



# ENERGY STAR<sup>®</sup> Program Requirements

## Product Specification for Residential Dishwashers

### Test Method for Determining Residential Dishwasher Cleaning Performance

Rev. Feb-2014

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## 1 OVERVIEW

The following test method shall be used for determining compliance with the cleaning performance requirements included in the ENERGY STAR Eligibility Criteria for Residential Dishwashers. Cleaning performance of soil-sensing dishwashers shall be determined on the same test units during the same cycles as the energy and water consumption tests for ENERGY STAR qualification, while that of non-soil sensing dishwashers shall be evaluated on the same test units immediately following the energy and water consumption tests.

## 2 APPLICABILITY

The following test method shall be used to determine the cleaning performance of all Residential Dishwasher products for the ENERGY STAR program.

## 3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions in the ENERGY STAR Eligibility Criteria for Residential Dishwashers, and those in the Federal test procedure for Residential Dishwashers that is codified in the Code of Federal Regulations (CFR) at 10 CFR Part 430, Subpart B, Appendix C1.

### A) Acronyms and Units:

- 1) AHAM: Association of Home Appliance Manufacturers
- 2) ANSI: American National Standards Institute
- 3) CFR: Code of Federal Regulations
- 4) UUT: Unit under test

## 4 TEST SETUP

- A) Test Setup and Instrumentation: Test setup and instrumentation for all portions of this method shall be in accordance with those specified in 10 CFR Part 430, Subpart B, Appendix C1.
- B) Cleaning Performance Rating Conditions: The lighting setup in the evaluation room shall be according to the requirements specified in section 5.10 of American National Standards Institute (ANSI) and Association of Home Appliance Manufacturers (AHAM) standard, ANSI/AHAM DW-1-2010, "Household Electric Dishwashers" (ANSI/AHAM standard DW-1-2010).
- C) Water Hardness: The supply water hardness shall be as specified in section 4.8.3 of ANSI/AHAM standard DW-1-2010.

## 5 TEST PROCEDURES FOR ALL PRODUCTS

### 5.1 Test Cycles

- A) Preconditioning Cycle: Precondition the unit under test (UUT) as specified in 10 CFR Part 430, Subpart B, Appendix C1. The quantity of detergent required for operating the UUT shall be determined as specified in 10 CFR Part 430, Subpart B, Appendix C1.
- 1) For soil-sensing dishwashers, input power to the UUT shall be supplied continuously, throughout all preconditioning and test cycles, as required by 10 CFR Part 430, Subpart B, Appendix C1, to ensure that the turbidity sensor, which detects the presence of soil particles in water and infers the soil level of the load to initiate the appropriate cycle, does not change its calibration between tests.
- B) Soil-sensing Normal Cycle: For dishwashers with a soil-sensing normal cycle, as defined in 10 CFR Part 430, Subpart B, Appendix C1, testing shall be conducted according to 10 CFR Part 430, Subpart B, Appendix C1.
- 1) Cleaning performance shall be evaluated on the same units and during the same cycles that measure energy and water consumption using the test loads described in 10 CFR Part 430, Subpart B, Appendix C1.
  - 2) The tests shall be conducted starting with the sensor heavy response test load, followed by the sensor medium response test load, then the sensor light response test load, with no cleaning of the UUT between test cycles.
- C) Non-soil Sensing Normal Cycle: For non-soil sensing dishwashers, and dishwashers with soil-sensing capability, but a non-soil sensing normal cycle as defined in 10 CFR Part 430, Subpart B, Appendix C1, testing shall be conducted according to 10 CFR Part 430, Subpart B, Appendix C1; however, cleaning performance shall be evaluated on the normal cycle using the sensor heavy, medium, and light response test loads described for soil-sensing dishwashers in 10 CFR Part 430, Subpart B, Appendix C1 immediately after performing the energy and water consumption tests.
- 1) The tests shall be conducted starting with the sensor heavy response test load, followed by the sensor medium response test load, then the sensor light response test load.
  - 2) No other cycles shall be operated and the UUT shall not be cleaned between any of the test cycles.
- D) Loading Requirements: The UUT shall be loaded according to the instructions included in 10 CFR Part 430, Subpart B, Appendix C1, with the following additional requirements.
- 1) Each item of the test load shall alternate clean and soiled items.
  - 2) **Similar items** (e.g., all bread and butter plates or all fruit bowls) shall be loaded in the racks consecutively without any empty rack spaces in between. Empty rack spaces between **different items** (e.g., between the set of bread and butter plates and set of fruit bowls) are acceptable only if one, or both, of the following conditions are met:
    - a) The capacity of the UUT is greater than the number of place settings required by 10 CFR Part 430, Subpart B, Appendix C1.
    - b) The manufacturer's use and care guide for the UUT instructs the user to leave empty rack spaces while loading.
  - 3) Clean items shall be loaded in the UUT first, followed by the soiled items.

- 4) For each soil load, the alternating of clean and soiled items for **standard dishwashers** is explained below. Test load items adjacent to any empty rack spaces shall be clean.
- Sensor Heavy Response Test Load: Alternate clean and soiled items. Figure 1 in Appendix A shows a schematic of the Sensor Heavy Response loading pattern for an example dishwasher.
  - Sensor Medium Response Test Load: Load items such that the soiled item is repeated after every two clean items. Figure 2 in Appendix A shows a schematic of the Sensor Medium Response loading pattern for an example dishwasher.
  - Sensor Light Response Test Load: Load the soiled item towards the middle of the load (e.g., when all dinner plates are loaded into the dishwasher, the soiled dinner plate should be either the fourth or fifth dinner plate). Figure 3 in Appendix A shows a schematic of the Sensor Light Response loading pattern for an example dishwasher.
- 5) For each soil load, the alternating of clean and soiled items for **compact dishwashers** is explained below. Test load items adjacent to any empty racks spaces shall be clean.
- Sensor Heavy Response Test Load: Alternate clean and soiled items.
  - Sensor Medium Response Test Load and Sensor Light Response Test Load: Load the soiled item towards the middle of the load (e.g., when all dinner plates are loaded into the dishwasher, the soiled dinner plate should be either the second or third dinner plate).
- E) Rinse aid shall not be used in the UUT.

## 5.2 Grading

- A) After the completion of each test cycle, each item in the test load shall be graded on a scale from 0 to 9 according to the instructions in section 5.10 of ANSI/AHAM standard DW-1-2010.

## 5.3 Cleaning Index

- A) For each test cycle, calculate the UUT per-cycle cleaning index ( $CI_i$ ) according to Equation 1 below.

### Equation 1: Calculation of Per-Cycle Cleaning Index

$$CI_i = 100 - \frac{(12.5 \times N_{1,i} + 25 \times N_{2,3,i} + 50 \times N_{4,5,6,i} + 75 \times N_{7,8,i} + 100 \times N_{9,i})}{N}$$

Where:

- $N$  is the total number of items in the test load
- $N_{1,i}$  is the total number of items in the test load with a grade of 1
- $N_{2,3,i}$  is the total number of items in the test load with a grade of 2 and/or 3
- $N_{4,5,6,i}$  is the total number of items in the test load with a grade of 4, 5, and/or 6
- $N_{7,8,i}$  is the total number of items in the test load with a grade of 7 and/or 8
- $N_{9,i}$  is the total number of items in the test load with a grade of 9
- $i$  is the test cycle type (heavy,  $h$ ; medium,  $m$ ; or light,  $l$ )

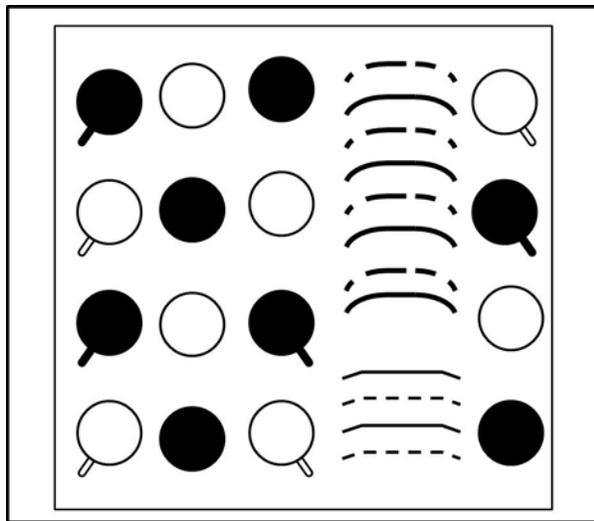
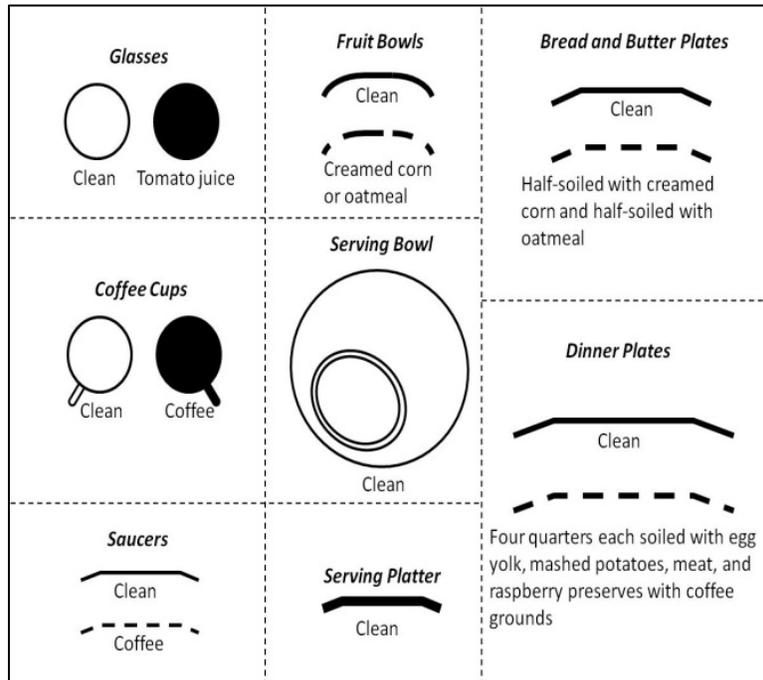
Note: The total number of items in the test load with a grade of 0 ( $N_{0,i}$ ), is not included in the equation for calculating  $CI_i$  because this grade represents a completely clean item, and the  $CI_i$  calculation deducts points from a perfect score of 100 for items that have some residual soil. While items receiving a grade of 0 are not included in the calculation of  $CI_i$ , these items are accounted for in the total number of items in the test load.

## **6 REFERENCES**

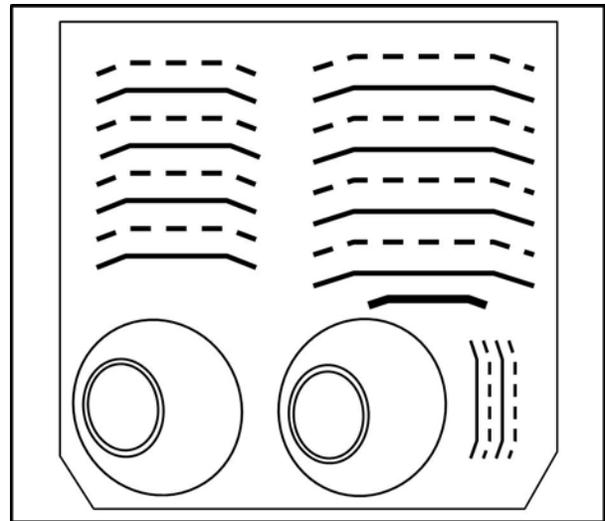
- A) ANSI/AHAM DW-1-2010. Household Electric Dishwashers.
- B) 10 CFR Part 430, Subpart B, Appendix C1. Uniform Test Method for Measuring the Energy Consumption of Dishwashers.

## 7 APPENDIX A: SCHEMATIC OF LOADING PATTERN

The figures below show schematics for the loading pattern of an example standard dishwasher for the sensor heavy response, sensor medium response, and sensor light response soil loads. These schematics show examples of potential ways to alternate clean and soiled items, and should be used for reference only. The instructions in 10 CFR Part 430, Subpart B, Appendix C1 shall be followed for loading the UUT, with clean and soiled items alternated as shown in the examples below.

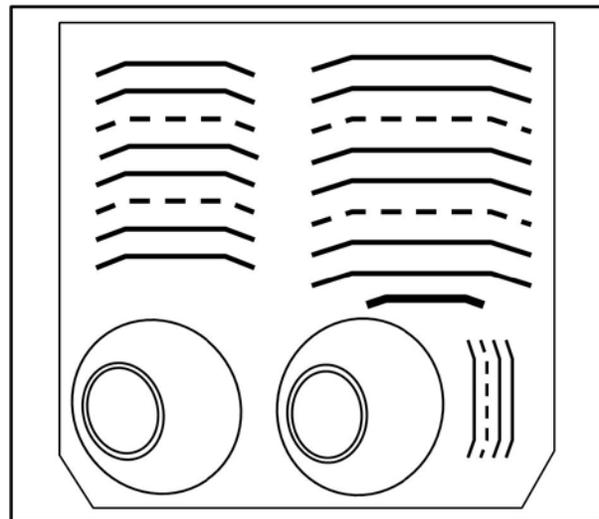
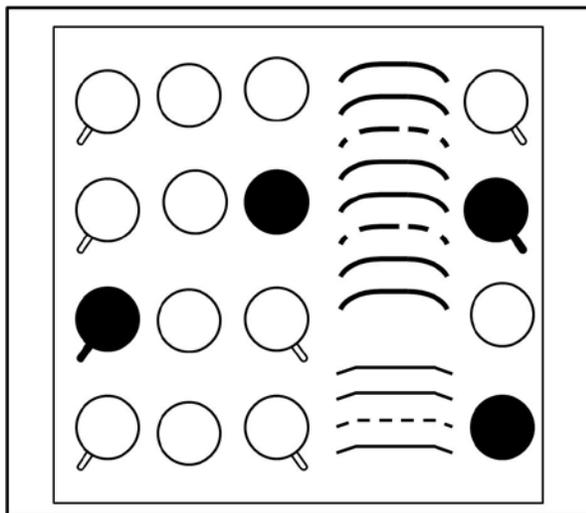
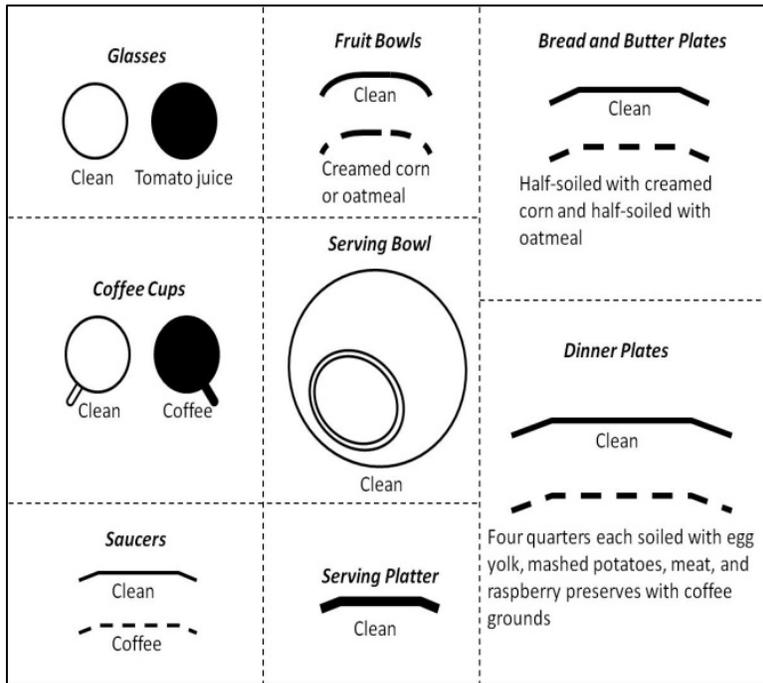


TOP RACK

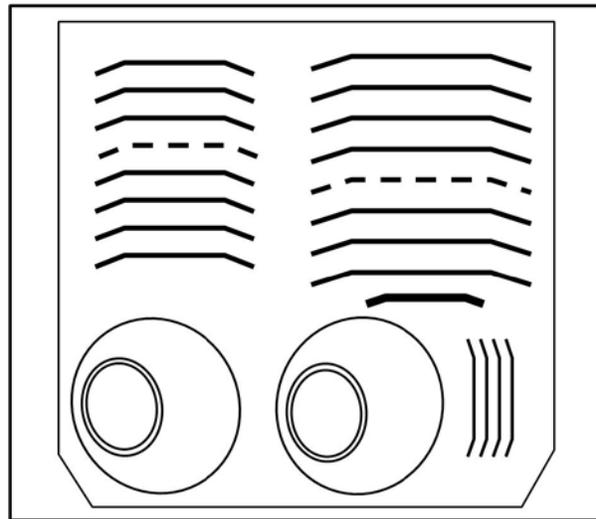
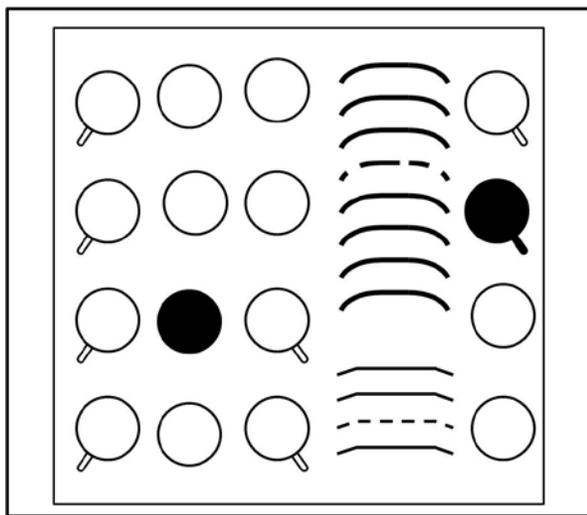
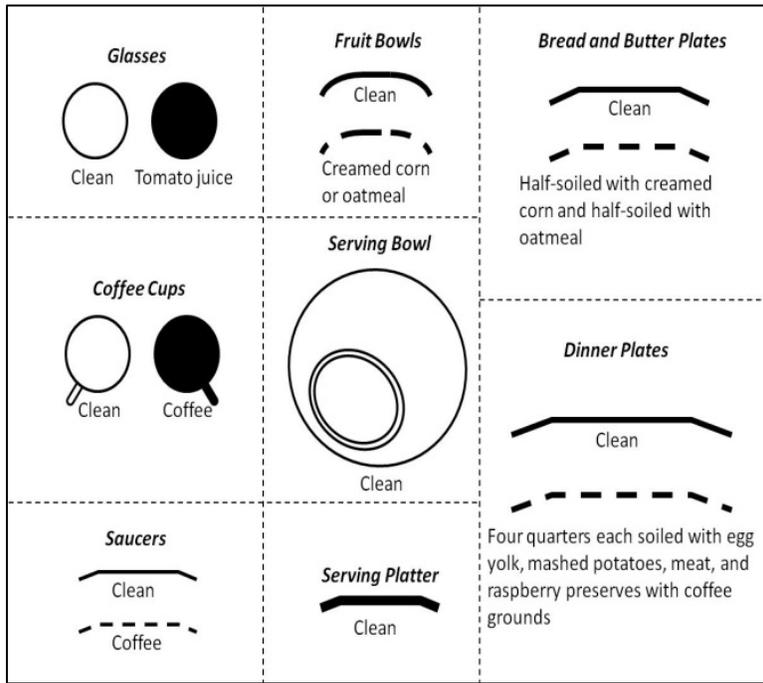


BOTTOM RACK

Figure 1: Loading pattern for the sensor heavy response soil load.



**Figure 2: Loading pattern for the sensor medium response soil load.**



**Figure 3: Loading pattern for the sensor light response soil load.**