



ENERGY STAR® Program Requirements Product Specification for Commercial Ovens

Eligibility Criteria Draft 1: Version 2.0

Following is the **Draft 1 Version 2.0** 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
- B. 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 product family may include: controls, door-opening orientation, and any topical, aesthetic additions that have no impact on oven performance in any mode.

Note: EPA has expanded the current Version 1.1 product family definition to clarify the allowable differences within any one product line for purposes of family qualification. This definition seeks to ensure that end-users receive similar performance across all product line offerings within an ENERGY STAR qualified product family, while helping to reduce the testing burden on the manufacturer. Stakeholders are encouraged to provide feedback on the product family definition.

Oven Types

- C. 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 An oven that uses more than 0.25 gallons per hour (GPH) in any operating mode shall be classified as a combination oven. The combination oven is also referred to as a combination oven/steamer, combi or combo.
 - Countertop Combination Oven: A combination oven capable of holding half-size steam table pans measuring 10 ³/₈ x 12 ³/₄ x 2 ¹/₂-inch and unable to accommodate a minimum of one steam table pan measuring 12 x 20 x 2 ¹/₂-inch.
 - Full-Size Combination Oven: A combination oven that is able to accept a maximum of twelve steam table pans measuring 12 x 20 x 2 ¹/₂-inch.
 - Floor-Mounted, Full-Size Combination Oven: A combination oven that is able to accept a minimum of thirteen steam table pans measuring 12 x 20 x 2 ¹/₂-inch and a maximum of twenty standard sheet pans measuring 18 x 26-inch.

Note: The definition proposed above for Combination Oven is adopted from ASTM Standard F-2861-10, *Standard Test Method for Enhanced Performance of Combination Oven in Various Modes*. Convection ovens with moisture assist that have an average water consumption rate greater than 0.25 GPH are considered combination ovens and therefore, must meet all of the combination oven performance levels in Table 2 to qualify for ENERGY STAR.

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*.

Note cont.

Stakeholders are encouraged to provide feedback on whether this definition clearly differentiates combination ovens from other oven types defined within this specification.

The addition of the subtype definitions proposed above for Countertop Combination Oven, Full-Size Combination Oven and Floor-Mounted, Full-Size Combination Oven are based on the Fisher Nickel, Inc., *Commercial Cooking Appliance Technology Assessment* available at www.fishnick.com. Stakeholders are encouraged to provide feedback on the subtype combination oven definitions and proposed pan capacity ranges.

- D. **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. Maximum water consumption within the oven cavity must not exceed 0.25 gallons per hour (GPH). 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.
- **Full-Size Convection Oven:** A convection oven that is able to accept a minimum of five standard full-size sheet pans measuring 18 x 26 x 1-inch.
 - **Half-Size Convection Oven:** A convection oven that is able to accept a minimum of five sheet pans measuring 18 x 13 x 1-inch.

Note: During the development of the Version 1.0 specification, questions were raised regarding moisture assist convection ovens and their eligibility. EPA added a ≤ 0.25 GPH water consumption maximum to exclude these product types with the intention of addressing them along with combination ovens at a later date. However, with the inclusion of combination ovens in the scope of Version 2.0, EPA is interested in hearing from stakeholders on how to best define convection ovens with moisture assist and whether they should be covered in the combination oven definition.

- E. **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, 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.
- F. **Conveyor Oven:** An oven designed to carry food product on a moving belt into and through a heated chamber.
- G. **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.
- H. **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.
- I. **Mini-Rack Oven:** A rack oven that has the ability to produce steam internally and includes an internal rotating rack where pans are manually pushed into the racks. Mini-rack ovens typically hold 5 – 8 full-size sheet pans.
- J. **Rack (Roll-In) Oven:** A high-capacity oven, with the ability to produce steam internally and fitted with a motor-driven mechanism for rotating multiple pans fitted into one or more pan racks within the cavity.

- Single Rack Oven: A rack oven that is able to hold one full rack of sheet pans of product at a time, based on nominal 4-inch spacing between pans.
 - Double Rack Oven: A rack oven that is able to hold two single racks or one double-width rack, based on nominal 4-inch spacing between pans.
- K. 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.
- L. 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.
- M. 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

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

Water Consumption

- P. Average Water Rate: The ratio of the average potable water used to the maximum number of steam table pans the oven can accept during heavy-load cooking; expressed as gallons per hour (GPH) per pan.

Note: In the case of potable condensate cooling water, EPA understands that combination ovens may be required by local or state code to reduce the condensate to a specified temperature. EPA also understands that some manufacturers ship units with temperature sensors that control the effluent temperature, while others do not address condensate cooling until the unit is in the field (depending on the code). Though the condensate cooling water does not have an impact on energy performance (i.e., water heating), the range of average water consumption is significant according to EPA's dataset (0.05 – 3.20 GPH per pan) and may be of interest to end users looking for ways in which to reduce water use in the kitchen. As such, EPA is interested in discussing with stakeholders the opportunity to consistently measure and report the average water rate, as defined above.

Due to the significant pan-capacity variation in the oven market, EPA suggests that water consumption is reported as GPH per pan. Normalizing the water consumption per pan will allow the end users to better evaluate and compare the water consumption rates of the ovens. Additionally, the GPH per pan metric aligns with the Leadership in Energy and Environmental Design (LEED) and the International Green Construction Code metric. The ASTM procedure referenced in Section 4, below, includes the test method for measuring water consumption in combination ovens. However, EPA understands that there are no standard test conditions with regards to water flow settings, which can be adjusted depending on local code requirements. For purposes of reporting water consumption on the ENERGY STAR website, standard conditions need to be determined and added to this specification as a clarification to ASTM F-2861-10.

EPA is interested in stakeholder feedback on whether reporting the maximum water consumption rate as GPH per pan is the most appropriate metric and the conditions under which average water rate should be measured.

2) Scope:

- A. **Included Products:** Products that meet the definitions of a Commercial Oven and Convection Oven or Combination 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: (1) full-size gas and half- and full-size electric convection ovens; and (2) full-size and floor-mounted- full-size gas and electric combination ovens, as defined in Section 1 above.

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. Countertop-size gas and electric combination ovens, as well as hybrid ovens not listed in Section 2.A, such as those incorporating microwave settings in addition to convection, are excluded from this specification. Other oven types excluded, as defined in Section 1, include: conventional or standard; conveyor; slow cook-and-hold; deck; mini-rack; rack; range; rapid cook; and rotisserie.

Note: Countertop-size combination ovens are excluded from the Version 2.0 scope primarily because the referenced ASTM test procedure in Section 4, below, does not address combination ovens of this size. Based on manufacturer input, EPA understands end-users tend not to use this type of oven because: (1) alternative equipment (i.e., microwave) can be used for simple cooking and re-heating applications and does not require an exhaust hood; (2) the need for a water connection line creates some installation challenges that may not be cost effective for an appliance this size; and (3) kitchen space may be limiting.

Additional stakeholder feedback is encouraged on the proposed scope of this Version 2.0 specification.

3) Qualification Criteria:

A. 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	$\leq 13,000$	≥ 44
Electric		
Oven capacity	Idle Rate, kW	Cooking-Energy Efficiency, %
Half-Size	≤ 1.0	≥ 70
Full-Size	≤ 1.6	

Note: According to the 2010 ENERGY STAR Unit Shipment Data report ENERGY STAR qualified convection ovens represented approximately 36% of total sales in the U.S. (www.energystar.gov/usd). At this level of market penetration, it is appropriate for EPA to review ENERGY STAR performance levels to ensure continued relevance in the marketplace and identify potential new opportunities for additional savings.

EPA expects to complete such a review once efforts by the ASTM F26 Committee to review and revise the existing test method have been completed. Depending on the effects of the revisions to the ASTM F1496-99 Convection Oven test method on measured idle rate and cooking-energy efficiency, the ENERGY STAR levels presented in Table 1, above, may need to be adjusted. The proposed changes to the test method may affect heavy-load cooking-energy efficiency values to account for the increase in product load and the energy absorbed by the pans. These changes will yield a more accurate performance comparison between convection ovens and combination ovens operating in convection mode.

Once the ASTM revision process is complete, EPA will work with industry stakeholders to collect and analyze convection oven data based on the new test method to determine if these changes warrant revision to convection oven idle rate and cooking-energy efficiency levels to ensure ENERGY STAR continues to represent the top performers.

Table 2: Energy Efficiency Requirements for Combination Ovens		
Gas		
Operation	Idle Rate, Btu/h	Cooking-Energy Efficiency, %
Steam Mode	$\leq 35P+11,111$	≥ 44
Convection Mode	$\leq 42P+6,625$	≥ 54
Electric		
Operation	Idle Rate, kW	Cooking-Energy Efficiency, %
Steam Mode	$\leq 0.02P+2.5889$	≥ 49
Convection Mode	$\leq 0.078P+0.8587$	≥ 74

Note: The idle and cooking-energy efficiency levels proposed in Table 2, above, are based on data provided by PG&E's Food Service Technology Center and other industry stakeholders following the December ENERGY STAR webinar. Due to the inherent versatility of combination ovens, there were multiple modes and applications to analyze, thus increasing the complexity of choosing levels that represent the top performers within each of these modes and achieve overall qualification rate (e.g. approximately 25%) that result in an adequate selection of labeled models. Several of the combination ovens that EPA received performance data on excelled in certain modes and applications, while falling short in others.

To ensure that ENERGY STAR recognizes the top performing combination ovens and to maximize the energy savings potential for end users, EPA performed an analysis to determine proper weighting based on energy intensity and time spent in varying modes.

Note cont.

Based on usage (e.g., time spent in each mode, production capacity) assumptions and calculations provided primarily by PG&E's Food Service Technology Center's (FSTC) on-line Combination Oven Life-Cycle Cost Calculator, EPA entered model specific performance data across all four modes to determine the annual energy consumption of each oven data point for each of these modes. The estimated annual energy consumption (therms or kWh) was then averaged and calculated into percentages of total oven energy use. The results are as follows for gas and electric ovens, respectively:

Gas:

- Steam-idle, 37%;
- Steam-cooking, 14%;
- Convection-idle, 20%; and
- Convection-cooking, 28%.

Electric:

- Steam-idle, 42%;
- Steam-cooking, 15%;
- Convection-idle, 16%; and
- Convection-cooking, 27%.

These percentages indicate that steam-idle and convection-cooking modes are the most energy intensive modes for both gas and electric and therefore, are the modes that EPA placed the greatest emphasis on in setting the requirements.

The resulting overall qualification rate provides end users with a range of choices based on brand, size, and fuel type.

Idle Mode Approach

EPA is adopting an equation method to determine steam- and convection-mode idle rate levels because the data suggests that idle energy consumption is linked to the size of the cavity (i.e., pan-capacity). Though the steam idle levels have a very gradual scaling trend, due in part to the fact that EPA has received limited data for larger-capacity models, the approach is still more appropriate than a straight-line approach. Straight-line idle rate levels tend to benefit smaller-sized combination ovens while putting larger-sized models at a disadvantage. However, scaling the idle rate levels allows for a greater variety of oven sizes while still representing the top 25%, overall. EPA is not taking this approach for cooking-energy efficiency because the data does not indicate the same link between cooking-energy consumption and cavity size. Additionally, the heavy-load cooking-energy efficiency tests require fully-loaded steam pans with a consistent quantity and weight of food product, which theoretically maximizes the pan-capacity. Because the heavy-load cooking test procedures are written as such to address the ratio of cavity volume to maximum pan-capacity, cooking-energy efficiencies can be compared across all oven sizes.

Combination Mode

The absence of a standard, industry-accepted cooking-energy efficiency test method coupled with inconsistencies noted by stakeholders regarding the idle test method in combination mode is preventing EPA from establishing combination mode metrics at this time.

However, based upon EPA's preliminary analysis, it appears that steam- and convection-mode idle and cooking-energy efficiency modes serve as good representations of how the product will perform in combination mode. Therefore, EPA's analysis has determined that performances in steam and convection modes will provide a strong surrogate for ranking these products.

Stakeholders are encouraged to provide feedback on the metrics and levels proposed in Table 2, above. EPA is also interested in reviewing additional data points particularly those that represent standard efficiency oven designs, especially larger-capacity ovens (i.e., 40-pan capacity), to confirm the appropriateness of the performance levels proposed.

B. 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. Calculated results shall be rounded to the nearest significant digit as expressed in the corresponding specification limit. Calculated results for gas combination oven idle rates shall be rounded to the nearest whole value. Calculated results for electric combination oven idle rates shall be rounded to the nearest tenth.

Note: Combination oven idle rate requirements are in the form of a calculation; therefore, because there is no consistent corresponding specification limit, direction is needed to indicate what the calculated value shall be rounded to.

- b. Unless otherwise specified, compliance with specification limits shall be evaluated using exact 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) 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, the most energy consuming model within the product family shall serve as the representative model.
- B. When testing commercial ovens, the following test methods shall be used to determine ENERGY STAR qualification and water consumption rates:

Table 3: Convection Oven Test Methods for ENERGY STAR Qualification	
ENERGY STAR Requirement	Test Method Reference
Convection Ovens: Cooking-Energy Efficiency and Idle Energy Rate	ASTM F-1496-99 (2012), <i>Standard Test Method for Performance of Convection Ovens</i>
Combination Ovens: Cooking Energy Efficiency and Idle Energy Rate	ASTM F-2861-10, <i>Standard Test Method for Enhanced Performance of Combination Oven in Various Modes</i>

Note: In anticipation of the finalization of the updated ASTM F-1496-99 (2012) test method, EPA will reference the revised test method and will re-evaluate the convection oven performance levels once data is available. Stakeholders are encouraged to submit convection oven test data as per the ASTM F-1496-99 (2012) test method.

- C. For ovens with variable Btu/h or kW input, each available input shall be tested individually and meet the cooking energy efficiency and idle energy rate requirements presented in Table 1 or Table 2 of this specification.
- D. For ovens with multiple voltages, the most energy consumptive voltage should be tested for qualification.

Note: In the event that an electric oven has sliding voltage versatility, the oven shall be tested at its expected worst-performing voltage to represent a worst-case scenario amongst the product family.

Other ovens in the product family are eligible to be tested independently from the worst performing family product representative, but may not represent the complete product family. Stakeholders are encouraged to comment on this testing direction.

- E. If the representative model under test includes a setback mode or automatic controls, these features must be disabled or overridden during testing for purposes of ENERGY STAR qualification.
- F. If the representative combination oven model under test is designed to hold 18 x 26-inch sheet pans, manufacturer-supplied wire racks may be positioned in the oven to accommodate 12 x 20 x 2¹/₂-inch steam table pans. During idle testing in various modes; because the oven shall be idling in a "ready-to-cook" state, the removable wire racks used to accommodate steam table pans shall remain in place during all idle tests. Energy absorbed by the wire racks during idle and cooking-energy efficiency testing shall not be considered

Note: EPA recognizes that some combination ovens are designed to hold full-size sheet pans measuring 18 x 26-inch. For those ovens, wire racks shall be situated in the oven and the steam pans shall be placed on the wire racks. Stakeholders are encouraged to provide feedback in regards to the use of wire racks to accommodate steam table pans.

- 5) Effective Date:** The ENERGY STAR Commercial Oven Specification shall take effect on **July 1, 2012**. 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: Following the Draft 1 comment period, EPA will work toward releasing the next Draft 2 specification in April and use the National Restaurant Association (NRA) Show, May 5-8, 2012, to meet with manufacturers to discuss the draft proposal.

EPA plans to then release a Final Draft specification shortly after the show and finalize the Version 2.0 requirements by July 1, 2012. This date may be adjusted based on the amount of feedback and complexity of comments received, thus requiring further stakeholder discussions and draft versions. Once finalized, manufacturers may immediately begin submitting products for third party certification under the new Version 2.0.

- 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.