



ENERGY STAR® Program Requirements Product Specification for Commercial Ovens

Eligibility Criteria Draft 1: Version 2.2

Following is the **Draft 1 Version 2.2** product specification for ENERGY STAR qualified 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 170-2010, *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 fixed 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, based on nominal 4-inch spacing between pans.
 - 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, based on nominal 4-inch spacing between pans.
 - 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, based on nominal 4-inch spacing between pans.
 - 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, based on nominal 4-inch spacing between pans.

Note: Based on stakeholder recommendations, EPA made minor changes to the Rack Oven definition in Section 1.H., and amended the subtype definitions for Mini Rack Oven, Single Rack Oven, and Double Rack Oven in Section 1.H.a-c. EPA also added a subtype definition in Section 1.H.d for Quadruple Rack Oven to reflect the available product market. Stakeholders are encouraged to provide feedback on the proposed rack oven and rack oven subtype definitions, which will be used to categorize scope and determine performance levels.

- 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: The ratio of energy absorbed by the food product to the total energy supplied to the oven during baking.

- M. Cooking-Energy Efficiency: The ratio of energy absorbed by the food product to the total energy supplied to the oven during cooking.
- 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.

Note: Baking-Energy Efficiency was added as an energy efficiency metric in Section 1.L. The definition of Baking-Energy Efficiency is identical to the Cooking-Energy Efficiency definition, with the exception of the food preparation approach (cooking versus baking). EPA is interested in further characterizing the energy efficiency metrics. Stakeholders are encouraged to comment on the proposed definitions and suggest additional text that provides greater detail and further clarifies these metrics.

Water Consumption

- O. 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.
- P. 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.
- Q. 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

- R. 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 qualification include: controls, door-opening orientation, and any aesthetic additions that have no impact on oven energy consumption in any operating mode.
- S. Pan Capacity: The number of steam table pans the combination oven is able to accommodate as per the ASTM F-1495-05 standard specification.
- T. 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.
- U. 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.

Note: EPA proposed definitions for single rack and double-width rack in Section 1.T-U. The suggested definitions are based on industry terminology and are consistent with the ASTM F2093-11 baking-energy efficiency and production capacity test method. EPA realizes there may be some variability on rack size and is interested in learning more about those products to determine whether a range of sheet pans should be provided to expand coverage of single and double-width rack ovens currently available in the marketplace.

EPA encourages stakeholders to comment on the proposed rack definitions and the single and double-width rack sheet pan capacities.

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 subtypes 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.

Note: As indicated in the March 30, 2015, Version 2.2 launch memorandum, EPA intended to address both electric and gas rack ovens of various sizes in this revision. EPA assembled data on several single and double gas rack ovens, but was not able to collect data on other subtypes of rack ovens, such as electric rack ovens and mini and quadruple gas rack ovens. Without data to set performance levels for these product types, EPA will continue to exclude mini and quadruple gas rack ovens and all electric rack ovens.

As EPA continues to develop this Version 2.2 specification, stakeholder comments on the proposed scope expansion are encouraged. In preparing additional drafts of this specification, EPA will consider additional energy performance data that may be submitted.

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	Idle Rate, Btu/h	Baking-Energy Efficiency, %
Single	≤ 21,000	≥ 45%
Double	≤ 26,000	≥ 54%

Note: When evaluating a product category for potential ENERGY STAR labeling, EPA considers several guiding principles including the return on consumer investment in greater energy efficiency. EPA conducted savings and cost-effectiveness analyses, and concluded that products expected to meet the proposed levels are in some cases less expensive than more energy intensive models of similar size and capacity. In addition to these savings, the ability for efficient models to meet or exceed the performance of less efficient models, and the significant energy and carbon savings potential indicate that commercial rack ovens are a good addition to the ENERGY STAR program.

The idle and baking-energy efficiency levels proposed in Table 3 are based on data gathered by the Consortium for Energy Efficiency (CEE) and other industry performance reports. EPA performed a data analysis of common types of rack ovens available in the U.S. market (predominantly single and double-sized) to determine Draft 1 levels in an effort to ensure that ENERGY STAR recognizes the top performing rack ovens and maximizes energy saving potential for end users. These levels recognize the top 22% and 23% most energy-efficient single and double gas rack ovens available in the market today, respectively, and represent models from multiple manufacturers.

Stakeholders are encouraged to provide feedback on the proposed levels. EPA is also interested in reviewing additional data points, particularly those that represent standard efficiency oven designs, to ensure that the data set is representative of the range of efficiencies currently available in the marketplace.

D. Additional Idle Calculation Guidance: Compliance with the Convection Oven, Combination Oven, and Rack 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 total electric energy consumption measured during idle tests shall be reported separately.

Note: As indicated in Section 3.D, when calculating the gas oven idle rates, the electric energy consumed by auxiliary components; such as, lights, control displays, and motors, shall not be taken into consideration. Similar to other ENERGY STAR oven categories, EPA requires that the electric energy idle rate be reported separately.

E. 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, 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, Idle Energy Rate, and Production Capacity	ASTM F2093-11, <i>Standard Test Method for Performance of Rack Ovens</i>

Note: For purposes of ENERGY STAR certification, rack oven performance will be evaluated using ASTM F2093-11, *Standard Test Method for Performance of Rack Ovens*, which is now referenced in Table 4.

Additionally, since the Version 2.0 specification was finalized in April, 2013, the ASTM test methods for convection and combination ovens have been superseded. However, nothing changed in the standard test methods that impacts the energy performance measurements. Therefore, ovens currently certified to Version 2.0 or 2.1 do not need to undergo additional testing to retain ENERGY STAR certification. Test method references for convection and combination ovens have been updated to the new F1496-13 and F2861-14 versions, respectively.

Stakeholders may submit rack oven test data per the ASTM F2093-11 standard test method for further consideration.

- C. For ovens with variable Btu/h or kW input, each available input shall be tested and reported individually and meet the idle energy rate and cooking and baking-energy efficiency requirements presented in Table 1, Table 2, or Table 3, above, 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.

Note: Per the note above regarding the electric energy consumption in gas ovens, EPA requires this information to be reported when certifying rack ovens under this specification. The purpose of this reporting requirement is to provide customers with a complete energy consumption profile of ENERGY STAR certified products and to determine a total cost of ownership.

5) Effective Date: The ENERGY STAR Commercial Oven Specification shall take effect immediately upon finalization. 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 the Version 2.2 requirements of this specification by August 1, 2015. This date may be adjusted based on the amount of feedback and complexity of comments received, thus requiring further stakeholder discussions and draft versions. Upon finalization of the revision to this specification, manufacturers may immediately begin submitting products for third party testing and 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.