



ENERGY STAR Program Requirements Product Specification for Residential Water Heaters

Eligibility Criteria Version 2.0: Draft 3

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7 Following is the **Draft 3** Version 2.0 product specification for ENERGY STAR qualified water heaters. A
8 product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

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10 **1) Definitions:** Below are the definitions of the relevant terms in this document.

11 A. Residential Water Heater: A product that utilizes gas, electricity, or solar thermal energy to heat
12 potable water for use outside the heater upon demand, including:

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14 a. Storage type units which heat and store water at a thermostatically controlled
15 temperature, including: gas storage water heaters with an input of 75,000 British thermal
16 units (Btu) per hour or less and storage volume between 20 and 100 gallons; electric heat
17 pump type units, with a maximum current rating of 24 amperes at a voltage no greater
18 than 250 volts and designed to transfer thermal energy from one temperature level to a
19 higher temperature level for the purpose of heating water, and, if a tank is supplied,
20 having a storage volume of 120 gallons or less.

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22 b. Instantaneous (or “tankless”) type units which heat water but contain no more than one
23 gallon of water per 4,000 Btu per hour of input, including: gas instantaneous water
24 heaters with an input of 200,000 Btu per hour or less and with storage volume of less
25 than 2 gallons.

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27 c. Hybrid type units which heat water but contain no more than one gallon of water per
28 4,000 Btu per hour of input, including: gas hybrid water heaters with an input of 200,000
29 btu per hour or less, storage volume of 2 gallons or more, and also containing no more
30 than 1 gallon of water per 4,000 btu per hour of input under 240,000 btu per hour.

31 **Note:** A definition for hybrid water heaters has been added, comprising a small subset of units defined as
32 “instantaneous” under the definition in 10 CFR 430 and 431, and covered by efficiency standards under
33 EPACT and NAECA. The scope proposed in the definition is intended to limit the coverage of this
34 specification to units with hot water delivery capability appropriate for residential use. See section 3B for
35 efficiency requirements for these units.

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37 d. Solar water heaters must include a collector and storage tank, and must use the sun's
38 thermal energy to heat water. Solar type units eligible for the ENERGY STAR Water
39 Heaters Program must be tested according to OG-300 as developed by the Solar Rating
40 and Certification Corporation (SRCC). According to the SRCC, solar units employ one of
41 the four basic types of solar water heating systems: forced circulation (includes both
42 direct and indirect systems), integrated collector and storage, thermosiphon, or self-
43 pumped.¹

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45 e. Add-on Heat Pump Unit: Add-on heat pump units are air to water heat pumps designed
46 for use with a storage-type water heater or a storage tank that is not specified or supplied
47 by the manufacturer.

¹ SRCC, Part 6: Types of Solar Thermal Systems. http://www.solar-rating.org/facts/system_ratings.html

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49 B. Energy Factor: Energy Factor (“EF”) is the ratio of useful energy output from the water heater to
50 the total amount of energy delivered to the water heater.
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52 C. Solar Energy Factor: Solar Energy Factor (“SEF”) refers to the energy delivered by the total
53 system divided by the electrical or gas energy put into the system.
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55 D. Thermal Efficiency: Thermal efficiency (TE) is the ratio of the heat transferred to the water flowing
56 through the water heater to the amount of energy consumed by the water heater.
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58 E. Standby Loss: Standby Loss (SL) means the average hourly energy required to maintain the
59 stored water temperature.
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61 F. First-Hour Rating: The First-Hour Rating (“FHR”) is the amount of hot water in gallons a storage
62 water heater can supply per hour (starting with a tank full of hot water).
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64 G. Gallons per Minute: Gallons per Minute (“GPM”) is the amount of hot water in gallons an
65 instantaneous water heater can supply per minute over a 77°F rise.
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67 H. Manufacturer Limited Warranty: Manufacturer limited warranty is an assurance by the
68 manufacturer to the consumer that the water heater, including purchased system equipment and
69 components, are guaranteed to work for a defined period of time.
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71 I. Basic Model Group: All units of a given type of covered product (or class thereof) manufactured
72 by one manufacturer and which have the same primary energy source and, which have
73 essentially identical electrical, physical, or functional (or hydraulic) characteristics that affect
74 energy consumption, energy efficiency, water consumption or water efficiency.
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76 J. Lower Compressor Cut-off Temperature: The temperature below which a heat pump water
77 heater’s compressor will no longer operate, such that the unit will only work as a conventional
78 electric resistance water heater.
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80 K. Combination Space-Heating and Water Heating Appliance: Appliance that provides both space
81 conditioning (boiler) and hot water heating with one appliance or energy source. The combination
82 appliance circulates hot water from the water heater through a heat exchanger in the air handler.
83 A blower will move the heated air through a standard duct system. In the summer, an air
84 conditioner is connected to the exchanger and the system functions similarly, with cool air being
pushed through the ductwork.

85 **Note:** Per stakeholder suggestion, the definition of a residential water heater was modified to include
86 solar thermal energy as an acceptable fuel source. Details regarding the qualification of this product type
87 are provided in Section 4, below.

88 The definition for whole home units, add on heat pump, and Solar Fraction has been removed and new
89 definitions for Solar Energy Factor, Thermal Efficiency and Standby Loss have been added. Explanations
90 for these changes are provided in Section 3, below. A new definition for Combination Space-Heating and
91 Water Heating Appliance has also been added. Stakeholders are encouraged to provide feedback on
92 these changes.

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94 **2) Scope:**

- 95 A. Included Products: Only products that meet the definition of a residential water heater, as
96 specified herein, are eligible for ENERGY STAR qualification.
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98 B. Excluded Products: Electric resistance water heaters, Add-on Heat Pump units, and products
99 intended only for commercial use are not eligible for this ENERGY STAR Water Heater
100 Specification. Combination space-heating and water heating appliances, as defined in Section 1,
101 above, are not eligible under this ENERGY STAR Water Heaters specification.
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104 **3) Qualification Criteria:**

105 A. Product Performance Requirements for Electric Water Heaters:
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Criteria	ENERGY STAR Requirements
Energy Factor	EF ≥ 2.0
First Hour Rating	FHR ≥ 50 gallons per hour
Warranty	6 years on sealed system
Safety	UL 174 and UL1995

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110 **Additional qualification requirements:**

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112 1. The unit shall include a visible or audible alert to notify if the compressor shuts off or if there
113 is a blockage in condensate drain. The alert will also activate no more than 48 hours after
114 users lock out compressor operation voluntarily, as when the unit is set into a resistance-only
115 mode.
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117 2. Manufacturers shall report the ambient temperature below which the compressor cuts off and
118 electric resistance only operation begins.
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120 **Note:** Ensuring that ENERGY STAR qualified products offer significant energy savings on a national
121 basis and similar or better performance as compared to standard designs are important guiding principles
122 of the ENERGY STAR products program. EPA has explored the energy savings achievable for water
123 heaters and the challenges posed by including additional types of water heaters in the scope of the
124 specification, most notably add on electric heat pump heaters and point of use (POU) electric heaters. In
125 this Draft 3 specification, EPA has excluded these products from the scope. The following sections will
126 explain EPA’s rationale for this decision.

127 **Add-on Heat Pump Water Heaters**

128 EPA has reached out to various stakeholders, including several utility groups with experience installing
129 these units. Earlier field observations shared with EPA show that while energy savings were achieved at
130 most of the installations, there were significant issues regarding reliability and customer acceptance. In
131 addition, EPA is concerned that consumers whose water heaters fail due to manufacturing defects will be
132 left without recourse because the warranty and safety certifications of tank heaters will generally be
133 voided by installation of an add-on heat pump. Due to these issues, EPA has decided that add-on heat
134 pump units will not be eligible under this Version 2.0 specification.

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136 **Note cont'd:**

137 EPA believes that in the next few years, additional pilot data reflecting the performance of a new
138 generation of heat pumps could increase confidence that manufacturers have addressed reliability and
139 consumer acceptance issues. In some cases, additional test methods can assist, such as for sound.
140 EPA also intends to work with stakeholders between now and the next revision to address issues with
141 voided warranty and safety certifications.

142 **Point-of-Use (POU)**

143 POU water heaters can deliver meaningful energy savings from water heating and from hot water
144 distribution. However, depending on the application, the purchase of a POU may or may not be as
145 energy-saving as other options designated with the ENERGY STAR label. Determining whether a POU is
146 the better choice typically requires the evaluation of complex trade-offs, with a number of factors affecting
147 savings. These include when water tends to be used in the household, the distance between fixtures and
148 the central hot water heater and characteristics of the POU heater itself. EPA thus concludes that POU
149 units are not a good fit for a binary label, and has decided not to include them in this version 2.0
150 specification. However, these products present an opportunity for the ENERGY STAR program as part of
151 its consumer education efforts. EPA will work with POU manufacturers to ensure that ENERGY STAR is
152 a credible source of information regarding the advantages of this technology.

153 In addition, EPA supports industry efforts to establish test methods for performance characteristics that
154 are important for energy savings and user satisfaction, most notably output temperature accuracy and low
155 flow rate. Progress on these activities will feed into consideration of POU heaters for inclusion in future
156 specifications.

157 **Additional Qualification Requirements**

158 Revisions have been made to the Additional Qualification Requirements section proposed in Draft 2 for
159 whole-home electric units. There have been several changes made to the requirement for an audible
160 alert when the compressor shuts off due to a blockage in condensate drain. Stakeholder feedback
161 indicated that such a requirement may create an unnecessary sense of urgency and would add significant
162 cost to the product. It is not EPA's intent to inappropriately alarm consumers; however it is important that
163 the consumer be made aware when their water heater is not running at its optimum efficiency. Instead,
164 EPA has modified the requirement to include an option for a visible notification instead of an audible one
165 to help mitigate this concern. EPA would like to emphasize that the term "alert" is being used instead of
166 "alarm", as the notification is not intended to cause panic but to simply make the consumer aware of a
167 possible malfunction.

168 It has also been noted that due to differences in product designs, the compressor may not automatically
169 shut off when the condensate drain is blocked, and instead the condensate could be re-directed to a
170 secondary overflow line. The language has been modified to take this type of product design into account
171 and require an alert if there is a blockage of condensate drain regardless if the compressor shuts off or
172 not. EPA received manufacturer feedback that the secondary overflow line is sufficient if the product is
173 installed correctly. However, in discussions with stakeholders with field experience, EPA learned that it is
174 not unusual for units to be installed in areas with insufficient floor drainage. In this case, the blockage
175 alert provides a simple, low cost backup in cases of imperfect installation.

176 Finally, EPA has taken into account instances where the consumer may voluntarily switch the unit to
177 resistance only mode for high demand periods. Since one of the primary intents of this requirement is to
178 notify the consumer that they are not optimizing energy savings, EPA is requiring that the alert also act as
179 a reminder to the consumer that the unit is operating in resistance only mode, and that the alert activate
180 within 48 hours from when the consumer locks out the compressor.

181 The requirement to indicate the compressor cut off temperature in product literature has been modified to
182 a reporting requirement. If it makes sense to do so, EPA will be able to include this information in
183 qualified product lists, where it can be coupled with guidance about what it means for performance in
184 various areas.

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B. Product Performance Requirements for Gas Water Heaters:

a. Gas Storage Units

Criteria	ENERGY STAR Requirements
Energy Factor	EF \geq 0.67
First Hour Rating	FHR \geq 67 gallons per hour
Warranty	Warranty \geq 6 years on system
Safety	ANSI Z21.10.1/CSA 4.1

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b. Gas Instantaneous Units

Criteria Item	ENERGY STAR Requirements
Energy Factor	EF \geq 0.82
Gallons-Per-Minute	GPM \geq 2.5 over a 77° rise
Warranty	Warranty \geq 10 years on heat exchanger and 5 years on parts
Safety	ANSI Z21.10.3/CSA 4.3

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c. Gas Hybrid Units

Criteria Item	ENERGY STAR Requirements
Energy Factor (\leq 20 gal volume)	EF \geq 0.75 (units with 20 gal volume or less)
Thermal Efficiency ($>$ 20 gal volume)	TE \geq 0.80
Standby Loss ($>$ 20 gal volume)	Standby loss \leq 2374 btu/hr * (TE - 0.74)
Warranty	Warranty \geq 6 years on system, 10 years on heat exchanger
Safety (units intended for floor mounting only)	ANSI Z21.10.3/CSA 4.3

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Note: EPA proposes requirements for Whole Home Gas Hybrid Water Heaters based on Energy Factor, or Thermal Efficiency (TE) and Standby Loss (SL), for NAECA and EPACT covered products respectively. (Gas storage water heaters that are less than or equal to 20 gallons are covered under NAECA and hence, are rated based on EF.) EPA is proposing a level of 0.75 EF for the NAECA covered products and 0.80 TE plus standby loss requirements for EPACT covered products. Though the TE requirement is equal to the Federal minimum level, the standby loss requirement provides significant savings for low use situations like homes. Although very few hybrid water heater models are currently available on the market, discussions with some manufacturers lead us to believe that these levels are achievable, and they represent significant savings for households.

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Note Cont'd:

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EPA considers its approach to including hybrid water heaters as a step towards a future technology-neutral specification that would level the playing field across all whole home gas water heater technologies and ensure that the ENERGY STAR label is serving its intended purpose of making it easy for consumers to identify the most efficient water heater, regardless of technology. The proposed performance requirements fall in the efficiency gap between traditional storage and instantaneous water heaters. These units can provide higher efficiency than traditional storage water heaters, and excellent performance, without requiring a larger gas line to be installed in retrofit applications, expanding consumer choice for energy savings through their water heater. The two sets of requirements (NAECA and EPACT) are intended to be approximately equivalent in terms of field energy use. EPA welcomes stakeholder feedback on these requirements, and also on appropriate hot water delivery requirements. The Agency recognizes that NAECA covered hybrid water heaters would not be eligible for the ENERGY STAR label until a test procedure is finalized. EPA understands that DOE is in the process of developing a test method for the NAECA covered hybrid products. If needed, EPA will revisit the hybrid unit's EF requirements once the DOE test method is finalized.

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Proposed warranty and safety requirements for hybrid units are comparable to those for other residential gas water heaters. This includes FVIR protection for units intended to be mounted on the floor rather than the wall. While FVIR has not previously applied to EPACT covered units, this is because they were presumed to be sold into the commercial market. To the extent that these units are installed in the same location and manner as traditional residential gas storage water heaters, EPA believes it is important that they be subject to the same safety precautions for purposes of ENERGY STAR.

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Under the warranty requirements of Whole-Home Gas Storage units, EPA has removed the term "sealed" from the requirement language as there is no sealed system in a gas storage unit.

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- C. Product Performance Requirements for Solar Water Heaters:
 - a. Whole-Home Solar Units

Criteria	ENERGY STAR Requirements
Solar Energy Factor	SEF ≥ 1.8 for electric backup SEF ≥ 1.2 for gas backup
Warranty	10 years on collector, 6 years sealed system, 2 years on controls, 1 year on parts

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Note: EPA received several comments on the value of the ENERGY STAR mark in the solar water heating market. EPA agrees that labeling solar water heaters has a positive impact for consumers and the environment, and has decided to retain the solar water heater category within this ENERGY STAR Version 2.0 specification. As for all products, EPA will continue to monitor the role that ENERGY STAR plays in utility incentive programs, and the ultimate impact that the program has on market adoption.

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Stakeholder feedback indicated that the use of Solar Fraction (SF) in the specification was not in line with industry practice, and supported the use of Solar Energy Factor (SEF) as an appropriate alternate requirement. EPA has decided to replace SF with SEF metric and has converted the SF efficiency requirement to SEF value. EPA used the Solar Rating Certification Corporation's OG-300 model combined with the minimum federal efficiency standards for gas and electric auxiliary tanks to determine appropriate SEF levels. An OG-300 certified solar water heater with a 0.5 SF and a fifty gallon electric auxiliary tank at the federal standard of 0.9 would achieve a SEF of 1.8. An OG-300 certified solar water heater with a 0.5 SF and a fifty gallon gas auxiliary tank at the federal standard of 0.6 would achieve a SEF of 1.2.

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D. Significant Digits and Rounding:

- a. All calculations shall be carried out with directly measured (unrounded) values. EF shall be rounded to the nearest 0.01, as specified in 10 CFR 430.23(e)(2).
- b. Compliance with the specification EF limits shall be evaluated using values rounded to the nearest 0.01.
- c. Directly measured or calculated values that are submitted for reporting on the ENERGY STAR website shall be rounded to the nearest significant digit as expressed in the corresponding specification limit.

Note: EPA has modified the significant digits and rounding requirements to better coordinate with values for DOE ratings.

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4) Test Requirements:

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- A. A representative model shall be selected for testing per the following requirements:
 - 1) For qualification of an individual product model, the representative mode shall be equivalent to that which is intended to be marketed and labeled as ENERGY STAR ;
 - 2) For qualification of a basic model group, any model within that basic model group may be considered the representative model.
- B. One of the following sampling plans shall be used for purposes of testing for ENERGY STAR qualification:
 - 1) A single unit is selected, obtained, and tested. The measured performance of this unit and of each subsequent unit manufactured must be equal to or better than the ENERGY STAR specification requirements. Results of the tested unit may be used to qualify additional individual model variations within a basic model as long as the definition for basic model group provided in Section 1, above, is met. Further, all individual models within a basic model must have the same certified rating based on the applicable sampling criteria per DOE's regulations in Part 429, and this rating must be used for all manufacturer literature, the qualified product list and certification of compliance to DOE standards.; or
 - 2) Units are selected for testing and results calculated according to the sampling requirements defined in 10 CFR Part 429, Subpart B § 429.17. The certified rating must be equal to or better than the ENERGY STAR specification requirements. Results of the tested unit may be used to qualify additional model variations within a basic model as long as the definition for basic model provided in Section 1, above, is met. Further, all individual models within a basic model must have the same certified rating.
- C. When testing residential water heaters, the following test methods shall be used to determine ENERGY STAR qualification:

Test Methods for ENERGY STAR Qualification		
ENERGY STAR Requirement	Test Method Reference	Applicable Products
Energy Factor	10 CFR 430, Subpart B, Appendix E*	Gas and electric units; FHR only for storage units, GPM only for instantaneous.
First Hour Rating (FHR)		
Gallons per minute (GPM)		
Thermal Efficiency	10 CFR 431, Subpart G	EPACT covered Gas Hybrid Units
Standby Loss		
Solar Energy Factor	SRCC – OG-300: Operating Guidelines and Minimum Standards for Certifying Solar Water Heating Systems	Whole-home solar units

304 * This includes any applicable guidance that DOE has issued regarding the testing of these products (See
305 <http://www1.eere.energy.gov/guidance/default.aspx?pid=2&spid=1>). **Note on recovery efficiency:**
306 Guidance includes that for thermostatically-controlled water heaters that do not initiate and complete a
307 recovery cycle prior to the start of the second draw of the simulated-use test, the recovery efficiency shall
308 be determined as specified in Section 11.2 of ASHRAE 118.2.

309 **Note:** The placeholders for test methods for Low Flow Rate (GPM) and Flicker for POU units have been
310 deleted. Also, the table has been updated with the test method for Solar Energy Factor replacing Solar
311 Fraction, though note that the test method itself remains the same. The test method for Thermal
312 Efficiency and Standby Loss has been added.

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314 **5) Effective Date:**

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316 The ENERGY STAR Residential Water Heater specification shall take effect on **February 1, 2013**. To
317 qualify for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on the
318 model's date of manufacture. The date of manufacture is specific to each unit and is the date on which a
319 unit is considered to be completely assembled.

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321 **Note:** The effective date has been moved to February 1, 2013, to allow sufficient time to transition to the
322 new specification requirements.

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325 **6) Future Criteria Revisions:**

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