



Standard Test Methods for Performance of Range Tops¹

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1. Scope

1.1 These test methods cover the energy consumption and cooking performance of range tops. The food service operator can use this evaluation to select a range top and understand its energy consumption.

1.2 These test methods are applicable to gas and electric range tops including both discreet burners and elements and hot tops.

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

1.3.1 Energy input rate (see 10.2), and

1.3.2 Pilot energy consumption (see 10.3).

1.3.3 Heat-up temperature response and temperature uniformity at minimum and maximum control settings (see 10.4),

1.3.4 Cooking energy efficiency and production capacity (see 10.5), and

1.3.5 Simmer energy consumption rate (optional, see 10.6).

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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.*

¹ These test methods are under the jurisdiction of ASTM Committee F26 on Food Service Equipment and are the direct responsibility of Subcommittee F26.06 on Productivity and Energy Protocol.

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2. Referenced Documents

2.1 ASTM Standards:²

A36/A36M Specification for Carbon Structural Steel
D3588 Practice for Calculating Heat Value, Compressibility Factor, and Relative Density of Gaseous Fuels

2.2 ASHRAE Standard:

ASHRAE Guideline 2-1986 (RA90) Thermal and Related Properties of Food and Food Materials³

3. Terminology

3.1 Definitions:

3.1.1 *cooking container*—a vessel used to hold the food product that is being heated by the cooking unit.

3.1.2 *cooking energy*—energy consumed by the cooking unit as it is used to raise the temperature of water in a cooking container under full-input rate.

3.1.3 *cooking energy efficiency*—quantity of energy input to the water expressed as a percentage of the quantity of energy input to the cooking unit during the full-input rate tests.

3.1.4 *cooking unit*—a heating device located on the range top that is powered by a single heat source comprised of either a gas burner or an electrical element that is independently controlled.

3.1.5 *energy input rate*—rate (Btu/h) at which an appliance consumes energy.

3.1.6 *heat-up temperature response*—temperature rise on the surface of a steel plate during the test period in accordance with the heat-up temperature-response test.

3.1.7 *production capacity*—maximum rate at which the cooking unit heats water in accordance with the cooking energy-efficiency test.

3.1.8 *production rate*—rate at which the cooking unit heats water in accordance with the cooking energy-efficiency test.

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 See *ASHRAE Handbook of Fundamentals*, Chapter 30, Table I, 1989, available from American Society of Heating, Refrigeration, and Air-Conditioning Engineers, 1791 Tullie Circle NE, Atlanta, GA 30329.

3.1.9 *range top*—a device for cooking food by direct or indirect heat transfer from one or more cooking units to one or more cooking containers.

3.1.10 *simmer*—maintaining liquid in a cooking container at a high steady-state temperature.

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

4. Summary of Test Methods

4.1 The range top to be tested is connected to the appropriate metered energy source. The energy input rate is determined for each type of cooking unit on the range top and for the entire range top (all cooking units operating at the same time) to confirm that the range top is operating within 5.0 % of the nameplate energy input rate. The pilot energy consumption is also determined when applicable to the range top being tested.

4.2 Energy consumption and time are monitored as each different type of cooking unit on the range top is used to heat water from 70°F to 200°F (21°C to 93°C) at the full-energy input rate. Heat-up energy efficiency and production capacity are calculated from this data.

4.3 Energy consumption and time are monitored as each different type of cooking unit on the range top is used to maintain water at an average 200°F $\pm$ 3°F (93°C $\pm$ 1.7°C) for 30 min at a steady input rate. Simmer energy is calculated from this data.

5. Significance and Use

5.1 The energy input rate test is used to confirm that the range top under test is operating at the manufacturer's rated input. This test would also indicate any problems with the electric power supply or gas service pressure.

5.2 The heat transfer characteristics of a cooking unit can be simulated by measuring the temperature uniformity of a steel plate.

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

5.4 The heat-up energy efficiency is a direct measurement of range top efficiency at the full-energy input rate and simmer energy is a measurement of the range top efficiency while maintaining operational temperature. This data can be used by food service operators in the selection of range tops, as well as for the management of a restaurant's energy demands.

NOTE 1—The PG&E Food Service Technology Center has determined that the cooking energy efficiency does not significantly change for different input rates. If precise efficiency calculations are desired at lower input rates, the full-input rate test procedure is valid for all input rates (that is, less than full-input).

5.5 Production rate and production capacity can be used to estimate the amount of time required for food preparation and as a measure of range top capacity. This helps the food service operator match a range top to particular food output requirements.

6. Apparatus

6.1 *Analytical Balance Scale*, for the determination of water and cooking container weight, with a resolution of 0.01 lb (5 g).

6.2 *Barometer*, for measuring absolute atmospheric pressure, to be used for adjustment of measured natural gas volume to standard conditions. The barometer shall have a resolution of 0.2 in. Hg (670 Pa).

6.3 *Cooking Container*, 13-in. (330-mm) diameter, 20-qt (19-L), sauce pot with matching lid. The bottom of the pot shall be flat to within 0.0625 in. (1.6 mm) over the diameter.

6.3.1 The recommended cooking container for all testing shall be a professional standard weight Wear Ever Model 4333 sauce pot with a Wear Ever Model 4193 lid.⁴ If it is not possible to use the recommended cooking container for testing, then a cooking container with a similar capacity may be substituted. The cooking container capacity should be no less than 12-qt and no more than 24-qt. The cooking container may be aluminum or steel. The weight of the substituted cooking container and lid must be noted and included in 11.7.1.

NOTE 2—The recommended aluminum sauce pot may not always be a suitable cooking container. For example, an electric induction range top requires that the cooking container be magnetic, typically steel or stainless steel plated nickel. For this reason 6.3.1 is included for flexibility.

6.4 *Canopy Exhaust Hood*, 4 ft (1.2 m) in depth, wall-mounted with the lower edge of the hood 6½ ft (2.0 m) from the floor and with the capacity to operate at a nominal exhaust ventilation rate of 300 ft³/min/linear foot (230 L/s/linear metre) of active hood length. This hood shall extend a minimum of 6 in. (150 mm) past both sides of the cooking appliance and shall not incorporate side curtains or partitions.

6.5 *Gas Meter*, for measuring the gas consumption of a range top, shall be a positive displacement type with a resolution of at least 0.1 ft³ (0.003 m³) and a maximum error no greater than 1 % of the measured value for any demand greater than 2.2 ft³/h (0.06 m³/h). If the meter is used for measuring the gas consumed by the pilot lights, it shall have a resolution of at least 0.1 ft³ (0.003 m³) and have a maximum error no greater than 2 % of the measured value.

6.6 *Pressure Gage*, for monitoring natural gas pressure, with a range from 0 to 10 in. H₂O (0 to 2.5 kPa), a resolution of 0.5 in. H₂O (125 Pa), and a maximum uncertainty of 1 % of the measured value.

6.7 *Steel Plate*, composed of structural-grade carbon steel in accordance with Specification A36/A36M, free of rust or corrosion, 12-in. (300-mm) diameter, and ¼ in. (6.4 mm) thick. The plate shall be flat to within 0.010 in. (3 mm) over the diameter.

⁴ The sole source of supply of the apparatus known to the committee at this time is The Vollrath Company, LLC., 1236 N. 18th Street, Sheboygan, WI 53081. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.