituted nonfat dry milk, and 2/3 cup (158 ml) potato flakes until potatoes are smooth.

The mashed potatoes will be applied to the dinner plates, one of the serving spoons, and one serving bowl.

Apply mashed potato mixture within 30 minutes of preparation.

Do not use microwave to prepare instant mashed potatoes.

5) Ground Beef Mixture

Prepare ground beef from round steak with all visible fat removed. Mix together (by weight) 75% round steak with 25% kidney suet; grind together twice. A grinding wheel with 1/8 inch (3 mm) holes shall be used.

NOTE: For convenience, the ground beef/kidney suet mixture may be purchased in large quantities and frozen in 1 lb (454 g) packages before using. If frozen, thaw in a refrigerator or water bath before preparation.

Break up the 1 lb (454 g) fresh ground beef and place in the skillet.