



ENERGY STAR® Program Requirements Product Specification for Residential Water Heaters

Eligibility Criteria Draft Version 3.2

Following is the Draft Version 3.2 product specification for ENERGY STAR certified water heaters. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

Note: Products may be certified using the Uniform Energy Factor (UEF) metric and current Uniform Test Method for Measuring the Energy Consumption of Water Heaters.¹ Criteria that are specific to UEF for electric and gas-fired water heaters are outlined in Appendix A of this document.

1) Definitions: Below are the definitions of the relevant terms in this document. See Appendix A, Section 1 for definitions relevant to UEF.

- A. Residential Water Heater (Consumer Water Heater): A product that utilizes gas, electricity, or solar thermal energy to heat potable water for use outside the heater upon demand, including:
- a. Storage type units designed to heat and store water at a thermostatically-controlled temperature of less than 180 °F, including: gas storage water heaters with a nominal input of 75,000 British thermal units (Btu) per hour or less and having a rated storage capacity of not less than 20 gallons nor more than 100 gallons; electric heat pump type units with a maximum current rating of 24 amperes at an input voltage 250 volts or less, and, if the tank is supplied, having a manufacturer's rated storage capacity of 120 gallons or less.²
 - b. Instantaneous (or "tankless") type units which initiate heating based on sensing water flow and deliver water at a controlled temperature of less than 180 °F, heat water, but contain no more than one gallon of water per 4,000 Btu per hour of input with an input capacity greater than 50,000 Btu per hour but less than 200,000 Btu per hour.^{3,4}
 - c. Solar water heaters include a collector and storage tank, and use the sun's thermal energy to heat water using one of the four basic types of solar water heating systems:
 - i. forced circulation (includes both direct and indirect systems),
 - ii. integrated collector and storage,
 - iii. thermosiphon, or
 - iv. self-pumped.
 - d. Add-on Heat Pump Units are air to water heat pumps designed for use with a storage-type water heater or a storage tank that is not specified or supplied by the manufacturer.
 - e. Light Duty EPACT covered gas water heaters heat and store water at a thermostatically-controlled temperature, with an input rate >75,000 Btu per hour and ≤100,000 Btu per hour, and storage volume between 20 and 100 gallons.

¹ 10 CFR Part 430, Subpart B, Appendix E

² 10 CFR Part 430, Subpart B, Appendix E. Revised as of January 1, 2014.

³ 10 CFR Part 430, Subpart B, Appendix E. Revised as of January 1, 2014.

⁴ 10 CFR Part 430, Subpart A, § 430.2 Definitions. Revised as of January 1, 2014.

- 43 B. Energy Factor⁵: Energy Factor (EF), a measure of water heater overall efficiency, is the ratio of
44 useful energy output from the water heater to the total amount of energy delivered to the water
45 heater.
46
- 47 C. Solar Energy Factor: Solar Energy Factor (SEF) refers to the energy delivered by the total system
48 divided by the electrical or gas energy put into the system.
49
- 50 D. Thermal Efficiency⁶: Thermal efficiency (TE) is the ratio of the heat transferred to the water
51 flowing through the water heater to the amount of energy consumed by the water heater.
52
- 53 E. Standby Loss⁷: Standby Loss (SL) means the average hourly energy required to maintain the
54 stored water temperature.
55
- 56 F. First-Hour Rating⁸: The First-Hour Rating (FHR) is an estimate of the maximum volume of hot
57 water in gallons that a storage water heater can supply within an hour that begins with the water
58 heater fully heated.
59
- 60 G. Gallons per Minute⁹: Gallons per Minute (“GPM”) is the amount of gallons per minute of hot water
61 that can be supplied by an instantaneous water heater while maintaining a nominal temperature
62 rise of 77°F during steady state operation.
63
- 64 H. Manufacturer Limited Warranty: Manufacturer limited warranty is an assurance by the
65 manufacturer to the consumer that the water heater, including purchased system equipment and
66 components, are guaranteed to work for a defined period of time.
67
- 68 I. Basic Model: All units of a given type of covered product (or class thereof) manufactured by one
69 manufacturer and which have the same primary energy source and, which have essentially
70 identical electrical, physical, or functional (or hydraulic) characteristics that affect energy
71 consumption, energy efficiency, water consumption or water efficiency.¹⁰ Further, all individual
72 models within a basic model have the same certified rating based on the applicable sampling
73 criteria per U.S. Department of Energy’s (DOE) regulations in Part 429¹¹, and this rating must be
74 used for all manufacturer literature, the qualified product list and certification of compliance to
75 DOE standards.
76
- 77 J. Lower Compressor Cut-off Temperature: The temperature below which a heat pump water
78 heater’s compressor will no longer operate, such that the unit will only work as a conventional
79 electric resistance water heater.
- 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
85 pushed through the ductwork.
86
87

⁵ Based on definition in 10 CFR Part 430, Subpart B, Appendix E. Revised as of January 1, 2014.

⁶ 10 CFR Part 431, Subpart G. Revised as of January 1, 2014.

⁷ 10 CFR Part 431, Subpart G. Revised as of January 1, 2014.

⁸ 10 CFR Part 430, Subpart B, Appendix E. Revised as of January 1, 2014.

⁹ 10 CFR Part 430, Subpart B, Appendix E. Revised as of January 1, 2014.

¹⁰ 10 CFR Part 430, Subpart B, Appendix E

¹¹ 10 CFR Part 429, Subpart B

88 **2) Scope:**

89 A. Included Products: Only products that meet the definition of a Residential Water Heater, as
90 specified herein, are eligible for ENERGY STAR certification with exception of those products
91 listed in Section 2B.

92
93 B. Excluded Products:

- 94
95 a. Electric resistance water heaters,
96 b. Add-on heat pump units,
97 c. Products intended only for commercial applications,
98 d. Combination space-heating and water-heating appliances.

99 **3) Certification Criteria:**

100 **Note:** Products may be certified using the Uniform Energy Factor (UEF) metric and current Uniform Test
101 Method for Measuring the Energy Consumption of Water Heaters.¹² See Appendix A, Section 2 for
102 Product Performance Requirements for water heaters certifying using UEF.

103 A. Significant Digits and Rounding:

- 104
105 a. All calculations shall be carried out with actual measured (unrounded) values. Only the final
106 result of a calculation shall be rounded.
107 b. Unless otherwise noted in this section, compliance with specification limit shall be evaluated
108 using exact values without any benefit from rounding.
109 c. Reporting on the ENERGY STAR website shall be performed using calculation results or
110 measured values that are rounded to the nearest unit in the last right-hand digit as specified
111 in the corresponding specification requirement below.

112
113 B. Product Performance Requirements for Electric Water Heaters:

114
115 **Table 1: Criteria for Certified Electric Water Heaters**

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

¹² 10 CFR Part 430, Subpart B, Appendix E

116
117
118
119
120

C. Product Performance Requirements for Gas Water Heaters:

a. Gas Storage Water Heaters:

Table 2: Criteria for Certified Gas Storage Water Heaters

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

121
122
123
124
125

b. Gas Instantaneous Water Heaters:

Table 3: Criteria for Certified Gas Instantaneous Water Heaters

Criteria	ENERGY STAR Requirements
Energy Factor	EF ≥ 0.90
Gallons Per Minute	GPM ≥ 2.5 over a 77°F rise
Warranty	Warranty ≥ 6 years on heat exchanger and ≥ 5 years on parts
Safety	ANSI Z21.10.3/CSA 4.3

126
127
128
129

c. Light Duty EPACT covered Gas Water Heaters:

Table 4: Criteria for Certified Light Duty EPACT covered Gas Water Heaters

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

130

131 D. Product Performance Requirements for Solar Water Heaters:
132
133

Table 5: Criteria for Certified Solar Water Heaters

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

134

135 **4) Test Requirements:**

136 **Note:** See Appendix A, Section 3 for Test Methods for water heaters certifying using UEF.

137 A. One of the following sampling plans shall be used to test energy performance for qualification to
138 ENERGY STAR:

- 139 a. A single unit is selected, obtained, and tested. The measured performance of this unit and of
140 each subsequent unit manufactured must be equal to or better than the ENERGY STAR
141 specification requirements. Results of the tested unit may be used to certify additional
142 individual model variations within a basic model as long as the definition for basic model
143 provided in Section 1, above, is met; or
144
- 145 b. Units are selected for testing and results are calculated according to the sampling
146 requirements defined in 10 CFR Part 429, Subpart B §429.17. The certified rating must be
147 equal to or better than the ENERGY STAR specification requirements. Results of the tested
148 unit may be used to certify additional variations within a basic model as long as the definition
149 for basic model provided in Section 1, above, is met. Further, all individual models within a
150 basic model must have the same certified rating based on the applicable sampling criteria.
151 This rating must be used for all manufacturer literature, the qualified products list, and
152 certification of compliance to DOE standards.
153

154

155

156

157

158

159

160

161

162

163 B. When testing residential water heaters, the following test methods shall be used to determine
 164 ENERGY STAR certification:

165 **Table 6: Test Methods for ENERGY STAR Certification**

Applicable Products	ENERGY STAR Requirement	Test Method Reference
Gas and electric units; FHR only for storage units, GPM only for instantaneous units.	Energy Factor	10 CFR Part 430, Subpart B, Appendix E* Revised as of January 1, 2014**
	First-Hour Rating (FHR)	
	Gallons per minute (GPM)	
Light Duty EPACT covered gas water heaters	Thermal Efficiency	10 CFR Part 431, Subpart G Revised as of January 1, 2014**
	Standby Loss	
Whole-home solar units	Solar Energy Factor	SRCC – OG-300: Operating Guidelines and Minimum Standards for Certifying Solar Water Heating Systems

167 * Includes any applicable guidance that DOE has issued regarding the testing of these products (See
 168 <http://www1.eere.energy.gov/guidance/default.aspx?pid=2&spid=1>).

169 **Note on recovery efficiency:** Guidance includes that for thermostatically-controlled water heaters
 170 that do not initiate and complete a recovery cycle prior to the start of the second draw of the simulated-
 171 use test, the recovery efficiency shall be determined as specified in Section 11.2 of ASHRAE 118.2.
 172

173 **Refer to the 10 CFR parts 200 to 499 edition revised as of January 1, 2014. An abbreviated version
 174 of this reference, titled “*Historical Water Heaters Test Method*” can be found on the ENERGY STAR
 175 Water Heaters for [Partners webpage](#).
 176

177
 178 **5) Effective Date:**

179 The ENERGY STAR Residential Water Heaters specification shall take effect on **April 16, 2015**. To
 180 qualify for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on
 181 the model’s date of manufacture. The date of manufacture is specific to each unit and is the date on
 182 which a unit is considered to be completely assembled.
 183

184 **6) Future Specification Revisions:**

185 EPA reserves the right to change the specification should technological and/or market changes affect
 186 its usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to
 187 the specification are arrived at through industry discussions. In the event of a specification revision,
 188 please note that the ENERGY STAR certification is not automatically granted for the life of a product
 189 model. EPA is planning to further investigate the following topics in future revisions:
 190

- 191 A. Several factors will lead to significant change to the mix of products available on the market in the
 192 next few years. First, the impact of the newest federal standards has been delayed by confusion
 193 around test method and metric. Second, the new test method allows different types of products to
 194 move into the market. Third, all products will eventually have UEF test data available, and
 195 consumers may use this measure to more easily compare different types of water heaters. Taking
 196 these factors into consideration, EPA expects the market will be in a position to begin a revision
 197 in the 2019 or 2020 timeframe.
- 198 B. For some time, DOE has had minimum efficiency standard equations that rely largely on some
 199 measure of capacity while EPA has had single levels. This continues to be true now. EPA has not
 200 examined this practice for this version, but will reconsider it for future revisions.
 201
 202

203 C. The service delivered by gas-fired storage and gas-fired instantaneous water heaters is similar
204 enough that consumers, particularly those working with new construction, actively consider which
205 type of water heater to purchase. Therefore, it may be appropriate for EPA to set a single level for
206 all gas-fired water heaters. EPA has not done so in the past because market dynamics and test
207 method peculiarities have prevented this course of action. EPA will re-examine this possibility for
208 the next revision.
209

210 D. Several stakeholders have mentioned that the time may be approaching for EPA to develop
211 connected requirements for electric storage water heaters. EPA is interested in establishing
212 connected requirements in the next revision. Water heater models that meet these optional
213 requirements would be identified as “connected” on the ENERGY STAR certified products list.
214

215 EPA plans to consider criteria similar to those in the ENERGY STAR [Version 1.1 Pool Pump](#)
216 [specification](#), with requirements for open standards and an Interface Control Document (IDC)
217 covering similar capabilities. This would include the same three types of demand response (i.e., a
218 short deep load reduction, a longer shallower load reduction, and a temporary load increase)
219 originally derived from the Electric Power Research Institute (EPRI) device framework. EPA
220 would also consider user message criteria to include a notice of fault condition or similar. EPA
221 seeks stakeholder feedback on the best way to encourage useful demand response capability.
222

223 EPA will continue to monitor industry efforts to establish technical criteria for grid responsive
224 water heaters, and to whatever extent possible, harmonize with such efforts. EPA participation in
225 such industry efforts eases the path to harmonization, so EPA encourages stakeholders to
226 proactively include the Agency in any such efforts.

227 **Appendix A – Eligibility Requirements in terms of Uniform Energy Factor**

228 Appendix A contains the definitions, product performance criteria, and test requirements applicable to
229 water heaters certifying using UEF, which, by appearing in Appendix A, supersede those in the rest of the
230 specification. Aside from those appearing in Appendix A, all definitions, criteria, and test requirements in
231 the specification above apply to water heaters certified via UEF.

232

233 **1) Definitions:** Below are the definitions relevant to the UEF test method.

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

236 a. Storage type units designed to heat and store water at a thermostatically-controlled
237 temperature, including: gas-fired storage water heaters with a nameplate input of 75,000 Btu
238 per hour or less, containing more than one gallon of water per 4,000 Btu per hour of input;
239 electric heat pump type units with a maximum current rating of 24 amperes at an input
240 voltage 250 volts or less.¹³

241

242 b. Instantaneous type units heat water, but contain no more than one gallon of water per 4,000
243 Btu per hour of input with an input capacity less than or equal to 200,000 Btu per hour for
244 gas-fired instantaneous.¹⁴

245

246 c. Gas-fired storage residential-duty commercial water heaters include gas-fired storage water
247 heaters that are designed to deliver hot water at a temperature less than or equal to 180°F,
248 with an input rate greater than 75,000 Btu per hour and not exceeding 105,000 Btu per hour,
249 containing more than one gallon of water per 4,000 Btu per hour of input, and storage volume
250 less than or equal to 120 gallons. For models requiring electricity, a single-phase external
251 power supply is used.¹⁵

252 B. Uniform Energy Factor¹⁶: Uniform Energy Factor (UEF) is the measure of water heater overall
253 efficiency.

254

255 C. First-Hour Rating¹⁷: The First-Hour Rating (FHR) is an estimate of the maximum volume of “hot”
256 water that a storage-type water heater can supply within an hour that begins with the water heater
257 fully heated (i.e., with all thermostats satisfied). It is a function of both the storage volume and the
258 recovery rate.

259

260 D. Maximum GPM Rating¹⁸: Maximum GPM is the maximum gallons per minute of hot water that
261 can be supplied by an instantaneous water heater while maintaining a nominal temperature rise
262 of 67 °F (37.3 °C) during steady-state operation.

¹³ Adapted from 10 CFR Part 430, Subpart A §430.2 *Definitions*

¹⁴ Adapted from 10 CFR Part 430, Subpart A §430.2 *Definitions*

¹⁵ Adapted from 10 CFR Part 431, Subpart G §431.102 *Definitions*

¹⁶ 10 CFR Part 430, Subpart B, Appendix E

¹⁷ 10 CFR Part 430, Subpart B, Appendix E

¹⁸ 10 CFR Part 430, Subpart B, Appendix E

263 **2) Product Performance Requirements:**

264 **Note:** Below are the product performance requirements for water heaters certifying using UEF.

265

266 A. Product Performance Requirements for Electric Water Heaters:

267

268

Table 1: Criteria for Certified Electric Water Heaters

Criteria		ENERGY STAR Requirements
Uniform Energy Factor	≤ 55 gallons	UEF ≥ 2.00
	> 55 gallons	UEF ≥ 2.20
First-Hour Rating		FHR ≥ 45 gallons per hour
Warranty		Warranty ≥ 6 years on sealed system
Safety		UL 174 and UL 1995
Lower Compressor Cut-Off Temperature (Reporting Requirement Only)		Report ambient temperature below which the compressor cuts off and electric resistance only operation begins

269

270

B. Product Performance Requirements for Gas-fired Water Heaters:

271

272

273

274

a. Gas-fired Storage Water Heaters:

Table 2: Criteria for Certified Gas-fired Storage Water Heaters

Criteria		ENERGY STAR Requirements
Uniform Energy Factor	≤ 55 gallons	Medium Draw Pattern UEF ≥ 0.64 High Draw Pattern UEF ≥ 0.68
	> 55 gallons	Medium Draw Pattern UEF ≥ 0.78 High Draw Pattern UEF ≥ 0.80
First-Hour Rating		FHR ≥ 67 gallons per hour
Warranty		Warranty ≥ 6 years on system (including parts)
Safety		ANSI Z21.10.1/CSA 4.1

275

276

b. Gas-fired Instantaneous Water Heaters:

277

278

Table 3: Criteria for Certified Gas-fired Instantaneous Water Heaters

Criteria	ENERGY STAR Requirements
Uniform Energy Factor	UEF ≥ 0.87
Maximum Gallons Per Minute	Max GPM ≥ 2.9 over a 67°F rise
Warranty	Warranty ≥ 6 years on heat exchanger and ≥ 5 years on parts
Safety	ANSI Z21.10.3/CSA 4.3

279 c. Gas-fired Storage Residential-duty Commercial Water Heaters:

280

281

Table 4: Criteria for Certified Gas-fired Storage Residential-duty Commercial Water Heaters

Criteria	ENERGY STAR Requirements
Uniform Energy Factor	UEF ≥ 0.80
Warranty	Warranty ≥ 6 years on system
Safety	ANSI Z21.10.3/CSA 4.3

282

283

284

285

286

Note: The UEF criteria for electric water heaters has been updated from 2.16 in Version 3.1 to 2.20 in Version 3.2. This criteria was inadvertently converted to a value lower than the federal minimum for a select number of high draw pattern water heaters larger than 55 gallons. In order to remedy this and ensure that the single ENERGY STAR UEF level is more strict than the federal minimum for all storage volumes and draw patterns, EPA is making this revision.

287

288

289

There are currently no products on the ENERGY STAR Qualified Products List that are certified to the UEF criteria for electric water heaters. As such, EPA expects that no products will be affected in any way by this revision.

290

3) Test Methods:

291

Note: Below are the test methods for water heaters certifying using UEF.

292

293

294

A. When testing residential water heaters, the following test methods shall be used to determine ENERGY STAR certification:

295

296

297

Table 5: Test Methods for ENERGY STAR Certification

Applicable Products	ENERGY STAR Requirement	Test Method Reference
Gas and Electric products (not including gas-fired storage residential-duty commercial water heaters); FHR is applicable to storage products and Maximum GPM is applicable to instantaneous products.	Uniform Energy Factor (UEF)	10 CFR Part 430, Subpart B, Appendix E
	First Hour Rating (FHR)	
	Maximum GPM Rating	
Gas-fired Storage Residential-duty Commercial products	Uniform Energy Factor (UEF)	10 CFR Part 431, Subpart G

298