



5

ENERGY STAR[®] Program Requirements Product Specification for Furnaces

Eligibility Criteria Version 3.0: Draft 2

6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50

Following is the **Draft 2** Version 3.0 product specification for ENERGY STAR qualified furnaces. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

Note: Proper installation is critical to ensuring the energy performance of HVAC equipment. As such, EPA plans to include consumer education requirements in the ENERGY STAR Partner Commitments section of these Program Requirements, which encourages consumers to ask contractors about using an ACCA/ANSI Quality Installation checklist. Stakeholders are encouraged to provide suggestions on the important elements to include in this requirement.

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

- A. **Residential Furnace:** A heating unit with a heat input rate of less than 225,000 Btu per hour whose function is the combustion of fossil fuel (natural gas, propane, or oil) for space heating with forced hot air. Unit must include burner(s), heat exchanger(s), blower(s) and connections to heating ducts. A heating unit that meets this definition and also provides hot water for domestic or other use may be considered a furnace for purposes of this agreement. Available furnace configurations¹ are provided below:
 - a. **Upflow:** A model with the airflow discharge vertically upward at or near the top of the furnace, with the blower mounted below the heating element.
 - b. **Lowboy:** A model generally with a shorter cabinet in which the airflow discharge is vertically upward at or near the top of the furnace with the blower mounted beside the heating element.
 - c. **Downflow:** A model with the airflow discharge vertically downward at or near the bottom of the furnace, with the blower mounted above the heating element.
 - d. **Horizontal:** A model designed for low headroom installation with airflow across the heating element in a horizontal path.
- B. **Product Family:** A group of models which have identical ratings for heating input, output heating capacity, electric power (PE), auxiliary electrical energy consumption (E_{AE}), fossil fuel energy consumption (E_F), and annual fuel utilization efficiency (AFUE).
- C. **Annual Fuel Utilization Efficiency (AFUE):** The amount of fuel converted to space heat in proportion to the amount of fuel entering the furnace. This is commonly expressed as a percentage.
- D. **Furnace Fan Efficiency ("e"):** The ratio of the electric consumption to the total energy consumption of the furnace. The "e" metric is calculated using Annual Electricity Use (E_{AE}) and Annual Fuel Energy Use (E_F) as follows:
$$e = \frac{E_{AE} \times 3413}{(E_{AE} \times 3413) + (E_F \times 1,000,000)}$$

¹ <http://www.ahridirectory.org/ahridirectory/helpdocs/RFRDirectory.pdf>

51 **Note:** EPA has added a definition for furnace fan efficiency (“e”) to support the new requirement proposed
52 in Section 3 of this specification. Stakeholders are encouraged to provide feedback on the definition.

- 53
54 E. Air Leakage (Q_{leak}): The airflow rate required to maintain the applied pressures is the air leakage
55 rate of the equipment under test, Q_{leak} . The percent of the rated flow of the fan that leaves or
56 enters through cracks, joints and penetrations in the furnace cabinet rather than through supply
57 and return ducts installed in accordance with manufacturer’s instructions.
58
59 F. Heating Degree Days (HDD): HDD are calculated by subtracting the mean daily temperature from
60 a balance temperature, and summing only positive values over an entire year.
61
62

63 **2) Scope:**

- 64
65 A. Included Products: Products that meet the definition of a Residential Furnace as specified herein
66 are eligible for ENERGY STAR qualification, with the exception of products listed in Section 2.B.
67 Only non-weatherized furnaces approved for residential installation are eligible.
68
69 B. Excluded Products: Furnaces intended for commercial installation and/or with a rating of 225,000
70 Btu per hour energy or higher are not eligible for ENERGY STAR.
71

72 **Note:** A recommendation was made to further clarify the scope of products to ensure that only non-
73 weatherized furnaces that are approved for residential installation are eligible for ENERGY STAR. EPA
74 agrees that this clarification would remove any ambiguity associated with weatherized furnaces below
75 225,000 BTUH which are approved for both residential and commercial installations.

76
77 **3) Qualification Criteria:**

- 78
79 A. Regions: ENERGY STAR qualification is determined by intended distribution and sales into the
80 following three regions:
81
82 a. U.S. North - States with population-weighted Heating Degree Days (HDD) equal to or greater
83 than 5000.
84 b. U.S. South - States with population-weighted Heating Degree Days (HDD) less than 5000.
85 c. Canada - All provinces and territories.
86

U.S. Regions	U.S. States per Region
U.S. North	Alaska, Colorado, Connecticut, Idaho, Illinois, Indiana, Iowa, Kansas, Maine, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, South Dakota, Utah, Vermont, Washington, West Virginia, Wisconsin and Wyoming.
U.S. South	Alabama, American Samoa, Arizona, Arkansas, California, Delaware, District of Columbia, Florida, Georgia, Guam, Hawaii, Kentucky, Louisiana, Maryland, Mississippi, Nevada, New Mexico, North Carolina, Oklahoma, Puerto Rico, South Carolina, Tennessee, Texas and Virginia.

87
88

89
90 B. Energy Efficiency Requirements:

91
92 **Table 1: ENERGY STAR Gas and Oil Furnace Requirements**

Product Type	Regions	AFUE	e (%)	Air Leakage (Q_{leak})
Gas Furnace	U.S. North/Canada	$\geq 95\%$	$\leq 2\%$	$\leq 2\%$
	U.S. South	$\geq 92\%$		
Oil Furnace	U.S. (all)/Canada	$\geq 85\%$		

93
94 **Note:** EPA received several stakeholder comments on the performance criteria and labeling approach
95 proposed in the previous Draft 1:

96 Furnace Fan Efficiency Metric

97 EPA received several comments on the furnace fan efficiency metric (AECR) that was proposed in the
98 Draft 1 document. This feedback included concerns that rating by annual performance is misleading
99 because actual performance will vary based on installation, equipment type, consumer usage patterns,
100 and rated airflow, which varies by manufacturer. There was some concern about using a test method
101 (CSA C823) that is not yet finalized, and concern that the method is more useful to guide design than for
102 measuring performance. Per the recommendations from stakeholders, EPA evaluated the metric “e”
103 (currently being referenced in 25(c) federal tax credits) and has decided to use this metric to measure
104 furnace fan efficiency.

105
106 EPA intends to use the “e” metric at least until 1) DOE has finished a fan efficiency test metric (currently
107 scheduled December 2012) and 2) enough data is published based on it to inform decisions about
108 qualifying levels.

109
110 Based on analysis of the AHRI directory, and comments received from stakeholders, EPA believes that
111 the 2% “e” level, in combination with AFUE and air leakage, provides excellent differentiation amidst
112 products on the market while giving consumers sufficient choice of products. Stakeholders are
113 encouraged to comment on the use of the “e” metric and the proposed performance level.

114
115 EPA also received several stakeholder comments about the annual heating hours proposed for calculating
116 AECR. The discussions these comments generated were very useful, but not directly relevant to this
117 specification since the AECR requirement was removed.

118
119 Regional AFUE

120 A few stakeholders suggested having the same AFUE level for U.S. North and Canada or having a single
121 AFUE level for the entire U.S. EPA considered these suggestions and performed a cost effectiveness
122 analysis for these two scenarios. This analysis showed that 95 AFUE furnaces are cost effective in the
123 U.S. North, and that 92 AFUE furnaces may be cost effective in the U.S. South.

124
125 EPA calculated operating cost using data on annual fuel use per region from the 2007 DOE Technical
126 Support Documents (TSD) and natural gas prices for winter 2009-2010 from the Energy Information
127 Administration. For AFUE 80 and 95 furnaces, EPA used retail prices from the most recent version of the
128 ENERGY STAR Furnace savings calculator, based on market research conducted in August 2010. To
129 account for installation cost, EPA used the price differential provided in the 2007 DOE TSD. This is a
130 conservative choice, as installer familiarity with condensing furnace installation is likely to have brought the
131 installation differential further down.

132
133 EPA did not have readily available pricing data for 92 AFUE furnaces. Comparing the price differential
134 between 80 AFUE and 95 AFUE furnaces from two sources (2007: DOE TSD and 2010: ENERGY STAR
135 Savings Calculator) shows that high AFUE furnaces have come down in price significantly since the 2007
136 DOE TSD. Using a similar % cost decrease for 92 AFUE furnaces, we estimated the retail cost of 92
137 AFUE furnaces.
138

139 **Note cont.**

140
141 Based on EPA's analysis, a 95 AFUE furnace in the U.S. North yields a consumer payback of 3.6 years,
142 and a 92 AFUE furnace in the U.S. South yields a payback of 3.7 years. Provided below are the
143 assumptions used for the analysis:

144

145 AFUE	Retail Cost	Installation Cost	Fuel Use (North)	Fuel Use (South)
146 80	\$957.50\$816		71.02 MBtu	38.66
147 92	\$1183	\$1109	---	33.00
148 95.5	\$1199.99	\$1109	58.2 MBtu	---

149

150 Based on cost effectiveness, EPA has decided to apply the same AFUE requirement to both U.S. North
151 and Canada. Note that this level has been adjusted from 94 AFUE, which was proposed in the previous
152 Draft 1 version, to 95 AFUE which better reflects product availability. Stakeholders are encouraged to
153 comment on the assumptions used in EPA's cost effectiveness analysis and the new AFUE proposal for
154 harmonizing U.S North and Canada.

155
156 Scope of ENERGY STAR Regions

157 Some stakeholders expressed concerns in regards to regional ENERGY STAR labeling implementation
158 and compliance. These stakeholders suggest that EPA harmonize with DOE's methodology and approach
159 to determining regions of the U.S. for the purposes of heating standards. EPA recognizes that such a
160 harmonization reduces burden on manufacturers and avoids confusion in the marketplace, and reiterates
161 its intention to align with DOE in regards to scope of its regions and, to the extent practical, when it comes
162 to ENERGY STAR implementation.

163
164
165 C. Multiple Configurations: To earn the ENERGY STAR, models offered in multiple configurations
166 (i.e., upflow, downflow, horizontal, lowboy) shall meet the regional ENERGY STAR levels
167 presented in Table 1 for all configurations they are offered in. For example, if a model is intended
168 to be sold in the U.S. North region and is offered in upflow, downflow, and horizontal
169 configurations, then the model shall meet the U.S. North region ENERGY STAR levels as tested
170 in all three configurations. Manufacturers cannot claim that a model meets ENERGY STAR U.S.
171 North when installed in the downflow configuration only. Similarly, a model cannot be qualified
172 across two different regions depending on configuration. For example, if sold in Canada all
173 configurations shall meet the Canadian requirements in Table 1 to bear the ENERGY STAR.
174 Models may qualify for labeling in every region for which all offered configurations meet the
175 requirements of that region. For instance, models qualified for labeling in Canada may also be
176 labeled everywhere in the U.S while models qualified only for labeling in the US South may only
177 be labeled in that region.

178
179
180 D. Significant Digits and Rounding:

- 181
- 182 a. All calculations shall be carried out with actual measured or observed values. Only the final
183 result of a calculation shall be rounded. Calculated results shall be rounded to the nearest
184 significant digit as expressed in the corresponding specification limit.
 - 185
 - 186 b. Unless otherwise specified, compliance with specification limit shall be evaluated using
187 exact values without any benefit from rounding.
- 188
189

190 **4) Warranty Requirements:**

191
192 Manufacturer shall offer a limited warranty on all ENERGY STAR qualified furnaces. For purposes of this
193 specification, a limited warranty is an assurance by the Partner that purchased system equipment and

194 components are warranted by the manufacturer for a period of time. The period of time is typically
 195 expressed in numbers of years. The exact terms of the limited warranty shall be determined by the
 196 manufacturer.
 197

198 **Note:** Some stakeholders expressed concern with the inclusion of warranty, claiming that it is
 199 inappropriate for ENERGY STAR to dictate this requirement. An important Guiding Principle of the
 200 ENERGY STAR program is that performance is maintained or enhanced with greater energy efficiency.
 201 To ensure quality performance, EPA has included warranty requirements or other quality assurance
 202 metrics in several of its ENERGY STAR specifications. This warranty requirement was first introduced
 203 early in the evolution of the ENERGY STAR Furnace Specification and has since been retained in
 204 subsequent revisions. However, if providing consumers with a limited warranty is not a distinguishing
 205 feature of high quality products, EPA may consider removing this as a minimum requirement for ENERGY
 206 STAR. Stakeholders are encouraged to comment on whether a warranty requirement continues to add
 207 value to the consumer and differentiate top performers.

208
 209 **5) Test Requirements:**

- 210
 211 A. Representative Models shall be selected for testing per the following requirements:
 212
 213 a. For qualification of an individual product model, the representative model shall be equivalent
 214 to that which is intended to be marketed and labeled as ENERGY STAR.
 215
 216 b. For qualification of a product family, any model within that product family can be tested and
 217 serve as the representative model.
 218
 219 B. When testing residential furnaces, the following test methods shall be used to determine ENERGY
 220 STAR qualification:
 221
 222

Table 2: Test Methods for ENERGY STAR Qualification	
ENERGY STAR Requirement	Test Method Reference
AFUE, e (E_{AE} , E_F)	10 CFR Part 430, Appendix N
Air Leakage (Q_{leak})	ANSI/ASHRAE Standard 193-2010 "Method of Test for Determining the Airtightness of HVAC Equipment"

223 **Note:** Since Annual Electricity Use (E_{AE}) and Annual Fuel Energy Use (E_F), used to calculate the metric
 224 "e", are outputs of the DOE test procedure (10 CFR Part 430, Appendix N) these metrics have been added
 225 to the table above.

226 The Qualification and Verification section included in the previous Draft 1 has been removed from this
 227 specification. This information is being provided directly to EPA-recognized Certification Bodies.

228 **6) Effective Date:**

229
 230 The ENERGY STAR Version 3.0 Furnace specification shall take effect on **November 15, 2011**. To qualify
 231 for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on its date of
 232 manufacture. The date of manufacture is specific to each unit and is the date (e.g., month and year) on
 233 which a unit is considered to be completely assembled.
 234

235
236
237
238
239
240
241
242
243
244
245
246
247
248
249
250
251
252
253
254

Note: Stakeholders have requested that EPA give at least 6 to 12 months for manufacturers to acquire instrumentation and develop procedures to test the products to the new ENERGY STAR requirements. Such consideration is part of every ENERGY STAR specification revision process. EPA aims to finalize the Version 3.0 Furnace specification by February 15, 2011 and a new November 15, 2011 effective date is proposed.

7) Future Specification Revisions:

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

Review of Energy Efficiency Requirements: Over the next several years, EPA will monitor U.S. and Canadian markets and review AFUE, e, and Air Leakage data to determine whether the limits provided in Table 1 continue to provide sufficient differentiation for the consumer. If it is determined that revisions are needed, EPA will work closely with industry stakeholders to develop appropriate new levels. EPA might also consider revisiting this specification to address digital communications and diagnostics features in HVAC systems as these technologies are more widely introduced into the marketplace.