



ENERGY STAR[®] Program Requirements Product Specification for Clothes Dryers

Eligibility Criteria Final Draft Version 1.0

Following is the **Final Draft Version 1.0** product specification for ENERGY STAR certified residential clothes dryers. A product shall meet all of the identified required criteria to earn the ENERGY STAR.

- 1) Definitions:** Below are the definitions of the relevant terms in this document. As noted below, definitions are identical with definitions in the DOE test procedure at 10 CFR 430, Subpart B, Appendix D2 or 10 CFR 430.2. When in conflict, the definitions in the Code of Federal Regulations (CFR) take precedence.
- A. Electric Clothes Dryer¹: A cabinet-like appliance designed to dry fabrics in a tumble-type drum with forced air circulation. The heat source is electricity and the drum and blower(s) are driven by an electric motor(s).
 - B. Gas Clothes Dryer¹: A cabinet-like appliance designed to dry fabrics in a tumble-type drum with forced air circulation. The heat source is gas and the drum and blower(s) are driven by an electric motor(s).
 - C. Compact size Clothes Dryer²: A clothes dryer with a drum capacity of less than 4.4 cubic feet.
 - D. Standard size Clothes Dryer²: A clothes dryer with a drum capacity of 4.4 cubic feet or greater.
 - E. Conventional (Vented) Clothes Dryer²: A clothes dryer that exhausts the evaporated moisture from the cabinet.
 - F. Ventless Clothes Dryer²: A clothes dryer that uses a closed-loop system with an internal condenser to remove the evaporated moisture from the heated air. Moist air is not discharged from the cabinet.
 - G. Water-Cooled Ventless Clothes Dryer: A ventless clothes dryer that uses cold tap water for internal condenser cooling.
 - H. Commercial Clothes Dryer: An electric or gas clothes dryer that is designed for use in:
 - 1. Applications in which the occupants of more than one household will be using the clothes dryer, such as multi-family housing common areas and coin laundries; or
 - 2. Other commercial applications.
 - I. Combination All-in-One Washer-Dryer: A consumer product designed to clean and dry fabrics in a single drum, where a separate drying cycle uses electricity or gas as a heat source and forced air circulation.
 - J. Residential Clothes Washer with Optional Dry Cycle: A Residential Clothes Washer that has an optional add-on dry cycle, where drying is accomplished through use of electricity or gas as a heat source and forced air circulation; drying cannot be selected independently from a wash cycle.
 - K. Combined Energy Factor (CEF)²: The clothes dryer test load weight in pounds divided by the sum of the per cycle standby and off mode energy consumption and either the total per-cycle electric dryer energy consumption or the total per-cycle gas dryer energy consumption expressed in kilowatt hours (kWh).

¹ 10 CFR 430 Subpart A, Section 430.2

² 10 CFR 430 Subpart B, Appendix D2

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- L. Basic Model³: Units of a given type of covered product (or class thereof) manufactured by one manufacturer, having the same primary energy source, and which have essentially identical electrical, physical, and functional (or hydraulic) characteristics that affect energy consumption, energy efficiency, water consumption, or water efficiency.
- M. Consumer Product³: Any article (other than an automobile, as defined in Section 501(1) of the Motor Vehicle Information Cost Savings Act) which: (1) in operation consumes, or is designed to consume, energy and (2) to any significant extent, is distributed in commerce for personal use or consumption by individuals.

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Note: EPA has corrected the test method reference included in the introductory paragraph of Section 1, making it consistent with the other test method references in this document.

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2) Scope:

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- A. Included Products: Products that meet the definition of an Electric Clothes Dryer or Gas Clothes Dryer, and the definition of a consumer product as specified herein are eligible for ENERGY STAR qualification, with the exception of products listed in Section 2B.
- B. Excluded Products: Commercial Clothes Dryers, Water-Cooled Ventless Clothes Dryer, Combination All-in-One Washer-Dryers, and Residential Clothes Washers with an Optional Dry Cycle as defined in Section 1 are not eligible for ENERGY STAR under this specification.

3) Qualification Criteria:

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- A. Combined Energy Factor (CEF): CEF shall be greater than or equal to the Minimum CEF (CEF_{MIN}) as calculated per Equation 1.

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Equation 1. Calculation of Minimum CEF

$$CEF_{MIN} = CEF_{BASE} - CEF_{Adder_Connected}$$

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where,

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CEF_{BASE} is the base CEF, per Table 1

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CEF_{Adder_Connected} is the CEF connected allowance, per Table 2

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³ 10 CFR 430 Subpart A, Section 430.2. Note: Definition of consumer product has been abbreviated to be specific to clothes dryers by omitting the regulatory definition's references to lighting and water.

Table 1: Base CEF

Product Type	CEF _{BASE} (lbs/kWh)
Vented Gas	3.48
Ventless or Vented Electric, Standard (4.4 cu-ft or greater capacity)	3.93
Ventless or Vented Electric, Compact (120V) (less than 4.4 cu-ft capacity)	3.80
Vented Electric, Compact (240V) (less than 4.4 cu-ft capacity)	3.45
Ventless Electric, Compact (240 V) (less than 4.4 cu-ft capacity)	2.68

Table 2: Connected Allowance

Description	Product Type	CEF _{Adder_Connected} ²
Connected	All Electric Dryer Types in Table 1 ¹	0.05 x CEF _{BASE}

¹ Product must comply with all Section 4 criteria and be certified using the final and validated ENERGY STAR Clothes Dryers Test Method to Validate Demand Response to use the allowance.

² Calculated allowance shall be rounded down to the nearest hundredth before being applied in Equation 1.

- 82 B. Cycle Time: The elapsed time for the product to complete the test cycle, as measured by Section 5C,
83 must be 80 minutes or less.

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85 Note: Note: The cycle setting(s) tested under Appendix D2 should be designed to deliver satisfactory user
86 experience, such that settings providing equivalent or reduced energy use are encouraged across most
87 loads and anticipated consumer savings and environmental benefits are realized.

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89 C. User Information Requirements: Product shall be shipped with informational materials to notify consumers
90 of the following:
91 a. The specific cycle and setting selections (cycle type, heat setting, default settings engaged, etc.)
92 that the energy use rating of this dryer is based upon.
93 b. Guidance about cycles and settings that may use more or less energy than this one, such as
94 “Choosing the “Energy Saver Mode” will save about (*to be determined by manufacturer*)%
95 energy. Longer, low heat drying cycles tend to use less energy, as do less dry settings.”
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97 **Note:**

98 **Energy Efficiency Requirements**

99 EPA has not made any changes to the energy efficiency criteria, expressed as combined energy factor (CEF),
100 that were published in Draft 2. While some stakeholders recommended further strengthening efficiency
101 requirements, EPA also received feedback from several stakeholders who relayed that meeting the proposed
102 levels using the DOE test procedure located in Appendix D2 was feasible, but would be challenging. EPA
103 believes the current levels will provide meaningful differentiation for consumers by helping them identify more
104 energy efficient dryers. That said, the additional energy-efficiency performance data gathered through the
105 Version 1.0 specification, especially for compact dryers where there has been more limited data, is expected to be
106 valuable for further assessing new opportunities during the next specification revision.

108 **Note (Cont.):**

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110 **Drying Time Requirement**

111 So that efficiency gains are not made entirely at the expense of much longer drying cycles that consumers could
112 find to be unacceptable, EPA has retained the maximum drying time requirement of 80 minutes that was
113 proposed in the December 2013 Supplemental Proposal. A number of stakeholders supported the maximum
114 drying time requirement. However, there was concern expressed about lack of data on what constitutes
115 'acceptable' drying time for consumers, which EPA has also acknowledged. Despite this, the Agency believes
116 that including a drying time requirement is important at this stage as it reflects the program's interest in ensuring
117 that energy efficient products continue to meet consumer expectations for drying cycle length. Based on the test
118 cycle times of products included in the ENERGY STAR Draft 2 data set and the subsequent manufacturer
119 conversations regarding acceptable cycle lengths, EPA believes that the 80 minute time limitation will guard
120 against excessive cycle lengths but will not preclude products with new energy savings technologies (e.g., heat
121 pumps or hybrid heat pumps) from being eligible to earn the ENERGY STAR mark.
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123 **Removal of Test/Report for the 'Fastest' Mode**

124 In the Supplemental Proposal, EPA proposed an additional test and report requirement for a manufacturer-
125 defined 'fastest cycle' when tested using Appendix D2 (should it be different than the energy test mode already
126 being tested under Appendix D2). EPA received feedback that this requirement would substantially increase test
127 burden for vented clothes dryers. However, other stakeholders supported the proposal to test this mode, and
128 urged the Agency to further consider requiring that additional cycles be tested for ENERGY STAR certification.
129 Based on the feedback received, EPA has concerns that the value from proposed test/report requirement would
130 not outweigh the added test burden. Accordingly, the reporting requirement has not been included in the Final
131 Draft. Instead, EPA has added new explanatory language into Section 3.C of the Final Draft. This language
132 makes clear the Agency's intent that products provide consumers with a satisfactory experience in the tested
133 mode so as to encourage continued use and consistently yield both savings and environmental benefit. EPA is
134 also aware that efficiency organizations are pursuing plans that would involve more extensive testing of some
135 clothes dryers in a variety of different modes/settings in test labs and field settings. These efforts may yield new
136 information on the need or benefit from testing additional dryer modes that could be considered by EPA and
137 stakeholders during a future specification revision.
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139 **Consumer Information on the Cycle/Setting Selections**

140 In lieu of the test/report requirements, EPA is proposing to require that manufacturers provide consumer
141 information, as a step towards improving consumer understanding of the energy use rating and awareness of the
142 implications that cycle/setting selection will generally have on energy use. As part of the specification
143 development process, EPA has reviewed manufacturer provided "Use and Care Guides" for clothes dryer
144 products available in the market. This research has shown that clothes dryers are equipped with various
145 consumer selectable operational modes, with simpler designs offering as few as 5 auto termination cycle
146 selections to more advanced designs offering as many as 16 auto terminating cycle selections in addition to the
147 timer dry settings. In addition, EPA noted that some manufacturer provided literature already provides "tips" or
148 guidance on the best practices for minimizing energy consumption. EPA welcomes stakeholder feedback on the
149 proposal to have manufacturer literature specify the cycle settings used to rate the product for ENERGY STAR
150 certification and provide additional information intended to raise awareness among consumers on the impacts to
151 energy use associated with cycle setting selections.
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- 153 C. Significant Digits and Rounding: All calculations shall be carried out as specified in Subpart B of Part 430
154 Appendix D2, as applicable; and 10 CFR Part 430.23(d)(3), as applied to Appendix D2.
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156 D. Model Numbers: Model numbers used for ENERGY STAR certified product submissions shall be
157 consistent with Federal Trade Commission (FTC) and DOE submissions.

158 **4) Connected Product Criteria:**
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160 The following optional connected criteria are applicable to Included Products, Section 2A, that meet the
161 definition of an Electric Clothes Dryer.
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163 **Note:** Informed by stakeholder comments, EPA has added the above language, clarifying that Connected Product
164 Criteria are applicable only to electric clothes dryers, as defined in Section 2A.

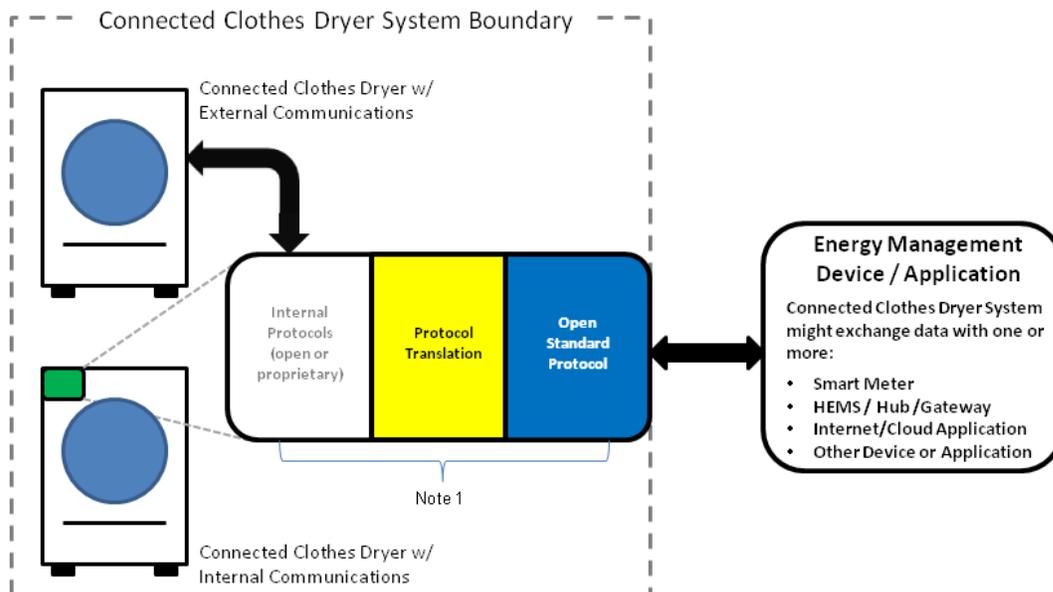
165 A. Connected Clothes Dryer System

166 To be recognized as connected and to be eligible for the connected allowance, a “connected clothes dryer
167 system” (Connected Clothes Dryer System, as shown in Figure 1) shall include the base appliance plus all
168 elements (hardware, software) required to enable communication in response to consumer-authorized
169 energy related commands (*not including third-party remote management which may be made available
170 solely at the discretion of the manufacturer*). These elements may be resident inside or outside of the
171 base appliance. This capability shall be supported through one or more means, as identified in section
172 4B2.

173 The specific design and implementation of the Connected Clothes Dryer System is at the manufacturer's
174 discretion provided it is interoperable with other devices via open communications protocol and enables
175 economical consumer-authorized third party access to the functionalities provided for in sections 4D, 4F
176 and 4G. The capabilities shall be supported through one or more means, as identified in section 4B2. A
177 product that enables economical and direct, on-premises, open- standards based interconnection is the
178 preferred option for meeting this requirement, but alternative approaches are also acceptable.
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180 The product must continue to comply with the applicable product safety standards – the addition of the
181 functionality described below shall not override existing safety protections and functions. The appliance
182 must meet manufacturer's internal minimum performance guidelines, e.g., drying performance.
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184 **Figure 1.** Connected Clothes Dryer System Boundary – Illustrative Example
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186 *Note 1: Communication device(s), link(s) and/or processing that enables open standards-based communication between the*
187 *Connected Clothes Dryer System and Energy Management Device/Application(s). These elements could be within the base*
188 *appliance, and/or an external communication module, a hub/gateway, or in the Internet/cloud.*
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B. Communications

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1. Open Standards – Communication with entities outside the Connected Clothes Dryer System that enables connected functionality (sections 4D, 4F and 4G) must use, for all communication layers, the standards:

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- Included in the Smart Grid Interoperability Panel (SGIP) Catalog of Standards,⁴ and/or
- Included in the NIST Smart Grid framework Tables 4.1 and 4.2, and/or
- Adopted by the American National Standards Institute (ANSI) or another well-established international standards organization such as the International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), International Telecommunication Union (ITU), Institute of Electrical and Electronics Engineers (IEEE) or Internet Engineering Task Force (IETF).

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2. Communications Hardware Architecture – Communication with entities outside the Connected Clothes Dryer System that enables connected functionality (sections 4D through 4G) shall be enabled by any of the following means, according to the manufacturer's preference:

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- a. Built-in communication technology
- b. Manufacturer-specific external communication module(s) and/or device(s)
- c. Open standards-based communication port on the appliance combined with open standards-based communications module
- d. Open standards-based communication port(s) on the appliance in addition to a, b or c, above

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If option b or c is used, the communication module/device(s) must be easy for a consumer to install and shipped with the appliance, provided to the consumer at the time of sale, or provided to the consumer in a reasonable amount of time after the sale.

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C. Open Access

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To enable interconnection with the product, in addition to section 4B1 that requires open-standards, an interface specification, API or similar documentation shall be made available to interested parties that at a minimum, allows transmission, reception and interpretation of the following information:

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- Energy Consumption Reporting specified in section 4D (must include accuracy, units and measurement interval);
- Operational Status, User Settings & Messages specified in section 4F (if transmitted via a communication link);
- Demand Response specified in section 4G.

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

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D. Energy Consumption Reporting

In order to enable simple, actionable energy use feedback to consumers and consumer authorized energy use reporting to 3rd parties, the product shall be capable of transmitting energy consumption data via a communication link to energy management systems and other consumer authorized devices, services, or applications. This data shall be representative of the product's interval energy consumption. It is recommended that data be reported in watt-hours for intervals of 15 minutes or less, however, representative data may also be reported in alternate units and intervals as specified in the product manufacturer's interface specification or API detailed in section 4C.

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

E. Remote Management

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

F. Operational Status, User Settings & Messages

1. The product shall be capable of providing the following information to energy management systems and other consumer authorized devices, services or applications via a communication link:
 - Operational / Demand Response status (e.g., off/standby, cycle in process, delay appliance load, temporary appliance load reduction).
2. The product shall be capable of providing the following information on the product and/or to energy management systems and other consumer authorized devices, services or applications via communication link:
 - At least two types of messages relevant to the energy consumption of the product. For example, messages for clothes dryers might address performance issue such as a clogged lint filter or report of energy consumption that is outside the product's normal range.

Note: Consistent with changes made in this section for the Version 7.0 Clothes Washer specification, EPA has incorporated minor changes into this draft, by suggesting that dryers be able to report only two basic states - whether they are in a lower power state (e.g., off or standby) or a cycle is running. Given the limited information available as to exactly what data elements will be most valuable, EPA removed the suggestion that a product also report when it is in a delay start mode. EPA may consider integrating greater specificity into future specification updates. The Agency welcomes feedback from manufacturers and utilities as to how more detailed operation status reporting could improve a utility's ability to implement a demand response program for appliances.

G. Demand Response

The product 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 for all cycle and setting combinations:

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.
 - a. Default settings –The product shall ship with default settings that enable a response in accordance with 4G1 for at least 3 hours.

- 277 b. Consumer override – The consumer shall be able to override the product’s Delay Appliance Load
278 response before or during a delay period.
- 279 c. The product shall be able to provide at least one Delay Appliance Load response per consumer
280 initiated operating cycle, but is not required to provide more than three Delay Appliance Load
281 responses in a rolling 24-hour period.
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- 283 2. *Temporary Appliance Load Reduction Capability:* The capability of the product to respond to a signal
284 by providing load reduction for a short time period, typically 10 minutes. Upon receipt of signal and in
285 accordance with consumer settings, except as permitted below, the product shall restrict its average
286 power draw during the load reduction period to no more than 20% relative to the baseline average
287 power draw defined in the ENERGY STAR Clothes Dryer Test Method to Validate Demand
288 Response.
- 289 a. Default settings - The product shall ship with default settings that enable a response in accordance
290 with 4G2 for a time period of at least 10 minutes.
- 291 b. Consumer override – The consumer shall be able to override the product’s Temporary Appliance
292 Load Reduction response before or during a load reduction period.
- 293 c. The product shall be able to provide at least one Temporary Appliance Load Reduction response
294 during each consumer initiated operating cycle.

295 **Note:** EPA has incorporated several minor edits and clarifications to the Section 4.G, including:
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- 297 - New language in the first paragraph of 4.G to clarify the Agency’s intent that a connected clothes dryer should
298 be able to respond to a signal to shift or temporarily reduce load for all dryer load cycles/settings.
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- 300 - Non-substantive updates to the some Delay Appliance Load (DAL) capability language to provide consistency
301 with the final Version 7.0 Clothes Washers specification.
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- 303 - Consistent with the finalized DAL language for clothes washers, revised criteria require a clothes dryer to delay
304 the start of each cycle, but does not require the product to be able to delay load more than three times in a rolling
305 24 hour period.
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- 307 - Correcting an error in Draft 2 to specify that a connected clothes dryer limit its power draw to no more than 20%
308 relative to the baseline as part of a Temporary Appliance Load Reduction (TALR), rather than the 80% that had
309 been included in the Draft 2.
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- 311 - Modifying the TALR response baseline to reference the baseline cycle or cycles that will be defined in the future
312 ENERGY STAR test method. EPA agrees with stakeholder feedback that the product should restrict its power
313 use relative to its use over the entire cycle, rather than the baseline during only the 10 minute period.
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- 315 - Revised language requiring a dryer provide one TALR response per operating cycle instead of two, in response
316 to stakeholder concern that multiple TALR requests could reduce dryer efficiencies (heat that is lost when the
317 drum cools) and may impact performance, i.e., increase wear and tear on clothing. EPA does not have data on
318 the performance impacts. Reducing heat and extending drying cycle length may also increase efficiency.
319 Consider stakeholder concern, EPA has reduced the requirement to one TALR response.

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321 H. Information to Consumers
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323 If additional modules, devices, services and/or infrastructure are part of the configuration required to
324 activate the product’s communications capabilities, prominent labels or other forms of consumer
325 notifications with instructions shall be displayed at the point of purchase and in the product literature.
326 These shall provide specific information on what consumers must do to activate these capabilities (e.g.
327 “This product has Wi-Fi capability and requires Internet connectivity and a wireless router to enable

328 interconnection with an Energy Management System, and/or with other external devices, systems or
329 applications.”).

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331 **5) Test Requirements:**

- 332 A. One of the following sampling plans shall be used to test energy performance for qualification to
333 ENERGY STAR:
- 334 1. A representative unit shall be selected for testing based on the definition for Basic Model provided in
335 Section 1 above; or
- 336 2. Units shall be selected for CEF testing per the sampling requirements defined in 10 CFR § 429.21,
337 which references 10 CFR § 429.11.
- 338 B. When testing the energy efficiency of clothes dryers, the following test method shall be used to
339 determining ENERGY STAR qualification:
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Table 3: Test Method for ENERGY STAR Certification

	ENERGY STAR Requirement	Test Method Reference
Clothes Dryers	CEF	10 CFR 430, Subpart B, Appendix D2 ¹

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

341 **Note:** EPA has retained the Appendix D2 test method reference for Version 1.0 specification. Many stakeholders,
342 including utilities, efficiency organizations, and a manufacturer strongly support referencing this test, confirming
343 that it would provide more accurate energy use and relative energy-efficiency comparisons of clothes dryers. A
344 number of stakeholders have also relayed that use of Appendix D2 is essential for future utility sponsored rebate
345 programs. EPA continues to believe the potential for consumer confusion is likely to be small, while the benefits
346 from measuring and rewarding products with more effective automatic termination controls are large.

- 347 C. The length of the drying cycle shall be determined, as required by Section 3B, by measuring the test cycle
348 time, t, for the drying test cycle specified in sections 3.3.1 and 3.3.2 of Appendix D2 for timer dryers and
349 automatic termination control dryers, respectively, using a timer accurate to within 2 seconds.

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351 For timer dryers, the following correction shall be applied to determine the drying cycle time:

$$352 t_{dry} = [55.5/(W_w - W_d)] \times t$$

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354 Where:

355 W_w = the moisture content of the wet test load as recorded in section 3.4.2 of 10 CFR 430,
356 subpart B, appendix D2.

357 W_d = the moisture content of the dry test load as recorded in section 3.4.3 of 10 CFR 430,
358 subpart B, appendix D2.

359 t = the measured test cycle time.
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361 For automatic termination dryers, the drying cycle time equals the test cycle time.
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- 363 D. Compliance with connected functionality, as specified in Section 4, shall be through examination of
364 product and/or product documentation. In addition, demand response functionality shall be certified using
365 the ENERGY STAR Clothes Dryers Test Method to Validate Demand Response (Ref TBD) in order to be
366 eligible for the connected allowance.

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Note: EPA and DOE did not receive any comments on the proposed method of measuring the duration of a clothes dryer operating cycle under the Appendix D2 test method. Therefore, no changes have been made to the method for measuring cycle duration.

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As noted in Draft 2, DOE plans to develop a test method to validate the DR capabilities of residential clothes dryers that will be referenced in this specification. DOE's test method development will be dependent upon working with manufacturers to obtain products for connected testing. DOE is initiating this effort now and anticipates contacting manufacturers to obtain products for testing or working with them to witness connected product testing in the near term. This test is anticipated to be a separate, add-on test method. Products would need to be certified using this final and validated ENERGY STAR test method to use the proposed allowance.

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6) Effective Date: The ENERGY STAR Clothes Dryer specification shall take effect on **January 1, 2015**. Any product model with a date of manufacture on or after this date shall meet this specification to earn the ENERGY STAR. The date of manufacture is specific to each unit and is the date on which a unit is considered to be completely assembled.

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Note: As noted in the Supplemental Proposal, the effective date for Version 1.0 specification would be January 1, 2015.

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7) Future Specification Revisions: EPA reserves the right to change the specification should federal requirements, technological and/or market changes affect its usefulness to consumers, industry or the environment. In keeping with current policy, revisions to the specification are arrived at through industry discussions. In the event of a specification revision, please note that ENERGY STAR qualification is not automatically granted for the life of a product model.