



ENERGY STAR® Program Requirements Product Specification for Commercial Ovens

Eligibility Criteria Final Draft: Version 2.2

Following is the **Final Draft** Version 2.2 product specification for ENERGY STAR certified commercial ovens. 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. Oven: A chamber designed for heating, roasting, or baking food by conduction, convection, radiation, and/or electromagnetic energy.¹

Oven Types

- B. Combination Oven: A device that combines the function of hot air convection (oven mode), saturated and superheated steam heating (steam mode), and combination convection/steam mode for moist heating, to perform steaming, baking, roasting, rethermalizing, and proofing of various food products. In general, the term combination oven is used to describe this type of equipment, which is self-contained.² The combination oven is also referred to as a combination oven/steamer, combi or combo.
- a. Half-Size Combination Oven: A combination oven capable of accommodating a single 12 x 20 x 2 ½-inch steam table pan per rack position, loaded from front-to-back or lengthwise.
- b. Full-Size Combination Oven: A combination oven capable of accommodating two 12 x 20 x 2 ½-inch steam table pans per rack position, loaded side by side, from front-to-back or lengthwise.
- c. 2/3-Size Combination Oven: A combination oven capable of accommodating a single 12 x 10 x 2 ½-inch steam table pan per rack position, loaded from front-to-back or lengthwise.
- C. Convection Oven: A general-purpose oven that cooks food by forcing hot dry air over the surface of the food product. The rapidly moving hot air strips away the layer of cooler air next to the food and enables the food to absorb the heat energy. For the purposes of this specification, convection ovens do not include ovens that have the ability to heat the cooking cavity with saturated or superheated steam. However, this oven type may have moisture injection capabilities (e.g., baking ovens and moisture-assist ovens). Ovens that include a *hold feature* are eligible under this specification as long as convection is the only method used to fully cook the food.
- a. Half-Size Convection Oven: A convection oven that is capable of accommodating half-size sheet pans measuring 18 x 13 x 1-inch.
- b. Full-Size Convection Oven: A convection oven that is capable of accommodating standard full-size sheet pans measuring 18 x 26 x 1-inch.
- D. Conventional or Standard Oven: An oven that cooks food primarily using the naturally occurring hot air currents to transfer heat over the surface of the food product without the use of a fan or blower. The burner or elements heat the air within the oven cavity as well as the cavity walls,

¹ NSF/ANSI 170-2014, *Glossary of Food Equipment Terminology*.

² ASTM Standard F-2861-10 *Standard Test Method for Enhanced Performance of Combination Oven in Various Modes*.

causing currents of hot air that transfer heat to the surface of the food. The hot air's buoyancy carries it upward through cooler air, which then slowly sinks to the bottom of the oven as it cools off.

- E. Conveyor Oven: An oven designed to carry food product on a moving belt into and through a heated chamber.
- F. Slow Cook-and-Hold Oven: An oven designed specifically for low-temperature (e.g., less than 300°F) cooking, followed by a holding period at a specified temperature.
- G. Deck Oven: An oven that cooks food product directly on the floor of a heated chamber. The bottom of each compartment is called a deck and heat is typically supplied by burners or elements located beneath the deck. The oven ceiling, floor, and walls are designed to absorb heat quickly and radiate that heat back slowly and evenly.
- H. Rack Oven: A high-capacity oven that offers the ability to produce steam internally and is fitted with a motor-driven mechanism for rotating multiple pans inserted into one or more removable or fixed pan racks within the oven cavity.
 - a. Mini Rack Oven: A stand-mounted rack oven designed with a load-in-place rack that cannot be removed. Mini rack ovens are capable of accommodating up to 10 standard full-size sheet pans measuring 18 x 26 x 1-inch.
 - b. Single Rack Oven: A floor-model rack oven that is able to accommodate one removable single rack of standard sheet pans measuring 18 x 26 x 1-inch.
 - c. Double Rack Oven: A floor-model rack oven that is able to accommodate two removable single racks of standard sheet pans measuring 18 x 26 x 1-inch, or one removable double-width rack.
 - d. Quadruple Rack Oven: A floor-model rack oven that is able to accommodate four removable single racks of standard sheet pans measuring 18 x 26 x 1-inch, or two removable double-width racks.
- I. Range Oven: An oven base for a commercial range top (i.e., burners, electric elements or hobs). Range ovens may use either standard or convection technologies to cook food.
- J. Rapid Cook Oven: An oven that utilizes one or more non-traditional heat transfer technologies to cook food product significantly faster than would be possible using conventional (e.g., convection, conduction, radiant) heat transfer technologies. Heat transfer technologies that may be employed include microwave, quartz halogen, and high-velocity or impingement convection.
- K. Rotisserie Oven: An oven fitted with a mechanism to move or turn food past a fixed heat source while the food is slowly being cooked on all sides.

Energy Efficiency Metrics

- L. Baking-Energy Efficiency: Quantity of energy imparted to the specified load, expressed as a percentage of energy consumed by the oven during the baking event.
- M. Cooking-Energy Efficiency: Quantity of energy imparted to the specified load, expressed as a percentage of energy consumed by the oven during the cooking event.
- N. Idle Energy Rate: The rate of oven energy consumption while it is maintaining or holding at a stabilized operating condition or temperature. Also called standby energy rate.
- O. Total Idle Energy Rate: The rate of oven energy consumption while it is maintaining or holding at a stabilized operating condition or temperature. Total idle energy rate includes gas and electric

energy (primary and auxiliary). Also called total standby energy rate.

Water Consumption

- P. Average Water Rates: The ratio of the average potable water used to the maximum number of steam table pans the oven can accept during heavy-load cooking in steam and convection modes; expressed as gallons per hour (GPH) per pan.
- Q. Average Condensate Temperature: The average temperature of the condensed steam and cooling water mixture exiting the combination oven and directed to the drain during heavy-load cooking in steam and convection modes.
- R. Maximum Condensate Temperature: The maximum temperature of the condensed steam and cooling water mixture exiting the combination oven and directed to the drain during heavy-load cooking in steam and convection modes.

Qualification Terms

- S. Product Family: Individual models offered within a product line based on the same engineering design, including pan capacity, fuel type, and method of steam generation, as applicable. Acceptable differences within a product family for purposes of certification include: controls, door-opening orientation, and any aesthetic additions that have no impact on oven energy consumption in any operating mode.
- T. Pan Capacity: The number of steam table pans the combination oven is able to accommodate as per the ASTM F-1495-05 standard specification.
- U. Single Rack: Single racks shall accommodate 15 full-size sheet pans measuring 18 x 26 x 1-inch, at a 4-inch spacing between rack positions. Single racks accommodate 1 full-size sheet pan per rack position.
- V. Double-Width Rack: Double racks shall accommodate 30 full-size sheet pans measuring 18 x 26 x 1-inch, at a 4-inch spacing between rack positions. Double racks accommodate 2 full-size sheet pan per rack position.
- W. Set-Back Idle Mode: A feature that includes automatic temperature reduction after extended periods of non-use. In addition, the feature may also incorporate the reduction or elimination of fan speed, lighting, and automated rack rotation during periods of non-use.

Note: In response to Draft 2, stakeholders requested EPA define set-back idle mode. Based on review of available models with this mode, EPA has added a set-back idle mode definition in Section 1.W, above.

2) Scope:

- A. Included Products: Products that meet the definitions of a Commercial Oven and Convection Oven, Combination Oven, or Rack Oven as specified herein are eligible for ENERGY STAR qualification, with the exception of products listed in Section 2.B. The following sub-types are eligible:
 - a. Full-size gas and half- and full-size electric convection ovens.
 - b. Half- and full-size gas combination ovens with a pan capacity ≥ 6 .
 - c. Half- and full-size electric combination ovens with a pan capacity ≥ 5 and ≤ 20 .
 - d. Single and double gas rack ovens.

To ensure only commercial ovens qualify under this specification, products shall be third-party

certified to NSF/ANSI Standard 4, *Commercial Cooking, Rethermalization and Powered Hot Food Holding and Transport Equipment*.

- B. **Excluded Products:** This specification is intended for commercial food-grade ovens. Ovens designed for residential or laboratory applications cannot qualify for ENERGY STAR under this specification. The following oven types and sub-types are ineligible for ENERGY STAR:
- a. Half-size gas convection ovens.
 - b. 2/3-size combination ovens.
 - c. Dual-fuel heat source combination ovens.
 - d. Hybrid ovens not listed in Section 2.A, above, such as those incorporating microwave settings in addition to convection.
 - e. Conventional or standard ovens; conveyor; slow cook-and-hold; deck; range; rapid cook; and rotisserie.
 - f. Gas combination ovens with a pan capacity of < 6.
 - g. Electric combination ovens with a pan capacity < 5 and > 20.
 - h. Mini and quadruple gas rack ovens.
 - i. Electric rack ovens.

3) Qualification Criteria:

- A. Convection Oven Cooking-Energy Efficiency and Idle Energy Rate Requirements:

Table 1: Energy Efficiency Requirements for Convection Ovens		
Gas		
Oven Capacity	Idle Rate, Btu/h	Cooking-Energy Efficiency, %
Full-Size	≤ 12,000	≥ 46
Electric		
Oven Capacity	Idle Rate, kW	Cooking-Energy Efficiency, %
Half-Size	≤ 1.00	≥ 71
Full-Size	≤ 1.60	

- B. Combination Oven Cooking-Energy Efficiency and Idle Energy Rate Requirements:

Table 2: Energy Efficiency Requirements for Combination Ovens		
Gas		
Operation	Idle Rate, Btu/h	Cooking-Energy Efficiency, %
Steam Mode	≤ 200P+6,511	≥ 41
Convection Mode	≤ 150P+5,425	≥ 56
Electric		
Operation	Idle Rate, kW	Cooking-Energy Efficiency, %
Steam Mode	≤ 0.133P+0.6400	≥ 55
Convection Mode	≤ 0.080P+0.4989	≥ 76

Note: P = Pan capacity as defined in Section 1.S, above.

- C. Rack Oven Baking-Energy Efficiency and Idle Energy Rate Requirements:

Table 3: Energy Efficiency Requirements for Rack Ovens

Gas		
Oven Size	Total Energy Idle Rate, Btu/h	Baking-Energy Efficiency, %
Single	≤ 25,000	≥ 48%
Double	≤ 30,000	≥ 52%

Note: In response to stakeholder concerns that the electric energy consumed during a rack oven idle test was not being taken into consideration when determining levels, EPA performed an analysis and determined that the auxiliary electrical energy does significantly contribute to total idle energy. As such, EPA took total idle energy into consideration when developing the alternative energy performance levels in Draft 2 Version 2.2 of this specification. EPA received broad support for this alternative approach. However one stakeholder expressed concern that the levels for double-sized, gas rack ovens may inadvertently exclude one or more models that excel in baking-energy efficiency, but have a higher total idle energy rate. Further, the stakeholder noted that an end-user's usage patterns (i.e. baking schedule, operating hours, product volume, etc.) can also impact total energy consumption, highlighting that an oven designed with a high baking-energy efficiency but an increased idle rate that is used for high-volume baking, may consume less total energy than a model with a lower baking-energy efficiency and idle rate that is primarily used for high-volume baking. The stakeholder suggested a more stringent baking-energy efficiency level and a more lenient idle rate level. EPA considered this proposal and found that adopting it would exclude models that consume less total energy in the typical operation as determined by American Society for Testing and Materials (ASTM), which could have a broader adverse impact than limiting qualifying model selection for some narrower applications.

Based on the available data set and industry-accepted average operating assumptions for rack ovens (as per the ASTM F2093-11, *Standard Test Method for Performance of Rack Ovens*), the levels for single- and double-sized, gas rack ovens, which remain unchanged from the Draft 2 levels, reflect the performance of the top 22% and 30% most energy efficient models available in the U.S. market, respectively.

ENERGY STAR Product Availability

EPA received a stakeholder comment requesting confirmation that the single-sized, gas rack ovens that meet the proposed levels are adequately available in most markets throughout the U.S. EPA conducted additional research and confirmed that models meeting the levels proposed in this final draft are readily available in the U.S. market. EPA contacted manufacturer representatives that have products that meet the proposed levels and received verbal confirmation that the products are available anywhere in the U.S. EPA also conducted on-line research and found various distributors that offer these products.

- D. Additional Idle Calculation Guidance: Compliance with the Convection Oven and Combination Oven idle rate requirements shall be based on gas energy only for purposes of qualifying gas models. When calculating the gas oven idle rates, electric energy consumed by auxiliary components shall not be taken into consideration. However, the electric energy consumption measured during idle tests shall be reported separately, as per Section 4.H.c.
- E. Additional Total Idle Calculation Guidance: Compliance with the Rack Oven total idle rate requirements shall be based on gas and electric energy for purposes of qualifying gas models. When calculating the gas rack oven total idle rates, electric energy consumed by auxiliary components shall be converted to Btu/h and added to the gas idle rate expressed in Btu/h. The electric energy consumption measured during idle tests shall also be reported separately as expressed in kW, as per Section 4.H.c.

Example: Consider a double-sized gas rack oven with a gas idle energy rate of 30,000 Btu/h; and the electric idle energy rate of 1.5 kW. First convert the 1.5 kW electric idle energy rate to Btu/h by multiplying the 1.5 kW by 3,412.142. Then add the result to the 30,000 Btu/h gas idle rate.

$$1 \text{ kW} = 3,412.142 \text{ Btu/h}$$

$$\text{Electric idle energy rate, converted to Btu/h: } 1.5 \text{ kW} \times 3,412.142 \text{ Btu/h} = 5,118.213 \text{ Btu/h}$$

$$\text{Total idle energy rate: } 30,000 \text{ Btu/h} + 5,118.213 \text{ Btu/h} = 35,118.213 \text{ Btu/h}$$

F. Significant Digits and Rounding:

- a. All calculations shall be carried out with directly measured (unrounded) values. Only the final result of a calculation shall be rounded.
- b. Unless otherwise specified in this specification, compliance with specification limits shall be evaluated using exact values without any benefit from rounding.
- c. Cooking and Baking-Energy Efficiency: 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.
- d. Idle Energy Rate: Calculated values for gas convection, combination, and rack oven idle rates that are submitted for reporting on the ENERGY STAR website shall be rounded to the nearest whole number. The calculated energy consumption values for electric convection and combination ovens shall be rounded to 0.01 for idle rates.

4) **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. When submitting product families, manufacturers continue to be held accountable for any efficiency claims made about their products, including those not tested or for which data was not reported.
- B. When testing commercial ovens, the following test methods shall be used to determine ENERGY STAR qualification.

Table 4: Test Methods for ENERGY STAR Qualification		
Oven Category	ENERGY STAR Requirement	Test Method Reference
Convection Ovens	Cooking-Energy Efficiency, Idle Energy Rate, and Production Capacity	ASTM F1496-13, <i>Standard Test Method for Performance of Convection Ovens</i>
Combination Ovens	Cooking-Energy Efficiency, Idle Energy Rate, Production Capacity, and Water Consumption	ASTM F2861-14, <i>Standard Test Method for Enhanced Performance of Combination Oven in Various Modes</i>
Rack Ovens	Baking-Energy Efficiency, Total Idle Energy Rate, and Production Capacity	ASTM F2093-11, <i>Standard Test Method for Performance of Rack Ovens</i>

- C. For ovens with variable Btu/h or kW input, each available input shall be tested and reported individually. Ovens need to meet the idle energy rate or total idle energy rate, and cooking- or baking-energy efficiency requirements presented in Table 1, Table 2, or Table 3, of this specification.
- D. For electric ovens with multiple voltage-versatility and those that are available in different voltage configurations, the representative oven shall be tested at the most energy consumptive voltage according to the manufacturer.
- E. If the representative combination oven model under test is designed to hold 18 x 26-inch sheet pans, manufacturer-supplied wire racks shall be positioned in the oven to accommodate 12 x 20 x 2¹/₂-inch steam table pans.

- F. Combination ovens with roll-in, removable racks shall have the racks positioned in place during steam mode and convection mode idle tests.
- G. For the steam mode idle and cooking-energy efficiency tests, the combination oven shall be manually set to operate at a nominal temperature of 212°F.
- H. Additional Reporting Requirements:
 - a. The average water consumption rates, the average condensate drain temperatures, and the maximum condensate drain temperatures shall be reported for all combination ovens. If the oven does not require condensate cooling water during convection mode operation, then it shall be reported as “0”.
 - b. The production capacity for all convection oven, combination oven, and rack oven cooking or baking-energy efficiency tests shall be reported.
 - c. The electric energy idle rate for gas convection, combination, and rack oven idle rate tests shall be reported.
 - d. Rack ovens that include energy saving feature(s) and that meet the minimum requirement of the set-back idle mode definition in Section 1.W. shall be reported.

Note: In response to the implementation of a set-back idle mode reporting requirement proposed in Draft 2, one stakeholder again suggested that set-back idle be included as a qualification criterion. EPA held additional follow-up discussions with stakeholders and other industry experts regarding the implementation of the set-back idle mode. After consideration of this input, the Agency has concluded that requiring a set-back idle mode is not feasible at this time. If an industry-accepted test procedure and data supporting the effectiveness of this feature become available, EPA may consider adding it as a certification requirement.

EPA will continue to promote the use of this and other energy-saving features and best practices for further energy reduction (i.e., turning off the oven during extended periods of non-use).

- 5) Effective Date:** The ENERGY STAR Commercial Oven Specification shall take effect on January 1, 2014. To qualify for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect on the model’s 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.

Note: EPA plans to finalize this Version 2.2 specification in September 2015. Upon finalization, manufacturers may immediately begin submitting rack ovens for third party certification under the new Version 2.2.

- 6) Future Specification Revisions:** EPA 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 ENERGY STAR qualification is not automatically granted for the life of a product model.