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An American National Standard

Standard Test Method for Performance of a Pasta Cooker[1]

This standard is issued under the fixed designation F 1784; 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 covers the energy consumption and cooking performance of floor-model and countertop pasta cookers. The food service operator can use this evaluation to select a pasta cooker and understand its energy consumption and production capacity.

1.2 This test method is applicable to floor and countertop model gas and electric units with 1000 to 4000-in.[3] cooking capacity. Cooking capacity is a measurement of available cooking volume. The depth of the cooking capacity is measured from the heating elements or heat transfer surface, or both, to the water fill line. The width is measured from the inside edge of the cooking vat across to the other inside edge of the cooking vat. The length is measured from the front inside edge of the cooking vat to the rear inside edge of the cooking vat.

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

1.3.1 Energy input rate (11.2),

1.3.2 Water-boil efficiency (11.3),

1.3.3 Preheat energy consumption, time, and rate (11.4),

1.3.4 Idle/simmer (11.5),

1.3.5 Pilot energy rate (11.6), and

1.3.6 Pasta cooking preparation (11.7).

1.4 This test method is not intended to answer all performance criteria in the evaluation and selection of a pasta cooker.

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

1.6 *This test method 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 *ASHRAE Documents:*

1989 ASHRAE *Handbook of Fundamentals*, Chapter 6, Table 2—Thermodynamic, Chapter 6, Table 2—Thermodynamic Properties of Water at Saturation[2]

ASHRAE Guideline 2—1986 (RA90), Engineering Analysis of Experimental Data, American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc.[2]

2.2 *AOAC Documents:*

AOAC 984.25 Moisture (Loss of Mass on Drying) in Frozen French Fried Potatoes[3]

AOAC 983.23 Fat in Foods: Chloroform-Methanol Extraction Method[3]

2.3 *ANSI Standard:*

ANSI Z83.13 Gas Food Service Equipment

3. Terminology

3.1 *Definitions:*

3.1.1 *auto-fill*, *n*—a water height sensor devise that activates a fresh water fill solenoid if the water level in the cooking vessel drops below predetermined height.

3.1.2 *overflow drain*, *n*—a drain for eliminating the excess foam and starch created during the cooking process.

3.1.3 *pasta cooker*, *n*—an appliance, including a cooking vessel, in which water is placed to such a depth that the cooking food is essentially supported by displacement of the water rather than by the bottom of the vessel. Heat is delivered to the water by means of an immersed electric element or band wrapped vessel (electric pasta cooker), or by heat transfer from gas burners through either the walls of the pasta cooker or through tubes passing through the water (gas pasta cooker).

3.1.4 *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.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *cold water bath*, *n*—a container filled with 60 to 80°F (15.6 to 26.7°C) water, that is used to cool the cooked pasta to stop the cooking process. The water bath needs enough water capacity to be able to completely cover the cooked pasta when a pasta basket is submerged into the cold water bath.

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

[3] Official Methods of Analysis of the Association of Official Analytical Chemists. Available from the Association of Official Analytical Chemists, 1111 N. 19th St., Arlington, VA 22209.

3.2.2 *energy input rate, n*—peak rate at which a pasta cooker consumes energy (Btu/h or kW).

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

3.2.4 *production capacity, n*—maximum rate (lb/h (kJ/h)) at which a pasta cooker can bring the specified food product to a specified "cooked" condition.

3.2.5 *production rate, n*—average rate (lb/h (kJ/h)) at which a pasta cooker brings the specified food product to a specified "cooked" condition. This does not necessarily refer to maximum rate.

3.2.6 *test, n*—a set of three loads of pasta cooked in a prescribed manner and sequential order.

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

3.2.8 *water-boil efficiency, n*—quantity of energy (latent heat of vaporization) required to boil water from the pasta cooker, expressed as a percentage of the quantity of energy input to the pasta cooker during the boil-off period.

3.2.9 *working capacity*—the calculated capacity of the manufacturer's cooking baskets as determined by a specified method of calculation.

4. Summary of Test Method

4.1 All of the pasta cooking tests shall be conducted with the pasta cooker installed under a wall-mounted canopy exhaust ventilation hood that shall operate at an airflow based on 300 cfm/linear ft (460 L/s/linear m) of hood length. Additionally, an energy supply meeting the manufacturer's specification shall be provided for the gas or electric pasta cooker under test.

4.2 The pasta cooker 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 testing.

4.3 The pasta cooker is place on a platform scale and operated with a known weight of water contained in the pasta cooker and the thermostat(s) set to the maximum setting. After a specified weight of water was boiled off, the water-boil efficiency is calculated.

4.4 The water temperature in the cooking zone of the pasta cooker is monitored at a location chosen to represent the average temperature of the water while the pasta cooker maintains a specified cooking temperature. The pasta cooker's thermostat is calibrated to achieve the calculated simmer/idle temperature at a location chosen to represent the average temperature of the water while the pasta cooker is maintaining the idle condition.

4.5 Preheat energy, time, and rate are determined while the pasta cooker is operated with the thermostat(s) are set to specified temperature. The idle/simmer/energy are determined while the pasta cooker operated with the thermostat(s) are set to specified idle temperature. The rate of pilot energy consumption also is determined when applicable to the pasta cooker under test.

4.6 Energy consumption and time are monitored while the pasta cooker is used to cook three loads of dry, 0.072 ± 0.004 in. in diameter spaghetti pasta to a condition of 125 ± 3 % weight gain with the thermostat(s) set at a calibrated cooking temperature. Production capacity is based on the largest pasta load.

5. Significance and Use

5.1 The energy input rate test is used to confirm that the pasta cooker under test is operating in accordance with its nameplate rating.

5.2 Water-boil efficiency is a quick indicator of pasta cooker energy efficiency performance under boiling conditions. This information enables the food service operator to consider energy efficiency performance when selecting a pasta cooker.

5.3 The pasta cooker temperature calibration is used to ensure that the pasta cooker being tested is operating at the specified temperature. Temperature calibration also can be used to evaluate and calibrate the thermostat control dial(s).

5.4 Preheat energy and time can be useful to food service operators to manage energy demands and to estimate the amount of time required for preheating a pasta cooker.

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

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

6. Apparatus

6.1 *Analytical Balance Scale*, for measuring weights up to 10 lb, with a resolution of 0.01 lb (0.004 kg) and an uncertainty of 0.01 lb.

6.2 *Barometer*, for measuring absolute atmospheric pressure, to be used for adjustment of measured gas volume to standard conditions. Shall have a resolution of 0.2 in. Hg (670 Pa) and an uncertainty of 0.2 in. Hg.

6.3 *Canopy Exhaust Hook*, 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/linear ft (460 L/s/linear m) 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.

6.4 *Convection Drying Oven*, with temperature controlled at 220 ± 5°F (100 ± 3°C), used to determine moisture content of both the dry and cooked pasta.

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

6.6 *Flowmeter*, for measuring total water consumption of the appliance. Shall have a resolution of 0.01 gal and an uncertainty of 0.01 gal at a flow rate as low as 0.2 gpm.

6.7 *Gas Meter*, for measuring the gas consumption of a pasta cooker, shall be a positive displacement type with a resolution of at least 0.01 ft^3(0.0003 m^3) and a maximum uncertainty no greater than 1 % of the measured value for any demand greater than 2.2 ft^3(0.06 m^3)/h. If the meter is used for measuring the gas consumed by the pilot lights, it shall have a

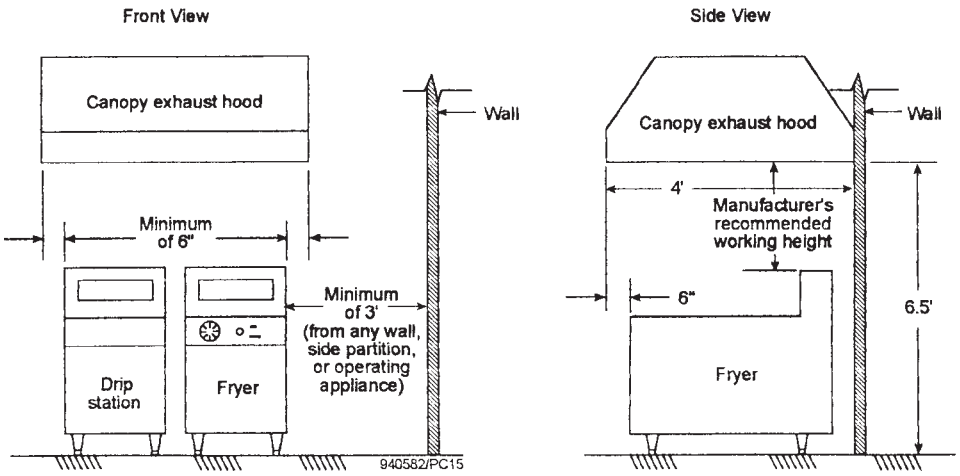

FIG. 1 Equipment Configuration

resolution of at least 0.01 ft^3 and a maximum uncertainty no greater than 2 % of the measured value.

6.8 *Platform Balance Scale*, or appropriate load cells, used to measure the loss of water from the pasta cooker during water boil test. The scale shall have a capacity to accommodate the total weight of the pasta cooker plus 200 lb (90.7 kg) of water, and shall have a precision of 0.2 lb (10 g) and an uncertainty of 0.2 lb when used to measure the loss of water from the pasta cooker.

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

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

6.11 *Thermocouple Probe(s)*, industry standard Type *T* or Type *K* thermocouples capable of immersion, with a range from 50 to 400°F and an uncertainty of ±1°F (±0.56°C).

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

6.13 *Pasta Cooker Baskets*, supplied by the manufacturer of the pasta cooker under testing. A total of three baskets is required to test each pasta cooker in accordance with these procedures.

6.14 *Watt-Hour Meter*, for measuring the electrical energy consumption of a pasta cooker, shall have 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 %.

7. Reagents and Materials [4]

7.1 *Water*, having a maximum hardness of three grains per gallon. Distilled water may be used.

7.2 *Deionized or Distilled Water*, Shall be used for the water-boil efficiency test, with a conductivity of no greater than 100 mΩ.

7.3 *Pasta Noodles*, will be a dry-type spaghetti shape. The spaghetti shall be manufactured from 100 % durum semolina wheat. The spaghetti diameter shall be 0.072 ± 0.004 in., with a specified initial moisture content (10 ± 2 %).

NOTE 1—Borden® Prince line is 100 % durum semolina wheat spaghetti-shape pasta and has been shown to be an acceptable product for testing by PG & E's Food Service Technology Center.

8. Sampling

8.1 *Pasta Cooker*—Select a representative production model for performance testing.

9. Preparation of Apparatus

9.1 Measure the pasta cookers vat's cooking capacity. The pasta cooker's cooking vat may be shaped in such a way that simple measurements do not yield the true cooking capacity. In this case fill the pasta cooker with water till the bottom edge of the cooking capacity is reached. Then measure the volume of water required to fill the cooking capacity to the top.

9.2 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 6 ft, 6 in. (1.98 m) from the floor. Position the pasta cooker with the front edge of the water in the cooking vat inset 6 in. (152 mm) 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. (152 mm) past the vertical plane of both sides of the pasta cooker. In addition, both sides of the pasta cooker shall be a minimum of 3 ft (0.9 m) from any side wall, side partition, or other operating appliance. A drip and cold bath station position next to the pasta cooker is recommended. Equipment configuration is shown in Fig. 1. The exhaust ventilation rate shall be 300 cfm/linear ft (460 L/s/linear m) of hood length. The associated heating or cooling system shall be capable of maintaining an ambient temperature of 75 ± 5°F (24 ± 3°C) within the testing environment when the exhaust ventilation system is operating.

9.3 Connect the pasta cooker to a calibrated energy test meter. For gas installations, install a pressure regulator downstream from the meter to maintain a constant pressure of gas for all tests. Install instrumentation to record both the pressure

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

and temperature of the gas supplied to the pasta cooker and the barometric pressure during each test so that the measured gas flow can be corrected to standard conditions. For electric installations, a voltage regulator may be required during tests if the voltage supply is not within ±2.5 % of the manufacturer's nameplate voltage.

9.4 For an electric pasta cooker, while the pasta cooker elements are energized, confirm 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—If an electric pasta cooker is rated for dual voltage, for example, 208/240 V, the pasta cooker shall be evaluated as two separate appliances in accordance with this test method. It is the intent of the testing procedure herein to evaluate the performance of a pasta cooker at its rated gas pressure or electric voltage. If an electric pasta cooker 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 pasta cooker is designed to operate at two voltages without changing the resistance of the heating elements, the performance of the pasta cooker, for example, preheat time, may differ at the two voltages.

9.5 For a gas pasta cooker, during maximum energy input, adjust 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 pasta cooker following the manufacturer's recommendations for optimizing combustion. Proper combustion may be verified by measuring air-free CO in accordance with ANSI Z83.13.

9.6 Make the pasta cooker ready for use in accordance with the manufacturer's instructions. Clean the pasta cooker by boiling with the manufacturer's recommended cleaner and water and then rinsing the inside of the cooking-vat thoroughly before starting each test procedure.

9.7 To prepare apparatus for conducting the water-boil efficiency test, place the pasta cooker on a platform balance scale, or load cells, located under the exhaust ventilation hood described in 9.1. The scale, or load cells, shall not reduce the distance between the cooking surface and the lower edge of the exhaust hood by more than 8 in. (200 mm) for the water-boil test than for the cooking test.

9.8 To prepare the pasta cooker for temperature calibration, attach an immersion-type thermocouple in the cooking vat before beginning any test. The thermocouple used to calibrate the pasta cooker shall be located in the back of the cooking vat, about ½ in. (13 mm) from the back edge of the cooking vat, ½ in. (13 mm) above the heat transfer area or elements, or both, and located in the center in relation to the sides of the cooking vat.

9.9 Fresh water supply to pasta cooker should be monitored to ensure that the water temperature is 65 ± 5°F (18 ± 3°C).

9.10 Install the flowmeter to the pasta cooker water inlet such that the total water flow to the appliance is measured.

9.11 For all tests, record the altitude of the testing facility.

10. Calibration

10.1 Fresh water temperature supplied to the pasta cooker shall be 65 ± 5°F (18 ± 3°C).

NOTE 3—If the fresh water temperature is not within the specified temperature, mix the supply water with hot or cold sources to meet the desired temperature. The supply water can be tempered to obtain the proper supply water temperature.

NOTE 4—The manufacturer may have a calibration procedure that may give some insight into their thermostatic control strategy. The manufacturer's calibration procedure may be used initially to help in the calibration of the cooking temperature. After applying the manufacturer's calibration procedure confirm calibration with 10.2.

10.2 Ensure the pasta cooker water is loaded to the indicated fill line. Preheat and allow the pasta cooker to stabilize for 30 min before beginning temperature calibration.

10.3 The pasta cooker water temperature shall be measured by attaching a calibrated immersion thermocouple type in the rear of the cooking zone as detailed in 9.8. Adjust the pasta cooker temperature control(s) to achieve a rolling boil. Record the water temperature over a 1-h period to verify temperature of the water at the rolling boil condition. The water temperature recorded over the 1-h period shall be considered as the average temperature for the pasta cooker.

10.4 Report on pasta cooker temperature calibration in accordance with Section 12.

10.5 To determine the idle/simmer temperature, subtract seven degrees Fahrenheit from the calibrated pasta cooking temperature (rolling boil temperature determined in 10.3).

NOTE 5—Boiling temperature is a function of altitude and can be less than 212°F. The intent of this test procedure is to idle/simmer at the same differential temperature for all altitudes.

10.6 Adjust the pasta cooker temperature control(s) to achieve the calculated idle/simmer temperature in 10.5. The water temperature recorded over three completed thermostat cycles at this point shall be considered as the average temperature for the pasta cooker. If the average temperature is not ±2°F (±1°C) of the calculated idle/simmer temperature in 10.5, repeat adjustment of the pasta cooker temperature control(s) until the pasta cooker vat temperature is within 2°F.

10.7 Record the temperature achieved in 10.6 as the idle/simmer temperature.

11. Procedure

11.1 *General*:

11.1.1 For gas appliances, record the following for each test run:

11.1.1.1 Higher heating value;

11.1.1.2 Standard gas pressure and temperature used to correct measured gas volume to standard conditions;

11.1.1.3 Measured gas temperature;

11.1.1.4 Measured gas pressure;

11.1.1.5 Barometric pressure; and,

11.1.1.6 Energy input rate during or immediately prior to test.

NOTE 6—The preferred method for determining the heating value of the gas supplied to the pasta cooker under test is by using a calorimeter or gas chromatograph in accordance with accepted laboratory procedures. The use of bottled natural gas with a certified heating value within the specified 1025 ± 25-Btu/ft^3(38160 ± 930-kJ/m^3) range is an acceptable alternative.

11.1.2 For a gas pasta cooker, add electric energy consumption to gas energy for all tests, with the exception of the energy input rate test (see 11.2).

11.1.3 For an electric pasta cooker, record the following for each run of each test run:

11.1.3.1 Voltage while elements are energized; and,

11.1.3.2 Energy input rate during or immediately prior to the test run.

11.1.4 For each test run, confirm that the peak input rate is within ±5 % of the rated nameplate input. If the difference is greater than 5 %, terminate testing and contact the manufacturer. The manufacturer may make appropriate changes or adjustments to the pasta cooker.

11.1.5 For all tests, record the altitude of the testing facility.

11.1.6 For all tests maintain water level at the indication line. If the pasta cooker has no indication line, then maintain the water level to the manufacturer's recommended capacity at all times.

11.2 *Measured Energy Input Rate*:

11.2.1 Load the pasta cooker to the indicated fill line with fresh water, and turn the pasta cooker on with the temperature control(s) set to the maximum setting.

11.2.2 Let the pasta cooker run for a period of 15 min, then monitor the time required for the pasta cooker to consume 5 ft^3(0.14 m^3) of gas. Adjustments to the input rate may be made by adjusting the gas manifold pressure (gas pasta cooker).

11.2.3 In accordance with 12.4, calculate the measured energy input rate for the pasta cooker under test. Report and compare the measured input to the nameplate energy input rate in Btu/h or kW. Confirm that the measured input rate is within ±5 % of the rated nameplate energy input rate. If the difference is greater than ±5 %, testing shall be terminated and the manufacturer contacted. The manufacturer may make appropriate changes or adjustments to the pasta cooker. Also the power supply may be changed, if necessary, to conform with the manufacturer's specifications. It is the intent of this test method to evaluate the performance of a pasta cooker at its rated energy input rate.

11.3 *Water-Boil Efficiency Determination*:

11.3.1 The water-boil efficiency test is to be run a minimum of three times (see Annex A1). Additional test runs may be necessary to obtain the required precision for the reported test results. The minimum three test runs shall be run on the same day within the shortest time possible.

11.3.2 Tare the pasta cooker on a balance scale or load cell(s) with a precision of 0.1 lb (50 g) calibrated to an accuracy of ±0.5 %, taking care that gas hoses or wires do not interfere with any weight readings.

11.3.3 Fill the pasta cooker with water to a level which covers all heat transfer surfaces or electric elements by at least 1.0 in. (25 mm). Note the weight of water. Continue filling the pasta cooker to the fill line and note this weight. Add an additional 5 lb (2.3 kg) of water.

NOTE 7—Some pasta cookers may be equipped with overflow drains that allow excess starch from the pasta to drain out of the cooking vat. If equipped with an overflow drain, plug the overflow drain in the vat with a test tube stopper or appropriate device to prevent drainage during the water-boil test.

11.3.4 Set the thermostat(s) on the pasta cooker at the maximum setting so that the burner(s) or element(s) will operate continuously. Bring the water to a boil. Proceed to boil off the 5 lb (2.3 kg) of water that was added above the fill line. When the weight of the boiling water in the pasta cooker equals the weight recorded at the fill line, simultaneously begin recording the time, weight loss of water, and energy consumption.

11.3.5 Continue boiling until the weight of water remaining in the pasta cooker equals the weight of water that covered the heat transfer surface or electric elements by 1.0 in. (25 mm). Note the final time, weight, and energy consumed. Record the barometric pressure during the test (to be used to determine the applicable heat of vaporization from the 1989 ASHRAE Handbook of Fundamentals. Also, measure and record all electric energy consumed by gas pasta cookers during the test.

NOTE 8—Some pasta cookers are equipped with low water sensor(s) to prevent boiling all of the water from the cooking vat. If equipped with low water sensor(s), the burner(s) or element(s) may turn off before the weight of the water that covered the heat transfer surface or electric elements by 1.0 in. (25 mm) has been reached. In this case monitor energy and weight loss until the burner(s) or element(s) turn off.

11.4 *Preheat-Energy Consumption, Time, and Rate*:

11.4.1 Ensure that the pasta cooker is filled to the indicated fill line, or if no indication line, then fill to the manufacturer's recommended water level. Record water temperature, barometric pressure, and ambient kitchen temperature at the start of the test. Water temperature shall be 65 ± 5°F (21 ± 3°C at the start of the test.

NOTE 9—The preheat test should be conducted prior to appliance operation on the day of the test. If another preheat is to conducted after the appliance has been preheated earlier, the pasta cooker mass temperature will need to be stabilized. Fill the pasta cooker with fresh water and allow the water in the cooking vat to stabilize at room temperature for at least 30 min. Drain the water from the pasta cooker and begin testing in accordance with 11.4.1.

11.4.2 Turn the pasta cooker on with the temperature controls set to attain the cooking temperature calibrated in Section 10.

NOTE 10—It is the intent of this test method to test the appliance at the cooking temperature calibrated in Section 10. If the appliance is unable to achieve the cooking temperature, then the manufacturer needs to be contacted. The manufacturer may make appropriate changes or adjustments to the pasta cooker.

11.4.3 Begin monitoring energy consumption and time as soon as the pasta cooker is turned on. The preheat period is measured from 75 to 200°F. Use the preheat energy consumption and time from 75 to 200°F for preheat energy consumption and elapsed time.

11.5 *Idle/Simmer Energy Rate*:

11.5.1 Ensure that the pasta cooker is filled to the indicated fill line or manufacturer's recommended water level. Record the barometric pressure and ambient kitchen temperature at the start of the test.

11.5.2 Allow the pasta cooker water to stabilize at calibrated idle/simmer temperature for at least 30 min after the last thermostat has commenced cycling about the thermostat set point.

11.5.3 Record the pasta cooker water temperature, barometric pressure, and ambient temperature at the start of the test.

11.5.4 Proceed to monitor the elapsed time and the energy consumption of the pasta cooker while it is operated under this idle/simmer condition for a minimum of 2 h.

11.6 *Pilot Energy Rate (Gas Models with Standing Pilots)*:

11.6.1 Where applicable, set gas valve controlling gas supply to appliance at the pilot position. Otherwise set the pasta temperature controls to the off position.

11.6.2 Light and adjust the pilots in accordance with the manufacturer's instructions.

11.6.3 Record gas reading, gas temperature, gas pressure, ambient temperature, barometric pressure, electric energy consumed, and time before and after a minimum of 8 h of pilot operation.

11.7 *Pasta Cooking Preparation*:

11.7.1 All cooking tests are to be conducted using dry spaghetti, 100 % semolina wheat pasta, 0.072 ± 0.004 in. in diameter. Moisture content of the pasta should be 10 ± 2 % by weight. This composition data can be provided by the manufacturer or determined using appropriate AOAC test methods (see 2.2).

11.7.2 For this test method, the working capacity (volume) of the manufacturer's cooking baskets needs to be determined. To determine the dry pasta cooking load size (in pounds), the working capacity (volume units of cubic inches) of the manufacturer's cooking basket needs to be multiplied by 0.009, which will yield the cooking load size in pounds of dry pasta. First measure the baskets as follows. All length measurements shall be done in inches. Fill the pasta cooker with water to the indication line. If no indication line, then fill to the manufacturer's recommend water level. Place the manufacturer's cooking basket in the pasta cooker. Measure the width of the basket, from the inside edge of one side of the basket across to the other inside edge of the basket. Measure the length of the basket from the inside edge across to the inside edge of the other side of the basket. The working depth is measured from the bottom of the basket to the top of the water surface. Make sure this measurement is with the basket submersed in the water of the pasta cooker. Multiply the width times the length times the working depth to calculate the working capacity ($inches^3$).

NOTE 11—The spaghetti strands may need to be broken in half to fit within pasta baskets. Before preparing dry pasta for the cooking tests, check to see how the pasta will lay in the basket(s). It is recommended that the pasta be layered in the basket, with each layer perpendicular to the previous layer. Several layers will be required to fill the basket.

11.7.3 The loads to be prepared for the cook-time determination test (see 11.8) will vary with the number of trials needed to establish a cooking time that demonstrates a 125 ± 3 % pasta weight gain during cooking. When cooking the three loads of the cooking-time determination test, the weight loss may vary slightly. If the estimated cooking time does not yield a 125 ± 3 % weight gain averaged over the three-load cooking-time determination test, the cooking time shall be adjusted and the three-load cooking-time determination test shall be repeated. If repeating the three load cook-time determination test, then ensure that the cooking vat has been completely replenished with fresh water for the new test.

11.7.4 Ensure that pasta cooker water is loaded to the indicated pasta cooker fill line, or, if there is no fill line, then fill to the manufacturer's recommended water level. Confirm that the pasta cooker water temperature is set to boiling as calibrated in 10.3. Allow the pasta cooker to stabilize for 30 min after being preheated.

11.7.5 All test loads will be cooked in preconditioned pasta cooker baskets held at room temperature (75 ± 5°F (24 ± 3°C)) prior to being loaded with the dry pasta. The pasta baskets shall be clean and moisture free. The baskets shall remain at room temperature throughout the cooking time determination test and production capacity test. The baskets should be cleaned after each cooking load.

11.8 *Cooking-Time Determination*:

11.8.1 Ensure that pasta cooker water is loaded to the indicated pasta cooker fill line, or, if there is no fill line, then fill to the manufacturer's recommended water level. Confirm that the pasta cooker water temperature is at its cooking temperature as calibrated in 10.3. Allow the pasta cooker to stabilize for 30 min after being preheated. Fill the cold water bath with water cold enough to maintain a temperature of 60 to 80°F.

11.8.2 Cook the first of the 6-lb loads of dry pasta with an estimated cook time. Vigorously stir the cooking pasta every 2 min. The duration for stirring should be 30 s long. If there is no water auto-fill, fill the pasta cooker with fresh water, 65 ± 5°F (18 ± 3°C), as needed during the test to maintain the water level in the pasta cooker to the manufacturer's recommended cooking water level.

NOTE 12—During the cooking-time determination and cooking energy consumption tests, vigorous stirring of the pasta in the basket(s) may move the basket(s) around in the pasta vat and cause the basket(s) to rub against the cooking zone temperature thermocouple. This contact between the temperature thermocouple and basket(s) may cause erroneous temperature readings. If contact happens, the thermocouple should be repositioned to eliminate this contact.

NOTE 13—Testing at the Food Service Technology Center has shown that if the cooking pasta is not stirred during production capacity test, the pasta will clump together, thus not allowing water to be absorbed quickly and uniformly by the pasta. Special attention needs to be applied to the edges and corners of the pasta basket during stirring. Clumping can have an adverse effect on the consistency of the end product and cook times.

11.8.3 Some pasta cookers have built-in water fill sensor(s) that automatically regulate the water level of the appliance. These auto-fill sensor(s) need periodic cleaning during cooking to maintain there accuracy. If during cooking tests the water fill sensor(s) fails to maintain the proper water level, the test will be terminated and a manual water filling may be substituted for testing.

11.8.4 At the end of the cook time, remove the pasta cooking basket(s) to the cold water bath and submerge the basket in the water for 30 s. The cold water bath temperature needs to be maintained below 80°F. Stir the pasta within the basket vigorously, while the basket is in the cold water bath so to cool the cooked pasta. After 30 s in the cold bath, remove the basket and let the water drain from the basket(s). Let water drain for 1½ min, continue to vigorously stir the pasta in the basket(s) to drain excess water trapped in the basket(s).

11.8.5 Submerging the pasta in the cold water bath after cooking stops the cooking process and slows the hydration process of cooking pasta. The 1.5-min drip period must not occur with the pasta baskets over the heated water. Use a drip station or appropriate pan placed beneath the basket(s).

11.8.6 At two minutes after removing the basket(s) from the pasta cooker, weight the pasta and determine its weight gain.

11.8.7 To obtain repeatable and constant results, the pasta needs to be weighted at the 2-min mark after removing from the pasta cooker.

11.8.8 Replenish any lost water by filling the pasta cooker vat to the required indication line or to the manufacturer's recommended water level with fresh water, 65 ± 5°F (18 ± 3°C), right after removing the pasta load from the pasta cooker, and allow the pasta cooker cooking water temperature to return within 2°F to its boiling temperature.

11.8.9 Ensure that the pasta cooker is filled with water to the indication line before inserting the next pasta load. Set the next load into the pasta cooker 10 s after removing the first load from the pasta cooker or after the cook temperature thermocouple indicates that the water temperature has recovered to within 2°F of the boiling temperature, whichever is longer. Repeat 11.8.2-11.8.9 until all three loads have been cooked.

NOTE 14—The 10 s allowed between loads is a preparation time necessary for logistic consideration of running a test. The actual recovery backup to the boiling temperature may be less than 10-s preparation time.

11.8.10 If the average weight gain over the three-load test is not 125 ± 3 %, adjust the cook time and repeat the cooking-time determination test (all three loads) as necessary, to produce an average 125 ± 3 % weight gain for the three-load test. When starting a new cooking-time determination test, completely drain and refill the cooking vat with fresh water.

NOTE 15—From cooking testing conducted at PG & E Food Service Technology Center, the excessive starch produced through the pasta cooking process can affect some appliance's thermostatic controls. In cases where there is an excessive buildup of starch in the water, the appliance's water level control sensors, if equipped, may not function properly. It is recommended that those sensor(s) be cleaned as need during all cooking tests. A brush typically is supplied by the manufacturer for this purpose.

11.9 *Production Capacity*:

11.9.1 Ensure that the pasta cooker is loaded with fresh water to the indicated fill line. Confirm that the pasta cooker water temperature control(s) are set to boiling as calibrated in 10.3. Allow the pasta cooker to stabilize for 30 min after being preheated. Fill the cold water bath with water cold enough to maintain a temperature of 60 to 80°F.

11.9.2 Prepare the required quantity of pasta for making up three replicates of the cooking test as described in 11.7.

11.9.3 Use a total of three pasta baskets to cook the three loads of pasta, also required for the cook-time determination tests. Hold the pasta baskets at room temperature, 75 ± 5°F (24 ± 3°C), prior to being loaded with the pasta. Also, the pasta baskets shall be clean and moisture free so as not to contaminate the pasta cooking water.

11.9.4 Cook the pasta for the time determined in 11.8 to produce the 125 % weight gain determined after the cooked pasta has been cooled for 0.5 min in the cold water bath and the pasta has drained for 1.5 min following the removal from the cold water bath. Fill the pasta cooker with fresh water, 65 ± 5°F (18 ± 3°C), anytime during the test to maintain the water level in the pasta cooker to the indication line, or, if there is no indication line, fill to the manufacturer's recommended cooking water level.

NOTE 16—From cooking testing conducted at FSTC, excessive starch produced through the pasta cooking process can affect some appliances' thermostatic controls as noted previously.

11.9.5 Replenish any water loss by filling the pasta cooker vat immediately after removing the pasta load to the required indication line or the manufacturer's recommended water level with fresh water, 65 ± 5°F (18 ± 3°C), and allow the pasta cooker cooking water temperature to return within 2°F to its pasta cookers' cooking temperature.

11.9.6 Set the next load into the pasta cooker 10 s after removing the first load from the pasta cooker or after the cook temperature thermocouple indicates that the water temperature has recovered to 2°F of the boiling temperature, whichever is longer.

11.9.7 Repeat 11.9.4-11.9.6 until the three spaghetti loads are cooked to 125 ± 3 % weight gain and the pasta cooker water temperature has recovery to within 2°F of the boiling temperature, or the additional 10 s, whichever is longer. Then stop monitoring energy and elapsed cook time. Determine cooking energy consumption in accordance with 12.11 and production capacity in accordance with 12.10.

11.9.8 The 10 s allowed between loads is a preparation time necessary for logistic consideration of running a test. The actual recovery backup to the boiling temperature may be less than 10-s preparation time.

12. Calculation and Report

12.1 *Test Pasta Cooker*—Summarize the physical and operating characteristics of the pasta cooker. If needed, describe other design or operating characteristics that may facilitate interpretation of the test results.

12.2 *Apparatus and Procedure*:

12.2.1 For an electric pasta cooker, report the voltage for each test.

12.2.2 For a gas pasta cooker, report the higher heating value of the gas supplied to the pasta cooker during each test.

12.3 *Gas Energy Calculations*:

12.3.1 For a gas pasta cooker, add electric energy consumption to gas energy for all tests, with the exception of the energy input rate test (see 12.4).

12.3.2 Calculate the energy consumed based on the following:

$$E_{gas} = V \times HV \quad (1)$$

where:

E_{gas} = energy consumed by the appliance;
HV = higher heating value;
= energy content of gas measured at standard conditions, Btu/ft^3; and,
V = actual volume of gas corrected for temperature and pressure at standard conditions, ft^3.

$$V_{meas} \times T_{cf} \times P_{cf} \quad (2)$$

where:

V_{meas} = measured volume of gas, ft^3;

T_{cf} = temperature correction factor;

$$= \frac{\textit{absolute standard gas temperature}, °R}{\textit{absolute actual gas temperature}, °R};$$

$$= \frac{\textit{absolute standard gas temperature}, °R}{[\textit{gas temperature}° F + 459.67], ° R};$$

P_{cf} = pressure correction factor;

$$= \frac{\textit{absolute actual gas pressure}, \text{psia}}{\textit{absolute standard pressure}, \text{psia}}; \text{ and,}$$

$$= \frac{\textit{gas gage pressure}, \text{psig} + \textit{barometric pressure}, \text{psia}}{\textit{absolute standard pressure}, \text{psia}}$$

NOTE 17—Absolute standard gas temperature and pressure used in this calculation should be the same values used for determining the higher heating value. PG & E standard conditions are 519.67°R and 14.73 psia.

12.4 *Energy Input Rate*:

12.4.1 Report the manufacturer's nameplate energy input rate in Btu/h for a gas pasta cooker and kW for an electric pasta cooker.

12.4.2 For gas or electric pasta cooker, calculate and report the measured energy input rate (Btu/h or kW) based on the energy consumed by the pasta cooker during the period of peak energy input in accordance with the following relationship:

$$E_{input\ rate} = \frac{E \times 60}{t} \tag{3}$$

where:

$E_{input\ rate}$ = measured peak energy input rate, Btu/h or kW;

E = energy consumed during period of peak energy input, Btu or kWh; and,

t = period of peak energy input, min.

12.5 *Pasta Cooker Temperature Calibration*—Report the average bulk temperature for the water in the pasta cooker after calibration. Report any discrepancies between the temperature indicated on the control and the measured average water temperature. Report the altitude of the testing facility.

12.6 *Preheat Energy and Time*:

12.6.1 Report the preheat energy consumption (Btu or kWh) and preheat time (min).

12.6.2 Calculate and report the average preheat rate (°F (°C)/min) based on the preheat period.

12.7 *Idle Energy Rate*—Calculate and report the idle energy rate (Btu/h or kW) based on the following:

$$E_{idle\ rate} = \frac{E \times 60}{t} \tag{4}$$

where:

$E_{idle\ rate}$ = idle energy rate, Btu/h or kW;

E = energy consumed during the test period, Btu or kWh; and,

t = test period, min.

12.8 *Pilot Energy Rate*—Calculate and report the pilot energy rate (Btu/h) based on the following:

$$E_{pilot\ rate} = \frac{E \times 60}{t} \tag{5}$$

where:

$E_{pilot\ rate}$ = pilot energy rate, Btu/h;

E = energy consumed during the test period, Btu; and,

t = test period, min.

12.9 *Water-Boil Efficiency*—Calculate and report the water boil efficiency (%) based on the following:

$$\eta_{water\ boil} = \frac{E_{water}}{E_{appliance}} \times 100 \tag{6}$$

where:

$\eta_{water\ boil}$ = water boil efficiency, %; and,

E_{water} = energy into water, Btu.

$$(W_i - W_f) \times E_{vap} \tag{7}$$

where:

W_i = initial weight of water, lb;

W_f = final weight of water, lb;

E_{vap} = heat of vaporization of water at test conditions, Btu/lb;

E_{vap} = 970 Btu/lb at 14.73 psia; and

$E_{appliance}$ = energy into the appliance, Btu.

12.10 *Production Capacity*:

12.10.1 Calculate production capacity (lb) based on the following:

$$PC = \frac{W \times 60}{t} \tag{8}$$

where:

PC = production capacity of the pasta cooker, lb/h;

W = total weight of food cooked during three load production test, lb (cooker); and,

t = total time of three load cooking test, min.

12.10.2 Report final cook times in minutes and individual pasta load weight, lb (kg).

12.11 *Cooking Energy Rate*—Calculate and report the cooking energy rate for three loads test based on the following:

$$E_{cooking\ rate} = \frac{E \times 60}{t} \tag{9}$$

where:

$E_{cooking\ rate}$ = cooking energy rate, Btu/h (kJ/h) or kW;

E = energy consumed during the test period, Btu (kJ) or kWh; and,

t = test period, min.

For gas pasta cookers, report separately a gas cooking energy rate and an electric cooking energy rate.

13. Precision and Bias

13.1 *Precision*:

13.1.1 *Repeatability (Within Laboratory, Same Operator and Equipment)*:

13.1.1.1 For cooking energy rate, production capacity, and water-boil efficiency results, the percent uncertainty in each

result has been specified to be no greater than ±10 % based on at least three test runs.

13.1.1.2 The repeatability of each reported parameter is being determined.

13.1.2 *Reproducibility (Multiple Laboratories)*—The interlaboratory precision of the procedure in this test method for measuring each reported parameter is being determined.

13.2 *Bias*—No statement can be made concerning the bias of the procedures in this test method because there are no accepted reference values for the parameters reported.