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# ENERGY STAR<sup>®</sup> Product Specification for Furnaces

## Eligibility Criteria Version 3.0: Draft 1

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Following is the **Draft 1** 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.

**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:
  - 1. 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.
  - 2. 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.
  - 3. 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.
  - 4. 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<sub>AE</sub>), fossil fuel energy consumption (E<sub>F</sub>), and annual fuel utilization efficiency (AFUE).
- C. Annual Fuel Utilization Efficiency (AFUE): The AFUE measures 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. For purposes of this agreement, the efficiency of a furnace shall be measured using AFUE. Test procedures have been developed to test AFUE by the Department of Energy (DOE). These procedures are specified in 10 Code of Federal Regulations (CFR) part 430, Appendix N.
- D. Annual Electrical Energy Consumption Rating (AEER): The standardized Integrated Mechanical System (IMS) electrical energy consumption rating. AEER accounts for the annual electrical energy used by an IMS to provide standardized space heating, water heating, and ventilation loads.
- E. Air Leakage (Q<sub>leak</sub>): The airflow rate required to maintain the applied pressures is the air leakage rate of the equipment under test, Q<sub>leak</sub>. 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.

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<sup>1</sup> www.ahrinet.org

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 58 F. Heating Degree Days (HDD): HDD<sup>2</sup> are used to estimate how cold the climate is and how much  
 59 energy may be needed to keep buildings warm. They are calculated by subtracting the mean  
 60 daily temperature from a balance temperature, and summing only positive values over an entire  
 61 year.  
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63 **Note:** Definitions for Annual Electrical Energy Consumption Rating (AECR), air leakage, heating degree  
 64 days, product family and configurations have been added.

65 The AECR definition has been adopted from CSA P.10-07 *Performance of Integrated Mechanical Systems*  
 66 *for Residential Heating and Ventilation*. The definitions for the product family and configurations were  
 67 derived from the Air-Conditioning, Heating and Refrigeration Institute (AHRI) furnace certification program  
 68 and the Heating Degree Days definition has been taken from the EPA glossary <sup>2</sup>.

69 The term “residential” has been added to the furnace definition above in response to several questions  
 70 received from industry stakeholders regarding commercial furnace eligibility. Stakeholders are  
 71 encouraged to provide suggestions to EPA regarding changes to the furnace definition or additional  
 72 requirements in this section that clarifies EPA’s intent to only qualify residential furnaces.

73 Stakeholders are encouraged to review all the definitions presented above and provide suggestions on  
 74 how they might be improved or clarified. EPA is also interested in whether there are additional terms that  
 75 require defining for purposes of specification clarification.

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 77 **2) Scope:**  
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- 79 A. Included Products: Products that meet the definition of a Residential Furnace as specified herein  
 80 are eligible for ENERGY STAR qualification, with the exception of products listed in Section 2.B.  
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 82 B. Excluded Products: Furnaces intended for commercial installation and/or with a rating of 225,000  
 83 Btu per hour energy or higher are not eligible for ENERGY STAR under this specification.  
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85 **3) Qualification Criteria:** To qualify for ENERGY STAR, residential furnaces shall meet all of the  
 86 requirements presented below.  
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- 88 A. **Regions:** ENERGY STAR qualification is determined by intended distribution and sales into the  
 89 following three regions:  
 90 1. U.S. North - States with population-weighted Heating Degree Days (HDD) equal to or greater  
 91 than 5000.  
 92 2. U.S. South - States with population-weighted Heating Degree Days (HDD) less than 5000.  
 93 3. Canada - All provinces and territories.  
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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.

<sup>2</sup> <http://www.epa.gov/hiri/resources/glossary.htm#h>

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**B. Energy Efficiency Requirements**

**Table1: ENERGY STAR Requirements**

<b>Furnace</b>	<b>Regions</b>	<b>AFUE</b>	<b>AECR (kWh)</b>	<b>Air Leakage (<math>Q_{leak}</math>)</b>
Gas Furnace	U.S. North	≥92%	TBD	2%
	U.S. South	≥90%	TBD	2%
	Canada	≥94%	TBD	2%
Oil Furnace	U.S. All	≥85%	TBD	2%
	Canada	≥85%	TBD	2%

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**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.

**D. Significant Digits and Rounding:** AFUE, AECR, and Air Leakage shall be reported using the rounding principles provided below.

- 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.

**Note:** EPA estimates that the current market share for ENERGY STAR qualified gas furnaces is 43%. Consistent with the Agency’s commitment to ensuring that the ENERGY STAR continues to designate top performers in the market, EPA has researched the potential for establishing more stringent ENERGY STAR Furnace requirements. A number of factors support the prospect of a more stringent specification consistent with program principles, including cost effectiveness, and savings without a sacrifice in performance. These include:

- Canadian Energy Efficiency Regulation requirement for gas-fired furnaces equivalent to current ENERGY STAR level of 90% AFUE, effective December 31, 2009.
- Revisions to the DOE federal minimum standards for gas furnaces, scheduled to be published in May 2011.

In establishing new ENERGY STAR requirements, EPA generally looks to the performance of the most efficient 25% of models in the marketplace. In this case, EPA proposes combining regional AFUE levels with fan efficiency and cabinet air leakage requirements. EPA believes that there are additional energy savings that could be realized by evaluating products based on Annual Electrical Energy Consumption (AECR) ratings and air leakage for ENERGY STAR qualification. EPA has included Canadian efficiency requirements in this specification for the convenience of presenting all the requirements in one document.

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**Regional Approach**

The amount of money and energy consumers can save with a high efficiency furnace is dependent upon the heating requirements of their local climate. EPA proposes a regional approach based on climate to ensure that consumers recover their investment in ENERGY STAR equipment within a reasonable amount of time considering the expected lifetime of the product.

The regions EPA proposes are based on  $\geq 5,000$  HDD (population-weighted average by state), in accordance with a proposal from DOE's standard rulemaking process. DOE's proposal is in accordance with a consensus agreement between the AHRI, American Council for an Energy Efficient Economy (ACEEE), California Energy Commission and other industry stakeholders with recommended minimum federal levels by regions. Aligning with the proposed DOE regional structure provides consistency, reducing the burden on manufacturers and distributors and minimizing consumer confusion.

Regional labels are currently under development and will be defined in the ENERGY STAR Identity Guidelines and the Special Applications for Furnaces, along with requirements for their size/placement.

**AFUE**

For gas furnaces, EPA is proposing to keep the current 90% AFUE level for the U.S. South region, as the cost effectiveness of a more stringent efficiency requirement is less compelling in this region; however, EPA proposes to tighten the requirements to 92% AFUE in the Northern U.S. region and to 94% AFUE in Canada. These AFUE levels provide consumer with substantial energy savings and favorable payback (i.e., less than 5 years) in their respective regions. Reviewing the latest AHRI Certified Products Directory shows that a sufficient number and variety of models meeting the tighter AFUE requirements are available.

The U.S. oil furnace market is much smaller than the gas furnace market, and is shrinking. A relatively small proportion of oil furnaces sold in the U.S. are ENERGY STAR qualified. Therefore, EPA proposes to maintain the existing ENERGY STAR efficiency level of 85% AFUE. A similar market dynamic in Canada leads EPA to also propose maintaining the current ENERGY STAR efficiency level of 85% AFUE for Canadian Oil Furnaces.

**AECR**

AECR is the annual electrical energy consumption metric introduced in the CSA C823 standard to measure the annual energy consumed by an air handler during both heating and cooling seasons. With the annual full load heating and cooling hours for Canada (2000 hrs for heating, 400 hrs for cooling), U.S. National Average (1970 hrs for heating, 399 hrs for cooling), U.S. North (2400 hrs for heating, 310 hrs for cooling), and U.S. South (1700 hrs for heating, 460 hrs for cooling) being so close, EPA proposes to apply the CSA standard to the U.S. regions as currently written.

EPA will propose ENERGY STAR levels for AECR based on data representing units tested in accordance with the CSA C823 test procedures and submitted to EPA by September 30, 2010. The data will be used to derive the AECR efficiency levels for U.S. and Canada and EPA will share a masked version of the data with stakeholders for review.

EPA is closely following the DOE rulemaking process for fan efficiency. A final rule defining efficiency metric in the U.S., and associated minimum federal requirements, is due to be finalized in May 2011. While the requirements will not go into effect for some time afterwards, EPA would be able to use the metric immediately after it is finalized. While it is attractive to use a single metric for all purposes in the U.S., doing so would delay implementation of this revision.

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**Air Leakage ( $Q_{leak}$ )**

For furnaces located in unconditioned space (e.g., garage, attic), air leakage increases the space conditioning load and reduces energy efficiency and occupant comfort. Depending on the location of the furnace, it may also affect indoor air quality and occupant health. In order to reduce these losses and increase the overall system efficiency, EPA proposes an air leakage maximum of 2% for gas and oil furnaces sold in the U.S. and Canada. This proposal is based on a review of the 2007 Florida Building Code for residential buildings which gives credit for 2% or lower leakage rate for furnace air handlers. As of 2003, there were many furnaces available that met a 2% air leakage level, though it is not clear what procedure manufacturers used to self-certify the results. Additionally, recent studies have found that many furnaces on the market have low leakage. It is EPA's belief that air leakage should be an important design consideration and requiring a maximum 2% air leakage for ENERGY STAR qualification will provide consumers with substantial additional savings, further differentiating highly efficient furnaces.

Stakeholders are requested to bring up any issues or concerns they might have regarding these newly introduced metrics and their proposed levels.

**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 Criteria:**

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 Efficiency Requirement	Test Method Reference
AFUE	10 CFR Part 430, Appendix N
AECR	CSA C823 " <i>Performance standard for air handlers in residential space conditioning system</i> "
Air Leakage ( $Q_{leak}$ )	ANSI/ASHRAE Standard 193-2010 " <i>Method of Test for Determining the Airtightness of HVAC Equipment</i> "

**Note:** The test standard for measuring annual electrical energy consumption, CSA C823 standard – *Performance standard for air handlers in residential space conditioning systems*, is still in draft format. CSA aims to complete the standard by late 2010 or early 2011. CSA has recently released the C823 standard for public review on July 7, 2010. Stakeholders are encouraged to review the standard and provide feedback on the test method and operating conditions. Stakeholders interested in participating in the development of the C823 standard can contact Jose Luis Hernandez at [joseluis.hernandez@csa.ca](mailto:joseluis.hernandez@csa.ca).

EPA will propose levels based on data from units tested according to the C823 standard and submitted to EPA by September 30, 2010.

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The test standard for measuring air leakage is ANSI/ASHRAE Standard 193-2010 - *Method of Test for Determining the Airtightness of HVAC Equipment*. Manufacturers should review the ASHRAE standard and are encouraged to test their units using the standard to identify any potential issues with the test method. The requirement level was chosen in cognizance of the aforementioned credit in the Florida building codes, as well as proposals for 2% requirements in the International Energy Conservation Code (IECC) and by the California Energy Commission.

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**6) Qualification and Reporting:**

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A. Product Families: Product families that are submitted for ENERGY STAR qualification shall include the following:

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a. Documentation of test results for the representative model.

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b. A list of all model numbers to be included in the product family.

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c. Documentation sufficient to provide evidence that all models in the product family share a common basic design (e.g., specification sheets).

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B. Data Collection: Data shall be collected using the format provided in Appendix A.

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C. Registered/Rated Performance: Registered or rated performance data may be submitted for inclusion on the consumer-facing ENERGY STAR qualified product list. This optional data submission is in addition to the required submission of actual measured test data produced using the test methods specified in this document. Registered or rated data shall meet all of the requirements presented in this ENERGY STAR specification, and shall not represent an improvement over tested product performance.

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**7) Effective Date:**

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The ENERGY STAR Furnace specification shall go into effect on **September 1, 2011**. To qualify with the energy efficiency criteria of ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on the 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.

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**Note:** EPA aims to finalize the Version 3.0 Furnace specification by December 1, 2010, with a proposed September 1, 2011 effective date.

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**8) Future Specification Revisions:**

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ENERGY STAR reserves the right to change the 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 industry 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.

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**Review of Energy Efficiency Requirements:** Within one year of this specification becoming effective, ENERGY STAR will review the AFUE, AECR, and Air Leakage data to determine whether the limits provided in Table 1 provide for sufficient differentiation in the U.S. and Canadian markets. If it is determined that revisions are needed, EPA will work closely with industry stakeholders to develop appropriate new levels. EPA might also consider including self diagnostics requirements under this revision.

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## **Appendix A – Data Collection Requirements**

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Specified below are the data collection requirements for furnaces:

1. Manufacturer Name and Contact Information
2. Brand Name
3. Model Name
4. Model Number
5. Test Lab Information
6. Date Tested
7. Fuel Type (Gas, Oil)
8. Configuration (Upflow, Downflow, Lowboy, and Horizontal)
9. Hot Water Heating Capability (Yes/No)
10. Performance Data:
  - a. Region (U.S. North, U.S. South, Canada)
  - b. Input Rate, Btu
  - c. AFUE, %
  - d. AEER, kWh. Provide the AEER data in accordance with the reporting template specified in Annex A of the CSA standard C823-2010.
  - e. Air Leakage ( $Q_{leak}$ ). Provide the air leakage data in accordance with the reporting requirements specified in Section 7 of ASHRAE Standard 193-2010.