



# ENERGY STAR® Program Requirements Product Specification for Furnaces

## Eligibility Criteria Version 3.0: Draft 2

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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 configurations<sup>1</sup> 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:  $(E_{AE} \times 3413) / [(E_{AE} \times 3413) + (E_F \times 1,000,000)]$

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

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

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

## 2) Scope:

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

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

## 3) Qualification Criteria:

- A. Regions: ENERGY STAR qualification is determined by intended distribution and sales into the following three regions:
- U.S. North - States with population-weighted Heating Degree Days (HDD) equal to or greater than 5000.
  - U.S. South - States with population-weighted Heating Degree Days (HDD) less than 5000.
  - Canada - All provinces and territories.

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.

B. Energy Efficiency Requirements:

**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	$\geq 85\%$		

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

Furnace Fan Efficiency Metric

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

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

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

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

Regional AFUE

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

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

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

**Note cont.**

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

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

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

Scope of ENERGY STAR Regions

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

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

D. Significant Digits and Rounding:

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

**4) Warranty Requirements:**

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

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

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

## 5) Test Requirements:

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

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"

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

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

## 6) Effective Date:

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

**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.