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An American National Standard

Standard Test Method for Performance of Griddles[1]

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This standard has been approved for use by agencies of the Department of Defense.

ε[1] NOTE—Sections 2.2 and 9.3 were editorially corrected in February 2005.

1. Scope

1.1 This test method evaluates the energy consumption and cooking performance of griddles. The food service operator can use this evaluation to select a griddle and understand its energy efficiency and production capacity.

1.2 This test method is applicable to thermostatically controlled, single-source (bottom) gas and electric griddles.

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

1.3.1 Energy input rate (10.2),

1.3.2 Temperature uniformity across the cooking surface and accuracy of the thermostats (10.3),

1.3.3 Preheat energy and time (10.4),

1.3.4 Idle energy rate (10.5),

1.3.5 Pilot energy rate (10.6),

1.3.6 Cooking energy rate and efficiency (10.7), and

1.3.7 Production capacity and cooking surface temperature recovery time (10.7).

1.4 The values stated in inch-pound units are to be regarded as the standard. The values 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 3588 Practice for Calculating Heat Value, Compressibility, and Relative Density of Gaseous Fuels

2.2 *ANSI Standard:*[3]

ANSI Z83.11 American National Standard for Gas Food Service Equipment

2.3 *AOAC Documents:*[4]

AOAC Official Action 950.46B Air Drying to Determine Moisture Content of Meat and Meat Products

AOAC Official Action 960.39 Fat (Crude) or Ether Extract in Meat

2.4 *ASHRAE Document:*[5]

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

3. Terminology

3.1 *Definitions:*

3.1.1 *cook time*, *n*—the time required to cook frozen hamburgers, as specified in 7.1, to a 35 ± 2 % weight loss during a cooking energy efficiency test.

3.1.2 *cooking energy*, *n*—energy consumed (Btu (kJ) or kWh) by the griddle as it is used to cook hamburgers under heavy- and light-load conditions.

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

3.1.4 *cooking energy rate*, *n*—the average rate of energy consumption (Btu/h (kJ/h) or kW) during the cooking energy efficiency tests. It refers to all loading scenarios (heavy and light).

3.1.5 *energy input rate*, *n*—the peak rate (Btu/h (kJ/h) or kW) at which an appliance will consume energy, typically reflected during preheating.

3.1.6 *griddle*, *n*—a device for cooking food in oil or its own juices by direct contact with a hot surface.

[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.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

[4] Available from Association of Official Analytical Chemists, 1111 N. 19th Street, Arlington, VA 22209.

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

3.1.7 *idle energy rate*, *n*—the average rate of energy consumed (Btu/h (kJ/h) or kW) by the griddle while "holding" or maintaining the cooking surface at the thermostat set point.

3.1.8 *pilot energy rate*, *n*—the average rate of energy consumption (Btu/h (kJ/h)) by a griddle's continuous pilot (if applicable).

3.1.9 *preheat energy*, *n*—the amount of energy consumed (Btu (kJ) or kWh) by the griddle while preheating the cooking surface from ambient room temperature to the thermostat set point.

3.1.10 *preheat rate*, *n*—the average rate (°F/min (°C/min)) at which the cooking surface temperature is heated from ambient temperature to the griddle's thermostat set point.

3.1.11 *preheat time*, *n*—the time required for the cooking surface to preheat from ambient room temperature to the thermostat set point.

3.1.12 *production capacity*, *n*—the maximum rate (lb/h (kg/h)) at which the griddle can bring the specified food product to a specified "cooked" condition.

3.1.13 *production rate*, *n*—the average rate (lb/h (kg/h)) at which a griddle brings the specified food product to a specified "cooked" condition. It does not necessarily refer to the maximum rate. The production rate varies with the amount of food being cooked.

3.1.14 *recovery time*, *n*—the average time from the removal of the last hamburger patty of a load until all sections of the cooking surface are back up to within 25°F (14°C) of set temperature and are ready to be reloaded.

3.1.15 *test method*, *n*—a definitive procedure for the identification, measurement, and evaluation of one or more qualities, characteristics, or properties of a material, product, system, or service that produces a test result.

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

4. Summary of Test Methods

4.1 The griddle under test is connected to the appropriate, metered energy source. The measured energy input rate is determined and checked against the rated input before continuing with any further testing.

4.2 The griddle surface temperature is monitored directly above the thermostat sensing points, and the cooking surface is calibrated to 375°F (191°C) based on these points. Additional points are monitored at predetermined locations while the griddle is idled at a nominal 375°F.

4.3 The preheat energy and time and idle energy rate are determined while the griddle is operating with the thermostats set at a calibrated 375°F (191°C). The rate of pilot energy consumption is also determined when applicable to the griddle under test.

4.4 Energy consumption and time are monitored while the griddle is used to cook six loads of frozen, ¼-lb (0.11-kg), 20 % fat pure beef hamburger patties to a medium-done condition with the thermostats set at a calibrated 375°F (191°C). Cooking energy efficiency, cooking energy rate, production capacity, and surface temperature recovery time are determined for heavy- (whole cooking surface loaded with product) and light-load (single serving) test conditions.

5. Significance and Use

5.1 The energy input rate test is used to confirm that the griddle is operating properly prior to further testing.

5.2 The temperature uniformity of the cooking surface is used by food service operators to choose a griddle that provides a uniformly cooked product.

5.3 Preheat energy and time can be useful to food service operators to manage power demands and to know how rapidly the griddle can be ready for operation.

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

5.5 Cooking energy efficiency is a precise indicator of griddle energy performance under various loading conditions. This information enables the food service operator to consider energy performance when selecting a griddle.

5.6 Production capacity is used by food service operators to choose a griddle that matches their food output requirements.

6. Apparatus

6.1 *Watt-Hour Meter*, for measuring the electrical energy consumption of a griddle, 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. The meter shall have a resolution of at least 10 Wh and a maximum uncertainty no greater than 10 % for any demand less than 100 W.

6.2 *Gas Meter*, for measuring the gas consumption of a griddle, being a positive displacement type with a resolution of at least 0.01 ft^3 (0.0003 m^3) and a maximum error no greater than 1 % of the measured value for any demand greater than 2.2 ft^3/h (0.06 m^3/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 ft^3 (0.0003 m^3) and have a maximum error no greater than 2 % of the measured value.

6.3 *Thermocouple(s)*, 24 gage, Type K thermocouple wire, peened flat at the exposed ends and spot welded to surfaces with a strain gage welder.

6.4 *Thermocouple Probe(s)*, industry standard Type T or Type K thermocouples capable of immersion with a range from 50 to 200°F (10 to 93°C) and an uncertainty of ±1°F (0.56°C).

6.5 *Analytical Balance Scale*, for the determination of hamburger patty weight before and after cooking and for the moisture loss determination test, with a resolution of 0.01 lb (0.004 kg).

6.6 *Convection Drying Oven*, with the temperature controlled at 215 to 220°F (101 to 104°C), used to determine the moisture content of both the raw and cooked hamburger.

6.7 *Canopy Exhaust Hood*, 4 ft (1.2 m) in depth, wall-mounted, with the lower edge of the hood 6 ft, 6 in. (1.98 m) from the floor and with the capacity to operate at a nominal net exhaust ventilation rate of 300 cfm per linear foot (460 L/s per linear metre) of active hood length. This hood shall extend a minimum of 6 in. (152 mm) past both sides and the front of the cooking appliance and shall not incorporate side curtains or partitions. Makeup air shall be delivered through face registers or from the space, or both.

6.8 *Barometer*, for measuring absolute atmospheric pressure, to be used for the adjustment of measured gas volume to

standard conditions. It shall have a resolution of 0.2 in. Hg (670 Pa) and an uncertainty of 0.2 in. Hg.

6.9 *Data Acquisition System*, for measuring energy and temperatures, capable of multiple temperature displays updating at least every 2 s.

6.10 *Pressure Gage*, for monitoring gas pressure, having a range from 0 to 15 in. H_2O (0 to 3.7 kPa), resolution of 0.5 in. H_2O (125 Pa), and maximum uncertainty of 1 % of the measured value.

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

6.12 *Temperature Sensor*, for measuring gas temperature in the range from 50 to 100°F (10 to 38°C), with an uncertainty of ±1°F (0.56°C).

6.13 *Strain Gage Welder*, capable of welding thermocouples to steel.[6]

7. Reagents and Materials

7.1 *Hamburger Patties*—A sufficient quantity of frozen hamburger patties shall be obtained from a meat purveyor to conduct the heavy- and light-load cooking tests. Specifications for the patties shall be four per pound, 20 ± 2 % fat (by weight), finished grind, pure beef patties with a moisture content between 58 and 62 % of the total hamburger weight. The prefrozen, ¼-lb (0.11-kg) patties shall be machine-prepared to produce ⅜-in. (9.5-mm) thick patties with a nominal diameter of 5 in. (127 mm).

NOTE 1—It is important to confirm by laboratory tests that the hamburger patties are within the above specifications because these specifications impact directly on cook time and energy consumption.

7.2 *Half-Size Sheet Pans*, measuring 18 by 13 by 1 in. (46 by 33 by 2.5 cm), for use in packaging frozen hamburger patties.

7.3 *Freezer Paper*—Waxed commercial grade, 18-in. (46-cm) wide.

7.4 *Plastic Wrap*—Commercial grade, 18-in. (46-cm) wide.

7.5 *Drip Rack*—Measuring 18 by 26 by 1 in. (46 by 66 by 2.5 cm), to hold a load of cooked hamburger patties in a single layer (that is, 24 patties for a 36 by 24-in. (91 by 61-cm) griddle).

8. Sampling and Test Units

8.1 *Griddle*—A representative production model shall be selected for performance testing.

9. Preparation of Apparatus

9.1 Install the appliance according to the manufacturer's instructions under a 4-ft (1.2-m) deep canopy exhaust hood mounted against the wall with the lower edge of the hood 78 in. (198 cm) from the floor. Position the griddle with the front edge of the cooking surface inset 6 in. (15 cm) from the front edge of the hood at the manufacturer's recommended working height. The length of the exhaust hood and active filter area shall extend a minimum of 6 in. (15 cm) past both sides of the griddle. In addition, both sides of the griddle shall be a minimum of 3 ft (0.9 m) from any side wall, side partition, or other appliance. The exhaust ventilation rate shall be 300 cfm per linear foot (460 L/s per linear metre) of hood length. (For example, a 3-ft (0.9-m) griddle shall be ventilated, at minimum, by a hood 4 by 4 ft (1.2 by 1.2 m) with a nominal air flow rate of 1200 cfm (1840 L/s). The application of a longer hood is acceptable, provided that the ventilation rate is maintained at 300 cfm per linear foot (460 L/s per linear metre) over the entire length of active hood.) Air flow rates and flow measurement procedures shall be reported. The associated heating or cooling system shall be capable of maintaining an ambient temperature of 75 ± 5°F (24 ± 2.8°C) within the testing environment when the exhaust ventilation system is working without the appliance being operated.

9.2 Connect the griddle to a calibrated energy test meter. For gas installations, a pressure regulator shall be installed downstream from the meter to maintain a constant pressure of gas for all tests. Both the pressure and temperature of the gas supplied to a griddle, as well as the barometric pressure, shall be recorded during each test so that the measured gas flow can be corrected to standard conditions. For electric installations, a voltage regulator may be required to maintain a constant nameplate voltage during all tests.

9.3 For a gas griddle, adjust (during maximum energy input) the gas supply pressure downstream from the appliance's pressure regulator to within ±2.5 % of the operating manifold pressure specified by the manufacturer. Make adjustments to the griddle following the manufacturer's recommendations for optimizing combustion. Proper combustion may be verified by measuring air-free CO in accordance with ANSI Z83.11.

9.4 For an electric griddle, confirm (while the griddle elements are energized) that the supply voltage is within ±2.5 % of the operating voltage specified by the manufacturer. Record the test voltage for each test.

NOTE 2—It is the intent of the test procedure herein to evaluate the performance of a griddle at its rated gas pressure or electric voltage. If an electric griddle is rated dual voltage (that is, designed to operate at either 208 or 240 V with no change in components), the voltage selected by the manufacturer or tester, or both, shall be reported. If a griddle is designed to operate at two voltages without a change in the resistance of the heating elements, the performance of the griddle (for example, the preheat time) may differ at the two voltages.

9.5 Make the griddle ready for use in accordance with the manufacturer's instructions. Temper the griddle cooking surface by following the procedures specified by the manufacturer. If not specified by the manufacturer, follow the procedures described in 9.5.1.

9.5.1 Heat the griddle surface to 375°F (191°C) as indicated by the thermostat settings. Coat the entire cooking surface with a salt-free cooking oil. Wipe off the oil residue after 5 min of heating. The griddle surface is now conditioned for testing.

10. Procedure

NOTE 3—Do not conduct griddle performance tests without operating the exhaust ventilation system.

10.1 *General*:

10.1.1 For gas griddles, record the following for each test run:

(1) Higher heating value,

[6] Eaton Model W1200 Strain Gauge Welder, available from Eaton Corp., 1728 Maplelawn Road, Troy, MI 48084, has been found satisfactory for this purpose.