



# ENERGY STAR Program Requirements Product Specification for Residential Water Heaters

## Eligibility Criteria Version 2.0: Draft 2

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7 Following is the **Draft 2** 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 or electricity to heat potable water for use  
12 outside the heater upon demand, including:

13

14 a. Whole-home Unit: For the purposes of this specification, a whole-home unit refers to a  
15 water heater that is designed to provide potable hot water for the entire home.  
16 Technologies include:

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18 i. Storage type units which heat and store water at a thermostatically controlled  
19 temperature, including: gas storage water heaters with an input of 75,000 British  
20 thermal units (Btu) per hour or less and storage volume between 20 and 100  
21 gallons; electric heat pump type units, with a maximum current rating of 24  
22 amperes at a voltage no greater than 250 volts and designed to transfer thermal  
23 energy from one temperature level to a higher temperature level for the purpose  
24 of heating water, and, if a tank is supplied, having a storage volume of 120  
25 gallons or less. Add-on heat pump units are air to water heat pumps designed  
26 for use with a storage-type water heater or a storage tank that is not specified or  
27 supplied by the manufacturer.

28

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

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

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42 b. Point-of-Use (POU) Unit: For the purposes of this specification, a Point-of-Use unit refers  
43 to a water heater that is designed for use near the fixture.

44

45 i. Point-of-Use units with an input of less than or equal to 25kW and storage  
46 volume of less than 20 gallons will be included under this specification upon  
47 inclusion of such units in section 321(27)(B) of the Energy Policy and  
48 Conservation Act (42 U.S.C. 6291(27)(B)), and/or upon inclusion by the

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<sup>1</sup> SRCC, Part 6: Types of Solar Thermal Systems. [http://www.solar-rating.org/facts/system\\_ratings.html](http://www.solar-rating.org/facts/system_ratings.html)

49 Department of Energy (DOE) in the CFR of a test method which yields an EF  
50 rating.

51 **Note:** EPA proposes a 20 gallon capacity requirement instead of the physical dimension limit in Draft 1.  
52 Several stakeholders expressed that a 20 gallon capacity limit would be approximately equivalent to a 25  
53 kW input limit for tankless heaters under typical POU usage conditions. This change will assure that  
54 higher capacity units actually intended for whole home use will not be included in the POU definition.

- 55 B. Energy Factor: Energy Factor (“EF”) is the ratio of useful energy output from the water heater to  
56 the total amount of energy delivered to the water heater.  
57
- 58 C. Solar Fraction: Solar Fraction (“SF”) is the portion of the total conventional hot water heating load  
59 (delivered energy and standby losses) provided by solar energy.  
60
- 61 D. 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).  
63
- 64 E. Gallons per Minute: Gallons per Minute (“GPM”) is the amount of hot water in gallons a tankless  
65 water heater can supply per minute over a 77°F rise.  
66
- 67 F. 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.  
70
- 71 G. 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.  
75
- 76 H. 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.

79  
80 **2) Scope:**

- 81 A. Included Products: Only products that meet the definition of a residential water heater, as  
82 specified herein are eligible for ENERGY STAR qualification.  
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- 84 B. Excluded Products: Whole home electric resistance water heaters, products intended only for  
85 commercial use, and combination appliances that supply both space and water heating are not  
86 eligible for the ENERGY STAR Water Heater Program.  
87

88 **Note:** Under included products, the scope has been updated to take into consideration that residential  
89 water heaters may be used in commercial settings if appropriate for the application. EPA does not wish to  
90 limit the market for these units, and thus has eliminated the statement that the products must be intended  
91 only for sale in the residential market. The scope for excluded products has not been modified.

92  
93 **3) Qualification Criteria:**

- 94 A. Product Performance Requirements for Electric Water Heaters:  
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96 a. Whole-Home Electric Units

Criteria	ENERGY STAR Requirements
Energy Factor	EF $\geq$ 2.0
First Hour Rating	FHR $\geq$ 50 gallons per hour
Warranty	6 years on sealed system; see additional requirements for add-on units
Safety	UL 174 and UL1995

98 **Note:** EPA continues to weigh the appropriate metric or metrics for add-on heat pump performance. A  
 99 test method for energy efficiency of these units is provided in 10CFR Part 430 Subpart B Appendix E  
 100 Section 4.10. Furthermore, there will be a minority of cases where consumers consider both an  
 101 integrated solution and an add-on and will need to compare them. For these reasons, add-on  
 102 manufacturers will need to report an EF, no matter what other metrics are listed. However, EPA is  
 103 interested in adding a second metric for use by the ENERGY STAR program.

104 Evaluating add-on heat pumps on the basis of how much they improve the EF of an existing tank would  
 105 recognize the unique potential add-on heat pumps have to improve the efficiency of the installed base of  
 106 water heaters, and would provide consumers with a tool to gauge the effect of adding a heat pump to  
 107 their hot water system. One proposed metric is an energy factor multiplier (EFM), reflecting the fact that  
 108 to first order, the effect of adding a heat pump to an existing tank will be to multiply its energy factor by an  
 109 amount depending on hot water usage. Since the DOE test method for residential water heaters defines  
 110 a usage pattern for test, a multiplier that applies to this pattern could be derived easily. To enable timely  
 111 progress and wide stakeholder participation in the evaluation of an energy factor multiplier, EPA will share  
 112 for stakeholder review and comment a proposed approach for such a metric in a brief document released  
 113 by early December 2011.

114 EPA seeks stakeholder feedback on the proposed EFM metric, and on possible strategies to qualify add-  
 115 on heat pumps on the basis of EFM while retaining some basic EF requirements as well.

116 **Additional warranty requirements for Add-on Heat Pump Water Heaters:**

117 Manufacturers of add-on heat pumps must include a consumer warning as follows on product  
 118 packaging and literature:

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 120 "Installation of this product may void the manufacturer's warranty on the storage water heater  
 121 it is installed on. Consumers are advised to contact the manufacturer of their water heater for  
 122 more information."

123  
 124 This warning shall be in letters no less than .5 inches high on the exterior package of the add on  
 125 heat pump, and must appear prominently as well in installation manuals, users manuals, and  
 126 marketing material such as web pages and sales brochures.  
 127

128 **Note:** Many stakeholders commented on the warranty requirements for add-on heat pump units that were  
 129 proposed in Draft 1. After consideration, EPA now proposes that add-on manufacturers be responsible  
 130 only for their own equipment, but that they are required to include prominent warnings to consumers that  
 131 installation of their products may void the warranty of their original storage water heater.

132 **Additional qualification requirements:**

- 133  
 134 1. The units shall include an audible alert to notify when the compressor turns off due to a  
 135 blockage in the condensate drain.  
 136

137 2. Manufacturers shall report in their literature the ambient temperature below which the  
 138 compressor cuts off and electric resistance only operation begins.

139 **Note:** As suggested by stakeholders, EPA reviewed the Northern Climate Specification for Heat Pump  
 140 Water Heaters. Though some of the requirements identified in the Northern Climate specification make  
 141 sense for ENERGY STAR, most cannot be adopted until a test method is in place. The two requirements  
 142 above are an exception.

143 The audible alert would notify the consumer that the heat-pump operation of the product has been  
 144 disabled in the event of a compressor shut down. This fault is easily remedied once the homeowner is  
 145 notified. Heat pump operation is essential in achieving the savings expected from a heat pump water  
 146 heater, and stakeholder feedback indicated that prolonged operation in electric resistance heat only mode  
 147 due to condensate drain malfunction is a frequent consumer complaint.

148 The reporting requirement for lower compressor cut-off temperature will help to guide consumer choice in  
 149 selecting a model appropriate for their particular installation conditions. While this product attribute is not  
 150 necessary for effective heat pump operation in all regions, it is very useful in determining suitability in  
 151 colder climates or installation in unconditioned areas such as a garage or basement.

152 Lastly, stakeholders expressed concerns that the installation of an add-on heat pump water heater would  
 153 void the safety certification of the storage tank on which it is installed. UL confirmed that any change  
 154 made to the wiring of the tank would void the UL safety certification of that electric resistance storage  
 155 tank. EPA understands that all add on heat pump water heaters require modification of the existing  
 156 storage tank wiring during installation. If this concern cannot be satisfactorily resolved, EPA will not  
 157 include add-on heat pump water heaters in this specification. EPA considers safety certification as a  
 158 valued feature by consumers and hence, would not propose to include products which would void it.

159 b. Point-Of-Use Electric Units  
 160

Criteria	ENERGY STAR Requirements
Energy Factor	EF>.97
Low Flow Rate Requirement	Activation must occur at a flow rate of 5kW input or less: 0.3 GPM or less >5kW input: 0.5 GPM or less
Warranty	Warranty ≥ 6 years on heat exchanger and 1 year on parts
Safety	ANSI/UL499
Flicker	Units shall perform within acceptable region defined by IEC 61000-2-2
Temperature Adjustment	Unit must have a feature that allows the user to adjust temperature. Manufacturer must submit a copy of the operation manual, which verifies this capability

161 **Note:** Upon further consideration, EPA believes that the ENERGY STAR label may not be an effective  
 162 consumer tool for POU water heaters. The choice whether to purchase a POU heater for residential use  
 163 is complex, with many different scenarios and choices of type of product to use. Consumers may be  
 164 better served by more nuanced education than by a binary label.  
 165  
 166  
 167

168 **Note Contd.**

169 Some of the more common scenarios EPA has considered are in new construction, construction of a  
170 major addition, and to serve an existing fixture distant from the whole home hot water heater. In new  
171 construction, EPA estimates that an ENERGY STAR qualified heat pump water heater may likely provide  
172 more value than a POU design. If distant fixtures cannot be avoided, EPA understands that consumers  
173 have numerous options that may, depending on the details of the situation, provide better savings than a  
174 POU unit. Major additions built because more people will be using the house may warrant upgrading the  
175 home's hot water delivery. EPA is considering the value proposition for homeowners in this situation. For  
176 the case of serving an existing fixture distant from a whole home hot water heater, energy savings  
177 depends on a number of contextual factors, and it is not clear that a binary label can do justice to them.  
178 EPA specifically seeks additional data regarding energy savings in various scenarios for use of POU  
179 water heaters, as well as installed cost and monetary savings.

180 Please note that the only scenarios examined for cost effectiveness and for national savings for this  
181 specification revision are residential use cases. Additional use cases in commercial settings may be  
182 analyzed in the upcoming commercial water heaters specification development effort.

183 In the event POU units are included in the scope of the specification, EPA proposes removing the booster  
184 capability requirement, as it is a feature easily discernable by consumers at the time of purchase, and not  
185 needed in most cases. In addition, EPA received stakeholder feedback that 0.3 GPM flow rate  
186 represents a scalding risk for higher input rate units and has raised the level to .5 GPM for them.

187 Should compelling use case scenarios be identified, there are still some units in scope for which test  
188 method work remains to be done. Several stakeholders recommended using an alternative metric  
189 (standby loss) for efficiency for small storage heaters, which would require defining a new test method.  
190 Several stakeholders recommended particular existing test methods as a starting place for this additional  
191 metric. Given that an additional metric would delay this revision, and that DOE is developing an EF test  
192 method for these units, EPA does not anticipate using a new metric.

193  
194 B. Product Performance Requirements for Gas Water Heaters:

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196 a. Whole-Home Gas Storage Units

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

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200 **Note:** The majority of stakeholders agreed that it is appropriate to merge the high efficiency gas storage  
201 category and the gas condensing category into one whole-home gas storage category.

202 Some stakeholders commented that the combination of these two technologies into the whole-home  
203 category should also warrant an increase in the EF requirement. EPA reiterates that it is not an  
204 advantageous time to raise the level given the low market penetration at the current EF level. EPA will re-  
205 examine this issue during the next specification revision, before the new federal standards take effect in  
206 2015.

207

208 **Note Contd.,**

209 Upon consideration of stakeholder comments, EPA proposes requiring a 6 year warranty for these units  
210 instead of 8 years as proposed in Draft 1, because 6 years provides sufficient assurance of product  
211 performance.

212 b. Whole-Home Gas Instantaneous Units

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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

214 **Note:** The reference to the safety standard Z21.10.1/CSA 4.1 has been removed, as all instantaneous  
215 gas products are covered under ANSI Z21.10.3/CSA 4.3.

216 C. Product Performance Requirements for Solar Water Heaters:

217 a. Whole-Home Solar Units

218

Criteria	ENERGY STAR Requirements
Solar Fraction	SF $\geq$ 0.5
Warranty	10 years on collector, 6 years sealed system, 2 years on controls, 1 year on parts

221 **Note:** EPA received some comments from stakeholders indicating that the ENERGY STAR label is  
222 valuable to the Solar Water Heater market. EPA is continuing discussions with stakeholders about this  
223 issue, with the goal of developing data that shows the effect of the ENERGY STAR label on these  
224 products. EPA welcomes additional data and comments from the industry to justify retaining the Solar  
225 Water Heaters in the ENERGY STAR program.

226 D. Significant Digits and Rounding:

227 a. All calculations shall be carried out with actual measured or observed values. Only the  
228 final result of a calculation shall be rounded. Unless otherwise specified in 10 CFR part  
229 430 or part 431, calculated results shall be rounded to the nearest significant digit as  
230 expressed in the corresponding specification limit.

231 b. Unless otherwise specified, compliance with specification limit shall be evaluated using  
232 exact values without any benefit from rounding.

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238 **4) Test Requirements:**

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- 240 A. A representative model shall be selected for testing per the following requirements:
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- 242 1) For qualification of an individual product model, the representative model is that model;
- 243
- 244 2) For qualification of a basic model group, any model within that basic model group may be
- 245 considered the representative model.
- 246
- 247 B. One of the following sampling plans shall be used for purposes of testing for ENERGY STAR
- 248 qualification:
- 249
- 250 1) A single unit is selected, obtained, and tested. The measured performance of this unit and of
- 251 each subsequent unit manufactured must be equal to or better than the ENERGY STAR
- 252 specification requirements. Results of the tested unit may be used to qualify additional
- 253 individual model variations within a basic model as long as the definition for basic model
- 254 group provided in Section 1, above, is met. Further, all individual models within a basic
- 255 model must have the same certified rating based on the applicable sampling criteria per
- 256 DOE's regulations in Part 429, and this rating must be used for all manufacturer literature,
- 257 the qualified product list and certification of compliance to DOE standards.; or
- 258
- 259 2) Units are selected for testing and results calculated according to the sampling requirements
- 260 defined in 10 CFR Part 429, Subpart B § 429.17. The certified rating must be equal to or
- 261 better than the ENERGY STAR specification requirements. Results of the tested unit may be
- 262 used to qualify additional model variations within a basic model as long as the definition for
- 263 basic model provided in Section 1, above, is met. Further, all individual models within a
- 264 basic model must have the same certified rating.
- 265
- 266 C. When testing residential water heaters, the following test methods shall be used to determine
- 267 ENERGY STAR qualification:
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- 269

<b>Test Methods for ENERGY STAR Qualification</b>		
<b>ENERGY STAR Requirement</b>	<b>Test Method Reference</b>	<b>Applicable Products</b>
Energy Factor	10 CFR 430, Subpart B, Appendix E*	Gas and electric units; FHR only for storage units, GPM only for tankless.
First Hour Rating (FHR)		
Gallons per minute (GPM)		
Low flow rate (GPM)		POU electric units
Flicker		POU electric units
Solar Fraction	SRCC – OG-300: Operating Guidelines and Minimum Standards for Certifying Solar Water Heating Systems	Whole-home solar units

270 \* This includes any applicable guidance that DOE has issued regarding the testing of these products (See

271 <http://www1.eere.energy.gov/guidance/default.aspx?pid=2&spid=1>). **Note on recovery efficiency:**

272 Guidance includes that for thermostatically-controlled water heaters that do not initiate and complete a

273 recovery cycle prior to the start of the second draw of the simulated-use test, the recovery efficiency shall

274 be determined as specified in Section 11.2 of ASHRAE 118.2.

275 **5) Effective Date:**

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277 The ENERGY STAR Residential Water Heater specification shall take effect on November 1, 2012. To

278 qualify for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on the

279 model's date of manufacture. The date of manufacture is specific to each unit and is the date on which a  
280 unit is considered to be completely assembled.  
281

282 **Note:** EPA aims to finalize the Version 2.0 Residential Water Heaters specification in January 2012, with  
283 a proposed November 1, 2012 effective date.

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