



ENERGY STAR Program Requirements Product Specification for Commercial Water Heaters

Eligibility Criteria Draft 1 Version 2.0

1 Following is the Draft 1 Version 2.0 product specification for ENERGY STAR certified commercial water
2 heaters. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

3
4 **1) Definitions:** Below are the definitions of the relevant terms in this document.

5 A. Commercial Water Heater: A product that utilizes gas or electricity to heat potable water for use
6 outside the heater upon demand, at a thermostatically controlled temperature, including:

7
8 a. A storage type unit¹ which heats and stores water within the appliance at a thermostatically
9 controlled temperature for delivery on demand, including:

10
11 i. Gas-fired storage water heaters with an input rate both greater than 75,000 British thermal
12 units (Btu) per hour and less than 4,000 Btu/h per gallon of stored water, and

13
14 ii. Commercial heat pump water heaters designed to transfer thermal energy from a low-
15 temperature source to a higher-temperature sink for the purpose of heating potable water,
16 including air-source, water-source, and direct geo-exchange units, with a rated electric
17 power input greater than 12 kW (including all ancillary equipment such as fans, blowers,
18 pumps, storage tanks, piping, and controls, as applicable).

19
20 b. Commercial-duty residential heat pump, capable of operating with a three-phase power
21 supply to transfer thermal energy from a low-temperature source to a higher-temperature sink
22 for the purpose of heating potable water, including air-source, water-source, and direct geo-
23 exchange units, with a rated electric power input less than or equal to 12 kW (including all
24 ancillary equipment such as fans, blowers, pumps, piping, and controls, as applicable). Tanks
25 are not necessarily specified or supplied by the manufacturer and the heat pump is capable
26 of heating water separate from a tank or storage-type water heater.

27
28 c. A gas-fired instantaneous type unit¹ with an input rate both greater than 200,000 Btu/h and
29 not less than 4,000 Btu/hr per gallon of stored water.

30
31 B. Thermal Efficiency (TE)¹: The ratio of the heat energy (Btu/hr) transferred to the water flowing
32 through the water heater to the amount of energy (Btu/hr) consumed by the water heater during
33 full-firing rate, steady-state operation.

34
35 C. Standby Loss (SL)¹: The average hourly energy, expressed in Btu per hour, required to maintain
36 the stored water temperature based on a 70°F temperature differential between stored water and
37 ambient room temperature.

38
39 D. Coefficient of Performance (COP_h)¹: The dimensionless ratio of the rate of useful heat transfer
40 gained by the water, expressed in Btu/h, to the rate of electrical power consumed during full input
41 rate operation, expressed in Btu/h.

42

¹ 10 CFR Part 431 Subpart G

- 43 E. Uniform Energy Factor (UEF)²: The measure of residential water heater overall efficiency.
44
45 F. Manufacturer Limited Warranty: An assurance by the manufacturer to the consumer that the
46 water heater, including purchased system equipment and components, is guaranteed to work for
47 a defined period of time.
48
49 G. Basic Model¹: All units of a given type of covered product (or class thereof) manufactured by one
50 manufacturer, having the same primary energy source, and which have essentially identical
51 electrical, physical, and functional (or hydraulic) characteristics that affect energy consumption,
52 energy efficiency, water consumption, or water efficiency.
53
54 H. Fault Detection and Display: System is capable of detecting and reporting, in plain text, system
55 faults to the owner and/or technical professional. This includes, but is not limited to, the ability to
56 detect leaks which may lead to catastrophic failure. Faults are displayed on the system or
57 remotely (preferred). The system is also capable of storing at least five faults in a history log.
58
59 I. Performance Reporting: System is capable of reporting at least three system performance
60 metrics. Examples of performance metrics include, but are not limited to, fuel usage, hot water
61 usage, and run time.
62
63 J. Energy Savings Reporting: System is capable of analyzing performance in order to report energy
64 saving opportunities capable of being addressed via maintenance, firmware updates, or
65 operational changes. Plain text indications and/or detailed visuals that relay opportunities for
66 improvement to technical professionals are reported.
67
68 K. Predictive Maintenance Alert: System is capable of tracking water heater use and wear rates to
69 predict and alert the owner/technical professional when maintenance may be required.
70 Predictions are based on wear rates that are measured in real time or pre-programmed data that
71 indicate typical lifetimes of water heater components.

72 **Note:** Some of the definitions above have been updated to better align with the Department of Energy's
73 (DOE) definitions found in 10 CFR Part 431 Subpart G. The clarifications have been added in an effort to
74 provide more detail for describing products that are in scope for this specification. The definitions for
75 Coefficient of Performance (COP_h) and Uniform Energy Factor have been added to the specification to
76 describe the efficiency metrics that heat pump water heaters will be required to report for certification to
77 ENERGY STAR, dependent on type. A definition for commercial-duty residential heat pump water heaters
78 has been added to this section to describe commercial-use products that have a rated electric power
79 input less than or equal to 12 kW, which will be included in scope. These products do not meet DOE's
80 definition for commercial electric heat pump water heaters, which EPA has aligned with in this Draft 1,
81 because they have input rate less than 12 kW. EPA has determined that there are heat pump water
82 heaters designed for commercial use that have input rates less than or equal to 12 kW. Further
83 information on this is provided in subsequent note boxes.

84 Definitions for Fault Detection and Display, Performance Reporting, and Energy Savings Reporting, and
85 Predictive Maintenance Alert have been added to this section. These are the definitions for newly-
86 proposed reporting requirements. EPA is proposing these definitions, and associated reporting
87 requirements, in an effort to highlight products on the ENERGY STAR Product Finder that offer consumer
88 benefits regarding predictive maintenance and the potential for energy savings through performance
89 monitoring.

² Based on 10 CFR Part 430, Subpart B, Appendix E. Where a conflict arises, the CFR definition is definitive.

90 **2) Scope:**

91 A. Included Products: Only products that meet the definition of a commercial water heater, as
 92 specified herein, which are marketed for sale in the commercial market are eligible for ENERGY
 93 STAR certification.

94
 95 B. Excluded Products: The following products are not eligible for certification under this specification:

- 96
 97 a. Products that are covered under other ENERGY STAR product specifications. The list of
 98 specifications currently in effect can be found at www.energystar.gov/specifications.
 99
 100 b. Oil fired water heaters.
 101
 102 c. Combined heating/cooling and hot water systems.
 103
 104 d. Storage water heaters with greater than 140 gallons of capacity. Heat pump water heaters
 105 designed to operate in conjunction with tanks or storage type water heaters are exempt from
 106 this exclusion.
 107
 108 e. Heat pump water heaters with an integrated storage tank and rated electric power input less
 109 than or equal to 12 kW.
 110
 111 f. Add-on heat pump water heaters designed for use in residential installations.

112 **3) Certification Criteria:**

113 A. Product Performance Requirements for Gas-fired Water Heaters:

114 **Table 1: Requirements for Certified Gas-fired Water Heaters**

Criteria	Type	ENERGY STAR Requirements
Thermal Efficiency	Storage; Instantaneous	TE ≥ 0.94
Maximum Standby Loss ³	Storage	≤ 0.84 * [(Input Rate / 800) + 110(Volume _r) ^{1/2}] (expressed in Btu/hr)
	Instantaneous ≥ 10 gallons	
Minimum Manufacturer Limited Warranty	Storage; Instantaneous	3 years on tank and/or heat exchanger and 1 year on parts

116 B. Product Performance Requirements for Commercial Heat Pump Water Heaters and Commercial-
 117 duty Residential Heat Pump Water Heaters:

118 **Table 2: Criteria for Certified Electric Heat Pump Water Heaters**

Criteria	Type	ENERGY STAR Requirements
Coefficient of Performance (COP _h)	Commercial Heat Pump	COP _h ≥ 3.0
Uniform Energy Factor (UEF)	Commercial-duty Residential Heat Pump	UEF ≥ 2.20

119
³ Volume is the rated volume in gallons. Input Rate is the nameplate input rate in Btu/hr.

Criteria	Type	ENERGY STAR Requirements
Minimum Manufacturer Limited Warranty	Commercial Heat Pump; Commercial-duty Residential Heat Pump	5 years on the compressor and 2 years on parts

120

121 **Note:** The scope of this specification remains predominately the same (aside from the addition of
 122 commercial-duty residential heat pump water heaters), but product performance and safety requirements
 123 have undergone changes. For gas-fired water heaters, EPA has removed the Energy Factor requirement
 124 as no water heaters are currently certified against it and EPA does not expect them to. Also, the
 125 maximum standby loss requirement for gas-fired storage water heaters is now applicable to gas-fired
 126 instantaneous water heaters greater than or equal to 10 gallons in rated volume. This will ensure that
 127 larger instantaneous ENERGY STAR products are well-insulated and perform efficiently in standby mode.
 128 Currently, all models on the ENERGY STAR qualified products list larger than 10 gallons meet this
 129 requirement, so all will be able to certify to Version 2 without modification. Also, the safety requirements
 130 for gas-fired water heaters has been removed. Safety requirements are common in building codes and
 131 EPA feels they are no longer necessary for differentiation of ENERGY STAR commercial water heaters.
 132 EPA welcomes stakeholder feedback on these two modest changes to the requirements for gas-fired
 133 water heaters.

134 As of November 2016, DOE published a final rule test procedure which established Federal test
 135 procedures for determining the efficiency of commercial heat pump water heaters larger than 12 kW. Now
 136 that this process is complete, EPA proposes efficiency requirements based on it for covered heat pump
 137 water heaters (>12kW input). Some heat pump models that are sold in the commercial market do not
 138 meet DOE’s definition of a commercial product and, as such, are not required to use the commercial test
 139 procedure. Because these products are smaller than 12 kW, but heat water independent of a tank, EPA
 140 proposes that they be included in the specification as “Commercial-duty Residential Heat Pump Water
 141 Heaters”. Under this proposal, these products will be tested using DOE’s test procedure for residential
 142 (consumer) water heaters and meet minimum Uniform Energy Factor (UEF) criteria for certification.

143 EPA conducted research and stakeholder outreach in an effort to differentiate these products from those
 144 designed for residential installations, since both meet DOE’s definition of a residential (consumer) product
 145 having an input rate less than or equal to 12 kW. EPA is aware that products designed for commercial
 146 use are more likely to offer higher recovery rates, higher outlet water temperatures, etc. Though these
 147 commercial-duty residential heat pump water heaters may be designed for commercial use, testing to the
 148 residential (UEF) test procedure limits EPA’s ability to differentiate these products from products designed
 149 for and sold into the residential market using metrics such as First-Hour Rating (FHR) or recovery rate. As
 150 such, EPA has proposed to describe commercial-duty residential heat pump water heaters as being
 151 capable of operating with a three-phase power supply. EPA seeks stakeholder feedback on the definition
 152 and scope of commercial-duty residential heat pump water heaters.

153 EPA is proposing a minimum UEF criteria of 2.20 for commercial-duty residential heat pump water
 154 heaters. This criterion allows for differentiation from minimum efficiency standards for products in this
 155 category. It is EPA’s understanding that COP and UEF are not readily comparable, but the intention of
 156 this proposal is to specify criteria that distinguishes appropriately-designed heat pump water heaters,
 157 whether or not the input rate is less than or greater than 12 kW. EPA assumes that a UEF of 2.20 will
 158 provide broad selection of certified products for purchasers, and will provide significant savings when
 159 compared to the efficiency of standard commercial electric resistance water heaters. EPA particularly
 160 seeks stakeholder feedback on its approach in covering this type of product and the proposed UEF
 161 criteria in the specification. If EPA is unable to confirm that a UEF of 2.20 is adequate in differentiating
 162 high efficiency commercial-duty residential heat pump water heaters, the level may need to be set as
 163 TBD and addressed at a later date.

164 For heat pump water heaters that meet DOE’s definition as commercial (>12kW input), EPA conducted
 165 stakeholder outreach to determine that a proposed COP level of 3.0 will provide a broad range of
 166 products for purchasers to choose from. EPA estimates purchaser payback of 3.6 years compared to a
 167 standard efficiency electric resistance water heater, based on an average between a variety of specific

168 use situations, each weighted by the proportion of U.S. installations in those situations. It is notable that
169 for some applications, such as dormitories, hospitals, and full service restaurants, pay back periods are
170 considerably shorter. EPA notes that heat pump water heaters have faced barriers in the commercial
171 marketplace, even in applications with excellent payback. Market barriers such as unfamiliarity to
172 contractors and purchasers may be addressed through ENERGY STAR labeling.

173 C. Reporting Requirements: Products shall report whether they meet the following criteria as defined
174 in Section 1, and also report any ancillary equipment needed to use these functions, such as a
175 Wi-Fi router or proprietary hub.

- 176 a. Fault Detection and Display
- 177
- 178 b. Performance Reporting
- 179
- 180
- 181 c. Energy Savings Reporting
- 182
- 183 d. Predictive Maintenance Alerts

184 **Note:** EPA is proposing to highlight products that provide system status and messaging functions by
185 displaying reported capabilities on the Product Finder. Each of these functions are available on several
186 models in the market, offered by manufacturers because they provide predictability and insight to users.
187 EPA is interested in highlighting these functions for user convenience, but also because they have the
188 potential to address energy use for water heating in several ways. First, products in good repair operate
189 more efficiently. Second, some of these capabilities can provide insight to customers about how to save
190 energy in operation. Lastly, to the extent that products are able to provide a warning that they may fail
191 soon, purchasers will have more time to research and order highly efficient water heaters. Avoiding
192 emergency replacement is a huge win for purchasers, and potentially for energy efficiency as well.

193 D. Significant Digits and Rounding:

- 194
- 195 a. All calculations shall be carried out with actual measured (unrounded) values. Only the final
196 result of a calculation shall be rounded.
- 197 b. Unless otherwise noted in this section, compliance with specification limits shall be evaluated
198 using exact values without any benefit from rounding.
- 199 c. Reporting on the ENERGY STAR website shall be performed using measured or calculated
200 values that are rounded to the nearest unit in the last right-hand digit as specified in the
201 corresponding specification requirements. Standby Loss shall be rounded to the nearest
202 whole number.

203 **Note:** Significant digit and rounding requirements have been updated to match the language that is
204 common to recently revised ENERGY STAR specifications. Though the language has changed, the
205 requirements are fundamentally the same.

206 4) Test Requirements:

- 207
- 208 A. One of the following sampling plans shall be used for purposes of testing for ENERGY STAR
209 certification:
 - 210
 - 211 a. A single unit is selected, obtained, and tested. The measured performance of this unit and of
212 each subsequent unit manufactured must be equal to or better than the ENERGY STAR
213 specification requirements. Results of the tested unit may be used to certify additional
214 individual model variations within a basic model as long as the definition for basic model
215 provided in Section 1, above, is met; or
- 216

217 b. Units are selected for testing and results calculated according to the sampling requirements
 218 defined in 10 CFR Part 429, Subpart B § 429.44 (commercial water heaters) or Subpart B §
 219 429.17 (commercial-duty residential heat pump water heaters). The certified rating must be
 220 equal to or better than the ENERGY STAR specification requirements. Results of the tested
 221 unit may be used to certify additional model variations within a basic model as long as the
 222 definition for basic model provided in Section 1, above, is met. Further, all individual models
 223 within a basic model must have the same certified rating based on the applicable sampling
 224 criteria. This rating must be used for all manufacturer literature, the qualified product list, and
 225 certification of compliance to DOE standards.

226
 227 B. When testing commercial water heaters, the following test methods shall be used to determine
 228 ENERGY STAR certification:
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 230

Table 4: Test Methods for ENERGY STAR Certification

ENERGY STAR Requirement	Test Method Reference	Applicable Products
Thermal Efficiency	10 CFR Part 431.106	Gas-fired Storage and Gas-fired Instantaneous Water Heaters
Standby Loss		
Coefficient of Performance	10 CFR Part 431.106, Subpart G, Appendix E	Commercial Heat Pump Water Heaters
Uniform Energy Factor	10 CFR Part 430, Subpart B, Appendix E	Commercial-duty Residential Heat Pump Water Heaters

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232 **Note:** EPA has proposed to adopt DOE’s test procedure for commercial heat pump water heaters in 10
 233 CFR Part 431.106, Subpart G, Appendix E. This test procedure is used to determine the efficiency
 234 (COP_h) for heat pump water heaters. DOE’s test procedure for residential (consumer) water heaters (10
 235 CFR Part 430, Subpart B, Appendix E) is proposed for commercial-duty residential heat pump water
 236 heaters. EPA has also removed the reference to the test procedure for energy factor as this is no longer
 237 necessary.

238 **5) Effective Date:**

239
 240 The ENERGY STAR Commercial Water Heater specification shall take effect **TBD**. To certify for
 241 ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on the model’s
 242 date of manufacture. The date of manufacture is specific to each unit and is the date on which a unit is
 243 considered to be completely assembled.

244 **Note:** EPA plans to complete this revision by the end of 2017. Once Version 2.0 is finalized, products
 245 may immediately be certified to it. After a transition period that takes approximately nine months from
 246 finalization, Version 2.0 will take effect and only products certified to Version 2.0 will remain on the
 247 Product Finder.

248
 249 **6) Future Criteria Revisions:**

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