



ENERGY STAR® Product Specification for Residential Water Heaters

Eligibility Criteria Final Draft Version 3.0

1 Following is the **Final Draft** Version 3.0 product specification for ENERGY STAR certified water heaters.
2 A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

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

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

7 a. Storage type units¹ designed to heat and store water at a thermostatically controlled
8 temperature of less than 180 °F, including: gas storage water heaters with a nominal input of
9 75,000 British thermal units (Btu) per hour or less and having a rated storage capacity of not
10 less than 20 gallons nor more than 100 gallons; electric heat pump type units with a
11 maximum current rating of 24 amperes at an input voltage 250 volts or less, and, if the tank is
12 supplied, having a manufacturer's rated storage capacity of 120 gallons or less.

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14 b. Instantaneous (or "tankless") type units^{1,2} which initiate heating based on sensing water flow
15 and deliver water at a controlled temperature of less than 180 °F, heat water, but contain no
16 more than one gallon of water per 4,000 Btu per hour of input with an input capacity greater
17 than 50,000 Btu/h but less than 200,000 Btu per hour.

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19 c. Solar water heaters include a collector and storage tank, and use the sun's thermal energy to
20 heat water using one of the four basic types of solar water heating systems:

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22 i. forced circulation (includes both direct and indirect systems),
23 ii. integrated collector and storage,
24 iii. thermosiphon, or
25 iv. self-pumped.

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27 d. Add-on Heat Pump Units¹ are air to water heat pumps designed for use with a storage-type
28 water heater or a storage tank that is not specified or supplied by the manufacturer.

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30 e. Light Duty EPACT covered gas water heaters heat and store water at a thermostatically
31 controlled temperature, with an input rate >75,000 Btu per hour and ≤100,000 Btu per hour,
32 and storage volume between 20 and 100 gallons.

33 B. Energy Factor³: Energy Factor (EF), a measure of water heater overall efficiency, is the ratio of
34 useful energy output from the water heater to the total amount of energy delivered to the water
35 heater.

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37 C. Solar Energy Factor: Solar Energy Factor (SEF) refers to the energy delivered by the total system
38 divided by the electrical or gas energy put into the system.
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¹ 10 CFR 430, Subpart B, Appendix E

² 10 CFR 430, Subpart A, § 430.2 Definitions

³ Based on definition in 10 CFR 430, Subpart B, Appendix E

- 40 D. Thermal Efficiency⁴: Thermal efficiency (TE) is the ratio of the heat transferred to the water
41 flowing through the water heater to the amount of energy consumed by the water heater.
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- 43 E. Standby Loss⁴: Standby Loss (SL) means the average hourly energy required to maintain the
44 stored water temperature.
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- 46 F. First-Hour Rating¹: The First-Hour Rating (FHR) is an estimate of the maximum volume of hot
47 water in gallons that a storage water heater can supply within an hour that begins with the water
48 heater fully heated.
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- 50 G. Gallons per Minute¹: Gallons per Minute (“GPM”) is the amount of gallons per minute of hot water
51 that can be supplied by an instantaneous water heater while maintaining a nominal temperature
52 rise of 77°F during steady state operation.
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- 54 H. Manufacturer Limited Warranty: Manufacturer limited warranty is an assurance by the
55 manufacturer to the consumer that the water heater, including purchased system equipment and
56 components, are guaranteed to work for a defined period of time.
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- 58 I. Basic Model: All units of a given type of covered product (or class thereof) manufactured by one
59 manufacturer and which have the same primary energy source and, which have essentially
60 identical electrical, physical, or functional (or hydraulic) characteristics that affect energy
61 consumption, energy efficiency, water consumption or water efficiency¹. Further, all individual
62 models within a basic model have the same certified rating based on the applicable sampling
63 criteria per U.S. Department of Energy’s (DOE) regulations in Part 429⁵, and this rating must be
64 used for all manufacturer literature, the qualified product list and certification of compliance to
65 DOE standards.
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- 67 J. Lower Compressor Cut-off Temperature: The temperature below which a heat pump water
68 heater’s compressor will no longer operate, such that the unit will only work as a conventional
69 electric resistance water heater.
- 70 K. Combination Space-Heating and Water Heating Appliance: Appliance that provides both space
71 conditioning (boiler) and hot water heating with one appliance or energy source. The combination
72 appliance circulates hot water from the water heater through a heat exchanger in the air handler.
73 A blower will move the heated air through a standard duct system. In the summer, an air
74 conditioner is connected to the exchanger and the system functions similarly, with cool air being
75 pushed through the ductwork.
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77 **2) Scope:**

- 78 A. Included Products: Only products that meet the definition of a Residential Water Heater, as
79 specified herein, are eligible for ENERGY STAR qualification with exception of those products
80 listed in Section 2B.
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- 82 B. Excluded Products:
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- 84 a. Electric resistance water heaters,
 - 85 b. Add-on Heat Pump units,
 - 86 c. Products intended only for commercial applications,
 - 87 d. Combination Space-Heating and Water Heating Appliances.
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⁴ 10 CFR 431, Subpart G

⁵ 10 CFR 429, Subpart B

89 **3) Qualification Criteria:**

90 A. Significant Digits and Rounding:

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- 92 a. All calculations shall be carried out with actual measured (unrounded) values. Only the
- 93 final result of a calculation shall be rounded.
- 94 b. Unless otherwise noted in this section, compliance with specification limit shall be
- 95 evaluated using exact values without any benefit from rounding.
- 96 c. Reporting on the ENERGY STAR website shall be performed using calculation results or
- 97 measured values that are rounded to the nearest unit in the last right-hand digit as
- 98 specified in the corresponding specification requirement below.
- 99 d. EF shall be rounded to the nearest 0.01, as specified in 10 CFR 430.23(e)(2), for
- 100 purposes of evaluating compliance and for reporting on the ENERGY STAR website.

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102 B. Product Performance Requirements for Electric Water Heaters:

103 **Table 1: Criteria for Qualified Electric Water Heaters**

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Criteria		ENERGY STAR Requirements
Energy Factor	≤ 55 gallons	EF ≥ 2.00
	> 55 gallons	EF ≥ 2.20
First Hour Rating		FHR ≥ 50 gallons per hour
Warranty		Warranty ≥ 6 years on sealed system
Safety		UL 174 and UL1995
Lower Compressor Cut-Off Temperature (Reporting Requirement Only)		Report ambient temperature below which the compressor cuts off and electric resistance only operation begins

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106 C. Product Performance Requirements for Gas Water Heaters:

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- 108 a. Gas Storage Units:

109 **Table 2: Criteria for Qualified Gas Storage Water Heaters**

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Criteria		ENERGY STAR Requirements
Energy Factor	≤ 55 gallons	EF ≥ 0.67
	> 55 gallons	EF ≥ 0.77
First Hour Rating		FHR ≥ 67 gallons per hour
Warranty		Warranty ≥ 6 years on system (including parts)
Safety		ANSI Z21.10.1/CSA 4.1

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118 **Note:** For greater than 55 gal gas storage water heaters, several stakeholders commented that the
119 proposed EF of 0.80 is not achievable, and also that EPA should instead consider an EF that varies by
120 volume. Stakeholders also noted that in the final rule for the 2015 Federal standards, DOE updated the
121 maximum technologically feasible efficiency level to 0.77 EF from 0.80 EF due to the uncertainty
122 regarding the efficiencies achievable by these products as there are none currently available on the
123 market. EPA notes that since that time, a 48 gallon water heater with an EF of .82 has entered the
124 market.

125 Upon further research and discussions with a wide range of stakeholders, EPA better understands the
126 relationship between EF and volume. Though there are products currently available at 0.82 EF in the
127 less than 55 gal size category, EPA believes that for larger volume products, a lower EF would allow
128 more product participation, while still providing significant energy savings to the consumer. EPA has
129 therefore decided to lower the EF requirement to flat 0.77. EPA is not considering a volume dependent
130 requirement at this time, choosing instead to wait for test results from the new DOE test to be available,
131 with binning by hot water delivery.

132 While there are currently no products with volume greater than 55 gal available on the market that even
133 meet the DOE required level for April 2015, the consumer need is met by product offerings such as light
134 duty EPACT covered gas water heaters. EPA has proposed levels for both light duty EPACT and greater
135 than 55 gal product categories in such a manner that they both have similar annual energy consumption
136 and can serve as an alternate choice to meet consumer needs.

137 Also, the warranty requirements have been updated to clarify that the minimum warranty requirement of 6
138 years on system includes parts as well.

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140 a. Gas Instantaneous Units:

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Table 3: Criteria for Qualified Gas Instantaneous Water Heaters

Criteria	ENERGY STAR Requirements
Energy Factor	EF ≥ 0.90
Gallons-Per-Minute	GPM ≥ 2.5 over a 77° rise
Warranty	Warranty ≥ 6 years on system (including parts)
Safety	ANSI Z21.10.3/CSA 4.3

144 **Note:** The warranty requirement for the gas instantaneous water heaters has been revised to 6 years on
145 the entire system from 10 years on heat exchanger and 5 years on parts. The initial warranty
146 requirements were set high at 10 years as this product category was a newer technology at that time. As
147 the technology has become more popular and proven to be reliable, EPA has decided to revise the
148 requirements to be consistent with the warranty requirements of the rest of water heaters.

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b. Light Duty EPACT Covered Gas Water Heaters

Table 4: Criteria for Qualified Light Duty EPACT Covered Gas Water Heaters

Criteria	ENERGY STAR Requirements
Thermal Efficiency	TE ≥ 0.90
Standby Loss	Standby loss ≤ 1889 Btu/hr ×(TE–0.73)
Warranty	Warranty ≥ 6 years on system
Safety	ANSI Z21.10.3/CSA 4.3

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Note: Some stakeholders commented that the standby loss requirement previously proposed in Draft 1 was too stringent and would limit ENERGY STAR participation. Given that Light Duty EPACT products serve the same consumer needs as the greater than 55 gal gas storage water heaters and those requirements have been revised to a lower EF of 0.77, EPA has reassessed the light duty EPACT covered gas water heater requirements such that the annual energy consumption between both product categories is similar. In addition, EPA worked extensively with industry stakeholders to assure that the annual energy use comparison between EF rated and TE rated products reflects best practice. Based on this analysis, EPA has eased the standby loss requirements from those in the first draft, to provide more choice for consumers while maintaining significant energy savings.

EPA has heard from manufacturers that it is challenging for products to meet the proposed standby loss level at 0.90 TE. The requirements as written accommodate this, allowing manufacturers the option of raising TE rather than lowering standby loss.

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D. Product Performance Requirements for Solar Water Heaters:

Table 5: Criteria for Qualified Solar Water Heaters

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

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183 **4) ~~Connected Product Criteria:~~**
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185 **Note:** Most commenters expressed that while the discussion of connected or grid-aware water heaters is
 186 important, that it is premature to include connected criteria for ENERGY STAR water heaters at this time,
 187 in part because of the ongoing DOE rulemaking around grid-enabled large resistance water heaters.

188 EPA anticipates continued dialogue with stakeholders about the developing market for connected
 189 products and anticipates re-considering connected in its next specification for water heaters. EPA has a
 190 long-standing practice of supporting standardization, the use of open standards, and the consideration of
 191 consumer interests in similar efforts – benefiting consumers by furthering interoperability and consumer
 192 amenity, and manufacturers by creating a level playing field and delivering certainty. Manufacturers
 193 (through AHRI) and utilities (through CEE) are now working together on aspects of connected
 194 functionality for several product types, including water heaters. EPA will engage in this process with the
 195 interest of seeing that consumer needs are considered, both in reaping some of the benefit of these grid-
 196 responsive capabilities, and in other amenities that might be afforded by connected water heaters. .

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 198 **5) Test Requirements:**

- 199 A. One of the following sampling plans shall be used to test energy performance for qualification to
 200 ENERGY STAR:
- 201 a. A representative unit shall be selected for testing based on the definition for Basic Model
 202 provided in Section 1 above. The measured performance of this unit and of each subsequent
 203 unit manufactured must be equal to or better than the ENERGY STAR specification
 204 requirements; or
- 205 b. Units are selected for testing and results calculated according to the sampling requirements
 206 defined in 10 CFR Part 429, Subpart B § 429.17. The certified rating must be equal to or better
 207 than the ENERGY STAR specification requirements.

208 **Note:** The description of the sampling requirements has been simplified and made more consistent with
 209 that in other specifications. There is no change in its intended meaning.

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 211 B. When testing residential water heaters, the following test methods shall be used to determine
 212 ENERGY STAR qualification:
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Table 6: Test Methods for ENERGY STAR Qualification

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

215 * Includes any applicable guidance that DOE has issued regarding the testing of these products
 216 (See <http://www1.eere.energy.gov/guidance/default.aspx?pid=2&spid=1>). **Note on recovery**
 217 **efficiency:** Guidance includes that for thermostatically-controlled water heaters that do not

218 initiate and complete a recovery cycle prior to the start of the second draw of the simulated-use
219 test, the recovery efficiency shall be determined as specified in Section 11.2 of ASHRAE 118.2.
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221 **6) Effective Date:**

222 The ENERGY STAR Residential Water Heater specification shall take effect on **April 16, 2015**. To
223 qualify for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on
224 the model's date of manufacture. The date of manufacture is specific to each unit and is the date on
225 which a unit is considered to be completely assembled.

226 **Note:** The effective date of this Version 3.0 aligns with the federal standards effective date of April 16,
227 2015.

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229 **7) Future Criteria Revisions:**

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