



ENERGY STAR® Program Requirements for Furnaces

Partner Commitments

Following are the terms of the ENERGY STAR Partnership Agreement as it pertains to the manufacture and labeling of ENERGY STAR qualified products. The ENERGY STAR Partner must adhere to the following partner commitments:

Qualifying Products

1. Comply with current ENERGY STAR Eligibility Criteria, which define performance requirements and test procedures for furnaces. A list of eligible products and their corresponding Eligibility Criteria can be found at www.energystar.gov/specifications.
2. **Prior to associating the ENERGY STAR name or mark with any product**, obtain written certification of ENERGY STAR qualification from a Certification Body recognized by EPA for furnaces. As part of this certification process, products must be tested in a laboratory recognized by EPA to perform furnace testing. A list of EPA-recognized laboratories and certification bodies can be found at www.energystar.gov/testingandverification.

Using the ENERGY STAR Name and Marks

3. Comply with current ENERGY STAR Identity Guidelines, which define how the ENERGY STAR name and marks may be used. Partner is responsible for adhering to these guidelines and ensuring that its authorized representatives, such as advertising agencies, dealers, and distributors, are also in compliance. The ENERGY STAR Identity Guidelines are available at www.energystar.gov/logouse.
4. Use the ENERGY STAR name and marks only in association with qualified products. Partner may not refer to itself as an ENERGY STAR Partner unless at least one product is qualified and offered for sale in the U.S and/or ENERGY STAR partner countries.
5. Provide clear and consistent labeling of ENERGY STAR qualified furnaces.
 - 5.1. The ENERGY STAR mark must be clearly displayed in product literature (i.e., user manuals, spec sheets, etc.) and on the manufacturer's Internet site where information about ENERGY STAR qualified models is displayed.
 - 5.2. It is also recommended that the mark appear on the top/front of the product and on the product packaging.

Verifying Ongoing Product Qualification

6. Participate in third-party verification testing through a Certification Body recognized by EPA for furnaces, providing full cooperation and timely responses, EPA/DOE may also, at its discretion, conduct tests on products that are referred to as ENERGY STAR qualified. These products may be obtained on the open market, or voluntarily supplied by Partner at the government's request.

Providing Information to EPA

7. Provide unit shipment data or other market indicators to EPA annually to assist with creation of ENERGY STAR market penetration estimates, as follows:

- 7.1. Partner must submit the total number of ENERGY STAR qualified furnaces shipped in the calendar year or an equivalent measurement as agreed to in advance by EPA and Partner. Partner shall exclude shipments to organizations that rebrand and resell the shipments (unaffiliated private labelers).
- 7.2. Partner must provide unit shipment data segmented by meaningful product characteristics (e.g., type, capacity, presence of additional functions) as prescribed by EPA.
- 7.3. Partner must submit unit shipment data for each calendar year to EPA or an EPA-authorized third party, preferably in electronic format, no later than March 1 of the following year.

Submitted unit shipment data will be used by EPA only for program evaluation purposes and will be closely controlled. If requested under the Freedom of Information Act (FOIA), EPA will argue that the data is exempt. Any information used will be masked by EPA so as to protect the confidentiality of the Partner;

8. Report to EPA any attempts by recognized laboratories or Certification Bodies (CBs) to influence testing or certification results or to engage in discriminatory practices.
9. Notify EPA of a change in the designated responsible party or contacts within 30 days using the My ENERGY STAR Account tool (MESA) available at www.energystar.gov/mesa.

Training and Consumer Education

10. Partner shall comply with the following, product-specific requirements concerning training and education:
 - 10.1. Offer and encourage training to distributors and/or contractors on the following issues: system venting, condensate removal, code compliance, and proper use of the Manual J calculation, or other equivalent calculation, in order to encourage proper sizing of equipment.

Performance for Special Distinction

In order to receive additional recognition and/or support from EPA for its efforts within the Partnership, the ENERGY STAR Partner may consider the following voluntary measures, and should keep EPA informed on the progress of these efforts:

- Provide quarterly, written updates to EPA as to the efforts undertaken by Partner to increase availability of ENERGY STAR qualified products, and to promote awareness of ENERGY STAR and its message.
- Consider energy efficiency improvements in company facilities and pursue benchmarking buildings through the ENERGY STAR Buildings program.
- Purchase ENERGY STAR qualified products. Revise the company purchasing or procurement specifications to include ENERGY STAR. Provide procurement officials' contact information to EPA for periodic updates and coordination. Circulate general ENERGY STAR qualified product information to employees for use when purchasing products for their homes.
- Feature the ENERGY STAR mark(s) on Partner website and other promotional materials. If information concerning ENERGY STAR is provided on the Partner website as specified by the ENERGY STAR Web Linking Policy (available in the Partner Resources section of the ENERGY STAR website), EPA may provide links where appropriate to the Partner website.
- Ensure the power management feature is enabled on all ENERGY STAR qualified displays and computers in use in company facilities, particularly upon installation and after service is performed.
- Provide general information about the ENERGY STAR program to employees whose jobs are relevant to the development, marketing, sales, and service of current ENERGY STAR qualified products.
- Provide a simple plan to EPA outlining specific measures Partner plans to undertake beyond the program requirements listed above. By doing so, EPA may be able to coordinate, and communicate Partner's activities, provide an EPA representative, or include news about the event in the ENERGY

STAR newsletter, on the ENERGY STAR website, etc. The plan may be as simple as providing a list of planned activities or milestones of which Partner would like EPA to be aware. For example, activities may include: (1) increasing the availability of ENERGY STAR qualified products by converting the entire product line within two years to meet ENERGY STAR guidelines; (2) demonstrating the economic and environmental benefits of energy efficiency through special in-store displays twice a year; (3) providing information to users (via the website and user's manual) about energy-saving features and operating characteristics of ENERGY STAR qualified products; and (4) building awareness of the ENERGY STAR Partnership and brand identity by collaborating with EPA on one print advertorial and one live press event.

- Join EPA's SmartWay Transport Partnership to improve the environmental performance of the company's shipping operations. The SmartWay Transport Partnership works with freight carriers, shippers, and other stakeholders in the goods movement industry to reduce fuel consumption, greenhouse gases, and air pollution. For more information on SmartWay, visit www.epa.gov/smartway.
- Join EPA's Green Power Partnership. EPA's Green Power Partnership encourages organizations to buy green power as a way to reduce the environmental impacts associated with traditional fossil fuel-based electricity use. The partnership includes a diverse set of organizations including Fortune 500 companies, small and medium businesses, government institutions as well as a growing number of colleges and universities. For more information on Green Power, visit www.epa.gov/greenpower.



ENERGY STAR® Program Requirements Product Specification for Furnaces

Eligibility Criteria Version 4.0

Following is the Version 4.0 product specification for ENERGY STAR qualified furnaces. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

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):** For the exact definition of AFUE, refer to the federal test method 10 CFR 430, Appendix N to Subpart B. In general, the percentage of the heat in the incoming fuel which is converted to space heat instead of being lost.
- D. **Furnace Fan Efficiency ("e")²:** The ratio of the furnace fan electrical consumption to the total energy consumption of the furnace during the heating mode.
- E. **Air Leakage (Q_{leak}):** The percent of the rated airflow of the fan that is required to maintain the applied pressures, accounting for air 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 for each state are calculated by subtracting the population-weighted daily average temperature for that state from a balance temperature of 65°F, and summing only positive values over an entire year.

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

² Refer to "Interim Approach for Determining Furnace Fan Energy Use" document.

- G. Balance Temperature: Used in a heating degree day calculation, intended to represent a temperature at which neither heating or cooling is needed.

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 only for commercial installation and/or with a rating of 225,000 Btu per hour energy or higher are not eligible for ENERGY STAR. Weatherized furnaces are not eligible for ENERGY STAR.

3) Qualification Criteria:

- A. Regions: ENERGY STAR requirements are divided into the following three regions:
- a. U.S. North - States with population-weighted Heating Degree Days (HDD) equal to or greater than 5000.
 - b. U.S. South - States with population-weighted Heating Degree Days (HDD) less than 5000.
 - c. 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. |

Should the Department of Energy (DOE) issue a final rule on Residential Furnaces which uses regional distinctions, it is EPA's intention to align with them. EPA will monitor DOE rulemaking and will provide clarification or an update to the specification if necessary.

- B. Energy Efficiency Requirements:

Table 1: ENERGY STAR Gas and Oil Furnace Requirements

| Product Type | Regions | AFUE | Furnace Fan Efficiency (e) | Air Leakage (Q _{leak}) |
|--------------|-------------------|---------|----------------------------|----------------------------------|
| Gas Furnace | U.S. North/Canada | ≥ 95.0% | ≤ 2.0% | ≤ 2.0% |
| | U.S. South | ≥ 90.0% | | |
| Oil Furnace | U.S. (all)/Canada | ≥ 85.0% | | |

- C. Multiple Configurations: To earn the ENERGY STAR, models offered in multiple configurations (i.e., upflow, downflow, horizontal, and 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 and bear the standard ENERGY STAR logo, while models qualified only for labeling in the US South may only use the US South regional label.

D. Significant Digits and Rounding:

- a. All calculations shall be carried out with directly measured (unrounded) values.
- b. Unless otherwise specified, compliance with specification limits shall be evaluated using directly measured or calculated values without any benefit from rounding.
- c. Directly measured or calculated values that are submitted for reporting on the ENERGY STAR website shall be rounded to the nearest significant digit as expressed in the corresponding specification limit.

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.

5) Test Requirements:

A. A representative model shall be selected for testing per the following requirements:

- 1) For qualification of an individual product model, the representative model is that model;
- 2) For qualification of a product family, any model within that product family may be considered the representative model.

B. One of the following sampling plans shall be used for purposes of testing for ENERGY STAR qualification:

- 1) A single unit is selected, obtained, and tested. The measured performance of this unit and of each subsequent unit manufactured must be equal to or better than the ENERGY STAR specification requirements. Results of the tested unit may be used to qualify additional model variations within a product family as long as the definition for product family provided in Section 1, above, is met ; or
- 2) Units are selected for testing and results calculated according to the sampling requirements defined in 10 CFR Part 429, Subpart B § 429.18. Similar to AFUE, e must be calculated for each tested unit and a result for the model statistically calculated. The rated values must be equal to or better than the ENERGY STAR specification requirements. Results of the tested unit may be used to qualify additional model variations within a product family as long as the definition for product family provided in Section 1, above, is met.

C. 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 | 10 CFR Part 430, Appendix N |
| e | Interim Approach for Determining Furnace Fan Energy Use |
| Q_{leak} | ANSI/ASHRAE 193-2010 |

6) Effective Date:

The ENERGY STAR Version 4.0 Furnace specification shall take effect on **February 1, 2013**. 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 on which a unit is considered to be completely assembled.

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 Q_{leak} 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 may consider addressing digital communications and diagnostics features within HVAC systems as these technologies are more widely introduced into the marketplace.

Review of Definitions for Purposes of DOE Harmonization: EPA will monitor DOE efforts to revise definitions currently used in 10 CFR 430, Appendix N to Subpart B and will provide clarification or an update to the specification if necessary once finalized.



ENERGY STAR[®] Program Requirements Product Specification for Furnaces

Interim Approach for Determining Furnace Fan Energy Use Rev. Jun-2011

1 SCOPE

The following test method shall be used to calculate furnace fan efficiency (e) to determine product compliance with requirements in the ENERGY STAR Eligibility Criteria for Furnaces. The ENERGY STAR furnace eligibility requirements will eventually reference the DOE furnace fan test procedure, currently under development. The final rule for the DOE test procedure is required to be published by December 2013. Prior to the publication of the DOE test procedure, the ENERGY STAR furnace eligibility requirements will reference this test approach. This test approach duplicates that stipulated in EISA 2007.

2 DEFINITIONS

- A) Advanced Main Circulating Fan: A fan used in a furnace which is more efficient than a standard Furnace Fan (defined below). It is a high efficiency class of Furnace Fan, which includes those that have an annual electricity use of no more than two percent of the total annual energy use of the furnace.
- B) ANSI/ASHRAE Standard 103–1993: The test standard published in 1993 by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), approved by the American National Standards Institute (ANSI) on October 4, 1993, and entitled “Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers” (with errata of October 24, 1996).
- C) Burner Operating Hours for Furnaces Equipped with Single Stage Controls (BOHss): The national average number of burner operating hours for furnaces equipped with single-stage controls.
- D) Control Configurations:
 - 1) Single Stage Control: A control that cycles a burner between the maximum heat input rate and “off”.
 - 2) Step Modulating Control: A modulating control that cycles a burner between the reduced input rate and “off” if the heating load is light. If a higher heating load is encountered that cannot be met with the reduced input rate, the control goes into a modulating mode where it either gradually or incrementally increases the input rate to meet the higher heating load. At that point, if a lower heating load is encountered, the control either gradually or incrementally decreases to the reduced input rate.
 - 3) Two Stage Control: A modulating control that both cycles a burner between reduced heat input rate and “off” and between the maximum heat input rate and “off”. It may also switch from “off” to reduced fire to high fire to “off” under certain load conditions.
- E) e : The ratio of the furnace fan electrical consumption to the total energy consumption of the furnace during the heating mode.

- F) E_{AE} : Average annual auxiliary electrical energy consumption for gas or oil-fired furnaces, expressed in kilowatt hours (kWh).
- G) E_F : Average annual fuel energy consumption for gas or oil fueled furnaces expressed in British thermal units (Btu), and calculated using the equations defined in Section 3, Test Approach and Calculation Methodology.
- H) E_{Fan} : Annual electricity use of the Advanced Main Circulating Fan, expressed in kilowatt hours (kWh).
- I) $E_{Furnace}$: Average annual auxiliary electrical energy consumption for gas or oil-fired furnaces excluding the average annual electric standby mode and off mode energy consumption, expressed in kWh.
- J) E_M : Average annual energy use during the heating season, expressed in Btu.
- K) E_{SO} : Average annual electric standby mode and off mode energy consumption, expressed in kWh.
- L) Furnace Fan: An electrically powered device used in residential central heating, ventilation, and air conditioning (HVAC) systems for the purposes of circulating air through duct work. A furnace fan consists of a fan motor and its controls, an impeller, and sheet metal housing.
- M) Natural Gas Furnace: A furnace with natural gas as the energy source.
- N) Oil Furnace: A furnace with oil as the energy source.
- O) Operation Modes:
- 1) Active Mode: The mode of operation during which the Furnace Fan is powered and the impeller is in motion. A Furnace Fan is in active mode during the heating season in which the furnace or boiler is connected to the power source, and the burner, electric resistance elements, or any electrical auxiliaries such as blowers or pumps, are activated.
 - 2) Standby mode: The mode of operation during which the Furnace Fan is powered and the impeller is not in motion. A Furnace Fan is in standby mode during the heating season in which the furnace or boiler is connected to the power source, and the burner, electric resistance elements, or any electrical auxiliaries such as blowers or pumps, are not activated.
 - 3) Off mode: The mode of operation during which the Furnace Fan is not powered. A Furnace Fan is in off mode during the non-heating season in which the furnace or boiler is connected to the power source, and the burner, electric resistance elements, and any electrical auxiliaries such as blowers or pumps, are not activated.
- P) Propane Furnace: A furnace with propane as an energy source.
- Q) Q_{IN} : Fuel energy maximum nameplate input rate at steady-state operation, including any pilot light input, expressed in Btu/h.
- R) Q_P : Fuel energy input rate to pilot light, expressed in Btu/h.

3 TEST APPROACH¹ AND CALCULATION METHODOLOGY

The annual electricity use of the Advanced Main Circulating Fan (E_{Fan}) shall not exceed a defined percent, e , of the total annual energy use of the furnace:

$$E_{Fan} = e \times E_F \quad (1)$$

where²:

For furnaces fueled by gas or oil and equipped with single stage controls

$$e = \frac{E_{Furnace} \times 3,412}{(E_{Furnace} \times 3,412) + (E_F)} \quad (2)$$

$$E_F = BOH_{SS} \times (Q_{IN} - Q_P) + 8,760 \times Q_P \quad (3)$$

$$E_{Furnace} = E_{AE} - E_{SO} \quad (4)$$

For furnaces fueled by gas or oil and equipped with two-stage or step modulating controls

$$e = \frac{E_{Furnace} \times 3,412}{(E_{Furnace} \times 3,412) + (E_F)} \quad (5)$$

$$E_F = E_M + 4,600 \times Q_P \quad (6)$$

$$E_{Furnace} = E_{AE} - E_{SO} \quad (7)$$

Additional information, including a full set of detailed equations, is available in the following locations:

1. In the Code of Federal Regulations (CFR), Title 10, Appendix N to Subpart B of Part 430, found here: <http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=91ed077a2062df92f6e8cb313723a981&rgn=div9&view=text&node=10:3.0.1.4.16.2.9.6.14&idno=10>.
2. In ANSI/ASHRAE Standard 103–1993, which is available for purchase here: http://www.techstreet.com/cgi-bin/detail?doc_no=ASHRAE|103_1993&product_id=4146.

¹ Detailed test set-up and test approach are documented in ANSI/ASHRAE Standard 103-1993.

² As defined in the Code of Federal Regulations, Title 10, Appendix N to Subpart B of Part 430. Full summary available here: <http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=95cff987bc3e0a1c94bba37afe439cbf&rgn=div9&view=text&node=10:3.0.1.4.16.2.9.6.14&idno=10>

4 APPENDICES

A) Additional Equations

The following equations only apply to E_F , the average annual fuel energy consumption for gas or oil fueled furnaces, and are required to complete the calculations for furnaces equipped with two-stage or step modulating controls in the equations above. Constants and variables in these equations not already defined are defined in Table 1 of Appendix 4B.

For furnaces fueled by gas or oil and equipped with two-stage controls

Average Annual Energy Use during the Heating Season:

$$E_M = (Q_{IN} - Q_P) \times BOH_{SS} + (8,760 - 4,600) \times Q_P \quad (A1)$$

For furnaces fueled by gas or oil and equipped with step modulating controls

Average Annual Energy Use during the Heating Season:

$$E_M = (Q_{IN} - Q_P) \times BOH_{SS} + (8,760 - 4,600) \times Q_P \quad (A2)$$

B) Additional Constants

The remaining constants for use in Equations (1) through (7), (A1), and (A2) are defined in Table 1, as specified in the CFR, Title 10, Appendix N to Subpart B of Part 430 and ANSI/ASHRAE Standard 103–1993.

Table 1: Equation Constants

| <i>Constant</i> | <i>Definition</i> |
|-----------------|---|
| 3,412 | Conversion to express energy in terms of kWh instead of Btu |
| 4,600 | Average non-heating season hours per year |
| 8,760 | Total number of hours per year |