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OFFICE OF
AIR AND RADIATION

**Summary of Rationale for ENERGY STAR® Version 1.0
Commercial Oven Specification**

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I. Introduction and Background

The ENERGY STAR Version 1.0 Commercial Oven specification was finalized on May 13, 2009 and became effective on May 16, 2009. This memorandum provides the key milestones and decisions that were made in developing and finalizing the requirements of this specification.

The document is divided into the following sections:

- Summary of the ENERGY STAR specification
- Summary of key milestones in the development of the ENERGY STAR specification
- Summary of key comments provided by stakeholders
- EPA's rationale for deciding on key elements of the final ENERGY STAR specification

II. Summary of ENERGY STAR Specification

Key elements of the new Version 1.0 ENERGY STAR specification are provided below:

- The following product types are eligible for ENERGY STAR: full-size and half-size, electric convection ovens and full-size gas convection ovens. Hybrid ovens, such as those incorporating steam and/or microwave settings in addition to convection, are excluded from the specification.
- Qualifying ovens must be third-party certified to NSF/ANSI Standard 4, *Commercial Cooking, Rethermalization and Powered Hot Food Holding and Transport Equipment*. Ovens designed for residential or laboratory applications cannot qualify for ENERGY STAR.
- Qualifying products must meet minimum cooking energy efficiency and maximum idle energy rate requirements, as presented in Table 1 below. Cooking energy efficiency is based on heavy load conditions per the ASTM 1496 test standard.

Table 1: Energy Efficiency Requirements for Convection Ovens	
Gas	
Full-Size	
Cooking Energy Efficiency	≥ 44%
Idle Energy Rate	≤ 13,000 Btu/h
Electric	
Half-Size	
Cooking Energy Efficiency	≥ 70%
Idle Energy Rate	≤ 1.0 kW
Full-Size	
Cooking Energy Efficiency	≥ 70%
Idle Energy Rate	≤ 1.6 kW

- Ovens that offer multiple door options (e.g. glass, solid) must meet the requirements presented in Table 1, above, utilizing all of these options to qualify as ENERGY STAR. Manufacturers may use the test results representing the worst case scenario (i.e., glass door) to qualify all door options under one model number. In the case where a manufacturer wishes to qualify a model with only one compliant door option, a unique identifier must be used that provides clear delineation between ENERGY STAR qualified and non-compliant units.
- Manufacturers qualifying ovens with variable Btu/h or kW input must test and report performance results at all available inputs. The oven must meet the cooking energy efficiency and idle energy rate requirements presented in Table 1, above, at all available inputs to qualify for ENERGY STAR.
- Approximately one year after the effective date of this Version 1.0 specification (i.e., May 16, 2010), EPA will evaluate whether to extend coverage to combination ovens and other oven types defined in Section 1 of the Eligibility Criteria.

III. Key Milestones of Specification Development

Prior to launching the specification development process, EPA conducted market and engineering analyses, that included: an overview of the marketplace (e.g., market actors, product types available, market size); a summary of existing and emerging energy-efficient technologies; a snapshot of voluntary and regulatory considerations; an evaluation of existing test standards; and an analysis of the potential energy savings due to high efficiency designs¹. Based on this research, EPA decided to move forward with convection and rack ovens and officially announced its intention to develop an ENERGY STAR specification on October 13, 2008. This process spanned almost 7 months and included the following key milestones:

— Draft and Final Specifications

- Draft 1 released January 2, 2008 – Cooking/baking energy efficiency and idle rate levels were proposed for convection ovens and rack ovens. Placeholders were included for half-size gas convection ovens (idle energy rate) as well as gas single rack and electric single and double rack (baking energy efficiency and idle rate) until more data could be collected and analyzed. A requirement that ovens be third-party certified to NSF/ANSI

¹ Griddle and Oven Industry and Market Research Report, Oven Engineering Analysis, April 4, 2007 (Market Research Report updated January 2008).

Standard 4, *Commercial Cooking, Rethermalization and Powered Hot Food Holding and Transport Equipment* was included to further exclude ovens designed for residential and laboratory use. EPA proposed a May 1, 2009 effective date to coincide with the National Restaurant Association (NRA) Show, May 16 – 19, 2009. A note was included in Section 6: Future Specification Revisions, that approximately 1 year following the effective date EPA will evaluate whether to extend coverage to combination ovens and other oven types defined in Section 1 of the specification. EPA's decision would be based on: stakeholder interest, test procedure availability, and access to product performance data.

- Draft 2 released March 13, 2009 – A definition for mini rack ovens was added and the product type excluded from ENERGY STAR eligibility until more data can be reviewed. Definitions for half- and full-size convection ovens were slightly modified to require that the ovens be able to accept a minimum of 5 pans. EPA retained the performance levels proposed in Draft 1 and encouraged manufacturers to share data on standard efficiency models to confirm the proposed levels or suggest changes to these levels. Manufacturers were also encouraged to provide data on countertop and half-size gas convection ovens. Clarification was provided regarding the testing and qualification of oven models that offer: (1) different control and/or door types (e.g., glass, solid); (2) variable Btu input; and (3) set back mode features. EPA proposed requiring a laboratory technician or company representative to sign all Qualified Product Information (QPI) forms submitted for ENERGY STAR qualification. A new effective date of May 16, 2009 was proposed to allow more time for comment on the Draft specification prior to finalization.
- Final Draft released April 24, 2009 – Rack ovens were excluded from the specification due to limited data sets available by which to set performance levels. A maximum 0.25 gal/hr water consumption requirement was added to the convection oven definition to more clearly exclude combination ovens. A statement was added to clarify that hybrid models, such as those incorporating steam and/or microwave technologies, would be excluded from the specification. A clarification was provided that allowed manufacturers of oven models offering multiple door options to use glass door test results (i.e., worst case scenario) for purposes of qualifying both solid and glass door options or develop a unique identifier to differentiate ENERGY STAR qualified and non-compliant options.
- Final specification released May 13, 2009 – A clarification was provided in the definition for convection ovens that models offering a *hold feature* would be eligible for ENERGY STAR as long as the cooking process is complete prior to entering the holding mode. Additional guidance was provided regarding the rounding of test results when reporting cooking energy efficiency and idle energy results for ENERGY STAR qualification.

— **Industry Stakeholder Meetings, Correspondence, and Events**

- EPA attended the NRA Show, May 18 – 20, 2008 to meet with commercial oven manufacturers and view products.
- On February 4, 2009, EPA hosted a stakeholder meeting during the NAFEM Show to provide an overview of the ENERGY STAR program and discuss the Draft 1 specification. EPA also met with several commercial oven manufacturers during the NAFEM Show to view products and discuss the Draft 1 proposal in greater detail.

- EPA launched the new ENERGY STAR Version 1.0 Commercial Oven specification at the NRA Show held in Chicago, Illinois, May 16-29, 2009 and released an official press notice on May 18.

IV. Summary of Stakeholder Input

EPA received several comments on the draft specifications from a variety of industry stakeholders including: Burger King; Consortium for Energy Efficiency; Duke Manufacturing; Electric Foodservice Council; Electrolux; Hobart; ITW-Vulcan Hart; Lang; Pacific Gas & Electric; Revent; Southern California Edison Customer Technology Application Center; and Southern California Gas.

Provided below is a summary of key stakeholder comments and EPA responses. More detailed comments and responses are provided in note boxes found throughout the draft specifications. All materials related to the specification development process are available in the ENERGY STAR Product Development Archives located at: www.energystar.gov/productdevelopment.

Comment: One stakeholder suggested that EPA use the definitions that are provided in the relevant ASTM standards.

EPA Response: The ASTM definitions, as currently written, were too broad for ENERGY STAR purposes. For example, the ASTM rack oven definition could also apply to revolving tray ovens, which was outside the scope of the specification. Within the specification, EPA must clearly define the product types that are eligible for ENERGY STAR and also those that are not to ensure only those products intended to be covered by the specification are tested and submitted for qualification. Therefore, EPA based the definitions on the relevant ASTM standards but added clarification, where needed. For example, the following statement was added to the definition for convection oven: *Maximum water consumption within the oven cavity must not exceed 0.25 gallons/hour*. While combination ovens were separately defined within the specification, there continued to be confusion between convection ovens that apply small amounts of water to crisp product, using minimal amount of energy, and combination ovens that use steam to actually cook the product. Based on industry discussions, it was concluded that adding a maximum water consumption of 0.25 gallons/hour would continue to allow these product types to qualify for ENERGY STAR, which was EPA's intention, and more clearly exclude combination ovens.

Comment: Several stakeholders expressed interest in including mini-rack ovens and countertop convection ovens in the specification.

EPA Response: The ASTM test standards for convection and rack ovens do not currently address mini-rack designs. However, EPA included a definition for this product type in the specification with the intention of including them once a test method and performance data are made available.

EPA had limited data on countertop convection models and recognized that separate requirements may be warranted due to different production capacities and applications. The current ASTM test method for convection ovens specifies testing with 5 pans of product for the heavy-load potato test, which is referenced in the ENERGY STAR specification. Since countertop units hold less than 5 pans they are excluded from the ASTM test standard. However, EPA expressed a willingness to allow manufacturers to test ovens with smaller pan capacities by using the maximum number of pans that the oven could accommodate, up to five pans. Manufacturers were then encouraged to conduct testing on countertop models and provide additional information

to EPA for consideration. EPA did not receive any additional information on these product types and therefore, included them on the larger list of oven types to review under subsequent revisions.

A requirement that full-size and half-size convection ovens accept a *minimum* of five standard full size sheet pans was added to the definitions to temporarily exclude countertop units from the specification.

Comment: One stakeholder requested that EPA investigate the impact of volumetric variations on energy performance within each subcategory and provide a basis for why pan size (full/half) is a meaningful differentiator.

EPA Response: The proposed sub-categorization for convection ovens was based on the industry-accepted full and half-size nomenclature that refers to the standard sheet pan size that the oven can accommodate (i.e., 18 x 13 x 1-inch and 18 x 26 x 1-inch). EPA analyzed the impact of cavity size on idle energy consumption by plotting idle energy rate against oven cavity volume (ft³) to determine if there was an observable trend. The analysis indicated that larger volume does not necessarily result in higher idle energy rate. Therefore, EPA concluded that its initial approach of basing idle energy rate on full-size and half-size sub-categorization was feasible.

Comment: There was some concern that the data sets used to develop the ENERGY STAR convection oven levels might be skewed toward the top performers.

EPA Response: Manufacturers were encouraged to submit data points representing standard efficiency designs to confirm the proposed performance levels or indicate revisions that might be needed to better represent approximately the top 25% of the marketplace. EPA received a few additional data points that supported the proposed levels as well as indication from manufacturers that simple and cost effective solutions were available to redesign existing products to meet the proposed levels.

Comment: Several stakeholders encouraged EPA to keep gas double rack ovens in the specification even if levels cannot be determined for single-rack gas and electric rack ovens (single and double rack).

EPA Response: According to industry sources, electric rack ovens overall represent only 10% of the market while gas rack ovens represent 90% of the total products sold. While EPA could move forward with excluding electric rack ovens due to their small market share, it would be more difficult to move forward with a gas rack oven specification without including single rack models. Manufacturers were encouraged to provide additional data for EPA consideration. However, EPA did not receive any data points for gas single rack ovens and therefore, temporarily excluded the entire rack oven category from the specification until a robust data set is made available that demonstrates sufficient product differentiation.

Comment: It was suggested to EPA that half-size convection ovens be excluded from the specification based on the limited data made available.

EPA Response: According to industry sources, half-size gas convection ovens represent a very small portion of the half-size market (< 5%) compared to their electric counterparts (>95%). As such, EPA was comfortable setting efficiency levels *only* for electric half-size ovens, which would address the vast majority of the half-size units available in the marketplace. Therefore, half-size gas convection ovens were excluded from the specification.

Comment: Stakeholders were concerned that allowing set-back modes to be enabled during testing would not provide a realistic profile of how the equipment will operate in the kitchen. There was also some question as to whether operators will even use this feature in practice because of the perceived implications on food quality and/or business.

EPA Response: EPA decided that manufacturers would be required to test and report qualified products under the worst case scenario, which would mean disabling any set back features. However, EPA also agreed to work with ENERGY STAR partners to educate consumers about set back modes and other energy saving features.

Comment: Several stakeholders asked whether convection ovens would need to be tested and reported separately to EPA for ENERGY STAR qualification based on door and control type.

Response: To reduce the testing burden, EPA decided to allow manufacturers to test and qualify convection oven models using the glass door configuration, which represents the worst case scenario. Solid door options can be qualified based on the glass door test results. However, if the model only meets ENERGY STAR requirements using one door option then the manufacturer should qualify that configuration and assign a unique identifier to either the ENERGY STAR compliant or non-compliant option(s).

Based on industry discussions, EPA found that differences in control types have little impact on energy consumption. However, in the case that there is a difference in performance, the manufacturer will be responsible for making sure that the oven meets ENERGY STAR requirements using all control options.

Comment: One stakeholder requested clarification regarding convection ovens that offer a hold feature.

Response: A statement was added to the definition of convection ovens allowing those units that offer a hold feature to qualify for ENERGY STAR as long as the cooking process is complete prior to entering the holding mode. Ovens that utilize the holding mode to complete the cooking process (i.e., slow cook and hold ovens, as defined in 1F of the specification) are tested using a different ASTM test standard and currently ineligible for ENERGY STAR.

Comment: One stakeholder asked for clarification regarding the testing and reporting of ovens that offer variable Btu inputs.

Response: It is important that the end user purchasing this type of oven is assured of ENERGY STAR performance at each chosen input. EPA added clarification that manufacturers would be required to test this oven type at all available inputs and the unit would need to meet the ENERGY STAR requirements at each input.

Comment: A few stakeholders were concerned that allowing self testing might lead to misrepresentation of performance.

Response: ENERGY STAR was created to be a voluntary, self-policing program. With more than 60 product categories now eligible for ENERGY STAR, EPA relies on its program partners to help monitor the marketplace for violations. EPA is supportive of requiring third party testing for ENERGY STAR qualification, where it makes sense. At the time of development, there were a limited number of laboratories available to test convection ovens using the ASTM test standard. The ASTM test standard can be conducted in house for a lower cost compared to third party

laboratories. Furthermore, manufacturers have been testing their convection ovens for several years and there was no indication that the results were being misused in the marketplace. As such, EPA concluded that third party testing was not feasible at this time. However, if gross misuse of the ENERGY STAR mark and/or inaccurate reporting is discovered for this product category then EPA may decide to revisit this requirement.

A requirement was added to the Qualified Product Information (QPI) form that each completed submittal must be signed by a laboratory technician or company representative. Furthermore, EPA also has the right to pull products from the marketplace at any time to confirm ENERGY STAR compliance.

Comment: EPA received interest from several stakeholders to develop specification requirements for other oven types, including combination ovens and conveyor ovens.

Response: Based on availability of industry accepted test procedures and performance data, EPA initially focused its efforts on developing energy efficiency requirements for convection, rack, and rotisserie ovens. Shortly after launching the specification development process in October, EPA learned that the ASTM test procedure for rotisserie ovens was being revised. As such, rotisserie ovens were dropped from consideration under the Version 1.0 specification.

The remaining oven categories either had test procedures under revision or in development through ASTM, including: range; conveyor; deck; cook and hold; combi; and rapid cook. EPA included language in Section 6: Future Specification Revisions, regarding its intention to extend ENERGY STAR coverage to additional commercial oven types in the future. The decision to develop requirements for new oven types will be based on stakeholder interest, test procedure availability, and access to product performance data.

V. EPA Rationale for Specification

EPA uses a consistent set of criteria in the development and revision of specifications for ENERGY STAR qualified products. These criteria guide EPA in its decision making and help to ensure that the ENERGY STAR mark will continue to be a trustworthy symbol for consumers to rely upon as they purchase products for the home or business, and that their purchases will deliver substantial environmental protection. These criteria include:

- Significant energy savings and environmental protection potential on a national basis;
- Efficiency level is technically feasible while product performance is maintained or enhanced;
- Labeled products will be cost-effective to the buyer;
- Efficiency can be achieved with several technology options;
- Product differentiation and testing are feasible; and
- Labeling would be effective and recognizable in the market.

Below EPA addresses the ENERGY STAR commercial oven specification relative to each of these criteria:

- Expected Energy Savings and Environmental Benefits on a National Basis. Commercial ovens that have earned the ENERGY STAR are about 20% more energy-efficient than standard ovens. Each ENERGY STAR qualified electric oven can save businesses 1,870 kWh annually, or an average of \$190/year on utility bills. Each ENERGY STAR qualified

gas oven can save 30 MBtu annually, or an average of \$360/year on utility bills. If all new shipments through 2010 were ENERGY STAR qualified units, the program would reduce 10 billion pounds of CO² emissions.

- Technical Feasibility/Impact on Product Performance/Functionality. While the full-size data sets clearly supported the levels proposed by EPA, the half-size electric oven data set was quite small (6 models total) and difficult to determine market share represented by the proposed levels. However, there was significant manufacturer interest in including these product types as they represented a large share of the half-size market. Overall, half-size units represent approximately 60% of the electric convection oven market and 95% of the half-size oven market. All quick service restaurants have half-size electric ovens in their kitchens. Because of their prevalence in the marketplace, and based on basic engineering principles (i.e., half-size ovens should be capable of performing at the same cooking energy efficiency level as full-size designs), EPA decided to continue to address electric half-size ovens in the specification. Specifically for idle energy rate, EPA chose a level that seemed feasible with some minor engineering design changes, based on existing data and discussions with manufacturers. For example, some preliminary data provided by one manufacturer showed that idle energy rate could be reduced by several kW simply by changing the insulation. At the time of finalization, 1 product met ENERGY STAR levels (74%, 0.63 kW) and another was being redesigned by its manufacturer to meet the levels. EPA was confident that the Version 1.0 levels are technical feasible and over time manufacturers will be able to redesign half-size models to meet these levels.

With commercial foodservice equipment, end users are most concerned with: food quality, food safety, and time to table. End users simply cannot sacrifice these needs for energy efficiency and therefore, any ENERGY STAR specification developed for this sector must ensure the same or better performance. The ASTM test standard referenced in the ENERGY STAR commercial oven specification provides end users with a representation of real world usage and measures cooking energy efficiency and idle energy rate. Cooking energy efficiency is defined as “the ratio of energy absorbed by the food product to the total energy supplied to the oven during cooking.” The higher the cooking energy efficiency, the quicker the cook times while using less energy. Idle energy is defined as “the rate of oven energy consumption while it is maintaining or holding at a stabilized operating condition or temperature.” Since idle energy rate is measured while the oven is not being used, a lower number should not directly impact cooking performance.

- Cost-Effectiveness to the Purchaser. End users purchasing ENERGY STAR qualified commercial ovens, on average, will see a payback ranging from 1 – 5 years, depending on fuel type, usage, and utility prices. EPA conducted a simple payback analysis on gas and electric full-size convection ovens, which is provided below. The analysis for gas units represents average price and energy savings, based on EPA’s analysis using ENERGY STAR and standard efficiency performance levels. A specific example is provided for electric because of the limited data available for that category. Note that pricing is based on a 50% discount off of list price, which is typical in this industry.

Gas Oven Payback Analysis – Average

Model	Initial Price	Incremental Cost	Idle Energy Rate (Btu/h)	Cooking Energy Efficiency	Annual Energy Consumption (MBtu/year)	Annual Energy Cost*	Annual Dollar Savings	Payback (years)
ENERGY STAR	\$4,700	\$12	13,000	44%	75	\$883	\$353	Immediate
Standard	\$4,688		18,000	30%	105	\$1,236		

Electric Oven Payback Analysis – Specific Example

Model	Initial Price	Incremental Cost	Idle Energy Rate (kW)	Cooking Energy Efficiency	Annual Energy Consumption (kWh/year)	Annual Energy Cost*	Annual Dollar Savings	Payback (years)
ENERGY STAR	\$4,996	\$931	1.5	71%	10,128	\$1,043	\$262	3.5
Standard	\$4,065		2.1	66%	12,667	\$1,305		

* Gas rate = \$11.77/Mbtu, Electric rate = \$0.103/kWh (ENERGY STAR Factoid Workbook, April 2009)

EPA also found several cases where more efficient equipment cost less than standard efficiency competitors, which would mean that the end user would experience an immediate payback.

- Achieve Efficiency With Several Technology Options. EPA designs its ENERGY STAR specifications to be performance-based. This means that it strives to recognize the better performing products on the market in terms of energy efficiency regardless of technology. Manufacturers have employed several technologies to reduce idle energy rate and increase cooking energy efficiency. There were several low cost design changes that could be made to existing ovens to meet the ENERGY STAR requirements, including improvements in insulation and door sealing.
- Testing Procedure. The ENERGY STAR specification references ASTM F1496, *Standard Test Method for Performance of Convection Ovens*, which is the industry accepted standard for measuring convection oven cooking energy efficiency and idle energy rate.
- Product Differentiation and Effectiveness of Labeling. Where feasible, EPA strives to develop ENERGY STAR specifications that represent approximately the top 25% of models available in regards to energy efficiency performance. The levels presented in the Version 1.0 specification represent approximately 21% and 33% of EPA’s gas and electric full-size convection data sets, respectively. Several manufacturers were represented by the compliant models.

EPA believes the ENERGY STAR mark serves an important role in the marketplace due to the absence of any other objective basis for end users to identify and manufacturers to promote highly efficient commercial convection ovens. Several key manufacturers contributed to the development process and many utilities and customers have expressed interest in rebating and purchasing ENERGY STAR qualified commercial convection ovens. Furthermore, the addition of commercial convection ovens helps to expand the number of energy and water saving opportunities in the growing suite of ENERGY STAR commercial foodservice equipment.