



Designation: F3051 – 14 (Reapproved 2019)

Standard Test Method for Performance of Cook-and-Hold Ovens¹

This standard is issued under the fixed designation F3051; 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 cook-and-hold ovens. The food service operator can use this evaluation to select a cook-and-hold oven and understand its energy consumption.

1.2 This test method is applicable to gas and electric cook-and-hold ovens.

1.3 The cook-and-hold oven can be evaluated with respect to the following (where applicable):

- 1.3.1 Energy input rate (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).
- 1.3.5 Cooking energy rate, and production capacity (10.7).
- 1.3.6 Holding energy rate, energy utilization factor, and product yield (10.7).

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 test method may involve hazardous materials, operations, and equipment. 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.*

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.

Current edition approved May 1, 2019. Published June 2019. Originally approved in 2014. Last previous edition approved in 2014 as F3051 – 14. DOI: 10.1520/F3051-14R19.

2. Referenced Documents

2.1 ASTM Standards:²

D3588 Practice for Calculating Heat Value, Compressibility Factor, and Relative Density of Gaseous Fuels

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

3. Terminology

3.1 Definitions:

3.1.1 *cook-and-hold oven, n*—an appliance with a closed heated cavity designed specifically for low-temperature cooking, followed by a holding period at a specified temperature.

3.1.2 *cooking energy rate, n*—average rate of energy consumption (Btu/h or kW) during the energy utilization factor tests.

3.1.3 *energy input rate, n*—peak rate at which a cook-and-hold oven consumes energy (Btu/h or kW).

3.1.4 *energy utilization factor, n*—the ratio of the energy consumed per pound yield (Wh/lbs) of food product during the cook-and-hold test.

3.1.5 *holding energy rate, n*—the rate of energy consumed (Btu/h or kW) by the cook-and-hold oven while maintaining the temperature of the cooked food product for a specified period.

3.1.6 *idle energy rate (ready-to-cook condition), n*—the cook-and-hold oven’s rate of energy consumption (Btu/h or kW), when empty, required to maintain its cavity temperature at the specified thermostat set point or to otherwise maintain the oven in a ready-to-cook condition.

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.

³ Available from American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329, <http://www.ashrae.org>.

3.1.7 *oven cavity, n*—that portion of the cook-and-hold oven in which food products are heated or cooked.

3.1.8 *pilot energy rate, n*—rate of energy consumed (Btu/h) by a cook-and-hold oven's continuous pilot (if applicable).

3.1.9 *preheat energy, n*—amount of energy consumed (Btu or kWh), by the cook-and-hold oven while preheating its cavity from ambient temperature to the specified thermostat set point or while preheating any other component of the oven, for example an integral heat exchanger, to a ready-to-cook condition.

3.1.10 *preheat time, n*—time (min.) required for the cook-and-hold oven cavity to preheat from ambient temperature to the specified thermostat set point or for the cook-and-hold oven to achieve a ready-to-cook condition.

3.1.11 *production capacity, n*—maximum rate (lb/h) at which a cook-and-hold oven can bring the specified food product to a specified “cooked” condition.

3.1.12 *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 cook-and-hold oven thermostat is checked at a setting of 225°F. This is accomplished by comparing the oven's temperature control setting with the temperature at the center of the oven's cavity. If necessary, the control is adjusted so that the maximum difference between its reading and the temperature at the center of the cavity is no more than $\pm 5^\circ\text{F}$.

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

4.3 The time and energy required to preheat the oven from room temperature ($75 \pm 5^\circ\text{F}$) to a ready-to-cook condition (for example, $225 \pm 5^\circ\text{F}$).

4.4 Idle energy rate is determined with the cook-and-hold oven set to maintain a ready-to-cook condition (for example, $225 \pm 5^\circ\text{F}$).

4.5 Cooking energy rate and production capacity are determined during heavy-load conditions using beef round roasts.

4.6 Holding energy rate, energy utilization factor, and average product yield are determined immediately following the cooking cycle.

5. Significance and Use

5.1 The energy input rate test is used to confirm that the cook-and-hold oven is operating properly prior to further testing.

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

5.3 Idle energy rate and pilot energy rate can be used to estimate energy consumption during non-cooking periods.

5.4 Energy utilization factor is a precise indicator of a cook-and-hold oven's energy performance while cooking and holding 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 cook-and-hold oven.

5.5 Production capacity information can help an end user to better understand the production capabilities of a cook-and-hold 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.

5.6 Holding energy rate may be used to determine the cost of holding cooked product in the cook-and-hold oven.

5.7 Product yield may be used by the food service operator to compare relative product output from one cook-and-hold oven to another. Additionally, product shrinkage during holding may be used by the food service operator to evaluate the cook-and-hold oven's performance when holding cooked product.

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. Shall have a resolution of 0.2 in. Hg and an uncertainty of 0.2 in. Hg.

6.3 *Flow Meter*, for measuring total water consumption of the appliance (if applicable). The meter shall have a resolution of 0.01 gal, and an uncertainty of 0.01 gal, at flow rate as low as 0.2 gpm.

6.4 *Gas Meter*, for measuring the gas consumption of a cook-and-hold 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.

6.5 *Pressure Gage*, for monitoring natural gas pressure. Shall have a range of zero to 10 in. H₂O, a resolution of 0.5 in. H₂O, and a maximum uncertainty of 1% of the measured value.

6.6 *Stop Watch*, with a 1-sec resolution.

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

6.8 *Thermocouple Probes*, Type K stainless-steel sheathed exposed junction with a range from -20 to 400°F , with a resolution of 0.2°F , and an uncertainty of 0.5°F , for measuring oven cavity and food product temperatures.

NOTE 1—To facilitate monitoring food temperatures, it is recommended