



Standard Test Method for Performance of Deck Ovens¹

This standard is issued under the fixed designation F1965; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method evaluates the energy consumption and cooking performance of deck ovens. The food service operator can use this evaluation to select a deck oven and understand its energy consumption.

1.2 This test method is applicable to gas and electric deck ovens.

1.3 The deck oven can be evaluated with respect to the following (where applicable):

- 1.3.1 Energy input rate and thermostat calibration (10.2),
- 1.3.2 Preheat energy consumption and time (10.3),
- 1.3.3 Idle energy rate (10.4),
- 1.3.4 Pilot energy rate (if applicable) (10.5), or
- 1.3.5 Cooking energy efficiency and production capacity (10.6).

1.4 The values stated in inch-pound units are to be regarded as standard. The SI units given in parentheses are for information only.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

A36/A36M Specification for Carbon Structural Steel

¹ This test method is under the jurisdiction of ASTM Committee F26 on Food Service Equipment and is the direct responsibility of Subcommittee F26.06 on Productivity and Energy Protocol.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

2.2 ASHRAE Documents:³

ASHRAE Handbook of Fundamentals, "Thermal and Related Properties of Food and Food Materials," Chapter 30, Table 1, 1989

ASHRAE Guideline 2-1986 (RA90) Engineering Analysis of Experimental Data

2.3 Other Document:⁴

AOAC Procedure 984.25 Moisture (Loss of Mass on Drying) in Frozen French Fried Potatoes

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *cooking energy efficiency, n*—quantity of energy imparted to the specified food product, expressed as a percentage of energy consumed by the deck oven during the cooking event.

3.1.2 *cooking energy rate, n*—average rate of energy consumption (Btu/h or kW) during the cooking energy efficiency tests. Refers to all loading scenarios (heavy, medium, light).

3.1.3 *deck oven, n*—an appliance that cooks the food product within a heated chamber. The food product can be placed directly on the floor of the chamber during cooking and energy may be delivered to the food product by convective, conductive, or radiant heat transfer. The chamber may be heated by gas or electric forced convection, radiants, or quartz tubes. Top and bottom heat may be independently controlled.

3.1.4 *energy input rate, n*—peak rate at which a deck oven consumes energy (Btu/h or kW).

3.1.5 *idle energy rate, n*—the deck oven's rate of energy consumption (Btu/h or kW), when empty, required to maintain its cavity temperature at the specified thermostat set point.

3.1.6 *oven cavity, n*—that portion of the deck oven in which food products are heated or cooked.

3.1.7 *pilot energy rate, n*—rate of energy consumption (Btu/h or kW) by a deck oven's continuous pilot (if applicable).

³ Available from American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329.

⁴ Available from AOAC International, 481 North Frederick Avenue, Suite 500, Gaithersburg, Maryland 20877-2417.

3.1.8 *preheat energy, n*—amount of energy consumed (Btu or kWh), by the deck oven while preheating its cavity from ambient temperature to the specified thermostat set point.

3.1.9 *preheat time, n*—time (minutes) required for the deck oven cavity to preheat from ambient temperature to the specified thermostat set point.

3.1.10 *production capacity, n*—maximum rate (lb/h) at which a deck oven can bring the specified food product to a specified cooked condition.

3.1.11 *production rate, n*—rate (lb/h) at which a deck oven brings the specified food product to a specified cooked condition; does not necessarily refer to maximum rate. Production rate varies with the amount of food being cooked.

3.1.12 *thermal disk, n*—a metal 5-in. diameter, 1/4-in. thick disk with thermal couple attached for measuring temperature.

3.1.13 *uncertainty, n*—measure of systematic and precision errors in specified instrumentation or measure of repeatability of a reported test result.

4. Summary of Test Method

4.1 Accuracy of the deck oven thermostat is checked at a setting of $475 \pm 5^\circ\text{F}$ ($246 \pm 2.75^\circ\text{C}$) determined by the average of 5 disks, and the thermostat is adjusted as necessary.

4.2 Energy input rate is determined to confirm that the deck oven is operating within 5 % of the nameplate energy input rate. For gas deck oven, the pilot energy rate and the fan and control energy rate are also determined.

4.3 Preheat energy and time are determined using average temperature of 5-disks.

4.4 Idle energy rate is determined at a thermostat setting using average temperature of 5-disks to achieve $475 \pm 5^\circ\text{F}$ ($246 \pm 2.75^\circ\text{C}$).

4.5 Cooking energy efficiency and production rate are determined during cooking tests using pizza as a food product.

5. Significance and Use

5.1 The energy input rate test and thermostat calibration are used to confirm that the deck oven is operating properly prior to further testing and to insure that all test results are determined at the same temperature.

5.2 Preheat energy and time can be useful to food service operators to manage power demands and to know how quickly the deck oven can be ready for operation.

5.3 Idle energy rate and pilot energy rate can be used to estimate energy consumption during noncooking periods.

5.4 Cooking energy efficiency is a precise indicator of deck oven energy performance while cooking a typical food product under various loading conditions. If energy performance information is desired using a food product other than the specified test food, the test method could be adapted and applied. Energy performance information allows an end user to better understand the operating characteristics of a deck oven.

5.5 Production capacity information can help an end user to better understand the production capabilities of a deck oven as

it is used to cook a typical food product and this could help in specifying the proper size and quantity of equipment. If production information is desired using a food product other than the specified test food, the test method could be adapted and applied.

6. Apparatus

6.1 *Analytical Balance Scale*, for measuring weights up to 20 lb, with a resolution of 0.01 lb and an uncertainty of 0.01 lb.

6.2 *Barometer*, for measuring absolute atmospheric pressure, to be used for adjustment of measured natural gas volume to standard conditions, having a resolution of 0.2 in. Hg and an uncertainty of 0.2 in. Hg.

6.3 *Canopy Exhaust Hood*, 4 ft in depth, wall-mounted with the lower edge of the hood 6 ft, 6 in. from the floor and with the capacity to operate at a nominal exhaust ventilation rate of 300 cfm per linear foot of active hood length. This hood shall extend a minimum of 6 in. past both sides and the front of the cooking appliance and shall not incorporate side curtains or partitions.

6.4 *Convection Drying Oven*, with temperature controlled at $220 \pm 5^\circ\text{F}$ ($104.4 \pm 2.75^\circ\text{C}$), to be used to determine moisture content of pizza crust, pizza sauce, and pizza cheese.

6.5 *Gas Meter*, for measuring the gas consumption of a deck oven, shall be a positive displacement type with a resolution of at least 0.01 ft³ and a maximum uncertainty no greater than 1 % of the measured value for any demand greater than 2.2 ft³/h. If the meter is used for measuring the gas consumed by the pilot lights, it shall have a resolution of at least 0.01 ft³ and a maximum uncertainty no greater than 2 % of the measured value.

6.6 *Pressure Gage*, for monitoring natural gas pressure, having a range from 0 to 10 in. H₂O, a resolution of 0.5 in. H₂O, and a maximum uncertainty of 1 % of the measured value.

6.7 *Stopwatch*, with a 1-s resolution.

6.8 *Temperature Sensor*, for measuring natural gas temperature in the range from 50 to 100°F with an uncertainty of $\pm 1^\circ\text{F}$.

6.9 *Thermocouple*, fiberglass insulated, 24 gage, Type K thermocouple wire, connected at the exposed ends by soldering the two wires together, or fiberglass insulated, 24-gage, Type K thermocouple wire, peened flat at the exposed ends and spot welded to steel disk surfaces with a strain gage welder.

6.10 *Thermocouple Probe*, Type K micro needle product probe with a response time from ambient to 200°F (93.3°C) of less than 20 s.

6.11 *Watt-Hour Meter*, for measuring the electrical energy consumption of a deck oven, having a resolution of at least 10 Wh and a maximum uncertainty no greater than 1.5 % of the measured value for any demand greater than 100 W. For any demand less than 100 W, the meter shall have a resolution of at least 10 Wh and a maximum uncertainty no greater than 10 %.

6.12 *Identification Markers*, required for keeping pizzas organized during handling process.