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An American National Standard

Standard Test Method for Performance of Rotisserie Ovens[1]

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1. Scope

1.1 This test method evaluates the energy consumption and cooking performance of rotisserie ovens. The food service operator can use this evaluation to select a rotisserie oven and understand its energy performance.

1.2 This test method is applicable to thermostatically-controlled gas and electric rotisserie ovens designed for batch cooking.

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

1.3.1 Energy input rate (10.2),

1.3.2 Preheat energy and time (10.4),

1.3.3 Idle energy rate (10.5),

1.3.4 Pilot energy rate, if applicable (10.6),

1.3.5 Cooking energy efficiency and production capacity (10.9), and

1.3.6 Holding energy rate and product shrinkage (optional, 10.10),

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 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 *ANSI Document:*

ANSI Standard Z83.11 American National Standard for Gas Food Service Equipment[2]

2.2 *ASHRAE Document:*

ASHRAE Guideline 2—1986 (RA90) Engineering Analysis of Experimental Data[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *cooking cavity*, *n*—that portion of the appliance in which food products are heated or cooked.

3.1.2 *cooking energy*, *n*—energy consumed by the rotisserie oven as it is used to cook whole chickens under heavy- and light-load conditions.

3.1.3 *cooking energy efficiency*, *n*—quantity of energy imparted to the chickens and appropriate spits, expressed as a percentage of energy consumed by the rotisserie oven during the cooking event.

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

3.1.5 *cook time*, *n*—time required to cook thawed (38 to 40°F) whole chickens as specified in 7.4 to an average temperature of 195°F during a cooking energy efficiency test.

3.1.6 *energy input rate*, *n*—peak rate at which a rotisserie oven consumes energy (Btu/h or kW), typically reflected during preheat.

3.1.7 *idle energy rate*, *n*—the rate of energy consumed (Btu/h or kW) by the rotisserie oven while “holding” or “idling” the cooking cavity at the thermostat set point.

3.1.8 *holding energy rate*, *n*—the rate of energy consumed (Btu/h or kW) by the rotisserie oven while keeping cooked product warm for display or merchandising purposes.

3.1.9 *pilot energy rate*, *n*—average rate of energy consumption (Btu/h) by a rotisserie oven’s continuous pilot (if applicable).

3.1.10 *preheat energy*, *n*—amount of energy consumed by the rotisserie oven while preheating the cooking cavity from ambient room temperature (75 ± 5°F) to a calibrated 350°F.

3.1.11 *preheat rate*, *n*—average rate (°F/min) at which the rotisserie oven’s cooking cavity is heated from ambient temperature (75 ± 5°F) to 350°F.

3.1.12 *preheat time*, *n*—time required for the rotisserie oven to preheat from ambient room temperature (75 ± 5°F) to 350°F.

3.1.13 *production capacity*, *n*—maximum rate (lb/h) at which the rotisserie oven can bring thawed (38 to 40°F) whole chickens as specified in 7.4 to an average temperature of 195°F.

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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 the International Approval Services, Inc., 8501 E. Pleasant Valley Road, Cleveland, OH 44131.

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

3.1.14 *production rate*, *n*—rate (lb/h) at which the rotisserie oven brings thawed (38 to 40°F) whole chickens as specified in 7.4 to an average temperature of 195°F. Does not necessarily refer to maximum rate. Production rate varies with the amount of food being cooked.

3.1.15 *product shrinkage*, *n*—the reduction in net chicken weight (%) which occurs during holding.

3.1.16 *rotisserie oven*, *n*—an appliance with a closed cavity designed for batch cooking, fitted with one or more spits that are mechanically rotated past a fixed heat source while the food is slowly being cooked on all sides.

3.1.17 *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 The rotisserie oven is connected to the appropriate metered energy source, and energy input rate is determined to confirm that the appliance is operating within 5 % of the nameplate energy input rate.

4.2 The amount of energy and time required to preheat the rotisserie oven to a calibrated 350°F thermostat set point is determined.

4.3 The idle energy rate is determined with the rotisserie oven set to maintain 350°F in the cooking cavity.

4.4 Pilot energy rate is determined, when applicable, for gas rotisserie ovens.

4.5 The rotisserie oven is used to cook thawed, whole chickens to an average internal temperature of 195°F. Cooking energy efficiency is determined for heavy- and light-load conditions. Production capacity and product yield are determined for the rotisserie oven based on the heavy-load cooking test.

NOTE 1—Surveys of national chains conducted by PG&E on 3-lb whole chickens has determined that an endpoint of 195 ± 5°F in the chicken breast ensures that the chicken is fully cooked (that is, no redness and the thigh juices run clear).

4.6 The rotisserie oven may be used to hold cooked chickens at 150°F for 90 min. Holding energy rate and product shrinkage may be determined for the rotisserie oven.

5. Significance and Use

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

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

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

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

5.5 Production capacity is used by food service operators to choose a rotisserie oven that matches their food output requirements.

5.6 Holding energy rate may be used to determine the cost of holding cooked product in the rotisserie oven.

5.7 Product yield may be used by the food service operator to compare relative product output from one rotisserie oven to another. Additionally, product shrinkage during holding may be used by the food service operator to evaluate the rotisserie 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 gas volume to standard conditions. Shall have a resolution of 0.2 in. Hg and an uncertainty of 0.2 in. Hg.

6.3 *Canopy Exhaust Hood*, 4 ft in depth, wall-mounted with the lower edge of the hood 6 ft, 6 in. from the floor and with the capacity to operate at a nominal net exhaust ventilation rate of 300 cfm per linear foot of active hood length. This hood shall extend a minimum of 6 in. 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 *Data Acquisition System*, for measuring energy and temperatures, capable of multiple channel displays updating at least every 2 s.

6.5 *Gas Meter*, for measuring the gas consumption of a rotisserie oven, shall be a positive displacement type with a resolution of at least 0.01 ft^3 and a maximum uncertainty no greater than 1 % of the measured value for any demand greater than 2.2 ft^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 and a maximum uncertainty no greater than 2 % of the measured value.

6.6 *Pressure Gage*, for monitoring gas pressure. Shall have a range of zero to 15 in. H_2O, a resolution of 0.5 in. H_2O, and a maximum uncertainty of 1 % of the measured value.

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

6.8 *Temperature sensor*, for measuring gas temperature in the range of 50°F to 100°F with an uncertainty of ±1°F.

6.9 *Thermocouple(s)*, industry standard Type T or Type K thermocouple wire with a range of 0°F to 500°F and an uncertainty of ±1°F.

6.10 *Thermocouple Probe(s)*, "fast response" Type T or Type K thermocouple probe, 1⁄16 in. or smaller diameter, with a 3-s or faster response time capable of immersion with a range of 30°F to 300°F and an uncertainty of ±1°F. The thermocouple probe's active zone shall be at the tip of the probe.

6.11 *Watt-Hour Meter*, for measuring the electrical energy consumption of a rotisserie oven, 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

7.1 *Drip Rack*—18 by 26 in. for draining raw chickens.

7.2 *Plastic Wrap*—Commercial grade, 18 in. wide.

7.3 *Sheet Pans*—18 by 26 by 1 in. for holding loaded spits.

7.4 *Whole Chickens*—A sufficient quantity of unmarinated, "ready to cook," whole, 3-lb frozen chickens, with skin on, shall be obtained from a poultry purveyor to conduct the heavy- and light-load cooking tests. The chicken shall be injected with a solution of water, salt, and sodium phosphate, not totaling more than 14 % of the total chicken weight.

8. Sampling, Test Units

8.1 *Rotisserie Oven*—Select a representative production model for performance testing.

9. Preparation of Apparatus

9.1 Install the appliance according to the manufacturer's instructions under a 4-ft-deep canopy exhaust hood mounted against the wall, with the lower edge of the hood 6 ft, 6 in. from the floor. Position the rotisserie oven with front edge of appliance inset 6 in. from the vertical plane of 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. past both sides of the rotisserie oven. In addition, both sides of the appliance shall be a minimum of 3 ft from any side wall, side partition, or other operating appliance. The exhaust ventilation rate shall be 300 cfm per linear foot of hood length (for example, a nominal 3-ft wide rotisserie oven shall be ventilated, at a minimum, by a hood 4 by 4 feet with a nominal air flow rate of 1200 cfm. The application of a longer hood is acceptable, provided the ventilation rate is maintained at 300 cfm per linear foot over the entire length of active hood). The associated heating or cooling system shall be capable of maintaining an ambient temperature of 75 ± 5°F within the testing environment (outside the vertical area of the rotisserie oven and hood) when the exhaust ventilation system is operating.

9.2 Connect the rotisserie oven 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 and temperature of the gas supplied to the rotisserie oven 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.

9.3 For a gas rotisserie oven, 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 appliance following the manufacturer's recommendations for optimizing combustion. Proper combustion may be verified by measuring air-free CO in accordance with ANSI Z83.12.

9.4 For an electric rotisserie oven, confirm (while the 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 testing procedure herein to evaluate the performance of a rotisserie oven at its rated gas pressure or electric voltage. If an electric unit 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 rotisserie oven is designed to operate at two voltages without a change in the resistance of the heating elements, the performance of the unit (for example, preheat time) may differ at the two voltages.

9.5 If applicable, set the ratio of radiant to convective heat as per manufacturer's recommendations. If not specified by the manufacturer, set the rotisserie oven controls to achieve 50 % radiant, 50 % convective heat.

10. Procedure

10.1 *General*:

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

10.1.1.1 Higher heating value,

10.1.1.2 Standard gas pressure and temperature used to correct measured gas volume to standard conditions,

10.1.1.3 Measured gas temperature,

10.1.1.4 Measured gas pressure,

10.1.1.5 Barometric pressure,

10.1.1.6 Ambient temperature, and

10.1.1.7 Energy input rate during or immediately prior to test.

NOTE 3—Using a calorimeter or gas chromatograph in accordance with accepted laboratory procedures is the preferred method for determining the higher heating value of gas supplied to the rotisserie oven under test. It is recommended that all testing be performed with natural gas having a higher heating value of 1000 to 1075 Btu/ft^3.

10.1.2 For gas rotisserie ovens, add any electric energy consumption to gas energy for all tests, with the exception of the energy input rate test (10.2).

10.1.3 For electric rotisserie ovens, record the following for each test run:

10.1.3.1 Voltage while elements are energized,

10.1.3.2 Ambient temperature, and

10.1.3.3 Energy input rate during or immediately prior to test run.

10.1.4 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 rotisserie oven.

10.2 *Energy Input Rate*:

10.2.1 For gas rotisserie ovens, set the controls to achieve maximum input. Allow the unit to operate for a period of 15 min, then monitor the time required for the rotisserie oven to consume 5 ft^3 of gas.

10.2.2 For electric rotisserie ovens, monitor the energy consumption for 15 min with the controls set to achieve maximum input. If the unit begins cycling during the 15 min interval, record the time and energy consumed for the time from when the unit was first turned on until it begins cycling.

10.2.3 Confirm that the measured input rate or power, (Btu/h for a gas rotisserie oven and kW for an electric rotisserie oven) is within 5 % of the rated nameplate input or power. (It is the intent of the testing procedures herein to evaluate the performance of a rotisserie oven at its rated energy input rate.) If the difference is greater than 5 %, terminate testing and contact the manufacturer. The manufacturer may make appropriate changes or adjustments to the rotisserie oven or supply another rotisserie oven for testing.

10.3 *Thermostat Calibration*:

10.3.1 Install a thermocouple in the cooking cavity within 1 in. of the tip of the thermostat probe.

10.3.2 Preheat the cooking cavity to a temperature of 350°F as indicated by the temperature dial on the controls. Stabilize for 60 min after the burners or elements commence cycling at the thermostat set point.

10.3.3 Monitor the cooking cavity temperature for a minimum of 1 h.

10.3.4 As required (as indicated by the average temperature), adjust the temperature control(s) to attain an actual cooking cavity temperature of 350 ± 5°F. Repeat 10.3.3 to confirm that the cooking cavity temperature is 350 ± 5°F.

10.3.5 To facilitate further testing, mark on the dial the exact position of the thermostat control(s) that corresponds to an average cooking cavity temperature of 350 ± 5°F (analog controls). Record the final thermostat setting.

10.3.6 Repeat 10.3.1-10.3.5 with the thermostat controls set to maintain 150°F (optional).

NOTE 4—The 150°F calibration point is used in the Holding Energy Rate test (10.9).

10.4 *Preheat Energy and Time*:

NOTE 5—The preheat test should be conducted as the first appliance operation on the day of the test, starting with the cooking cavity at room temperature (75 ± 5°F).

10.4.1 Record cooking cavity temperature and ambient temperature at the start of the test. The cooking cavity temperature shall be 75 ± 5°F at the start of the test.

10.4.2 Turn the unit on with controls set to maintain an average cooking cavity temperature of 350°F, as determined in 10.3.6. If the rotisserie mechanism has a separate control, then leave it turned off for the length of preheat.

10.4.3 Record the cooking cavity temperature over a minimum of 5-s intervals during the course of preheat.

10.4.4 Record the energy and time to preheat the rotisserie oven. Preheat is judged complete when the temperature at the thermostat probe reaches 350°F, as indicated by the thermocouple.

10.5 *Idle Energy Rate*:

NOTE 6—The idle test may be conducted immediately following the preheat test (10.4).

10.5.1 Preheat the rotisserie oven to 350°F and allow to stabilize for 1 h.

10.5.2 If the rotisserie mechanism has a separate control, then leave it turned off for the length of the idle period.

10.5.3 Monitor cooking cavity temperature and rotisserie oven energy consumption for an additional 2 h while the rotisserie oven is operated in this condition.

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

10.6.1 Where applicable, set the gas valve that controls gas supply to the appliance at the "pilot" position. Otherwise, set the rotisserie oven temperature controls to the "off" position.

10.6.2 Light and adjust pilots according to the manufacturer's instructions.

10.6.3 Record the gas reading after a minimum of 8 h of pilot operation.

10.7 *Chicken Preparation*:

10.7.1 Determine the number of chickens for each spit by loading a spit as per manufacturer recommendations with a 1 ± ¼ in. spacing between chickens on the spit.

NOTE 7—The specified spacing between chickens on the spit is has been determined to reduce the occurrence of white, or uncooked spots on the chickens.

10.7.2 Prepare enough chickens for a minimum of four runs each of both heavy- and light-load tests. For the heavy-load tests, use the maximum number of spits allowable. Use one spit for the light-load tests.

10.7.3 If necessary, the chickens may be thawed by immersing them in cold running water. Place the thawed chickens on a drip rack on a sheet pan and cover with plastic wrap. Place the wrapped chickens in the refrigerator.

10.7.4 Monitor the internal temperature of a sample chicken with a thermocouple probe. Its internal temperature must reach 38°F to 40°F before the chickens can be removed from the refrigerator and loaded onto the appropriate spits. If necessary, adjust the refrigerator temperature to achieve this required internal temperature.

10.7.5 Weigh and record the weight of each spit. Label the spits according to their weight.

10.7.6 Trim any loose fat and skin from the bottom of each chicken.

10.7.7 Load the chickens onto the appropriate spits, following the manufacturer's recommendations for securing the chickens onto the spits.

10.7.8 Place the loaded spits onto a drip rack on a sheet pan and cover with plastic wrap. Return the chickens to the refrigerator and allow them to stabilize at the 38°F to 40°F refrigerator temperature. Do not store the thawed chickens in the refrigerator for more than one week.

10.8 *Cook Time Determination*:

NOTE 8—A heavy-duty chef's thermometer may be used to pinpoint the cook time by inserting the thermometer into the thick part of a breast on one or more sample chickens prior to placing the loaded spits into the rotisserie. The thermometers should be secured to prevent them from falling out while the chickens are cooking.

10.8.1 Perform separate cook time determination tests for the heavy- and light-load tests.

10.8.2 Turn on the rotisserie oven with the controls set to maintain 350°F, as in 10.3.6. Allow the unit to stabilize for 1 h.

10.8.3 Remove the loaded spits from the refrigerator. Measure and record the temperature of at least one chicken on each spit by inserting a thermocouple probe in the thick part of the chicken breast.

10.8.4 Open the rotisserie oven door and commence loading the spits into the rotisserie oven. Allow 15 s per spit for loading. If the rotisserie oven is loaded in less time, keep the door open until the full loading time has passed (for example, 75 s for a 5-spit rotisserie). After the loading time has elapsed, close the rotisserie oven door and commence monitoring cook time.

10.8.5 When the chickens begin to turn golden-brown, open the rotisserie oven door and measure the internal chicken temperature by inserting a thermocouple probe in the thick part of a breast of one chicken with the spit positioned in the front of the rotisserie, approximately centered from top to bottom. Minimize the amount of time the rotisserie oven door is left open.

10.8.6 Continue cooking, periodically checking the temperature of the chickens as specified in 10.8.5. Be sure to check a different spit each time.

10.8.7 When the internal temperature of the chickens reaches 195 ± 5°F, confirm the endpoint by measuring the temperature of at least one chicken per spit as in 10.8.5. Once the final temperature is confirmed, turn off the rotisserie oven and record the total elapsed time. If the average of the temperature measurements is not 195 ± 5°F, then repeat 10.8.2-10.8.7.

NOTE 9—Research conducted by PG&E determined that an endpoint of 195°F is acceptable for whole cooked chickens.

10.8.8 Record the number of door openings and the average time the door was left open during this cook time determination test.

10.8.9 Adjust the final cook time to account for the door openings by subtracting product of the average time the door was left open and one-half of the total number of door openings.

$$t_{\text{adjusted cook}} = t_{\text{cook}} - t_{\text{open}} \times 1/2 \times n_{\text{openings}} \quad (1)$$

where:

$t_{\text{adjusted cook}}$ = the adjusted cook time, min,
t_{cook} = the measured cook time, min,
t_{open} = the average time the door was left open during each opening, min, and
n_{openings} = the total number of door openings.

10.9 *Cooking Energy Efficiency and Production Capacity*:

10.9.1 Conduct the cooking energy efficiency test a minimum of three times for each loading scenario. Additional test runs may be necessary to obtain the required precision for the reported test results (Annex A1).

10.9.2 Weigh and record the initial weight of the rotisserie oven's drip pan. Assure that the drip pan is cleaned of any accumulated drippings or water prior to weighing. Record the weight of water added to the drip pan prior to cooking (if any). Add this weight to the initial weight of the drip pan. This starting weight will be used in calculating the energy due to vaporization (11.8.1).

NOTE 10—Some rotisserie ovens require that a level of water is maintained in the drip pan to reduce the risk of fire.

10.9.3 Turn on the rotisserie oven with the controls set to maintain 350°F, as determined in 10.3.6. Allow the unit to stabilize for 1 h.

10.9.4 Remove the loaded spits from the refrigerator and weigh. Record the total weight of each loaded spit. Do not record the weight of any excess water that may have accumulated in the sheet pan(s). Also, measure and record the temperature of at least one chicken per spit by inserting a thermocouple probe in the thick part of the chicken breast.

10.9.5 Open the rotisserie oven door and commence loading the spits into the rotisserie oven. Allow 15 s per spit for loading. If the rotisserie oven is loaded in less time, keep the door open until the full loading time has passed (for example, 75 s for a 5-spit rotisserie). After the loading time has elapsed, close the rotisserie oven door and commence monitoring elapsed time, rotisserie oven temperature and energy consumption.

10.9.6 Cook the chickens for the time determined in 10.8.9.

10.9.7 After the cook time has elapsed, turn off the rotisserie oven. Record the total energy consumption during the cooking event.

10.9.8 Confirm the endpoint by measuring the temperature of at least one chicken per spit by inserting a thermocouple probe into the thick part of the chicken breast with the spit positioned in the front of the rotisserie, approximately centered from top to bottom.

10.9.9 The average internal temperature of the cooked chickens shall be 195 ± 5°F. If the average temperature is not 195 ± 5°F, then adjust the cook time as appropriate and repeat 10.9.2-10.9.8. Record the final cook time.

10.9.10 Remove the cooked chickens and weigh. Record the final weight of the cooked chickens and spit(s).

10.9.11 Weigh and record the weight of the rotisserie oven's drip pan, with any drippings collected during the cooking test. This ending weight will be used in calculating the energy due to vaporization (11.8.1).

10.9.12 Perform runs No. 2 and 3 by repeating 10.9.2-10.9.11. Follow the procedure in Annex A1 to determine whether more than three test runs are required.

10.9.13 Repeat 10.9.1-10.9.12, for the light-load scenario.

10.10 *Holding Energy Rate and Product Shrinkage (Optional)*:

NOTE 11—Some rotisserie ovens feature a programmable holding cycle to allow the user to cook and display the cooked food in the same appliance. If desired, the rotisserie oven's performance while holding a heavy-load of cooked chickens may be determined in the following section (10.10).

10.10.1 Cook a heavy-load of chickens by repeating 10.9.2-10.9.11. After weighing the cooked chickens and spits, allow no more than 5 min ± 30 s to pass before the cooked chickens are returned to the rotisserie oven.

NOTE 12—For best results, remove one spit at a time for weighing.

10.10.2 Turn the rotisserie oven on with the thermostat set to maintain 150°F, as determined in 10.3.5.

10.10.3 Load the cooked chickens into the rotisserie oven. Allow 15 s per spit for loading. If the rotisserie oven is loaded in less time, keep the door open until the full loading time has passed (for example, 75 s for a 5-spit rotisserie). After the loading time has elapsed, close the rotisserie oven door and commence monitoring elapsed time, rotisserie oven temperature and energy consumption.

10.10.4 After 90 ± 5 min have elapsed, turn off the rotisserie oven and remove the cooked chickens. Weigh and record the final weight of the cooked chickens and spit(s).

11. Calculation and Report

11.1 *Test Rotisserie Oven*:

11.1.1 Summarize the physical and operating characteristics of the rotisserie oven. If needed, describe other design or operating characteristics that may facilitate interpretation of the test results.

11.2 *Apparatus and Procedure*:

11.2.1 Confirm that the testing apparatus conformed to all of the specifications in Section 6. Describe any deviations from those specifications.

11.2.2 For electric rotisserie ovens, report the voltage for each test.

11.2.3 For gas rotisserie ovens, report the higher heating value of the gas supplied to the rotisserie oven during each test.

11.3 *Gas Energy Calculations*:

11.3.1 For gas rotisserie ovens, add electric energy consumption to gas energy for all tests, with the exception of the energy input rate test (10.2).

11.3.2 For all gas measurements, calculate the energy consumed based on:

$$E_{gas} = V \times HV \tag{2}$$

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
= $V_{meas} \times T_{cf} \times P_{cf}$.

where:

V_{meas} = measured volume of gas, ft^3
T_{cf} = temperature correction factor

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

$$= \frac{\text{absolute standard gas temperature, °}R}{[\text{gas temp °}F + 459.67]\text{, °}R}\text{, and}$$

P_{cf} = pressure correction factor

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

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

NOTE 13—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.

11.4 *Energy Input Rate*:

11.4.1 Report the manufacturer's nameplate energy input rate in Btu/h for a gas rotisserie oven and kW for an electric rotisserie oven.

11.4.2 For gas or electric rotisserie ovens, calculate and report the measured energy input rate (Btu/h or kW) based on the energy consumed by the rotisserie oven during the period of peak energy input according to 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.

11.4.3 Calculate and report the percent difference between the manufacturer's nameplate energy input rate and the measured energy input rate.

11.5 *Preheat Energy and Time*:

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

11.5.2 Calculate and report the average preheat rate (°F/min) based on the preheat period. Also report the starting temperature of the cooking cavity.

11.5.3 Generate a graph showing the cooking cavity temperature vs. time based on the preheat period.

11.6 *Idle Energy Rate*:

11.6.1 Calculate and report the idle energy rate (Btu/h or kW) based on:

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

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.

11.7 *Pilot Energy Rate*:

11.7.1 Calculate and report the pilot energy rate (Btu/h) based on:

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

where:

$E_{pilot\ rate}$ = pilot energy rate, Btu/h,
E = energy consumed during the test period, Btu, and
t = test period, min.

11.8 *Cooking Energy Efficiency, Cooking Energy Rate, and Production Capacity*:

11.8.1 Calculate and report the cooking energy efficiency for heavy- and light-load cooking tests based on:

$$\eta_{cook} = \frac{E_{food} + E_{spit}}{E_{appliance}} \times 100 \tag{6}$$

where:

η_{cook} = cooking energy efficiency, %, and
E_{food} = energy into food, Btu
= $E_{sens} + E_{evap}$.

where:

E_{sens} = the quantity of heat added to the chickens, which causes their temperature to increase from the starting temperature to 195°F, Btu
= $W_i \times C_p(C) \times (T_f - T_i)$

where:

W_i = initial weight of raw chickens, lb, and

$C_p\ (C)$ = specific heat of chicken, Btu/lb, °F
= 0.800.

NOTE 14—For this analysis, the specific heat ($C_p\ (C)$) of a chicken is considered to be the weighted average of the specific heat of its components (for example, water, fat, and nonfat protein). Research conducted by PG&E determined that the weighted average of the specific heat for chickens specified as in 7.4 was approximately 0.800 Btu/lb °F.

T_f = final average internal temperature of the cooked chickens, °F,
T_i = initial average internal temperature of the raw chickens, °F, and
E_{evap} = the latent heat (of vaporization) added to the chickens, which causes some of the moisture contained in the chickens to evaporate. The heat of vaporization cannot be perceived by a change in temperature and must be calculated after determining the amount of moisture lost from a fully cooked chicken.
= $W_{loss} \times H_v$

where:
W_{loss} = weight loss of water during cooking, lb.
= $(W_i - W_f) - W_{drip}$

NOTE 15—Chicken weight loss during the cooking process consists of expelled water, vaporized water and expelled fat. The amount of water vaporized during cooking can be determined by subtracting the weight of the drippings (consisting of expelled water and fat) from the total weight loss during cooking.

where:
W_i = initial weight of raw chickens, lb,
W_f = final weight of cooked chickens, lb, and
W_{drip} = weight of drippings collected during cooking, lb.
= $W_{pan,\,i} - W_{pan,\,f}$

where:
$W_{pan,\,i}$ = initial weight of the drip pan plus any water added prior to cooking, lb, and
$W_{pan,\,f}$ = final weight of drip pan and drippings after cooking, lb.
H_v = heat of vaporization, Btu/lb
= 970 Btu/lb at 212°F.
E_{spit} = energy into the spits, Btu.
= $W_s \times C_p(S) \times (T_f - T_i)$

where:
W_s = initial weight of spits, lb,
$C_p(S)$ = specific heat of the spits, Btu/lb, °F,
= 0.20
T_f = final average internal temperature of the cooked chickens,° F, and
T_i = initial average internal temperature of the raw chickens, °F.
$E_{appliance}$ = energy into the appliance, Btu.

11.8.2 Calculate and report the cooking energy rate for heavy- and light-load cooking tests based on:

$$E_{cook\ rate} = \frac{E \times 60}{t} \quad (7)$$

where:
$E_{cook\ rate}$ = cooking energy rate, Btu/h or kW,
E = energy consumed during cooking test, Btu or kWh, and
t = cooking test period, min.

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

11.8.3 Calculate and report the energy consumption per pound of food cooked for heavy- and light-load cooking tests based on:

$$E_{per\ pound} = \frac{E_{appliance}}{W} \quad (8)$$

where:
$E_{per\ pound}$ = energy per pound, Btu/lb or kWh/lb,
$E_{appliance}$ = energy consumed during the cooking test, Btu or kWh, and
W = initial weight of the chickens, lb.

11.8.4 Calculate and report the production capacity (lb/h) based on:

$$PC = \frac{W \times 60}{t} \quad (9)$$

where:
PC = production capacity of the rotisserie oven, lb/h,
W = total raw weight of chicken (excluding spits) cooked during heavy-load cooking test, lb, and
t = total cook time for the heavy-load test, min.

11.8.5 Calculate and report the production rate (lb/h) for the light-load test based on:

$$PR = \frac{W \times 60}{t} \quad (10)$$

where:
PR = production rate of the rotisserie oven, lb/h,
W = total raw weight of chicken (excluding spits) cooked during light-load cooking test, lb, and
t = total cook time for the light-load test, min.

11.8.6 Report the average cook time for the heavy- and light-load cooking tests.

11.8.7 Calculate and report the average product yield (%) for the heavy-load test based on:

$$Y = \frac{W_{cooked}}{W_{raw}} \times 100 \quad (11)$$

where:
Y = average product yield, %,
W_{raw} = total weight of the raw chicken (excluding spits), lb, and
W_{cooked} = total weight of the cooked chicken (excluding spits), lb.

11.9 *Holding Energy Rate and Product Shrinkage (Optional)*:

11.9.1 Calculate and report the holding energy rate (Btu/h or kW) based on:

$$E_{hold\ rate} = \frac{E \times 60}{t} \quad (12)$$

where:
$E_{hold\ rate}$ = holding energy rate, Btu/h or kW,
E = energy consumed during the test period, Btu or kWh, and
t = test period, min.

11.9.2 Calculate and report the product shrinkage during holding (%) based on:

$$S_h = \frac{(W_{cooked} - W_{held})}{W_{cooked}} \times 100 \quad (13)$$

where:

S_h = product shrinkage during holding, % ,
W_{cooked} = total weight of the cooked chicken (excluding spits), lb, and
W_{held} = total weight of the held chicken (excluding spits) after 2 h of holding, lb.

12. Precision and Bias

12.1 *Precision*:

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

12.1.1.1 For the cooking energy efficiency and production capacity results, the percent uncertainty in each result has been specified to be no greater than ±10 % based on at least three test runs.

12.1.1.2 The repeatability of each remaining reported parameter is being determined.

12.1.2 *Reproducibility (Multiple Laboratories)*:

12.1.2.1 The inter-laboratory precision of the procedure in this test method for measuring each reported parameter is being determined.

12.2 *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.

13. Keywords

13.1 cook time; energy efficiency; performance; production capacity; rotisserie oven; shrinkage; test method; yield

ANNEX

(Mandatory Information)

A1. PROCEDURE FOR DETERMINING THE UNCERTAINTY IN REPORTED TEST RESULTS

NOTE A1.1—This procedure is based on the ASHRAE method for determining the confidence interval for the average of several test results (ASHRAE Guideline 2—1986 (RA90)). It should only be applied to test results that have been obtained within the tolerances prescribed in this test method (for example, thermocouples calibrated, appliance operating within 5 % of rated input during the test run).

A1.1 For the cooking energy efficiency and production capacity results, the uncertainty in the averages of at least three test runs is reported. For each loading scenario, the uncertainty of the cooking energy efficiency and production capacity must be no greater than ±10 % before any of the parameters for that loading scenario can be reported.

A1.2 The uncertainty in a reported result is a measure of its precision. If, for example, the production capacity for the appliance is 30 lb/h, the uncertainty must not be greater than ±3 lb/h. Thus, the true production capacity is between 27 and 33 lb/h. This interval is determined at the 95 % confidence level, which means that there is only a 1 in 20 chance that the true production capacity could be outside of this interval.

A1.3 Calculating the uncertainty not only guarantees the maximum uncertainty in the reported results, but is also used to determine how many test runs are needed to satisfy this requirement. The uncertainty is calculated from the standard deviation of three or more test results and a factor from Table A1.1, which lists the number of test results used to calculate the average. The percent uncertainty is the ratio of the uncertainty to the average expressed as a percent.

A1.4 *Procedure:*

NOTE A1.2— Note A1.5 shows how to apply this procedure.

TABLE A1.1 Uncertainty Factors

Test Results, *n*	Uncertainty Factor, C_n
3	2.48
4	1.59
5	1.24
6	1.05
7	0.92
8	0.84
9	0.77
10	0.72

A1.4.1 *Step 1*—Calculate the average and the standard deviation for the test result (cooking-energy efficiency or production capacity) using the results of the first three test runs, as follows:

A1.4.1.1 The formula for the average (three test runs) is as follows:

$$Xa_3 = (1/3) \times (X_1 + X_2 + X_3) \quad (A1.1)$$

where:

Xa_3 = average of results for three test runs, and
X_1, X_2, X_3 = results for each test run.

A1.4.1.2 The formula for the sample standard deviation (three test runs) is as follows:

$$S_3 = (1/\sqrt{2}) \times \sqrt{(A_3 - B_3)} \quad (A1.2)$$

where:

S_3 = standard deviation of results for three test runs,
A_3 = $(X_1)^2 + (X_2)^2 + (X_3)^2$, and
B_3 = $(1/3) \times (X_1 + X_2 + X_3)^2$.

NOTE A1.3—The formulas may be used to calculate the average and sample standard deviation. However, a calculator with statistical function is recommended, in which case be sure to use the sample standard deviation function. The population standard deviation function will result in an error in the uncertainty.

NOTE A1.4—The "A" quantity is the sum of the squares of each test result, and the "B" quantity is the square of the sum of all test results multiplied by a constant (⅓ in this case).

A1.4.2 *Step 2*—Calculate the absolute uncertainty in the average for each parameter listed in Step 1. Multiply the standard deviation calculated in Step 1 by the uncertainty factor corresponding to three test results from Table A1.1.

A1.4.2.1 The formula for the absolute uncertainty (3 test runs) is as follows:

$$U_3 = C_3 \times S_3, \quad \text{(A1.3)}$$
$$U_3 = 2.48 \times S_3$$

where:
U_3 = absolute uncertainty in average for three test runs, and
C_3 = uncertainty factor for three test runs (Table A1.1).

A1.4.3 *Step 3*—Calculate the percent uncertainty in each parameter average using the averages from Step 1 and the absolute uncertainties from Step 2.

A1.4.3.1 The formula for the percent uncertainty (3 test runs) is as follows:

$$\%U_3 = (U_3/Xa_3) \times 100\ \% \quad \text{(A1.4)}$$

where:
$\%U_3$ = percent uncertainty in average for three test runs,
U_3 = absolute uncertainty in average for three test runs, and
Xa_3 = average of three test runs.

A1.4.4 If the percent uncertainty, $\%U_3$, is not greater than ± 10 % for the cooking-energy efficiency and production capacity, report the average for these parameters along with their corresponding absolute uncertainty, U_3, in the following format:

$$Xa_3 \pm U_3$$

If the percent uncertainty is greater than ±10 % for the cooking energy efficiency or production capacity, proceed to Step 5.

A1.4.5 *Step 5*—Run a fourth test for each loading scenario whose percent uncertainty was greater than ±10 %.

A1.4.6 *Step 6*—When a fourth test is run for a given loading scenario, calculate the average and standard deviation for test results using a calculator or the following formulas:

A1.4.6.1 The formula for the average (four test runs) is as follows:

$$Xa_4 = (1/4) \times (X_1 + X_2 + X_3 + X_4) \quad \text{(A1.5)}$$

where:
Xa_4 = average of results for four test runs, and
X_1, X_2, X_3, X_4 = results for each test run.

A1.4.6.2 The formula for the standard deviation (four test runs) is as follows:

$$S_4 = (1/\sqrt{3}) \times \sqrt{(A_4 - B_4)} \quad \text{(A1.6)}$$

where:
S_4 = standard deviation of results for four test runs,
A_4 = $(X_1)^2 + (X_2)^2 + (X_3)^2 + (X_4)^2$, and
B_4 = $(1/4) \times (X_1 + X_2 + X_3 + X_4)^2$.

A1.4.7 *Step 7*—Calculate the absolute uncertainty in the average for each parameter listed in Step 1. Multiply the standard deviation calculated in Step 6 by the uncertainty factor for four test results from Table A1.1.

A1.4.7.1 The formula for the absolute uncertainty (four test runs) is as follows:

$$U_4 = C_4 \times S_4, \quad \text{(A1.7)}$$
$$U_4 = 1.59 \times S_4$$

where:
U_4 = absolute uncertainty in average for four test runs, and
C_4 = the uncertainty factor for four test runs (Table A1.1).

A1.4.8 *Step 8*—Calculate the percent uncertainty in the parameter averages using the averages from Step 6 and the absolute uncertainties from Step 7.

A1.4.8.1 The formula for the percent uncertainty (four test runs) is as follows:

$$\%U_4 = (U_4/Xa_4) \times 100\ \% \quad \text{(A1.8)}$$

where:
$\%U_4$ = percent uncertainty in average for four test runs,
U_4 = absolute uncertainty in average for four test runs, and
Xa_4 = average of four test runs.

A1.4.9 *Step 9*—If the percent uncertainty, $\%U_4$, is not greater than ±10 % for the cooking energy efficiency and production capacity, report the average for these parameters along with their corresponding absolute uncertainty, U_4, in the following format:

$$Xa_4 \pm U_4$$

If the percent uncertainty is greater than ± 10 % for the cooking energy efficiency or production capacity, proceed to Step 10.

A1.4.10 *Step 10*—The steps required for five or more test runs are the same as those described above. More general formulas are listed below for calculating the average, standard deviation, absolute uncertainty, and percent uncertainty.

A1.4.10.1 The formula for the average (*n* test runs) is as follows:

$$Xa_n = (1/n) \times (X_1 + X_2 + X_3 + X_4 + ... + X_n) \quad \text{(A1.9)}$$

where:
n = number of test runs,
Xa_n = average of results n test runs, and
$X_1, X_2, X_3, X_4, ... X_n$ = results for each test run.

A1.4.10.2 The formula for the standard deviation (*n* test runs) is as follows:

$$S_n = (1/\sqrt{(n-1)}) \times (\sqrt{(A_n - B_n)}) \quad \text{(A1.10)}$$

where:
S_n = standard deviation of results for n test runs,
A_n = $(X_1)^2 + (X_2)^2 + (X_3)^2 + (X_4)^2 + ... + (X_n)^2$, and
B_n = $(1/n) \times (X_1 + X_2 + X_3 + X_4 + ... + X_n)^2$.

A1.4.10.3 The formula for the absolute uncertainty (*n* test runs) is as follows:

$$U_n = C_n \times S_n \quad \text{(A1.11)}$$

where:
U_n = absolute uncertainty in average for *n* test runs, and
C_n = uncertainty factor for *n* test runs (Table A1.1).

A1.4.10.4 The formula for the percent uncertainty (*n* test runs) is as follows:

$$\%U_n = (U_n/Xa_n) \times 100\ \% \qquad \text{(A1.12)}$$

where:
$\%U_n$ = percent uncertainty in average for *n* test runs,
U_n = absolute uncertainty in average for *n* test runs, and
Xa_n = average of *n* test runs.

When the percent uncertainty, $\%U_n$, is less than or equal to ± 10 % for the cooking energy efficiency and production capacity, report the average for these parameters along with their corresponding absolute uncertainty, U_n, in the following format:

$$Xa_n \pm U_n$$

NOTE A1.5—The researcher may compute a test result that deviates significantly from the other test results. Such a result should be discarded only if there is some physical evidence that the test run was not performed according to the conditions specified in this method. For example, a thermocouple was out of calibration, the appliance's input capacity was not within 5 % of the rated input, or the food product was not within specification. To assure that all results are obtained under approximately the same conditions, it is good practice to monitor those test conditions specified in this method.

A1.5 *Example of Determining Uncertainty in Average Test Result:*

A1.5.1 Three test runs for the full-load cooking scenario yielded the following production capacity (PC) results:

Test	PC
Run No. 1	33.8 lb/h
Run No. 2	34.1 lb/h
Run No. 3	31.0 lb/h

A1.5.2 *Step 1*—Calculate the average and standard deviation of the three test results for the PC.

A1.5.2.1 The average of the three test results is as follows:

$$Xa_3 = (1/3) \times (X_1 + X_2 + X_3), \qquad \text{(A1.13)}$$
$$Xa_3 = (1/3) \times (33.8 + 34.1 + 31.0),$$
$$Xa_3 = 33.0 \text{ lb/h}$$

A1.5.2.2 The standard deviation of the three test results is as follows. First calculate "A_3" and "B_3":

$$A_3 = (X_1)^2 + (X_2)^2 + (X_3)^2, \qquad \text{(A1.14)}$$
$$A_3 = (33.8)^2 + (34.1)^2 + (31.0)^2,$$
$$A_3 = 3266$$
$$B_3 = (1/3) \times [(X^1 + X^2 + X^3)^2],$$
$$B_3 = (1/3) \times [(33.8 + 34.1 + 31.0)^2],$$
$$B_3 = 3260$$

A1.5.2.3 The new standard deviation for the PC is as follows:

$$S_3 = (1/\sqrt{2}) \times \sqrt{(3266 - 3260)}, \qquad \text{(A1.15)}$$
$$S_3 = 1.73 \text{ lb/h}$$

A1.5.3 *Step 2*—Calculate the uncertainty in average.

$$U_3 = 2.48 \times S_3, \qquad \text{(A1.16)}$$
$$U_3 = 2.48 \times 1.73,$$
$$U_3 = 4.29 \text{ lb/h}$$

A1.5.4 *Step 3*—Calculate percent uncertainty.

$$\%U_3 = (U_3/Xa_3) \times 100\ \%, \qquad \text{(A1.17)}$$
$$\%U_3 = (4.29/33.0) \times 100\ \%,$$
$$\%U_3 = 13.0\ \%$$

A1.5.5 *Step 4*—Run a fourth test. Since the percent uncertainty for the production capacity is greater than ±10 %, the precision requirement has not been satisfied. An additional test is run in an attempt to reduce the uncertainty. The PC from the fourth test run was 32.5 lb/h.

A1.5.6 *Step 5*—Recalculate the average and standard deviation for the PC using the fourth test result:

A1.5.6.1 The new average PC is as follows:

$$Xa_4 = (1/4) \times (X_1 + X_2 + X_3 + X_4), \qquad \text{(A1.18)}$$
$$Xa_4 = (1/4) \times (33.8 + 34.1 + 31.0 + 32.5),$$
$$Xa_4 = 32.9 \text{ lb/h}$$

A1.5.6.2 The new standard deviation is. First calculate" A_4" and "B_4":

$$A_4 = (X_1)^2 + (X_2)^2 + (X_3)^2 + (X_4)^2, \qquad \text{(A1.19)}$$
$$A_4 = (33.8)^2 + (34.1)^2 + (31.0)^2 + (32.5)^2,$$
$$A_4 = 4322$$
$$B_4 = (1/4) \times [(X^1 + X^2 + X^3 + X_4)^2],$$
$$B_4 = (1/4) \times [(33.8 + 34.1 + 31.0 + 32.5)^2],$$
$$B_4 = 4316$$

A1.5.6.3 The new standard deviation for the PC is as follows:

$$S_4 = (1/\sqrt{3}) \times -(4322 - 4316), \qquad \text{(A1.20)}$$
$$S_4 = 1.41 \text{ lb/h}$$

A1.5.7 *Step 6*—Recalculate the absolute uncertainty using the new standard deviation and uncertainty factor.

$$U_4 = 1.59 \times S_4, \qquad \text{(A1.21)}$$
$$U_4 = 1.59 \times 1.41,$$
$$U_4 = 2.24 \text{ lb/h}$$

A1.5.8 *Step 7*—Recalculate the percent uncertainty using the new average.

$$\%U_4 = (U_4/Xa_4) \times 100\ \%, \qquad \text{(A1.22)}$$
$$\%U_4 = (2.24/32.9) \times 100\ \%,$$
$$\%U_4 = 6.8\ \%$$

A1.5.9 *Step 8*—Since the percent uncertainty, $\%U_4$, is less than ±10 %; the average for the production capacity is reported along with its corresponding absolute uncertainty, U_4 as follows:

$$PC\text{: } 32.9 \pm 2.24 \text{ lb/h} \qquad \text{(A1.23)}$$

The production capacity can be reported assuming the ±10 % precision requirement has been met for the corresponding cooking energy efficiency value. The cooking energy efficiency and its absolute uncertainty can be calculated following the same steps.

APPENDIX

(Nonmandatory Information)

X1. RESULTS REPORTING SHEETS

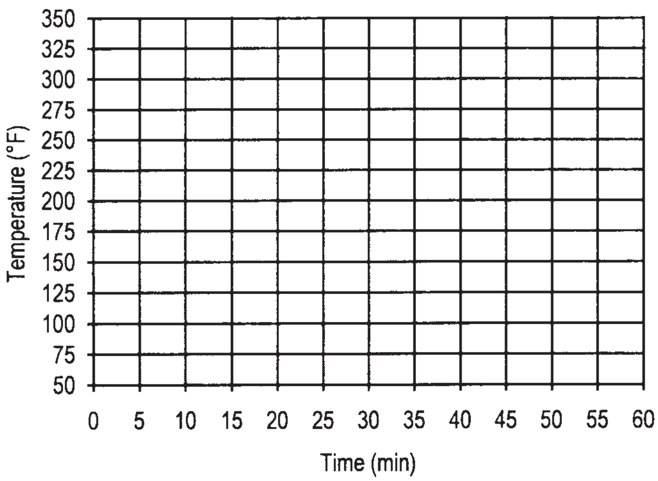
Manufacturer ____________________
Model ____________________
Date ____________________
Test Reference Number (optional) ____________________

Section 11.1 Test Rotisserie Oven

Description of operational characteristics: ____________________

Section 11.2 Apparatus

____Check if testing apparatus conformed to specifications in Section 6.
Deviations ____________________



Preheat Curve

Section 11.4 Energy Input Rate

Test Voltage (V) ____
Gas Heating Value (Btu/ft^3) ____
Measured (Btu/h or kW) ____
Rated (Btu/h or kW) ____
Percent Difference between Measured and Rated (%) ____

Section 11.5 Preheat Energy and Time

Test Voltage (V) ____
Gas Heating Value (Btu/ft^3) ____
Starting Temperature (°F) ____
Rotisserie Mechanism (on/off) ____
Energy Consumption (Btu or kWh) ____
Electric Energy Consumption (kW, gas rotisserie ovens only) ____
Duration (min) ____
Preheat Rate (°F/min) ____

Section 11.6 Idle Energy Rate

Test Voltage (V) ____
Gas Heating Value (Btu/ft^3) ____
Rotisserie Mechanism (on/off) ____
Idle Energy Rate (Btu/h or kW) ____
Electric Energy Rate (kW, gas rotisserie ovens only) ____

Section 11.7 Pilot Energy Rate (if applicable)

Gas Heating Value (Btu/ft^3) ____
Pilot Energy Rate (Btu/h or kW) ____

Section 11.8 Cooking Energy Efficiency, Cooking Energy Rate, and Production Capacity:

Heavy-Load:
Test Voltage (V) ____
Gas Heating Value (Btu/ft^3) ____
Cooking Time (min) ____
Production Capacity (lb/h) ____
Product Yield (%) ____
Energy to Food (Btu/lb) ____
Cooking Energy Rate (Btu/h or kW) ____
Electric Energy Rate (kW, gas rotisserie ovens only) ____
Energy per Pound of Food Cooked (Btu/lb or kWh/lb) ____
Cooking Energy Efficiency (%) ____

Light-Load:
Test Voltage (V) ____
Gas Heating Value (Btu/ft^3) ____
Cooking Time (min) ____
Production Rate (lb/h) ____
Energy to Food (Btu/lb) ____
Cooking Energy Rate (Btu/h or kW) ____
Electric Energy Rate (kW, gas rotisserie ovens only) ____
Energy per Pound of Food Cooked (Btu/lb or kWh/lb) ____
Cooking Energy Efficiency (%) ____

Section 11.9 Holding Energy Rate and Product Shrinkage (Optional):

Test Voltage (V) ____________
Gas Heating Value (Btu/ft^3) ____________
Holding Energy Rate (Btu/h or kW) ____________
Electric Energy Rate (kW, gas rotisserie ovens only) ____________
Shrinkage During Holding (%) ____________