



# ENERGY STAR® Program Requirements Product Specification for Commercial Ovens

## Eligibility Criteria Draft 2, Version 3.0

Following is the **Draft 2, Version 3.0** 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.<sup>1</sup>

### **Oven Types**

- B. Combination Oven: A device that combines the function of hot air convection (oven mode), steam heating (steam mode), and a combination of both (combination mode), which includes high and low temperature 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.<sup>2</sup> 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 12.7 x 20.8 x 2.5-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 12.7 x 20.8 x 2.5-inch steam table pans per rack position, loaded from front-to-back or lengthwise.
- c. 2/3-Size Combination Oven: A combination oven capable of accommodating a single 13.8 x 12.7 x 2.5-inch steam table pan per rack position, loaded from front-to-back or lengthwise. The 2/3-Size Combination oven may also be referred to as a mini-size combination oven.
- C. Convection Oven: A general-purpose oven that cooks food by forcing hot dry air over the food product's surface. The rapidly moving hot air strips away the cooler air layer next to the food and enables the food to absorb the heat energy. For this specification, convection ovens do not include ovens that can 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 cook the food fully.
- a. Half-Size Convection Oven: A convection oven capable of accommodating half-size sheet pans measuring 18 x 13 x 1-inch.
- b. Full-Size Convection Oven: A convection oven 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 food product's surface without the use of a fan or blower. The burner or elements heat the air within the oven cavity and the cavity walls, causing currents of hot air that transfer heat to the surface of the food. The hot air's buoyancy

<sup>1</sup> NSF/ANSI 170-2019, *Glossary of Food Equipment Terminology*.

<sup>2</sup> ASTM Standard F2861-20 *Standard Test Method for Enhanced Performance of Combination Oven in Various Modes*.

54 carries it upward through cooler air, which then slowly sinks to the bottom of the oven as it  
55 cools off.

56  
57 E. Conveyor Oven: An oven designed to carry food product on a moving belt into and through a  
58 heated chamber.

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60 F. Slow Cook-and-Hold Oven: An oven designed specifically for low-temperature (e.g., less than  
61 300°F) cooking, followed by a holding period at a specified temperature.

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63 G. Deck Oven: An oven that cooks food product directly on the floor of a heated chamber. The  
64 bottom of each compartment is called a deck and heat is typically supplied by burners or  
65 elements located beneath the deck. The oven ceiling, floor, and walls are designed to absorb  
66 heat quickly and radiate that heat back slowly and evenly.

67  
68 H. Hearth Oven: An oven designed with an open doorway and dome-shaped interior, usually  
69 composed of high-temperature refractory ceramic or concrete. Hearth ovens do not include  
70 ovens designed to use interior walls as cooking surfaces.

71 NOTE — Hearth ovens are designed with an unrestricted open doorway due in part to  
72 potentially high operational temperatures. A closed grease-laden oven compartment may  
73 present a fire hazard when oven surface temperatures exceed 600 °F (316 °C), and an  
74 oven door is opened.<sup>3</sup>

75  
76 I. Microwave Oven: An oven in which foods are heated and/or cooked when they absorb  
77 microwave energy (short electromagnetic waves) generated by a magnetron(s).<sup>4</sup>

78  
79 J. Rack Oven: A high-capacity oven that offers the ability to produce steam internally and is fitted  
80 with a motor-driven mechanism for rotating multiple pans inserted into one or more removable or  
81 fixed pan racks within the oven cavity.

82  
83 a. Mini Rack Oven: A stand-mounted rack oven designed with a load-in-place rack that cannot  
84 be removed. Mini rack ovens can accommodate up to 10 standard full-size sheet pans  
85 measuring 18 x 26 x 1-inch.

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87 b. Single Rack Oven: A floor-model rack oven that can accommodate one removable  
88 single rack of standard sheet pans measuring 18 x 26 x 1-inch.

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90 c. Double Rack Oven: A floor-model rack oven that can accommodate two removable single  
91 racks of standard sheet pans measuring 18 x 26 x 1-inch or one removable double-width  
92 rack.

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94 d. Quadruple Rack Oven: A floor-model rack oven that can accommodate four removable  
95 single racks of standard sheet pans measuring 18 x 26 x 1-inch or two removable double-  
96 width racks.

97  
98 K. Range Oven: An oven base for a commercial range top (i.e., burners, electric elements, or  
99 hobs). Range ovens may use either standard or convection technologies to cook food.

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101 L. Rapid Cook Oven: An oven that utilizes one or more non-traditional heat transfer technologies to  
102 cook food product significantly faster than would be possible using conventional (e.g., convection,  
103 conduction, radiant) heat transfer technologies. Heat transfer technologies that may be employed  
104 include microwave, quartz halogen, and high-velocity or impingement convection.

105  
106 M. Rotisserie Oven: An oven fitted with a mechanism to move or turn food past a fixed heat source  
107 while the food is slowly being cooked on all sides.

108  
109 N. Reel-type Oven (revolving tray oven): An oven with a motor-driven Ferris wheel device.<sup>5</sup>

<sup>3</sup> NSF/ANSI 170-2019, *Glossary of Food Equipment Terminology*.

<sup>4</sup> NSF/ANSI 170-2019, *Glossary of Food Equipment Terminology*.

<sup>5</sup> NSF/ANSI 170-2019, *Glossary of Food Equipment Terminology*.

110 **Preheat Values**

- 111
- 112 O. Preheat Energy: The amount of energy consumed by the convection, combination, or rack oven
- 113 while preheating its cavity from ambient temperature to the specified thermostat set point. It is
- 114 expressed in Btu or kWh.
- 115
- 116 P. Preheat Time: The time required for the oven cavity to preheat from ambient temperature to the
- 117 specified thermostat set point. It is expressed in minutes (min).
- 118

119 **Note:** EPA is maintaining the addition of *Preheat Energy* and *Preheat Time* proposed in Draft 1.

120 Stakeholders agreed that including the energy and time during the preheat sequence(s) provides

121 customers with a more comprehensive energy profile, is already captured using the referenced ASTM test

122 methods in Table 4 below, and should not be an additional burden on manufacturers. EPA uses these data

123 to capture a more realistic energy consumption profile for annual energy savings and does not anticipate

124 creating a criterion level at this time.

125

126 **Energy Efficiency Metrics**

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- 128 Q. Baking-Energy Efficiency: Quantity of energy imparted to the specified load, expressed as a
- 129 percentage of energy consumed by the oven during the baking event.
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- 131 R. Cooking-Energy Efficiency: Quantity of energy imparted to the specified load, expressed as a
- 132 percentage of energy consumed by the oven during the cooking event.
- 133
- 134 S. Idle Energy Rate: The rate of oven energy consumption while it is maintaining or holding at a
- 135 stabilized operating condition or temperature. Also called standby energy rate.
- 136
- 137 T. Total Idle Energy Rate: The rate of oven energy consumption while it is maintaining or holding at
- 138 a stabilized operating condition or temperature. Total idle energy rate includes gas and electric
- 139 energy (primary and auxiliary). Also called total standby energy rate.
- 140

141 **Water Consumption**

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- 143 U. Average Water Consumption Rates: The monitored water consumption of an oven during
- 144 specified test conditions. These metrics shall include condensate cooling water, if applicable.
- 145
- 146 a. Combination Oven Water Consumption Rate: The water consumed during idle and heavy-
- 147 load cooking periods in steam and convection mode, expressed as gallons per hour per
- 148 steam pan (gal/hr/pan). Gallon per hour per pan shall be based on GN 1/1 steam table
- 149 pans as defined in Section 1.B.a. and 1.B.b. for full and half-size combination ovens and
- 150 GN 2/3 steam table pans as defined in Section 1.B.c. for 2/3-size combination ovens.
- 151
- 152 b. Convection Oven Water Consumption Rate: The water consumed during the moisture
- 153 injection mode by an oven without a dedicated steam only mode. The highest moisture
- 154 injection mode available shall be tested during the idle and cooking modes, expressed as
- 155 gallons per hour per full-size or half-size sheet pan (gal/hr/pan), as defined in Section
- 156 1.C.a and 1.C.b., respectively.
- 157
- 158 c. Rack Oven Water Consumption Rate: The water consumed by an oven with a moisture
- 159 (steam) injection mode, the highest moisture setting delivered per cycle is captured.
- 160
- 161 V. Average Rack Oven Steam Injection Rate: Water consumption during a period where the
- 162 highest steam injection mode available is introduced into the baking cavity of a rack oven
- 163 during a steam injection cycle, expressed as gallons per minute (gal/min).
- 164
- 165 W. Average Combination Oven Condensate Temperature: The condensed steam and cooling
- 166 water mixture's average temperature exiting the combination oven and directed to the drain
- 167 during heavy-load cooking in steam and convection modes.
- 168

- 169 X. Maximum Combination Oven Condensate Temperature: The maximum temperature of the  
170 condensed steam and cooling water mixture exiting the combination oven and directed to the  
171 drain during heavy-load cooking in steam and convection modes.  
172

173 **Note:** EPA is interested in saving water. To that end, EPA's WaterSense® program labels water saving  
174 products. In cases where an ENERGY STAR product category also uses water, the two programs have  
175 agreed that ENERGY STAR will set water criteria in collaboration with WaterSense. Further, EPA wants to  
176 avoid tradeoffs that might not be good for the environment and requests comments from stakeholders on  
177 the possible tradeoffs of the proposed water consumption criteria. The programs are interested in further  
178 understanding water consumption rates for commercial ovens, especially during cooking and idle periods  
179 in steam and convection modes for combination ovens to help customers obtain a more complete water  
180 use profile. Therefore, the Agency proposes including new water consumption criteria during cooking  
181 periods in both steam and convection mode for combination ovens (see Section 3) and new water  
182 consumption reporting requirements for convection and rack ovens (see Section 4).  
183

184 Water consumption definitions are updated to clarify relevant terms. For instance, the additional language  
185 in Section 1.U., "This metric shall include condensate cooling water, if applicable.", clarifies that an oven  
186 deploying condensate cooling water is included in the water consumption rate metric.  
187

188 Some convection and rack ovens include moisture (or steam) injection modes. Convection ovens or rack  
189 ovens with moisture injection modes shall be tested to the referenced ASTM F2861-20, *Standard Test  
190 Method for Enhanced Performance of Combination Oven in Various Modes* for convection ovens, or ASTM  
191 F2093-18, *Standard Test Method for Performance of Rack Ovens* for rack ovens. Convection oven water  
192 consumption rates shall be reported in gallons per hour per standard full or half-size sheet pan  
193 (gal/hr/pan). Rack oven water consumption shall be reported as the average steam injection rate,  
194 expressed in gallons per minute (gal/min) and is dependent on the steam injection cycle.  
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196 Stakeholders are encouraged to provide feedback on revised definitions and water consumption units.  
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### 198 **Certification Terms**

- 199
- 200 Y. Product Family: Individual models offered within a product line based on the same engineering  
201 design, including pan capacity, fuel type, and method of steam generation, as applicable.  
202 Acceptable differences within a product family for certification purposes include controls, door-  
203 opening orientation, and any aesthetic additions that have no impact on oven energy  
204 consumption in any operating mode. Double stacked ovens with two separate, individually  
205 operated ovens shall be listed as an additional model under the product family base model since  
206 these ovens are tested as a single cavity and therefore have identical performance values. All  
207 models within a product family shall be listed as an additional model.  
208  
209

210 **Note:** Historically, double stacked ovens were tested as a single cavity – i.e., they were not tested with  
211 both cavities operating and therefore have identical performance values to the single cavity base model.  
212 Some partners have listed double stacked (decker) ovens as part of the base model while other partners  
213 have not, and the additional text clarifies how double stacked ovens shall be reported: double stacked  
214 ovens will be considered an additional model under the base product family model, not a separate model.  
215

216 All models within a product family should be listed in the additional model section in the Qualified Product  
217 List (QPL), and this clarification is included in 1.Y.  
218

219 EPA encourages additional stakeholder feedback on these clarifications and the addition of double  
220 stacked ovens to the product family.  
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- 222
- 223 Z. Pan Capacity: The number of steam table pans the combination oven can accommodate as per  
224 the ASTM F1495-20 standard specification.  
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- 226 AA. Single Rack: Single racks shall accommodate 15 full-size sheet pans measuring 18 x 26 x 1-inch,  
227 at a 4-inch spacing between rack positions. Single racks accommodate 1 full-size sheet pan per

228 rack position.

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230 BB. Double-Width Rack: Double racks shall accommodate 30 full-size sheet pans measuring 18 x 26  
231 x 1-inch, at a 4-inch spacing between rack positions. Double racks accommodate 2 full-size  
232 sheet pan per rack position.

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234 CC. Set-Back Idle Mode: A feature that includes automatic temperature reduction after extended  
235 periods of non-use. In addition, the feature may also incorporate the reduction or elimination of  
236 fan speed, lighting, and automatic rack rotation during periods of non-use.

## 237 238 239 2) **Scope:**

240  
241 A. Included Products: Products that meet the definitions of a Commercial Oven and Convection  
242 Oven, Combination Oven, or Rack Oven as specified herein are eligible for ENERGY STAR  
243 certification, except products listed in Section 2.B. The following sub-types are eligible:

- 244 a. Full-size gas and half- and full-size electric convection ovens.
- 245 b. Half- and full-size gas combination ovens with a pan capacity  $\geq 5$  and  $\leq 40$ .
- 246 c. Half- and full-size electric combination ovens with a pan capacity  $\geq 3$  and  $\leq 40$ .
- 247 d. 2/3-size electric combination ovens with a pan capacity  $\geq 3$  and  $\leq 5$ .
- 248 e. Single and double gas rack ovens.

249  
250 To ensure only commercial ovens are certified under this specification, products shall be third-party  
251 certified to NSF/ANSI Standard 4, *Commercial Cooking, Rethermalization, and Powered Hot Food*  
252 *Holding and Transport Equipment*.

253  
254 B. Excluded Products: This specification is intended for commercial food-grade ovens. Ovens  
255 designed for residential or laboratory applications cannot be certified for ENERGY STAR  
256 under this specification. The following oven types and sub-types are ineligible for ENERGY  
257 STAR:

- 258 a. Half-size gas convection ovens.
- 259 b. Dual-fuel heat source combination ovens.
- 260 c. Hybrid ovens not listed in Section 2.A, above, such as those incorporating microwave  
261 settings in addition to convection.
- 262 d. Conventional or standard ovens; conveyor; slow cook-and-hold; deck; hearth; microwave;  
263 range; rapid cook; reel-type; and rotisserie.
- 264 e. Half- and full-size gas combination ovens with a pan capacity of  $< 5$  or  $> 40$ .
- 265 f. Half- and full-size electric combination ovens with a pan capacity  $< 3$  or  $> 40$ .
- 266 g. Mini and quadruple gas rack ovens.
- 267 h. Electric rack ovens.
- 268 i. 2/3-size electric combination ovens with a pan capacity  $> 5$ .

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284 **Note:** We appreciate that several stakeholders supported the combination oven scope expansion and  
285 agreed that these changes may result in high operational and emission savings.

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3) Certification Criteria:

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

Table 1: Energy Efficiency and Water Consumption Rate Requirements for Convection Ovens		
<b>Gas</b>		
<b>Oven Capacity</b>	<b>Idle Rate, Btu/h</b>	<b>Cooking-Energy Efficiency, %</b>
Full-Size	≤ 9,500	≥ 49
<b>Electric</b>		
<b>Oven Capacity</b>	<b>Idle Rate, kW</b>	<b>Cooking-Energy Efficiency, %</b>
Half-Size	≤ 1.00	≥ 71
Full-Size ≥ 5 Pans	≤ 1.40	≥ 76
Full-Size < 5 Pans	≤ 1.00	
<b>Water Consumption Rate: All Convection Ovens with Moisture Injection Mode</b>		
<b>Mode</b>	<b>Idle Period (gal/hr/pan)</b>	<b>Cooking Period (gal/hr/pan)</b>
Moisture Injection Mode	Reporting Requirement	Reporting Requirement

Note: Pans = Standard full-size sheet pan capacity as defined in Section 1.C.b., above.

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

Table 2: Energy Efficiency and Water Consumption Rate Requirements for Combination Ovens		
<b>Gas: 5-40 Pan Capacity</b>		
<b>Operation</b>	<b>Idle Rate, Btu/h</b>	<b>Cooking-Energy Efficiency, %</b>
Steam Mode	≤ 200P+6,511	≥ 41
Convection Mode	≤ 140P+3,800	≥ 57
<b>Electric: 5-40 Pan Capacity</b>		
<b>Operation</b>	<b>Idle Rate, kW</b>	<b>Cooking-Energy Efficiency, %</b>
Steam Mode	≤ 0.133P+0.6400	≥ 55
Convection Mode	≤ 0.083P+0.35	≥ 78
<b>Electric: 3-4 Pan Capacity and 2/3-size with 3-5 Pan Capacity</b>		
<b>Operation</b>	<b>Idle Rate, kW</b>	<b>Cooking-Energy Efficiency, %</b>
Steam Mode	≤ 0.60P	≥ 51
Convection Mode	≤ 0.05P+0.55	≥ 70
<b>Water Consumption Rate: All Combination Ovens</b>		
<b>Operation</b>	<b>Electric and Gas During Idle Periods (gal/hr/pan)</b>	<b>Electric and Gas During Cooking Periods (gal/hr/pan)</b>
Steam Mode	Reporting Requirement	< 1.0 gal/hr/pan
Convection Mode	Reporting Requirement	< 0.5 gal/hr/pan

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

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

Table 3: Energy Efficiency and Water Consumption Rate Requirements for Rack Ovens		
<b>Gas</b>		
<b>Oven Size</b>	<b>Total Energy Idle Rate, Btu/h</b>	<b>Baking-Energy Efficiency, %</b>
Single	≤ 25,000	≥ 48
Double	≤ 30,000	≥ 52
<b>Water Consumption Rate: All Racks Ovens with Steam Injection Mode</b>		
<b>Mode</b>	<b>Steam Generation Period (gal/min)</b>	
Steam Injection Mode	Reporting Requirement	

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**Note:** The ENERGY STAR commercial ovens product types represent approximately 51% of the market based on the [ENERGY STAR Unit Shipment and Market Penetration Report Calendar Year 2019 Summary](#). This estimate was recently updated to 54% of the market, [ENERGY STAR Unit Shipment and](#)

304 [Market Penetration Report Calendar Year 2020 Summary](#). These market penetration estimates take into  
305 account U.S. shipment information, not North American shipments.

306  
307 Some stakeholders question the representativeness of the overall market penetration rate and individual  
308 sub-category market penetration rates in the industry, suggesting that the overall market penetration and  
309 individual sub-category market penetration might be 1-5 percentage points lower or higher. The Agency  
310 recognizes that ENERGY STAR partners do not represent the entire market and has published adjusted  
311 estimates in the 2019 and 2020 summary reports. Further, the U.S. sub-category market penetration  
312 (shipment) rates are also summarized within the data packet in tab “11. MS ENERGY STAR”. The current  
313 market penetration estimates for convection and combination oven sub-categories ranged from 47%-75%  
314 and 47%-71%, respectively. These market penetration estimates are sufficiently high to trigger revisions  
315 for most oven sub-categories. Partners and stakeholders are encouraged to share any additional market  
316 data for EPA consideration.

317  
318 Some stakeholders were also interested in payback assessments. EPA analyzes payback by assessing  
319 whether it is reasonable to expect a range of models to have favorable consumer payback at the proposed  
320 efficiency level. To effectively evaluate the payback period for ENERGY STAR equipment, EPA identifies  
321 and compares a limited set of like models (a model at or near the baseline efficiency versus a model at or  
322 just beyond the proposed ENERGY STAR criteria) to isolate a reasonable incremental cost due to the  
323 efficiency improvements. The payback analysis is included in the data packet tab “4. Incremental Cost and  
324 Payback”.

325  
326 Most of the energy performance data (approximately 75% of the dataset) used to propose idle and  
327 cooking-energy efficiency levels in Tables 1 and 2, above, are primarily based on data from ENERGY  
328 STAR’s QPL, other incentive program’s QPLs, and stakeholder-submitted data. The remaining data  
329 consists of less efficient baseline data from California’s Technical Reference Manual (TRM). Specific  
330 models were removed from the dataset based on stakeholder feedback or because they were  
331 miscategorized or were discontinued.

### 332 Convection Ovens

333 One stakeholder commented on energy efficient technologies for combination ovens and the possibility of  
334 implementing some of these technologies and features into convection oven designs. However, other  
335 stakeholders noted that energy efficient technologies could not be implemented in a cost-effective and  
336 timely manner in the short term, adding that convection ovens provide different needs, serve a distinct  
337 market segment, and are unique from combination ovens. EPA agrees with these comments. Therefore,  
338 convection ovens continue to be a separate category with distinct criteria. Over time, the proposed levels  
339 may encourage the development of additional energy efficient technologies for convection ovens.

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341  
342 Several stakeholders commented on the electric full-size convection oven criteria level advocating for more  
343 stringent minimum efficiency levels. Other commenters proposed less stringent thresholds due to Draft 1  
344 exclusion of several higher production capacity ovens. They offered, in one case, three strategies for  
345 including production capacity more directly into the convection oven criteria to fairly include higher capacity  
346 units:

- 347 1. Binning by production capacity rates
- 348 2. Redefining the full-size and half-size sub-categories by production capacity
- 349 3. Adjusting the idle energy rate equation by normalizing it by production capacity

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351 Production capacity is a critical decision-making tool for operators, and it is an additional factor EPA  
352 communicates to consumers through the Product Finder. EPA proposes binning full-size electric  
353 convection ovens by sheet pan capacity to include higher capacity ovens and more correctly distinguish  
354 between low capacity and high capacity ovens in the dataset. Initial stakeholder feedback supports this  
355 approach, and that sheet pan capacity can be a proxy for production capacity. Ultimately, binning by the  
356 number of sheet pans appears to be a more straightforward, intuitive, and less variable approach.

357  
358 On average, full-size electric convection ovens tend to hold five sheet pans. Based on stakeholders’  
359 feedback and EPA’s analyses, smaller capacity (<5 sheet pans) full-size electric convection ovens have  
360 different idle energy rates to ovens with higher capacities (≥ 5 sheet pans). Both high and low-capacity full-  
361 size electric convection ovens tend to have similar cooking-energy efficiencies. Therefore, EPA proposes  
362 that higher capacity electric convection ovens have an idle rate of ≤1.4 kW, and the lower capacity ovens

363 have an idle rate of  $\leq 1.0$  kW. The cooking-energy efficiency was only slightly increased (from 75% to 76%)  
364 to recognize approximately 30% of the most efficient full-size electric convection ovens.  
365

366 Commenters expressed concerns about the proposed criteria for full-size gas convection ovens limiting  
367 consumer choice. On average, approximately 22% of available brands pass current criteria, providing  
368 several options to consumers. Further, the convection mode cooking-energy efficiency was adjusted from  
369 50% to 49% to continue recognizing about 25% of the most energy efficient models. Any additional data  
370 on less efficient models in the market can help determine if current criteria are too stringent.  
371

#### 372 Combination Ovens

373 Oven manufacturers presented test data with varying steam saturation levels (SSL), which are possible in  
374 the ASTM test method. During testing, unstandardized humidity levels resulted in varying idle rates and  
375 cooking-energy efficiencies, affecting food appearance to varying degrees, which is a proxy for quality.  
376 EPA proposes maintaining Version 2.2 *steam idle rate* and *steam cooking-energy efficiency* metrics until  
377 the ASTM committee agrees on a standard humidity or SSL level. On the other hand, convection idle rates  
378 for electric and gas combination ovens have been adjusted and are more stringent from Draft 1 to continue  
379 recognizing about 25% of the most energy efficient combination oven models. While developing criteria,  
380 EPA attempts to have similar passing rates across a range of similar steam pan capacities and consumer  
381 choices that offer significant energy savings.  
382

383 EPA received support for the approach of binning smaller combination ovens (3-4 steam pan capacity and  
384 2/3-size pan models). The smaller combination ovens criteria may result in more energy per pan; however,  
385 binning them together allows greater consumer choice in line with different use cases and recognizes the  
386 most efficient units within this market segment. EPA expects that smaller combination ovens will begin to  
387 apply energy efficient designs seen in electric combination ovens (5-40 steam pan capacity), such that the  
388 Agency will revisit this binning approach in the future.  
389

#### 390 Water Consumption Criteria

391 Since the Commercial Ovens Version 2.0 Specification's effective date (January 1, 2014), the Agency has  
392 collected water consumption rates as an additional reporting requirement for ENERGY STAR certified  
393 combination ovens *during cooking periods* in convection and steam modes. EPA used the reported water  
394 consumption rates originally in units of gallons per hour (GPH) and converted them to gallons per hour per  
395 pan (or gal/hr/pan) as a baseline for proposing maximum water consumption levels for combination ovens  
396 operating during cooking periods in steam and convection modes, located in Table 2 Section 3.B.  
397 Additional water consumption rate data will be collected for combination ovens *during the idle periods* in  
398 convection and steam modes.  
399

400 Several standards have incorporated water consumption thresholds for combination ovens, for example,  
401 ASHRAE 189.1-2020 *Standard for the Design of High-Performance Green Buildings* (10 gallons per hour  
402 in full operational mode), *Leadership in Energy and Environmental Design (LEED) Version 4.1* (<1.5  
403 gallons per hour per pan including condensate cooling water), and ANSI/GBI 01-2019 *Green Globes*  
404 *Assessment Protocol for Commercial Buildings* (<1.5 gallons per hour per pan in steam mode). In  
405 recognition of this interest across building standards and the cost and environmental benefit of water  
406 savings, EPA proposes setting a maximum water consumption rate for gas and electric combination ovens  
407 to encourage innovations targeting both water and energy.  
408

409 EPA analyzed data from ENERGY STAR's QPL to determine a maximum water consumption rate of <1.0  
410 gallons per hour per pan for steam mode during cooking periods and <0.5 gallons per hour per pan in  
411 convection mode during cooking periods for all combination ovens. The proposed maximum water  
412 consumption rates result in a pass rate of approximately 25-29% for electric and gas combination ovens.  
413 These new water consumption thresholds account for boiler-based and boiler-less steam generation  
414 systems.  
415

416 The Agency did not collect water consumption data for convection or rack ovens in Version 2.0; therefore,  
417 EPA is not proposing water consumption rate criteria for either oven category. Instead, the water  
418 consumption rate for convection and rack ovens will be an additional reporting requirement to inform  
419 customers about water consumption rates and savings opportunities.  
420



421 Several stakeholders commented on the water consumption rate's units for combination ovens (gallons per  
422 hour per pan, or gal/hr/pan), preferring alternatives such as gallons per hour (GPH; the rate reported in  
423 ASTM 2861-20) or gallons per pan (GPP), an alternative rate independent of time. Due to stakeholder  
424 support of the gal/hr/pan unit during Version 2.0 specification development as well as the significant pan-  
425 capacity variation in the oven market, EPA suggests that water consumption continues to be reported in  
426 gal/hr/pan. Normalizing the water consumption per pan allows end-users to compare the water  
427 consumption rates of the ovens with similar capacities. Additionally, the gal/hr/pan rate aligns with LEED  
428 and the Green Globes standards. However, without a leading consensus among currently active  
429 stakeholders regarding the water consumption units, EPA would like to discuss this topic further and  
430 encourage written feedback.

431  
432 Creating a maximum water consumption threshold may also aid in the steam mode discussion concerning  
433 steam saturation levels. A water consumption rate threshold may also further advance condensate cooling  
434 design.

435  
436 EPA encourages stakeholder feedback on the water consumption rates (gal/hr/pan and gal/min), the  
437 maximum water consumption criteria, and proposed energy criteria levels. EPA is also interested in  
438 reviewing any additional energy and water performance data to ensure that the dataset represents  
439 currently available products in the marketplace.

440  
441 D. Additional Idle Calculation Guidance: Compliance with the convection oven and combination  
442 oven idle rate requirements shall be based on gas energy only for purposes of certifying gas  
443 models. When calculating the gas oven idle rates, electric energy consumed by auxiliary  
444 components shall not be considered. However, the electric energy consumption measured  
445 during idle tests shall be reported separately, as per Section 4.G.c.

446  
447 E. Additional Total Idle Calculation Guidance: Compliance with the rack oven total idle rate  
448 requirements shall be based on gas and electric energy for purposes of certifying gas models.  
449 When calculating the gas rack oven total idle rates, electric energy consumed by auxiliary  
450 components shall be converted to Btu/h and added to the gas idle rate expressed in Btu/h. The  
451 electric energy consumption measured during idle tests shall also be reported separately as  
452 expressed in kW, as per Section 4.G.c.

453  
454 **Example:** Consider a double-sized gas rack oven with a gas idle energy rate of 30,000.11 Btu/h;  
455 and the electric idle energy rate of 1.51 kW. First, convert the 1.51 kW electric idle energy rate to  
456 Btu/h by multiplying the 1.51 kW by 3,412.14. Then add the result to the 30,000.11 Btu/h gas idle  
457 rate.

458  
459 1 kW = 3,412.14 Btu/h

460 Electric idle energy rate, converted to Btu/h: 1.51 kW X 3,412.14 Btu/h = 5,152.3314 Btu/h

461 Total idle energy rate: 30,000.11 Btu/h + 5,152.3314 Btu/h = 35,152.44 Btu/h

462  
463 F. Significant Digits and Rounding:

- 464  
465 a. All calculations shall be carried out with directly measured (unrounded) values. Only the final  
466 result of a calculation shall be rounded.
- 467  
468 b. Unless otherwise specified in this specification, compliance with certification criteria in  
469 Section 3 shall be evaluated using exact values without any benefit from rounding.
- 470  
471 c. Cooking and Baking-Energy Efficiency: Calculated values that are submitted for reporting on  
472 the ENERGY STAR website shall be rounded to the nearest significant digit as expressed in  
473 the certification criteria in Section 3.
- 474  
475 d. Idle Energy Rate: Calculated values for gas convection, combination, and rack oven idle  
476 rates submitted for reporting on the ENERGY STAR website shall be rounded to the nearest  
477 whole number. The calculated energy consumption values for electric convection and  
478 combination ovens shall be rounded to 0.01 for idle rates.
- 479

480  
481  
482 **4) Test Requirements:**  
483

- 484 A. Representative models shall be selected for testing per the following requirements:  
485  
486 a. For certification of an individual product model, the representative model shall be equivalent  
487 to that which is intended to be marketed and labeled as ENERGY STAR.  
488  
489 b. For a product family certification, any model within that product family can be tested and serve  
490 as the representative model. When submitting product families, manufacturers continue to be  
491 held accountable for any efficiency claims made about their products, including those not  
492 tested or for which data was not reported.  
493  
494 B. When testing commercial ovens, the following test methods shall be used to determine ENERGY  
495 STAR certification  
496

**Table 4: Test Methods for ENERGY STAR Certification**

Oven Types	ENERGY STAR Requirements	Test Method Reference
Convection Ovens	Cooking-Energy Efficiency, Idle Energy Rate, Production Capacity, Water Consumption, Preheat Energy Consumption, and Preheat time	ASTM F1496-13(2019), <i>Standard Test Method for Performance of Convection Ovens</i>  For water metrics if applicable: ASTM F2861-20, <i>Standard Test Method for Enhanced Performance of Combination Oven in Various Modes</i>
Combination Ovens	Cooking-Energy Efficiency, Idle Energy Rate, Production Capacity, Water Consumption, Condensate Temperature, Preheat Energy Consumption, and Preheat time	ASTM F2861-20, <i>Standard Test Method for Enhanced Performance of Combination Oven in Various Modes</i>
Rack Ovens	Baking-Energy Efficiency, Total Idle Energy Rate, Production Capacity, Preheat Energy Consumption, Steam Rate, Steam Injection Cycle, and Preheat time	ASTM F2093-18, <i>Standard Test Method for Performance of Rack Ovens</i>

497  
498 **Note:** Table 4 includes the water consumption rate, steam injection rate, and steam injection cycle  
499 captured as a reporting requirement for applicable convection and rack ovens. Since water consumption  
500 data for convection and rack ovens were not collected in Version 2.0, water consumption rate criteria are  
501 not proposed for those oven categories at this time. Reporting water consumption rates for convection and  
502 rack ovens will help customers calculate water use and potentially save on water and sewage costs.  
503

- 504 C. For ovens with variable Btu/h or kW input, each available input shall be tested and reported  
505 individually. Ovens need to meet the idle energy rate or total idle energy rate and cooking- or  
506 baking-energy efficiency requirements presented in Table 1, Table 2, or Table 3, of this  
507 specification at each input setting.  
508  
509 D. For electric ovens with multiple voltage-versatility and those that are available in different voltage  
510 configurations, the representative oven shall be tested at the most energy consumptive voltage  
511 according to the manufacturer.  
512  
513 E. If the representative combination oven model under test is designed to hold 18 x 26-inch sheet  
514 pans, the manufacturer-supplied wire racks shall be positioned in the oven to accommodate 12 x  
515 20x 2.5 -inch steam table pans.  
516  
517 F. Combination ovens with roll-in, removable racks shall have the racks positioned in place during

518 steam mode and convection mode idle tests.

519  
520 G. Additional Reporting Requirements:

- 521  
522 a. The average water consumption rates, average steam injection rate, average steam  
523 injection cycle, average condensate drain temperatures, and the maximum condensate  
524 drain temperatures shall be reported for all applicable ovens and applicable modes.  
525  
526 b. The production capacity for all convection ovens, combination ovens, and rack ovens  
527 cooking or baking-energy efficiency tests shall be reported.  
528  
529 c. The electric energy idle rate for gas convection, combination, and rack oven idle rate tests  
530 shall be reported.  
531  
532 d. Rack ovens that include energy saving feature(s) and meet the minimum requirement of the  
533 set-back idle mode definition in Section 1.DD. shall be reported.  
534  
535 e. Preheat energy consumption and time for all convection, combination, and rack ovens shall  
536 be reported in Btu or kWh for energy consumption and in minutes for preheat time. For  
537 combination ovens, both steam and convection preheat energy consumption and time shall  
538 be reported. For gas ovens, the auxiliary components (e.g., fan energy consumption) that  
539 use electrical energy shall also be reported.  
540

541 **Note:** To capture a more comprehensive total energy profile for all oven types within scope, EPA proposed  
542 in Section 4.G.e. to require collecting the preheat energy consumption and time from partners. A  
543 stakeholder preferred not publishing preheating metrics since it might confuse customers, while others  
544 expressed that they are helpful metrics. Since this metric is beneficial to customers, EPA will include it in  
545 the QPL and will include a note briefly describing the test method. An additional note in the QPL will  
546 describe that condensate cooling water consumption is included for ovens using that technology.

- 547  
548  
549 **5) Effective Date:** This ENERGY STAR Version 3.0 Commercial Ovens specification shall take effect  
550 on TBD. To certify to ENERGY STAR, a product model shall meet the ENERGY STAR specification  
551 in effect on the model's manufacture date. The date of manufacture is specific to each unit and is the  
552 date on which a unit is considered to be completely assembled.  
553

554 **Note:** EPA anticipates finalizing this Version 3.0 specification in Q1 2022. Once a final specification is  
555 released, manufacturers may immediately begin certifying products to the new Version 3.0 specification,  
556 but will have nine months to transition to it, understanding that certification to the current version must  
557 cease 4.5 months after the final specification is published. Once the Version 3.0 specification takes effect,  
558 ovens that do not meet the criteria will be removed from the ENERGY STAR Product Finder and may no  
559 longer be marketed or labeled as ENERGY STAR unless retested and recertified.

- 560  
561  
562 **6) Future Specification Revisions:** EPA reserves the right to change the specification should  
563 technological and/or market changes affect its usefulness to consumers, industry, or the environment.  
564 In keeping with current policy, revisions to the specification are arrived at through industry  
565 discussions. In the event of a specification revision, please note that ENERGY STAR certification is  
566 not automatically granted for the life of a product model.