



ENERGY STAR[®] Program Requirements Product Specification for Residential Dishwashers

Eligibility Criteria Draft 2 Version 6.0

1 Following is the **Draft 2 Version 6.0** ENERGY STAR Product Specification for Residential Dishwashers. A
2 product shall meet all of the identified required criteria if it is to earn the ENERGY STAR.

3 **1) Definitions:**

4 Below are the definitions of the relevant terms in this document. Where noted below, definitions are identical
5 to the definitions in the U.S Department of Energy (DOE) test procedure at 10 Code of Federal Regulations
6 (CFR) 430, Subpart B, Appendix C1 or in 10 CFR 430.2. When in conflict, the definitions in the CFR take
7 precedence.

- 8 A. Dishwasher¹: A cabinet-like appliance which with the aid of water and detergent, washes, rinses, and
9 dries (when a drying process is included) dishware, glassware, eating utensils, and most cooking
10 utensils by chemical, mechanical and/or electrical means and discharges to the plumbing drainage
11 system.
- 12 a. Compact Dishwasher²: A dishwasher that has a capacity of less than eight place settings plus six
13 serving pieces as specified in ANSI/AHAM DW-1-2010 (incorporated by reference; see §430.3),
14 using the test load specified in section 2.7 of 10 CFR 430, Subpart B, Appendix C1.
- 15 b. Standard Dishwasher²: A dishwasher that has a capacity equal to or greater than eight place
16 settings plus six serving pieces as specified in ANSI/AHAM DW-1-2010 (incorporated by reference;
17 see §430.3), using the test load specified in section 2.7 of 10 CFR 430, Subpart B, Appendix C1.
- 18 c. Portable Dishwasher³: A dishwasher which is not permanently connected to the household water
19 and electric supply lines. It can be mounted on wheels and easily moved from one place to another
20 in normal use. This definition includes dishwashers intended to be used on a countertop or table.
- 21 B. Basic Model¹: All units of a given type of product (or class thereof) manufactured by one manufacturer,
22 having the same primary energy source, and which have essentially identical electrical, physical, and
23 functional (or hydraulic) characteristics that affect energy consumption, energy efficiency, water
24 consumption, or water efficiency.
- 25 C. Consumer Product¹: Any product (other than an automobile, as defined in Section 501(1) of the Motor
26 Vehicle Information Cost Savings Act) which: (1) in operation consumes, or is designed to consume,
27 energy and water (2) to any significant extent, is distributed in commerce for personal use or
28 consumption by individuals.
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¹ 10 CFR 430, Subpart A, Section 430.2 Note: Definition of consumer product has been abbreviated to be specific to residential dishwashers by omitting the regulatory definition's references to lighting and water.

² 10 CFR 430, Subpart B, Appendix C1

³ ANSI/AHAM DW-1-2010

Note: In response to stakeholder feedback, EPA has updated the portable dishwasher definition reference in footnote 3 to ANSI/AHAM DW-1-2010. EPA has also amended footnote 1, clarifying that the definition of consumer product is an abbreviated version of the definition in the CFR. Throughout the specification, EPA has replaced the term “qualification” with “certification” to harmonize the language with other ENERGY STAR specifications.

2) Scope

- A. Included Products: Products that meet the definition of a dishwasher and are a consumer product as specified herein are eligible for ENERGY STAR certification, with the exception of products listed in Section 2B.
- B. Excluded Products: Product types not specifically identified in Section 2A are not eligible for ENERGY STAR certification under this specification. Products that are covered under other ENERGY STAR product specifications (e.g., Commercial Dishwashers) are not eligible for certification under this specification.

3) Certification Criteria

A. Energy Performance Requirements

Annual Energy Consumption (AEC) shall be less than or equal to Maximum Annual Energy Consumption (AEC_{MAX}), as calculated per Equation 1.

Equation 1: Calculation of Maximum Annual Energy Consumption

$$AEC_{MAX} = AEC_{BASE} + AEC_{AdderConnected}$$

where,

AEC_{BASE} is the annual energy consumption base allowance (kWh/year), per Table 1

$AEC_{AdderConnected}$ is the annual energy connected allowance, per Table 2

Table 1: Annual Energy Consumption Base Allowances

Product Type	AEC_{BASE} (kWh per year)
Standard	270
Compact	203

Table 2: Connected Allowance

Product Type	$AEC_{AdderConnected}$
Standard Dishwashers	$0.05 \times AEC_{BASE}$

¹ There is no connected allowance for compact dishwashers.

² Product must be qualified using the final and validated ENERGY STAR Test Method for Residential Dishwashers to Validate Demand Response (TBD) to use the allowance.

³ Calculated allowance shall be rounded down to the nearest whole number before being applied in Equation 1.

58 B. Water Performance Requirements

59 **Table 3: Maximum Water Consumption**

Product Type	Water Consumption (gallons per cycle)
Standard	≤ 3.5
Compact	≤ 3.1

60 **Note:**

61 **Efficiency Criteria**

62 In the Draft 2 Version 6.0 specification, EPA is not proposing any changes to the standard residential dishwasher efficiency criteria. EPA is proposing compact dishwasher criteria of less than or equal to 203 kilowatt hours per year (kWh/year) and no more than 3.1 gallons of water per cycle in order to more accurately represent the energy and water efficiency gains achievable through multiple technologies. The Draft 2 compact efficiency criteria would reduce the energy use by 9% and the water use by 11% relative to a compact dishwasher that just meets the Federal standard. As noted in Draft 1, most compact dishwashers that were previously on the ENERGY STAR certified product list (prior to 12/31/2013) and currently on the DOE Energy Certification Database have a rated energy consumption of 220 kWh/year and 3.5 gallons/cycle. Stakeholder comments received on the Draft 1 specification recommended that EPA conduct further outreach to understand if increasing energy and water efficiency in compact products is achievable through more than one technology. As a result of additional outreach to compact dishwasher manufacturers, the Agency has determined these levels to be achievable for both dishdrawer and countertop models. Due to the small market for compact dishwashers and extremely limited cost data, EPA is making use of manufacturer-supplied incremental cost data, translated to incremental retail cost, and annual cost savings to estimate a payback period of 4.6 years for the proposed compact criteria levels. Further information regarding the payback calculation may be found in the data and analysis package. EPA welcomes comments on the proposed changes to the compact efficiency criteria.

78 **Connected Credit**

79 Considering the very small market for compact dishwashers, EPA does not see this product type as a target for demand response programs. In addition, the Agency is unaware of compact dishwasher manufacturers seeking to add connected functionality to these products. As such, EPA is proposing to limit eligibility for the optional connected criteria to standard dishwashers. The Agency has amended Table 2 to reflect this.

83 C. Significant Digits and Rounding: All calculations shall be carried out as specified in Appendix C1 to
84 Subpart B of Part 430 and 10 CFR Part 430.23(c).

85 D. Model Numbers: Model numbers used for ENERGY STAR qualified product submissions shall be
86 consistent with Federal Trade Commission (FTC) and Department of Energy (DOE) submissions.

87 **4) Optional Cleaning Performance Reporting**

88 The following optional cleaning performance reporting is applicable to those products included under Section
89 2A. Partners are encouraged to provide one complete set of cleaning performance data for each ENERGY
90 STAR certified product.

91 A. Data Reporting: The per-cycle Cleaning Index (CI) as defined in the ENERGY STAR Test Method for
92 Determining Residential Cleaning Performance Section 5.3A, may be reported for each ENERGY STAR
93 basic model. Cleaning performance data may be submitted through the data reporting templates
94 available to EPA recognized certification bodies or directly to the ENERGY STAR program.

95 B. Sampling Plan: For those basic models for which the manufacturer wishes to submit voluntary cleaning
96 performance data, the per-cycle Cleaning Index (CI) should be calculated as the average of the units in
97 the sample for each test cycle (heavy, medium, and light). The units comprising the sample must be the
98 identical units (i.e., same serial numbers) as those used in determining the energy and water scores
99 tested at the same lab pursuant to Section 6 of this specification.

100 C. Test Method: Testing of cleaning performance shall be performed using the ENERGY STAR Test
101 Method for Residential Cleaning Performance (Rev. Feb-2014).

102 **Note:** In the Draft 2 specification, EPA includes optional cleaning performance reporting. Consistent with the
103 ENERGY STAR's commitment to offering energy savings without sacrifice in performance, EPA continues to seek
104 a better understanding of cleaning performance as it relates to efficiency to ensure that efficiency gains are not
105 achieved at the expense of performance. Rather than a mandatory reporting requirement, EPA strongly
106 encourages manufacturers to provide cleaning performance data to EPA using the ENERGY STAR Test Method
107 for Determining Residential Dishwasher Cleaning Performance (Rev. Feb-2014). The Agency has added a new
108 Section 4 to the Draft 2 specification to define attributes for optional cleaning performance reporting. The
109 inclusion of Section 4 is intended to promote consistency in the data being submitted to the ENERGY STAR
110 program by manufacturers or certification bodies, and is not required to demonstrate ENERGY STAR compliance.

111 Some stakeholders have expressed concerns regarding the test method's repeatability and reproducibility. In
112 response to these concerns, DOE and EPA have followed up with stakeholders and remain confident that the test
113 method is an effective means of assessing relative cleaning performance in conjunction with energy and water
114 performance. EPA believes this call for data will allow the program to consider cleaning performance as it relates
115 to future specification setting process, while also allowing test labs to build familiarity with the ENERGY STAR
116 Cleaning Performance Test Method. Manufacturers are encouraged to work with their certification bodies to use
117 existing data reporting pathways during the certification process to submit cleaning performance
118 data. Alternately, manufacturers may elect to supply this data, once gathered, directly to the program via
119 appliances@energystar.gov. EPA will mask data before sharing it with stakeholders. EPA looks forward to
120 continuing its work with manufacturers and other stakeholders to obtain a better sense of dishwasher cleaning
121 performance as it relates to efficiency.

122 5) Connected Criteria:

123 The following optional connected criteria are applicable to Included Products, Section 2A, that meet the
124 definition of a standard dishwasher as defined in Section 1Ab.

125 **Note:** EPA has added language at the beginning of Section 5 to make clear the Agency's intent that the
126 Connected Product Criteria are only applicable to standard residential dishwashers.

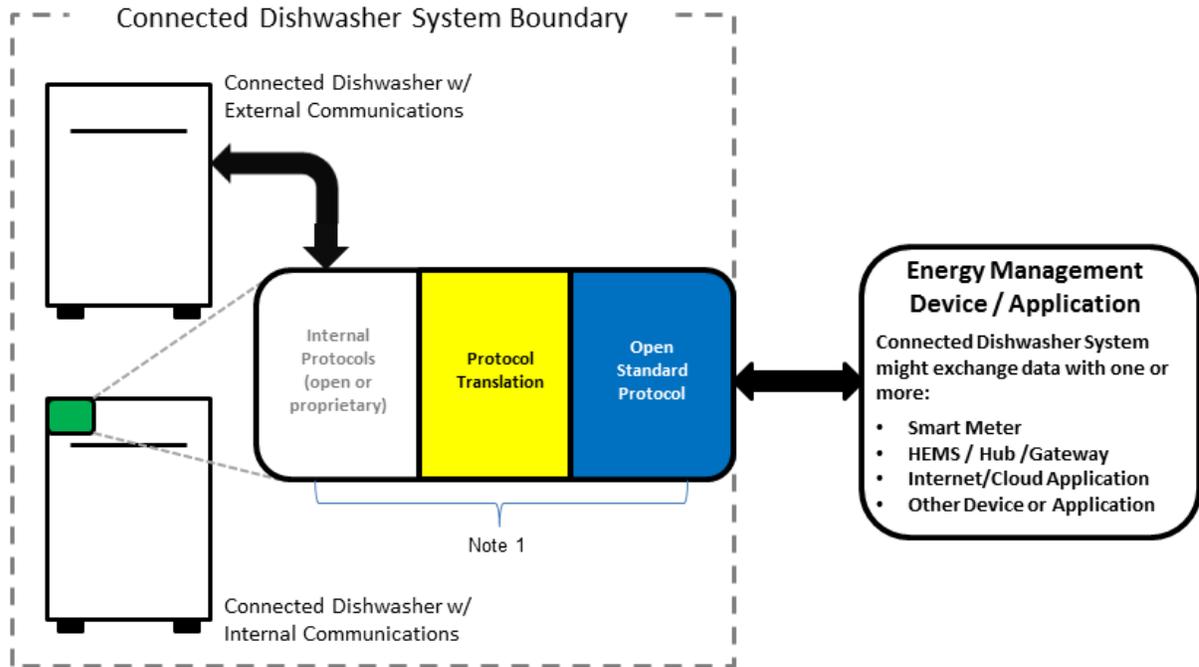
127 A. Connected Dishwasher System

128 To be recognized as connected and to be eligible for the connected allowance, a "connected dishwasher
129 system" (as shown in Figure 1) shall include the base appliance plus all elements (hardware, software)
130 required to enable communications in response to consumer-authorized energy related commands (*not*
131 *including third-party remote management which may be made available solely at the discretion of the*
132 *manufacturer*). These elements may be resident inside or outside of the base appliance.

133 The specific design and implementation of the connected dishwasher system is at the manufacturer's
134 discretion provided it is interoperable with other devices via open communications protocol and enables
135 economical consumer-authorized third party access to the functionalities provided for in sections 5D, 5F,
136 and 5G. The capabilities shall be supported through one or more means, as identified in section 5B2. A
137 product that enables economical and direct, on-premises, open-standards based interconnection is the
138 preferred option for meeting this requirement, but alternative approaches are also acceptable.

139 The product must continue to comply with the applicable product safety standards – the addition of the
140 functionality described below shall not override existing safety protections and functions. The appliance
141 must meet manufacturer's internal minimum performance guidelines, e.g., cleaning performance.

142 **Figure 1.** Connected Dishwasher System Boundary – Illustrative Example



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146 *Note 1: Communication device(s), link(s) and/or processing that enables open standards-based communication between the connected dishwasher system and Energy Management Device/Application(s). These elements could be within the base appliance, and/or an external communication module, a hub/gateway, or in the Internet/cloud.*

147 **B. Communications**

- 148 1. Open Standards – Communication with entities outside the connected dishwasher system that
149 enables connected functionality (sections 5D, 5F, 5G) must use, for all communication layers,
150 standards:
- 151 a. Included in the Smart Grid Interoperability Panel (SGIP) Catalog of Standards,⁴ and/or
 - 152 b. Included in the NIST Smart Grid framework Tables 4.1 and 4.2, and/or
 - 153 c. Adopted by the American National Standards Institute (ANSI) or another well-established
 - 154 international standards organization such as the International Organization for Standardization
 - 155 (ISO), International Electrotechnical Commission (IEC), International Telecommunication Union
 - 156 (ITU), Institute of Electrical and Electronics Engineers (IEEE), or Internet Engineering Task Force
 - 157 (IETF).
- 158 2. Communications Hardware Architecture – Communication with entities outside the connected
159 dishwasher system that enables connected functionality shall be enabled by any of the following
160 means, according to the manufacturer's preference:
- 161 a. Built-in communication technology
 - 162 b. Manufacturer-specific external communication module(s) and/or device(s)
 - 163 c. Open standards-based communication port on the appliance combined with open standards-
 - 164 based communications module

⁴ http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/PMO#Catalog_of_Standards_Processes

- 165 d. Open standards-based communication port(s) on the appliance in addition to a, b or c, above
166 If option b or c is used, the communication module/device(s) must be easy for a consumer to install
167 and shipped with the appliance, provided to the consumer at the time of sale, or provided to the
168 consumer in a reasonable amount of time after the sale.

169 C. Open Access

170 To enable interconnection with the product, in addition to section 5B1 that requires open-standards, an
171 interface specification, Application Programming Interface (API) or similar documentation shall be made
172 available to interested parties that at a minimum, allows transmission, reception and interpretation of the
173 following information:

- 174 1. Energy Consumption Reporting specified in section 5D (must include accuracy, units and
175 measurement interval);
176 2. Operational Status, User Settings & Messages specified in section 5F (if transmitted via a
177 communication link);
178 3. Demand Response specified in section 5G.

179 D. Energy Consumption Reporting

180 In order to enable simple, actionable energy use feedback to consumers and consumer authorized
181 energy use reporting to 3rd parties, the product shall be capable of transmitting energy consumption data
182 via a communication link to energy management systems and other consumer authorized devices,
183 services, or applications. This data shall be representative of the product's interval energy consumption.
184 It is recommended that data be reported in watt-hours for intervals of 15 minutes or less, however,
185 representative data may also be reported in alternate units and intervals as specified in the product
186 manufacturer's interface specification or API detailed in section 5C.

187 The product may also provide energy use feedback to the consumer on the product itself. On-product
188 feedback, if provided, may be in units and format chosen by the manufacturer (e.g., \$/month).

189 E. Remote Management

190 The product shall be capable of receiving and responding to consumer authorized remote requests (*not*
191 *including third-party remote management which may be made available solely at the discretion of the*
192 *manufacturer*), via a communication link, similar to consumer controllable functions on the product. The
193 product is not required to respond to remote requests that would compromise performance and/or product
194 safety as determined by the product manufacturer.

195 F. Operational Status, User Settings & Messages

- 196 1. The product shall be capable of providing the following information to energy management systems
197 and other consumer authorized devices, services or applications via a communication link:
- 198 • Operational / Demand Response (DR) status (e.g., off/standby, cycle in process, delay appliance
199 load, temporary appliance load reduction).
- 200 2. The product shall be capable of providing the following information on the product and/or to energy
201 management systems and other consumer authorized devices, services or applications via
202 communication link:
- 203 • At least two types of messages relevant to the energy consumption of the product. For example,
204 messages for dishwashers might address performance issues or report of energy consumption
205 that is outside the product's normal range.

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G. Demand Response

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A connected dishwasher system shall have the capability to receive, interpret and act upon consumer-authorized signals by automatically adjusting its operation depending on both the signal's contents and settings from consumers. At a minimum, the product shall be capable of providing the following capabilities in all operational modes:

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1. *Delay Appliance Load Capability:* The capability of the product to respond to a signal in accordance with consumer settings, except as permitted below, by delaying the start of an operating cycle beyond the delay period.

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- a. Default settings – The product shall ship with default settings that enable a response in accordance with 5G1 for at least 4 hours.

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- b. Consumer override – The consumer shall be able to override the product's Delay Appliance Load response before or during a delay period.

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- c. The product shall be able to provide a Delay Appliance Load response at the start of each consumer initiated operating cycle, but is not required to provide more than three Delay Appliance Load responses in a rolling 24-hour period (with a maximum of one 4-hour response per dishwasher cycle).

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Note: EPA has added additional language in section 5G1c to clarify that products responding to a Delay Appliance Load (DAL) signal are required to respond to no more than one 4-hour DAL per consumer initiated dishwasher operating cycle.

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2. *Temporary Appliance Load Reduction Capability:* The capability of the product to respond to a signal by providing load reduction for a short time period, typically 10 minutes. Upon receipt of signal and in accordance with consumer settings, except as permitted below, the product shall restrict its average power draw during the load reduction period to no more than 50% relative to the baseline average power draw defined in the Test Method to Validate Demand Response.

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- a. Default settings - The product shall ship with default settings that enable a response in accordance with 5G2 for a time period of least 10 minutes.

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- b. The product is not required to provide a response in accordance with 5G2a if the consumer selected wash cycle is a sanitization cycle in compliance with National Sanitation Foundation (NSF)/ American National Standards Institute (ANSI) Standard 184.

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- c. Upon receipt of a signal requesting a temporary appliance load reduction response, except as allowed by 5G2b, the product shall respond within 60 seconds of the requested start-time.

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Note: The product should respond at the requested start time whenever possible. The 60 second response time deferral is intended to allow soil-sensing and sensor calibration to complete.

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- d. Consumer override – The consumer shall be able to override the product's Temporary Appliance Load Reduction response before or during a load reduction period.

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- e. The product shall be able to provide at least one Temporary Appliance Load Reduction response per consumer initiated operating cycle.

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Note: In response to stakeholder feedback EPA has exempted NSF/ANSI Standard 184 (NSF 184) compliant sanitization cycles from needing to comply with the Temporary Appliance Load Reduction (TALR) criteria in Section 5G2. Stakeholders commented that responding to a TALR signal during a NSF 184 compliant sanitization cycle may result in an increase in energy use or failure to maintain consumer expectations on performance by not being able to achieve the Heat Unit Equivalent (HUE) counts necessary for sanitization to occur. Reviewing products available on the market, the Agency has determined that most standard dishwashers are equipped with at least one NSF184 compliant sanitization cycle. At this time, EPA is not aware of a dataset which shows consumer preference for the use of NSF 184 compliant sanitization cycles. However, conversations with manufacturers indicate NSF 184 compliant cycles are used infrequently by consumers. EPA welcomes additional information that would inform the consumer use of NSF 184 sanitization cycles and feedback on the proposed exemption of the NSF 184 cycle from responding to a TALR signals.

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Note (cont.): EPA has also amended the TALR criteria in Section 5G2 to allow for a TALR response delay of up to 60 seconds. This delay is intended to allow for completion of soil-sensing or calibration operations. Similarly, stakeholders commented that the interruption of soil-sensing operations in a dishwasher may impact the energy and water use of the product. Further manufacturer outreach has shown that products are equipped with a range of soil sensing capabilities with some products having as few as one soil sensing event per cycle to more than 20 sensing events per cycle. Depending on the control algorithms being used, EPA understands that the turbidity assessment lasts as little as 10 seconds per sensing occurrence, however may be tied to additional mechanical or control processes that result in a sensing event that lasts up to 60 seconds. In allowing products to delay the response to a TALR signal, EPA seeks to ensure that products with advanced sensing capabilities are not subject to energy, water, or performance impacts as a result of the TALR event. Should a product receive a TALR signal outside of the sensing or calibration operation, the Agency expects that the product be able to comply with the requested start time of the TALR without additional delays, and has included additional note language in section 5G2c to reflect this expectation. EPA welcomes additional stakeholder feedback on the proposed delay for TALR events that are received during soil sensing or calibration operations.

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H. Information to Consumers

If additional modules, devices, services and/or infrastructure are part of the configuration required to activate the product's communications capabilities, prominent labels or other forms of consumer notifications with instructions shall be displayed at the point of purchase and in the product literature. These shall provide specific information on what consumers must do to activate these capabilities (e.g. *"This product has Wi-Fi capability and requires Internet connectivity and a wireless router to enable interconnection with an Energy Management System, and/or with other external devices, systems or applications."*).

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6) Test Requirements

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A. One of the following sampling plans shall be used to test for certification to ENERGY STAR:

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a. A representative unit shall be selected for testing based on the definition for Basic Model provided in Section 1 above; or

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b. Units shall be selected for testing per the sampling requirements defined in 10 CFR § 429.19, which references 10 CFR § 429.11.

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Note: Due to the removal of the ENERGY STAR Cleaning Performance Reporting Requirement from the Draft 2, Version 6.0 specification, EPA has removed the sampling plan test requirements reference related to cleaning performance. The Cleaning Performance test method is available on the ENERGY STAR web site.

- 287 B. When testing residential dishwashers, the test methods specified in Table 4 shall be used to determine
 288 ENERGY STAR certification:

289 **Table 4: Test Methods for ENERGY STAR Certification**

ENERGY STAR Requirement	Test Method Reference
Energy Consumption (kWh/year)	10 CFR 430, Subpart B, Appendix C ¹
Water Consumption (gallons/cycle)	

¹And in accordance with any applicable DOE issued test procedure guidance, listed here: <http://www1.eere.energy.gov/guidance/default.aspx?pid=2&spid=1>

- 290 C. Compliance with Connected functionality, as specified in Section 5, shall be through examination of
 291 product and/or product documentation. In addition, demand response functionality will be certified using
 292 the **TBD** ENERGY STAR Test Method for Residential Dishwashers to Validate Demand Response in
 293 order to be eligible for the connected allowance.

294 **Note:** Due to the removal of the ENERGY STAR Cleaning Performance Reporting Requirement from the Draft 2,
 295 Version 6.0 specification, EPA has removed the test method references to cleaning performance.

296 **7) Effective Date**

297 The ENERGY STAR Residential Dishwasher specification shall take effect on **TBD**. To certify as ENERGY
 298 STAR, a product model shall meet the ENERGY STAR specification in effect on the date of manufacture. The
 299 date of manufacture is specific to each unit and is the date (e.g., month and year) on which a unit is
 300 considered to be completely assembled.

301 **Note:** The Version 6.0 specification will take effect approximately 9 months after the specification is finalized.

302 **8) Future Specification Revisions**

- 303 A. EPA reserves the right to change the specification should technological and/or market changes affect its
 304 usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to the
 305 specification are arrived at through industry discussions. In the event of a specification revision, please
 306 note that the ENERGY STAR certification is not automatically granted for the life of a product model.