



Standard Test Methods for Performance of Steam Cookers¹

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1. Scope

1.1 These test methods evaluate the energy consumption and cooking performance of steam cookers. The food service operator can use this evaluation to select a steam cooker and understand its energy consumption.

1.2 These test methods are applicable to the following steam cookers: high-pressure, low-pressure, pressureless and vacuum steam cookers (Specification F1217 Grades A, B, C and D); convection and non-convection steam cookers; steam cookers with self-contained gas-fired, electric, or steam coil steam generators, and those connected directly to an external potable steam source (Specification F1217 Styles i, ii, iii, and iv). The steam cookers will be tested for the following (where applicable):

- 1.2.1 Maximum energy input rate (see 10.2).
- 1.2.2 Preheat energy consumption and duration (see 10.3).
- 1.2.3 Idle energy rate (see 10.5).
- 1.2.4 Pilot energy rate (see 10.6).
- 1.2.5 Frozen green pea cooking energy efficiency (see 10.8).
- 1.2.6 Frozen green pea production capacity (see 10.8).
- 1.2.7 Whole potato cooking energy efficiency (see 10.9).
- 1.2.8 Whole potato production capacity (see 10.9).
- 1.2.9 Water consumption (see 10.7, 10.9, and 10.10).
- 1.2.10 Condensate temperature (see 10.8 and 10.9).
- 1.2.11 Cooking uniformity (see 10.11).

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

1.4 *This standard may involve hazardous materials, operations, and equipment. It does not 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.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standard-*

ization 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

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

F1217 Specification for Cooker, Steam

2.2 ASHRAE Documents:³

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

ASHRAE Handbook of Fundamentals Thermodynamic Properties of Water at Saturation, Chapter 6, Table 2, 1989

2.3 Other Document:⁴

Development and Application of a Uniform Testing Procedure for Steam Cookers

3. Terminology

3.1 Definitions:

3.1.1 *boiler, n*—self-contained vessel, separate from the cooking cavity, wherein water is boiled to produce steam for the steam cooker. Also called a steam generator.

3.1.2 *condensate, n*—mixture of condensed steam and cooling water, exiting the steam cooker and directed to the floor drain.

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

3.1.4 *cooking energy rate, n*—average rate of energy consumption (kBtu/h or kW) during the cooking energy efficiency test. Refers to any loading scenario in the green pea or potato load tests.

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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 Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., 1791 Tullie Circle, NE, Atlanta, GA 30329.

⁴ Available from the Food Service Technology Center, 12949 Alcosta Blvd., #101, San Ramon, CA 94583.

3.1.5 *electric energy rate, n*—refers to rate of electric energy consumption (kW) by steam cookers whose primary fuel source is not electricity (for example, gas). Electric energy is measured and reported separately from the primary fuel energy so that the respective fuel prices can be applied to estimate energy costs.

3.1.6 *green pea load, n*—12 by 20 by 2½ in. (300 by 500 by 65 mm) perforated hotel pan filled with 8.0 ± 0.01 lb ($3.6 \pm .005$ kg) of fresh-frozen, grade A, green peas.

3.1.7 *high-pressure steam cooker, n*—steam cooker wherein cooking compartment operates between 10 and 15 psig (Specification F1217 Classification Grade C).

3.1.8 *idle energy rate, n*—rate of energy consumed by the steam cooker while maintaining the boiler or reservoir at a manufacturer-defined operating pressure or temperature with no cooking taking place.

3.1.9 *low-pressure steam cooker, n*—steam cooker wherein cooking compartment operates between 3 and 9.9 psig (Specification F1217 Classification Grade B).

3.1.10 *maximum energy input rate, n*—peak rate at which an appliance consumes energy, typically reflected during preheat.

3.1.11 *pilot energy rate, n*—rate of energy consumption (kBtu/h) by a gas steam cooker's standing pilot (if applicable).

3.1.12 *potato load, n*—one 12 by 20 by 2½ in. (300 by 500 by 65 mm) perforated hotel pan filled with 50 ± 2 fresh, whole, US No. 1, size B, red potatoes, weighing 8.0 ± 0.2 lb (3.6 ± 0.1 kg).

3.1.13 *preheat, n*—process of bringing the steamer (boiler) water from city supply temperature to operating temperature (pressure).

3.1.14 *preheat duration, n*—total time required for preheat, from preheat initiation at controls to when the steam cooker is ready to cook.

3.1.15 *preheat energy, n*—amount of energy consumed by the steam cooker during a preheat.

3.1.16 *pressureless steam cooker, n*—steam cooker wherein cooking compartment operates between 0 and 2.9 psig (Specification F1217 Classification Grade A).

3.1.17 *production capacity, n*—maximum rate (lb (kg)/h) at which steam cooker can bring the specified food product to a specified “cooked” condition.

3.1.18 *production rate, n*—rate (lb (kg)/h) at which steam cooker brings the specified food product to a specified “cooked” condition. Does not necessarily refer to maximum rate. The production rate varies with the loading scenario and the amount of product being cooked.

3.1.19 *steam cooker, n*—cooking appliance wherein heat is imparted to food in a closed compartment by direct contact with steam. The compartment can be at or above atmospheric pressure. The steam can be static or circulated.

3.1.20 *water consumption, n*—water consumed by the steam cooker. Includes both water used in the production of steam and cooling water (if applicable) for condensing/cooling un-used steam.

4. Summary of Test Method

4.1 The maximum energy input rate is determined to check whether the steam cooker is operating properly. If the measured input rate is not within 5 % of the rated input, all further testing ceases and the manufacturer is contacted. The manufacturer may make appropriate changes or adjustments to the steam cooker.

4.2 The energy and time required to preheat the steamer to an operating condition are determined.

4.3 Idle energy rate is determined for the steamer while it is maintaining operating pressure or temperature when no cooking is taking place.

4.4 Pilot energy rate is determined when applicable to a gas fired steam cooker under test.

4.5 Green pea cooking energy efficiency is determined by cooking a capacity number of frozen green pea loads from 0 to 180°F (–18 to 82°C).

4.6 Whole potato cooking energy efficiency is determined by cooking a capacity number of fresh whole potatoes to a specified doneness.

4.7 Green pea load and whole potato load production capacities (lb_{pea}/h or lb_{potato}/h (kg_{pea}/h or kg_{potato}/h)) are determined by the respective cooking energy efficiency tests.

4.8 Water consumption (gal/h (L/h)) is monitored during all cooking energy efficiency tests to determine the rate of water usage.

4.9 Condensate temperature is monitored during all cooking energy efficiency tests.

4.10 The uniformity of heating within the steamer's compartment is determined and reported based on the average temperature on each pan during ice load cooking tests (pans of ice simulating pans of frozen food).

5. Significance and Use

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

5.2 Preheat energy and duration can be useful to food service operators for managing power demands and knowing how quickly the steam cooker can be ready for operation.

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

5.4 Green pea cooking energy efficiency is an indicator of steam cooker energy performance when cooking frozen products under various loading conditions. This allows the food service operator to consider energy costs when selecting a steam cooker.

5.5 Potato cooking energy efficiency is an indicator of steam cooker energy performance when cooking foods that require long cook times (for example, potatoes, beans, rice, lasagna or casserole rethermalization). The test demonstrates the difference in energy efficiency between pressure and pressureless