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American National Standard
Household Electric Dishwashers

ANSI/AHAM DW-1-1992
(Revision of ANSI/AHAM DW-1-1982)



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, be technically and scientifically sound."

Use or observance of AHAM standards is voluntary.

AHAM standards are presented to the American National Standards Institute (ANSI) for recognition as American National Standards. This standard was so recognized on February 7, 1992 and bears the American National Standard designation ANSI/AHAM DW-1-1992.

This standard contains

Test procedures which 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 an appropriate independent laboratory such as Underwriters Laboratories Inc., or the American Gas Association Laboratories, Inc., 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, "Standard for Safety, Household Dishwashers".

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.

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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 3.7.3.

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

3. DEFINITIONS

3.1 Air Gap

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

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

3.2 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.

3.3 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.

3.4 Detergent.

A cleaning agent in powder, granular or liquid form manufactured for use in household electric dishwashers to aid in the removal of food soils by chemical means. (See Appendix A for source.)

3.5 Dishwasher.

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

3.6 Dishwasher Capacity.

The "table setting capacity" of the household electric dishwasher is the number of place settings and serving pieces that may be placed in a dishwasher in accordance with 6.2.

3.7 Dishwasher Types

3.7.1 Installation

3.7.1.1 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.

3.7.1.2 Portable. A portable dishwasher is a dishwasher which is not permanently connected to the household water and electric supply lines. It can 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.

3.7.1.3 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.

3.7.1.4 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.

3.7.2 Loading

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

3.7.2.2 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.

3.7.3 Operation

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

3.7.3.2 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.

3.8 Dispenser

3.8.1 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.

3.8.2 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.

3.9 Drain Methods

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

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

3.10 Etching.

A chemical attack on glass surfaces resulting in cloudiness or opacity.

3.11 Filming.

A hard water phenomenon characterized by the accumulation of calcium and magnesium salts and other residues over the surfaces of items being washed and being particularly noticeable on glassware.

3.12 Flatware.

Implements used in preparing, serving and eating food: i.e., knives, forks, spoons, ladles, etc.

3.13 Flatware Holder.

Container for holding flatware in the dishwasher.

3.14 Heating Element

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

3.14.2 Sheathed Type. Same as air type heating element except that construction is such that it is enclosed for safe operation when immersed in water. Immersion heaters can be designed to operate in both air and water in various parts of dishwasher cycle.

3.15 Door Interlock Switch.

A safety switch in the electrical supply circuit of a dishwasher which opens or disconnects the supply

circuit when the dishwasher door or cover is either unlatched or opened.

3.16 Place Setting.

The dishware, glasses and flatware associated with a table serving for one person. It consists of the following:

3.16.1 Dishware. Corning "Pyroceram"

One cup.....#818 (Short) or #828 (tall)
One saucer.....#807
One dinner plate.....#810
One bread and butter plate.....#806
One fruit bowl.....#859

(See Appendix A for source.)

3.16.2 Glassware. Clear. No pattern.

One straight side ice tea glass - 12 fl. oz.

(See Appendix A for source.)

3.16.3 Flatware. Minimum pattern stainless steel with broad handle that will not protrude through flatware holder.

One dinner fork
One salad fork
One knife
Two teaspoons

3.17 Serving pieces.

The dishware and flatware used on the table.

3.17.1 Dishware. Corning "Pyroceram".

One platter.....#H-811
(Alternate #912)
Two serving bowls.....#432

(See Appendix A for source.)

3.17.2 Flatware. Minimum pattern.

Two serving spoons
One serving fork

3.18 Table Setting.

A table setting is the total of all place settings (3.16) at a table plus one set of serving pieces.

3.19 Rack.

Support for holding dishware and glassware in a dishwasher.

3.20 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.

3.21 Vent.

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

3.22 Washing Index.

A numerical value ranging between 0 and 100 which gives the relative washing ability of a dishwasher. The index is calculated from data taken during the washing evaluation as described in Section 6.

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 (usually with a flow control device) open for a definite 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 responsive to the amount of water.

4. GENERAL CONDITIONS FOR MEASUREMENTS

Conduct measurements under the following conditions:

4.1 Detergent.

Use 0.5% concentration by weight of Cascade powder national formula, dishwasher detergent in the wash and main wash cup.

4.2 Dishwasher Conditioning.

Install dishwasher in accordance with the manufacturer's instructions. The dishwasher is to be at room ambient (refer to section 4.6) at the start of each test. The dishwasher is to be clean and free of all residue at the start of test. To assure cleanliness of the dishwasher interior, run two preconditioning cycles using dishwasher detergent and water.

After each test run, run the dishwasher through a clean up cycle without dishes but with detergent and water.

4.3 Electrical Supply

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

4.3.2 Voltage. Operate dishwasher at 120 or 240 volts $\pm 2\%$.

4.4 Cycle.

If the dishwasher is equipped with an automatic timer and cycle selector giving two or more automatic cycles, the cycle for normal soils indicated by the manufacturer is to be used. Record cycle used per 6.11.

If the dishwasher is not equipped with an automatic timer, operate it manually using the cycle indicated by the manufacturer for regular or normal soils.

4.5 Rinse Agent.

Use the rinse agent recommended by the manufacturer and in the quantity as delivered by the automatic dispenser. Do not use rinse agent if the dishwasher is not equipped with an automatic dispenser.

4.6 Room Ambient.

Temperature is to be 70-80°F (21-20°C) with a relative humidity (RH) range of 25% to 60%.

4.7 Water Supply

4.7.1 Temperature. (140 \pm 5)°F (60 \pm 3°C) or (120 \pm 2)°F for water heating dishwasher or (50 \pm 2)°F for cold water dishwasher.

4.7.2 Water Pressure. Maintain the pressure of the water supply between 32.5 and 37.5 pounds per square inch gage.

4.7.3 Hardness. Water hardness should be between 0 and 85 parts per million (ppm). Where necessary a cation exchange water softener may be used to maintain water hardness at this level.

5. NAMEPLATE INFORMATION

5.1 Marking.

The nameplate should include the following information:

- (1) Voltage rating (V)
- (2) Frequency (Hz)
- (3) Input in amperes (A) or watts (W)
- (4) Name and address of merchandiser
- (5) Model designation and serial number

5.2 Location.

Locate the nameplate so the appliance does not have to be moved (unless portable) or a part requiring the use of tools be removed to read it.

6. PERFORMANCE EVALUATION METHOD AND PROCEDURE

6.1 Washing Performance - General.

Execute this test a minimum of three times in order to minimize the effect of variables due to soiling, dishwashing, judging or other general condition variables.

6.2 Load.

The test load is to consist of 10 place settings minimum (3.16) plus one set of serving pieces (3.17) for a 24" wide standard dishwasher. For compact under-counter dishwashers, the test load is to consist of 6 place settings, two 1-quart serving bowls and 1 serving platter. For undersink dishwashers, the test load is 7 place settings and two 1-quart serving bowls. The dishes are to be free from cracks or other damage with the glaze in good condition. Prepare all test load items as indicated in 6.2.1 below before soiling which is to be done in accordance with 6.7-Application of Soils to Loads.

6.2.1 Load Preparation. Before each test, the test load is to be thoroughly clean with no remaining soil.

Then condition the load by machine washing the test load in another dishwasher (not the test machine) using a normal cycle with dishwasher detergent and machine dry the test load. Rinse conditioner should not be used during this cycle.

Precondition new dishware or dishware from storage in the same manner as above.

6.2.2 Load Storage. Store dishes in such a manner to prevent scratching and damage.

6.3 Soil Preparation Utensils Needed

- (1) One qt. (1 L) saucepan with cover
- (2) One electric egg cooker (West Bend Model 86618, Sunbeam Model 23-1A or equivalent)
- (3) One bowl for egg yolks
- (4) Several sets of measuring spoons
- (5) Three brushes - 1/2 inch (13 mm) wide, 1 inch (25 mm) long, stiff bristle brush
- (6) Several rubber spatulas, 1 inch wide (Rubbermaid #2733 or equivalent)
- (7) Two glass measuring cups, 2 cup (480 ml) capacity
- (8) Can opener
- (9) One stopwatch
- (10) One 1-qt. (1 L) Tupperware container, or equivalent, with cover
- (11) One wooden spoon
- (12) One aluminum clad stainless skillet, or equivalent
- (13) One drip coffeemaker (minimum 4 cups) any brand,
- (14) One round wire mask divided in fourths (optional)
- (15) One round wire mask divided in halves (optional)

6.4 Soiling Ingredients

Sufficient for a ten place table setting.

ITEM	QUANTITY	DESCRIPTION
Corn	6 teaspoons (30 ml)	Cream Style
Eggs	4 (50 g) minimum weight	Fresh, Grade A, Large
Coffee Grounds	1¼ teaspoons (6 ml)	Folgers, Decaffeinated Drip Grind
Ground Beef Mixture	5 teaspoons (25 ml)	Round steak with all visible fat removed. Mix together 75% round steak with 25% kidney suet; grind together twice.
Margarine	1 tablespoon (15 ml)	Fleishmans corn oil (6 g of fat per 14 g serving) not whipped
Milk	2/3 cup (160 ml)	Carnation Nonfat Dry
Oatmeal	5 teaspoons (25 ml)	Quaker Oats Instant Regular Flavor (12 individual packages)
Peanut Butter	2½ teaspoons (13ml)	JIF Creamy
Potatoes	13 teaspoons (65 ml)	Hungry Jack Instant Mashed
Preserves	10 teaspoons (50 ml)	Smuckers Red Raspberry
Salt	¼ teaspoon (1.25 ml)	Morton Iodized
Tomato Juice	1 cup (240 ml)	Campbell's
Tomato Paste	12 oz can	Contadina

6.5 Soiling Agent Preparation

In order to obtain the most repeatable results it is necessary that the following sequence of events be adhered to very closely.

If refrigerated, allow margarine and tomato juice to reach ambient room temperature. Place eggs in 3 cups (750 ml) water at $70 \pm 10^{\circ}\text{F}$ ($21 \pm 5.5^{\circ}\text{C}$) in a 1 qt. (1 l) saucepan at least 30 minutes before using.

Use the following procedure to prepare the soiling materials:

1) Oatmeal

In a 2 cup measuring cup, add $\frac{1}{2}$ cup boiling water to a one-serving package of Quaker Oats Instant Oatmeal. Stir well.

Add 2 tablespoons of reconstituted Carnation Nonfat Dry Milk to the oatmeal mixture. Mix well.

Let stand for 1 minute; then use immediately.

2) Instant Mashed Potatoes

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

In a 1 qt. (1 l) saucepan, combine $\frac{2}{3}$ cup (160 ml) water, 1 tablespoon (15 ml) margarine, and $\frac{1}{4}$ teaspoon (1.25 ml) salt. Bring to a rolling boil and then remove from heat.

With a fork, stir into the mixture $\frac{1}{4}$ cup (60 ml) reconstituted nonfat dry milk, and $\frac{2}{3}$ cup (160 ml) potato flakes until potatoes are smooth. Set aside.

3) Cream Style Corn

No preparation necessary--use directly as purchased.

4) Eggs

Bring eggs to room temperature by immersing them in 3 cups (720 ml) water at $70 \pm 9^{\circ}\text{F}$ ($21 \pm 5^{\circ}\text{C}$) at least 20 minutes before cooking.

Fill egg cooker with water up to the rack. When the water boils, puncture the large end of 4 eggs and place large end down in the cooker. Cover and cook for 3 minutes and then place the eggs in the room temperature water for a minimum of 6 minutes. Alternate: Boil eggs in pot of water for 3 minutes.

Separate the yolks from their membrane and the whites (no more than 5 minutes before using them). Place yolks in a small cup and stir well. (Discard the whites.)

5) Ground Beef Mixture

Prepare ground beef from round steak with all visible fat removed. Mix together 75% round steak with 25% kidney suet; grind together twice.

NOTE: For convenience, the ground beef/kidney suet mixture may be purchased in large quantities and frozen in one pound packages before using. Thaw individual packages before using.

Break up the 1 lb. fresh ground beef and place in the skillet.

Cook until lightly browned on a surface unit of a range. Using a wooden spoon, stir meat during cooking process, breaking up meat pieces continuously.

Remove from surface unit and mix with one 12 oz can of Contadina Tomato Paste using a rubber spatula to get all the tomato paste out of the can.

Place the ground beef mixture in the tightly covered container and store in the refrigerator until ready to use. Prepare this mixture at least one day in advance. May be used for up to two weeks.

Before using the mixture, allow it to reach ambient room temperature. Do not reheat as this could cause excessive drying of the mixture.

6) Coffee (Drip)

Place 4 level tablespoons of drip ground coffee and 2½ cups (600 ml) of cold water into the coffeemaker. Set coffeemaker on strongest brew strength, if applicable. Energize coffeemaker.

6.6 Total Soil Quantities and Order of Application

SOIL	QUANTITY/ LOAD
Potatoes, Instant	65 ml
Red Raspberry Preserves	50 ml
Ground Beef Mixture	25 ml
Egg Yolks	50 ml
Coffee Grounds	13 ml
Creamed Corn	25 ml
Oatmeal	20 ml
Peanut Butter, Creamy	13 ml
Coffee	As required
Tomato Juice	As required
TOTAL LOAD	261 ml

Two hour air dry of the soiled ware is to start immediately after application of oatmeal.

NOTE: During drying period, the drying area is to be protected from air drafts.

6.7 Application of Soils to Load

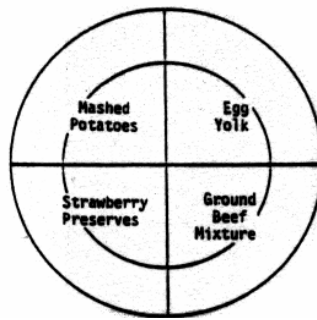
Each soil will be applied to all respective items (dishware, glasses and flatware) at the same time.

DINNER PLATES: Each plate shall be divided into 4 equal sections and each quarter soiled to the rim of the plate as follows:

Instant Mashed Potatoes (spread with spatula)	1 teaspoon (5 ml)
Red Raspberry Preserves (spread with spatula)	1 teaspoon (5 ml)
Ground Beef Mixture (spread with spatula)	½ teaspoon (2.5 ml)
Egg Yolk (spread with presoaked brush)	1 teaspoon (5 ml)

1/8 teaspoon of used and wet coffee grounds shall be sprinkled over the raspberry soil on each dinner plate.

DINNER PLATE SKETCH



BREAD AND BUTTER PLATES: Each plate shall be divided into 2 equal sections and shall be soiled over the entire sunken surface as follows:

Cream Style Corn (spread with brush presoiled with cream corn)	¼ teaspoon	(1.25 ml)
Oatmeal (spread with brush presoiled in oatmeal mixture)	¼ teaspoon	(1.25 ml)

FRUIT BOWLS: Five bowls shall be soiled over the entire sunken surface with ¼ teaspoon (1.25 ml) of Cream Style Corn (spread with brush presoiled with cream corn).

Five bowls shall be soiled over the entire sunken surface with ¼ teaspoon (1.25 ml) each of Oatmeal (spread with brush presoiled in oatmeal mixture).

NOTE: Two hour air dry is to start immediately after application of oatmeal.

FLATWARE:

Knives: $\frac{1}{4}$ teaspoon (1.25 ml) of peanut butter per knife applied uniformly for approximately $\frac{1}{2}$ blade length both sides (use finger). Rest the knife blade end on the rim of serving platter.

Spoons: Brush cream style corn on both sides of 10 spoons. Place them on the half of the bread and butter plates soiled with the corn. Brush the remaining 10 spoons with the oatmeal mixture and rest them on their respective halves of the bread and butter plates.

Forks: Tines to be soiled with egg yolk by brush and placed on the quarter of the dinner plates already soiled by egg yolk.

Serving Spoons: One shall be soiled with cream corn and placed in the serving bowl soiled with corn. The remaining spoon shall be soiled with potatoes and placed in the bowl soiled with potatoes.

Serving Fork: Shall be soiled with egg yolk and placed on any dinner plate in the quarter soiled with egg yolk.

COFFEE CUPS: Shall be soiled with liquid coffee by pouring from one cup to another until all cups are coated and excess drained off.

SAUCERS: Shall be soiled with coffee in the same manner as the coffee cups. Poured from saucer to saucer and excess drained off.

GLASSES: Shall be soiled with tomato juice. Pour 1 cup of tomato juice into a test glass. Pour the juice from glass to glass until all interiors are coated. Discard the remaining juice.

SERVING BOWLS: One bowl shall be soiled with 1 teaspoon (6 ml) of cream corn. Brush corn over the interior.

One bowl shall be soiled with 1 tablespoon (15 ml) of instant mashed potatoes. Coat interior with a spatula.

SERVING PLATTER: Platter shall be soiled by resting the knives on it, which will leave peanut butter on the outer rim.

6.8 Loading the Soiled Ware

After the two hour air dry period, the soiled ware is to be loaded as follows:

Stack dinner plates by rotating each $\frac{1}{4}$ turn. Stack bread and butter plates and fruit bowls by alternating the cream corn and oatmeal soils.

Load the dishwasher in accordance with manufacturer's recommendation without nesting the dishware or flatware.

Develop a precise loading configuration, photograph, and follow this pattern for all tests.

6.9 Dishwasher Operation

Operate the dishwasher through one complete normal cycle using power dry.

One cleanup run is required between individual test loads for more consistent results.

Testing is to be run until there is a probability of not less than .80 that the mean of the sample is within $\pm 10\%$ of the estimate of the true mean of the performance measure of the dishwasher.

6.10 Evaluation.

At the completion of the cycle, carefully remove one piece of the ware at a time and evaluate in a well-lighted area.

Each piece shall be examined visually by the judge and evaluated according to the scoring instructions in 6.10.1, 6.10.2, and 6.10.3. No single piece can exceed a cumulative count of 9. Thus, if the particle count plus the spot count for a piece was greater than 9, that piece would be assigned a value of "9".

NOTE: For comparative purposes, scoring should be performed by the same individual in a given facility. That individual should be experienced in use of this procedure. People who have never conducted previous tests should familiarize themselves by doing some trial tests in order to gain experience.

Dishware - Cups, saucers, dinner plates, bread and butter plates, fruit bowls, serving platter and serving bowls are scored on the basis of particle count only.

Glasses are scored on the basis of particles, spots and tine marks.

Flatware, including serving spoons and serving fork are scored on the basis of particles.

6.10.1 Scoring - Particles. Particles are scored according to size and number on each piece as follows:

Largest Linear Dimension

Less than 1/8"-	Score 1 per particle with a maximum score of 9
Greater than 1/8" and less than 1/4"-	Score 3 per particle with a maximum score of 9
Greater than 1/4" and less than 3/8"-	Score 7 per particle with a maximum score of 9
Greater than 3/8"-	Score 9

6.10.2 Scoring - Spots. A noticeable normal water spot with the largest linear dimension of 3/8" or less, score 1. A larger water spot - score 3.

6.10.3 Scoring - Tine marks. A tine mark on a glass is scored as follows: Each light mark, such as line with a faint area inside the line with no soil present - score 1. Each white mark that is not translucent with no soil present - score 3.

If soil particles are present in the tine marks, the glass is scored for particles as well.

6.11 Reporting.

Judge each article according to the above evaluation system and report results (See suggested Forms 1, 2 and 3 in Appendix B). Report the number of table settings and the cycle used in each evaluation.

6.12 Calculation of Washing Index.

The following operations are to be followed to calculate the washing index using the indicated forms.

6.12.1 Totaling Scores. Total the number of 0's, 1's, 2's, etc. on each report sheet (suggested Forms 1, 2 and 3) for each soiling. (suggested Form 4).

6.12.2 Washing Index

6.12.2.1 Group values as indicated below (suggested Form 5).

Omit all 0's (clean) reported.

Total all 1's for each soiling.

Total all 2's and 3's for each soiling.

Total all 4's, 5's, and 6's, for each soiling.

Total all 7's, and 8's, for each soiling.

Total all 9's for each soiling.

6.12.2.2 Calculate the percentage occurrence for each group as illustrated below:

$$\frac{\text{Total 1's (dishware) values}}{\text{Total dishware pieces}} \times 100$$

= Percentage 1's

Repeat this operation for all groups in each category (i.e., dishware, glass and flatware) and report results (suggested Form 5).

NOTE: Particles only are scored on flatware.

6.12.2.3 Using the data (Form 5) calculated in 6.12.2.2, calculate the washing index for each test using the following formula:

Washing index = 100 –

$$\frac{(\%1's) + 2(\%2's + 3's) + 4(\%4's + 5's) + 6(\%7's + 8's) + 8(\%9's)}{8}$$

6.12.3 Overall Washability Index. To determine the weighted arithmetic mean of the washing indexes of the three soilings, perform the following operation:

6.12.3.1 Average the washing indexes for dishware for the three soilings.

6.12.3.2 Repeat 6.12.3.1 using the washing indexes for glass.

6.12.3.3 Repeat 6.12.3.1 using the washing indexes for flatware.

6.12.3.4 Calculate the overall washability index mean using the formula:

Overall washability index =

$$\frac{WI_D \times N_D + WI_G \times N_G + WI_S \times N_S}{N_D + N_G + N_S}$$

where:

WI = washing index

N = number of pieces specified for Dishware (D) Glasses (G) and Flatware (S)

7. DISHWASHER DRAIN CONNECTION

7.1 Dishwasher Drain to Food Waste Disposer.

It is recommended that when a dishwasher is connected to a food waste disposer, the connection should accommodate a 3/4 inch iron pipe size (1.05 inch actual) (26.7 mm) or 7/8 inch (22.2 mm) outside diameter copper tubing.

7.2 Dishwasher Drain to Air Gap.

It is recommended that a dishwasher drain connection attached to an air gap can be fit to a minimum drain line of 1/2 O.D. (13 mm) copper tubing.

NOTE: The recommendations in 7.1 and 7.2 reflect common plumbing practice.

8. INLET AND DRAIN TUBING TESTS

This standard covers flexible tubing made from plastic and elastomeric materials and used on household electric dishwashers for:

(1) the drain tubing and (2) the water supply tubing where the tubing is exposed to flow pressures only

and not to the static pressure of the household water supply system.

8.1 Dimensions, Shapes and Characteristics.

The surfaces of the elastomeric tubing and elastomeric molded ends (for plastic tubing) are to be uniform in appearance and free from roughness and stains. The surfaces of the plastic tubing are to be uniform in appearance.

8.2 Aging Test - For elastomeric hoses and molded ends.

Age the tubing for 70 hours at atmospheric pressure in an air oven having a constant temperature of 158°F (70°C). It is recommended that at the end of this period, the tubing is to be in accordance with the following:

Characteristics	Maximum Variation From Values For Unaged Tubing
Elongation	-35%
Tensile Strength	-25%
Durometer Hardness	+10 points

8.3 Alkali and Hot Water Test - For elastomeric hoses and molded ends.

8.3.1 Drain Tubing. Immerse the tubing for 24 hours in an alkaline solution* having a pH of 11.8 ± 0.6 , and a temperature of 200-212°F (93-100°C). It is recommended that at the end of this period, the inside diameter of the tubing vary not more than 10% from the original diameter.

8.3.2 Water Supply Tubing. Immerse the tubing for 24 hours in distilled water having a temperature of 200-212°F (93-100°C). It is recommended that at the end of this period, the inside diameter of the tubing vary not more than 10% from the original diameter.

*This solution may be made by dissolving 15 g of trisodium phosphate (Na_3PO_4) or soda ash (Na_2CO_3) in 1 L of distilled water. 15 g/L is equivalent to 1/2 fl oz/qt.

8.4 Burst Pressure - For elastomeric and plastic hoses.

It is recommended that the tubing is to withstand a minimum of 50 psi (345 kPa) or 5 times the maximum water pressure developed in the tubing during the dishwasher cycle, whichever is greater, without bursting when tested in accordance with paragraph 14(a) of the "Methods of Testing Rubber Hose", ANSI J2.5 (ASTM D380).**

8.5 Collapse or Kinking Resistance of Drain Tubing - For elastomeric and plastic hoses.

The length of the sample and the measurement of collapse of tubing is to be in accordance with the "Methods of Testing Automotive Air Brake and Vacuum Brake Hose", ANSI J2.10 (ASTM D622).** It is recommended that the outside diameter of the tubing collapse not more than 15% at any point while formed in the direction of its normal curvature until the ends just meet.

8.6 Ozone Resistance Test for a Flexible Connection Between a Dishwasher Drain Line and a Food Waste Disposer - For elastomeric hoses and molded ends.

Test flexible connections in accordance with "Method of Test for Accelerated Ozone Cracking of Vulcanized Rubber", (ASTM D1149-64).**

Expose the test samples to an ozone concentration of 50 parts per 100 x 10⁶ at 104°F (40°C) for 72 hours. They are to be stressed by the insertion of a wooden dowel, or a suitable equivalent, for a distance of at least 1 inch (25 mm). The dowel is to be of such a size as will result in a 25% elongation in the inside circumference of the hose.

8.6.1 Evaluation of Test. After this test, grade samples as follows:

- RO = No cracking
- R1 = Cracking visible with a microscope (7-power)
- R2 = Cracking visible to the unaided eye
- R3 = Severe cracking

8.6.2 Recommended Level of Performance. It is recommended that flexible connections be R2 or better.

NOTE: Severe cracking (rating R3) of the hose could permit the breaking of the hose to the point where leaking or flooding could occur.

9. ENERGY CONSUMPTION MEASUREMENTS.

Energy consumption of household dishwashers may be measured using the Department of Energy (DOE) Test Procedure for Dishwashers, published in the Federal Register, Vol. 42, No. 152, Monday, August 8, 1977 and any applicable amendments as may be published.

**Copies are available from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

10. WATER CONSUMPTION MEASUREMENT.

Water consumption of household dishwashers may be measured using the following sections of the DOE Test Procedure for Dishwashers as described in Section 9. The applicable sections for this measurement are as follows:

2. Testing Conditions

- 2.1 Installation
- 2.2 Electrical Supply
- 2.3 Water Temperature
- 2.4 Water Pressure
- 2.5 Ambient and Machine Temperature
- 2.6 Load

3. Test Cycle and Measurements

- 3.1 Test Cycle
- 3.3 Water Consumption
- 3.4 Reported Values (measured water consumption only)

11. SAFETY AND SANITATION

It is recommended that dishwashers within the scope of this standard meet the safety and sanitation requirements of Underwriters Laboratories Standard No. 749, "Standard for Safety, Household Dishwashers" ANSI/UL 749, latest edition.*

*Copies are available from Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, Illinois 60062; 1285 Walt Whitman Road, Melville, Long Island, New York 11747 and 1655 Scott Boulevard, Santa Clara, California 95050.

APPENDIX A

Listing of Sources for Test Materials

Dishware can be ordered directly from:

Corning, Inc.
Food Service Products
HP-EB-02-2
Corning, NY 14831
(800) 451-7603
Contact: Robin Moore

Glass source is as follows:

Libbey Glass Division
Owens Illinois
Toledo, OH 45693
(419) 247-5000

Cascade detergent should be ordered directly from:

The Procter & Gamble Company
Ivorydale Technical Center
5299 Spring Grove Avenue
Cincinnati, OH 45217-1087
(513) 627-5431

(By ordering direct from Procter & Gamble, possible problems will be avoided which otherwise could be caused by varying formulations in test markets possibly running in various locales.)

APPENDIX B

Suggested Forms to be used in Reporting Performance and Calculating Washing Index

(Forms appear on the following pages.)

**Addendum to Appendix A
AHAM DW-1-1992**

August 20, 1999

It has come to the attention of AHAM that the dishware specified in AHAM DW-1-1992 is no longer available. The following Dishware may be considered an acceptable alternative.

3.16.1 Dishware.

Company/Designation

One cup - 0.21L.....	Arzberg #3824732100
One saucer - 14cm.....	Arzberg #3824731100
One dinner plate - 10 inch (26cm)	Corning/Comcor® #6003893
One bread and butter plate - 17cm	
.....	Arzberg #8500217100
One fruit bowl - 13cm.....	Arzberg #3820513100

3.17 Serving Pieces.

3.17.1 Dishware

Company/Designation.

Platter 9 1/2 inch Oval	
	Corning/Comcor® #6011655
Two Serving bowls 1 qt.	
	Corning/Corelle® #6003911

Comcor® and Corelle® Dishware are available from:

World Kitchen, Inc
1200 S. Antrim Way
Greencastle, PA, 17225
Customer Service: 1-800-947-1478
Fax: 1-800-685-3950
Sales: Andrea Kirkwood
1-800-451-7603

Arzberg Dishware is available from:

Eschenbach USA
14101 Sullyfield Circle
Suite 300
Chantilly, VA 20151
Tel: 703-263-1550
Fax: 703-263-2216
Attn: Stephen Thompson

FORM 1

(Any Other Data Can Be Included)

Judge _____

Object - China

Machine

Test _____

No. of Table Settings

Test Date _____

Cycle Used

SCORING

0-9 Count (any one piece larger than 3/8 inch (10 mm) in any direction rate as 9)

Dinner Plates

Bread & Butter Plates

Coffee Cups

Saucers

Fruit Bowls

Serving Dishes

FORM 2

(Any Other Data Can Be Included)

Object -- Glass

Judge _____

Machine

Test _____

No. of Table Settings

Test Date _____

Cycle Used

SCORING

0-9 Count (any one piece larger than 3/8 inch (10 mm) in any direction rate as 9)

FORM 3

(Any Other Data Can Be Included)

Object - Flatware

Judge _____

Test _____

Test Date _____

Machine

No. of Table Settings

Cycle Used

SCORING

0-9 Count (any one piece larger than 3/8 inch (10 mm) in any direction rate as 9)

Dinner Forks

Salad Forks

Knives

Teaspoons

Serving Items

(Any Other Data Can Be Included)

Judge_____

Machine

Evaluation_____

No. of Table Settings

Test Date_____

Cycle Used

	Test 1	Test 2	Test 3
China			
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
Total Pieces			
Glass			
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
Total Pieces			
Flatware			
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
Total Pieces			

FORM 5

(Any Other Data Can Be Included)

Judge _____

Machine

Evaluation _____

No. of Table Settings

Test Date _____

Cycle Used

Test 1

Test 2

Test 3

%0

CHINA

1's

2's + 3's

4's through 8's

9's

TOTAL

GLASS

1's

2's + 3's

4's through 8's

9's

TOTAL

FLATWARE

1's

2's + 3's

4's through 8's

9's

TOTAL



Association of Home Appliance Manufacturers
1111 19th Street, NW • Washington, D.C. 20036