Designation: F 1965 – 99

An American National Standard

# Standard Test Method for Performance of Deck Ovens[1]

This standard is issued under the fixed designation F 1965; 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 evaluates the energy consumption and cooking performance of deck ovens. The food service operator can use this evaluation to select a deck oven and understand its energy consumption.

1.2 This test method is applicable to gas and electric deck ovens.

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

1.3.1 Energy input rate and thermostat calibration (10.2),

1.3.2 Preheat energy consumption and time (10.3),

1.3.3 Idle energy rate (10.4),

1.3.4 Pilot energy rate (if applicable) (10.5), or

1.3.5 Cooking energy efficiency and production capacity (10.6).

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 standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASHRAE Documents:*[2]

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

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

2.2 *Other Document:*

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

## 3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

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

3.1.2 *cooking energy rate*, *n*—average rate of energy consumption (Btu/h or kW) during the cooking energy efficiency tests. Refers to all loading scenarios (heavy, medium, light).

3.1.3 *deck oven*, *n*—an appliance that cooks the food product within a heated chamber. The food product can be placed directly on the floor of the chamber during cooking and energy may be delivered to the food product by convective, conductive, or radiant heat transfer. The chamber may be heated by gas or electric forced convection, radiants, or quartz tubes. Top and bottom heat may be independently controlled.

3.1.4 *energy input rate*, *n*—peak rate at which a deck oven consumes energy (Btu/h or kW).

3.1.5 *idle energy rate*, *n*—the deck oven's rate of energy consumption (Btu/h or kW), when empty, required to maintain its cavity temperature at the specified thermostat set point.

3.1.6 *oven cavity*, *n*—that portion of the deck oven in which food products are heated or cooked.

3.1.7 *pilot energy rate*, *n*—rate of energy consumption (Btu/h or kW) by a deck oven's continuous pilot (if applicable).

3.1.8 *preheat energy*, *n*—amount of energy consumed (Btu or kWh), by the deck oven while preheating its cavity from ambient temperature to the specified thermostat set point.

3.1.9 *preheat time*, *n*—time (minutes) required for the deck oven cavity to preheat from ambient temperature to the specified thermostat set point.

3.1.10 *production capacity*, *n*—maximum rate (lb/h) at which a deck oven can bring the specified food product to a specified cooked condition.

3.1.11 *production rate*, *n*—rate (lb/h) at which a deck oven brings the specified food product to a specified cooked condition; does not necessarily refer to maximum rate. Production rate varies with the amount of food being cooked.

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

[1] This test method is under the jurisdiction of ASTM Committee F–26 on Food Service Equipment and is the direct responsibility of Subcommittee F26.06 on Productivity and Energy Protocol.

Current edition approved April 10, 1999. Published July 1999.

[2] Available from ASHRAE, 1791 Tullie Circle, N.E., Atlanta, GA 30329.

[3] Available from AOAC International, 481 North Frederick Avenue, Suite 500, Gaithersburg, Maryland 20877-2417.

## 4. Summary of Test Method

4.1 Accuracy of the deck oven thermostat is checked at a setting of 475°F, and the thermostat is adjusted as necessary.

4.2 Energy input rate is determined to confirm that the deck oven is operating within 5 % of the nameplate energy input rate. For gas deck oven, the pilot energy rate and the fan and control energy rate are also determined.

4.3 Preheat energy and time are determined.

4.4 Idle energy rate is determined at a thermostat setting of 475 °F.

4.5 Cooking energy efficiency and production rate are determined during cooking tests using pizza as a food product.

## 5. Significance and Use

5.1 The energy input rate test and thermostat calibration are used to confirm that the deck oven is operating properly prior to further testing and to insure that all test results are determined at the same temperature.

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

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

5.4 Cooking energy efficiency is a precise indicator of deck oven energy performance while cooking a typical food product under various loading conditions. If energy performance information is desired using a food product other than the specified test food, the test method could be adapted and applied. Energy performance information allows an end user to better understand the operating characteristics of a deck oven.

5.5 Production capacity information can help an end user to better understand the production capabilities of a deck oven as it is used to cook a typical food product and this could help in specifying the proper size and quantity of equipment. If production information is desired using a food product other than the specified test food, the test method could be adapted and applied.

## 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 natural gas volume to standard conditions, having 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 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.

6.4 *Convection Drying Oven*, with temperature controlled at 220 ± 5 °F, to be used to determine moisture content of pizza crust, pizza sauce, and pizza cheese.

6.5 *Gas Meter*, for measuring the gas consumption of a deck 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 natural gas pressure, having a range from 0 to 10 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 natural gas temperature in the range from 50 to 100 °F with an uncertainty of ±1 °F.

6.9 *Thermocouple*, fiberglass insulated, 24 gage, Type K thermocouple wire, connected at the exposed ends by tightly twisting or soldering the two wires together.

6.10 *Thermocouple Probe*, Type K micro needle product probe with a response time from ambient to 200 °F of less than 20 s.

6.11 *Watt-Hour Meter*, for measuring the electrical energy consumption of a deck oven, having a resolution of at least 10 Wh and a maximum uncertainty no greater than 1.5 % of the measured value for any demand greater than 100 W. 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 *Pizza Crust* shall be a 12 in. diameter, prebaked or parbaked crust weighing 0.9 ± 0.2 lb and having a moisture content of 36 ± 3 % by weight, based on a gravimetric moisture analysis. Refrigerate to 39 ± 1 °F.

7.2 *Pizza Sauce* shall be a simple tomato based sauce with a moisture content of 90 ± 2 % by weight, based on a gravimetric moisture analysis. Refrigerate to 39 ± 1 °F.

7.3 *Pizza Cheese* shall be a part skim, low moisture shredded mozzarella cheese with a moisture content of 50 ± 2 % by weight, based on a gravimetric moisture analysis. Refrigerate to 39 ± 1 °F.

7.4 *Pizza* shall be comprised of a pizza crust, pizza sauce, and pizza cheese in accordance with the following: uniformly spread 0.25 lb of pizza sauce on top of a pizza crust to within 0.5 in. of the edge of the crust and cover the pizza sauce with 0.375 lb of pizza cheese. Refer to 10.6.1 and Table 2 for guidelines on numbers of pizzas required for testing.

7.5 Gravimetric moisture analysis shall be performed as follows:

7.5.1 To determine moisture content, place a 1-lb sample of the test food on a dry, aluminum sheet pan and place the pan in a convection drying oven at a temperature of 220 ± 5 °F for a period of 24 h.

7.5.2 Weigh the sample before it is placed in the oven and after it is removed and determine the percent moisture content based on the percent weight loss of the sample.

7.5.3 The sample must be thoroughly chopped (⅛–in. or smaller squares) and spread evenly over the surface of the sheet pan in order for all of the moisture to evaporate during drying; it is permissible to spread the sample on top of baking paper in order to protect the sheet pan and simplify clean-up.

NOTE 1—The moisture content of the pizza crust, pizza sauce, and pizza cheese can be determined by a qualified chemistry lab using the AOAC Procedure 984.25.

## 8. Sampling

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

## 9. Preparation of Apparatus

9.1 Install the appliance in accordance with the manufacturer's instructions under a canopy exhaust hood. Position the deck oven so that a minimum of 6 in. is maintained between the edge of the hood and the vertical plane of the front and sides of the appliance. In addition, both sides of the deck oven 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. The associated heating or cooling system shall be capable of maintaining an ambient temperature of 75 ± 5 °F within the testing environment when the exhaust ventilation system is operating.

NOTE 2—The ambient temperature requirements are designed to simulate real world kitchen temperatures and are meant to provide a reasonable guideline for the temperature requirements during testing. If a facility is not able to maintain the required temperatures, then it is reasonable to expect that the application of the procedure may deviate from the specified requirements (if it cannot be avoided) as long as those deviations are noted on the Results Reporting Sheets.

9.2 Connect the deck 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 deck 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 an electric deck oven, confirm (while the deck oven 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 3—If an electric deck oven is rated for dual voltage (208/240 V), the deck oven shall be evaluated as two separate appliances in accordance with this test method.

9.4 For a gas deck 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.

## 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, and

10.1.1.6 Energy input rate during or immediately prior to test (for example, during the preheat for that days testing).

NOTE 4—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 deck oven under test. It is recommended that all testing be performed with gas having a higher heating value of 1000 to 1075 Btu/ft$^3$.

10.1.2 For gas deck ovens, add electric energy consumption to gas energy for all tests, with the exception of the energy input rate test (10.3).

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

10.1.3.1 Voltage while elements are energized and

10.1.3.2 Energy input rate during or immediately prior to test (for example, during the preheat for that days testing).

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 deck oven.

10.2 *Energy Input Rate and Thermostat Calibration*:

10.2.1 Install a thermocouple in the center of the oven cavity (side to side, front to back, and top to bottom).

10.2.2 Set the temperature control to 475 °F and turn the deck oven on. Record the time and energy consumption from the time when the unit is turned on until the time when any of the burners or elements first cycle off.

10.2.3 Calculate and record the deck oven's energy input rate and compare the result to the rated nameplate input. For gas deck ovens, only the burner energy consumption is used to compare the calculated energy input rate with the rated gas input; any electrical energy use shall be calculated and recorded separately as the fan/control energy rate.

10.2.4 Allow the deck oven to idle for 60 min after the burners or elements commence cycling at the thermostat set point.

10.2.5 After the 60–min idle period, start monitoring the deck oven cavity temperature and record the average temperature over a 30–min period. If this recorded temperature is 475 ± 5 °F, then the deck oven's thermostat is calibrated.

10.2.6 If the average temperature is not 475 ± 5 °F, adjust the deck oven's temperature control following the manufacturer's instructions and repeat 10.2.5 until it is within this range. Record the corrections made to the controls during calibration.

10.2.7 In accordance with 11.4, calculate and report the deck oven energy input rate, fan/control energy rate where applicable, and rated nameplate input.

10.3 *Preheat Energy Consumption and Time*:

10.3.1 Verify that the deck oven cavity temperature is 75 ± 5 °F. Set the calibrated temperature control to 475 °F and turn the deck oven on.

10.3.2 Record the time, temperature, and energy consumption required to preheat the deck oven, from the time when the unit is turned on until the time when the deck oven cavity reaches a temperature of 465 °F. Recording should occur at intervals of 5 s or less to accurately document the temperature rise of the oven cavity.

NOTE 5—Research at PG&E's Food Service Technology Center indicates that a deck oven is sufficiently preheated and ready to cook when the oven cavity temperature is within 10 °F of the oven set point (465 °F when the thermostat is set to maintain 475 °F).

10.3.3 In accordance with 11.5, calculate and report the preheat energy consumption and time and generate a preheat temperature vs. time graph.

10.4 *Idle Energy Rate*:

10.4.1 Set the calibrated temperature control to 475 °F and preheat the deck oven.

10.4.2 Allow the deck oven to idle for 60 min after the burners or elements commence cycling.

10.4.3 At the end of 60 min, begin recording the deck oven's idle energy consumption, at 475 °F, for a minimum of 2 h. Record the length of the idle period.

10.4.4 In accordance with 11.6, calculate and report the deck oven's idle energy rate.

10.5 *Pilot Energy Rate*:

10.5.1 For a gas deck oven with a standing pilot, set the gas valve at the pilot position and set the deck oven's temperature control to the off position.

10.5.2 Light and adjust the pilot according to the manufacturer's instructions.

10.5.3 Monitor gas consumption for a minimum of 8 h of pilot operation.

10.5.4 In accordance with 11.7, calculate and report the pilot energy rate.

10.6 *Pizza Preparation*:

10.6.1 Determine how many pizzas the deck oven can cook at one time, based on how many whole, 12-in. pizzas can fit completely within the oven cavity, with the oven door closed, in accordance with the manufacturer's recommended oven operation. This number of pizzas is designated as a heavy load. A medium load is designated as one-half the number of pizzas required for a heavy load, rounded up to the nearest whole pizza, and a light load is designated as a single pizza. Prepare enough pizzas (7.4) for a minimum of three runs of each loading scenario. Table 2 lists how many pizzas are required for a complete oven test (not including cook-time-determination pizzas, see 10.6.2)—three runs of the heavy load test, three runs of the medium load test, and three runs of the light load test based on the nominal depth and width of the oven deck. Weigh each uncooked pizza and record the weight. Cover the pizzas with plastic wrap to inhibit moisture loss, place in a refrigerator, and chill the pizzas until they stabilize at 40 ± 2 °F. Do not test with pizzas that have been in the refrigerator more than 24 h.

**TABLE 1 Number of Pizzas Required for Each Run of a Heavy–Load Test Based on the Nominal Depth and Width of the Oven Deck**

| Nominal Depth, ft | Nominal Width, ft | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| 1 | 1 | 2 | 3 | 4 |
| 2 | 2 | 4 | 6 | 8 |
| 3 | 3 | 6 | 9 | 12 |
| 4 | 4 | 8 | 12 | 16 |

**TABLE 2 Total Number of Pizzas Required for a Complete Oven Test Based on the Nominal Depth and Width of the Oven Deck**

| Nominal Depth, ft | Nominal Width, ft | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| 1 | 3 | 9 | 18 | 21 |
| 2 | 9 | 21 | 30 | 39 |
| 3 | 18 | 30 | 45 | 57 |
| 4 | 21 | 39 | 57 | 75 |

NOTE 6—The test pizzas should not be stored in the refrigerator for long periods, more than 24 h, because the pizza crust may absorb excessive moisture from the sauce and evaporation may reduce the moisture content of the sauce, changing the thermal characteristics of the pizza. The 24-h period is a practical time specification that allows the preparation of test pizzas on day one, overnight chilling and stabilization and application of the procedure the following day.

NOTE 7—In order to easily handle and store the pizzas, it is recommended that the prepared pizzas be placed on full-size (18 by 26 in.) sheet pans, two pizzas per pan. The entire pan can then be covered with food grade plastic wrap. When stacking multiple pans in the refrigerator, spacers are necessary between the pans in order to protect the pizzas from damage. Researchers at PG&E's Food Service Technology Center have found that sauce cups can be used as spacers.

NOTE 8—A minimum of three test runs is specified, however, more test runs may be necessary if the results do not meet the uncertainty criteria specified in Annex A1.

10.6.2 Prepare a minimum of four additional pizzas for use in cook time determination. The actual number of pizzas needed for the cook time determination will vary with the number of trials needed to establish a cooking time that demonstrates a 195 ± 3 °F final pizza temperature after cooking.

10.7 *Cook Time Determination*:

10.7.1 Set the calibrated temperature control to 475 °F, preheat the deck oven and allow it to idle for 60 min. Estimate a cook time for pizza. The cook time includes the time that the pizza is in direct contact with the oven deck, regardless of whether the oven door is open or closed. The cook time does not include the time that the pizza is being placed-into or removed-from the oven.

10.7.2 Remove a pizza from the refrigerator and place the pizza directly on the oven deck (do not use a pizza screen or pan) in the center of the oven. Do not allow more than 1 min to elapse from the time a pizza is removed from the refrigerator until it is placed on the oven deck.

10.7.3 Allow the pizza to cook for the duration of the estimated cook time and then remove the pizza from the deck oven and place the pizza on an insulated, nonmetallic surface such as corrugated cardboard. A standard cardboard pizza box is acceptable.

10.7.4 Determine the final temperature of the pizza by placing six thermocouple probes on the surface of the pizza. Locate the probes 3 in. from the center of the pizza and spaced equidistant from each other as shown in Fig. 1. The probes should penetrate the cheese and rest on the sauce-crust interface directly beneath the cheese. Allow no more than 10 s from the time the pizza is removed from the oven deck to the time

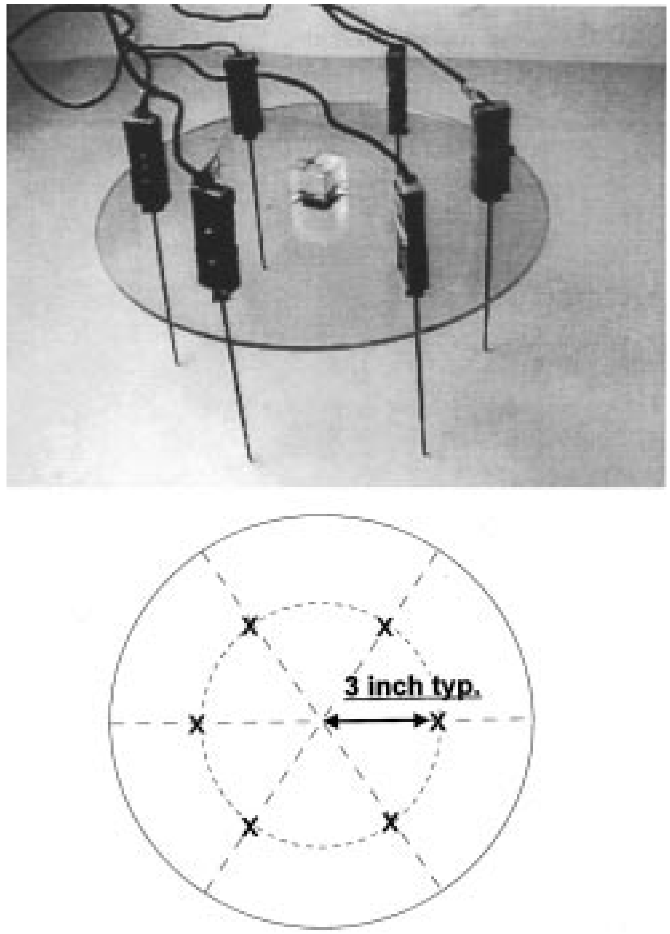



FIG. 1 Location of Thermocouple Probes on Pizza Surface

the probes are placed on the pizza. Wait 30 s after the probes are placed on the pizza, which allows time for the probes to stabilize, and record the temperatures of all six probes. Leave the probes in place and record the temperatures again at 40, 50, and 60 s. Fig. 2 details the timing of the temperature measurement. The final pizza temperature is the highest of these four averaged temperature readings. If the final pizza temperature is not 195 ± 3 °F, adjust the cook time and repeat the cook time determination test as necessary to produce a 195 ± 3 °F final temperature.

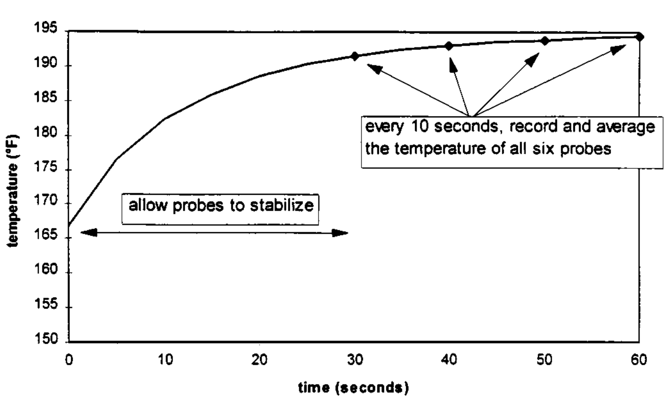



FIG. 2 Timing of Temperature Measurement after Probes are Placed on Cooked Pizza

NOTE 9—It is recommended that the six thermocouple probes be attached to a simple, lightweight, rigid structure that will maintain the proper spacing and upright position of the probes and will therefore help maintain the consistency of the temperature readings. Fig. 1shows a thermocouple structure that is made of Plexiglas™ and includes a simple handle for easy placement of the structure on the pizza. This structure can be gently set on top of the pizza during cooktime determination with just enough force to penetrate the cheese but not enough to push the probes beyond the sauce-crust interface. Because the sauce migrates into the crust during cooking, it is relatively easy to remain in the sauce-crust interface during temperature measurement.

10.7.5 Record the determined cook time for use during the cooking energy efficiency and production capacity tests.

10.8 *Cooking Energy Efficiency and Production Capacity*:

10.8.1 Set the calibrated temperature control to 475 °F, preheat the deck oven and allow it to idle for 60 min.

10.8.2 The cooking energy efficiency and production capacity tests are to be run a minimum of three times. Additional test runs may be necessary to obtain the required precision for the reported test results (see Annex A1). The cooking energy efficiency tests shall be performed in the following sequence, starting with the light loads and progressing to the heavy loads.

10.8.3 Remove from the refrigerator the amount of pizza required for a heavy-load test run. Monitor the oven's thermostat cycle and wait for the oven to cycle "on" and then "off" again. As soon as the burners or elements cycle "off," open the deck oven door. Place the pizza(s) directly on the oven deck (do not use a pizza screen or pan). Start monitoring time and energy immediately upon placing the first pizza on the oven deck. Do not allow more than 1 min to elapse from the time a pizza is removed from the refrigerator until it is placed on the oven deck and do not allow more than 5 s between the loading of any two successive pizzas into the oven. For a heavy load, place a pizza in every square foot of the oven deck, starting from the left rear corner of the oven and loading from rear to front and left to right. Close the oven door immediately after loading the last pizza. The example in Fig. 3 details light-, medium-, and heavy-loading scenarios for a 3 ft deep by 4 ft wide oven deck.

NOTE 10—It is recommended that a pizza peel be used to safely place pizzas on an oven deck. A pizza peel consists of a flat metal or wood blade connected to a long handle. Sized to lift a single pizza, the peel allows the operator to load and remove a pizza from the oven without having to extend an arm into the oven.

10.8.4 When the first pizza loaded into the oven has been on the oven deck the same amount of time as the cook time determined in 10.7, open the oven door and remove all the pizza(s) starting with the front left pizza and continuing front to rear and left to right. Do not allow more than 5 s between the unloading of any two successive pizzas from the oven. Determine the final pizza temperature (as detailed in the cook time determination) of the first, middle, and last pizza removed from the oven. (For a test with an even number of pizzas, choose either one of the two middle pizzas for the temperature determination.)

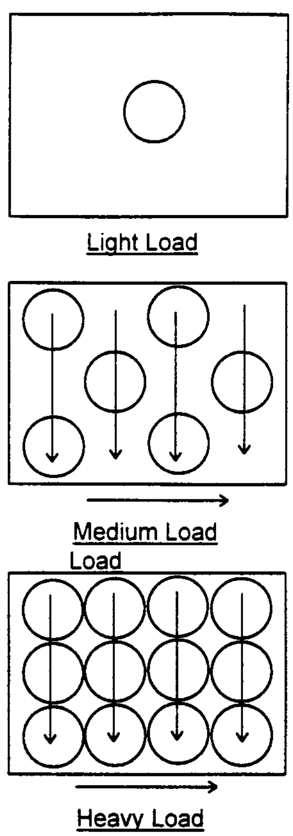



FIG. 3 Examples of Light-, Medium-, and Heavy-Loading Scenarios for a 3 ft Deep by 4 ft Wide Oven Deck

NOTE 11—In order to measure the temperature of the first, middle, and last pizzas, it is necessary to use at least two sets of thermocouple probes or two of the thermocouple structures as detailed in 10.7. This is because the pizzas are unloaded every 5 s while it takes 60 s to determine the final temperature of any one pizza. For example, in a test that uses twelve pizzas, the middle pizza will be unloaded only 30 s after the first pizza so a second thermocouple structure is required in order to start measuring the temperature within 10 s after a pizza is removed from the oven.

10.8.5 Close the oven door immediately after removing the last pizza. Stop monitoring time and energy as soon as the oven temperature has recovered to 465 °F. Remove any cheese that may stick to the thermocouple probes during temperature measurement and place the cheese back on the pizza. Weigh each cooked test pizza and record the weight. Record the time and the energy.

10.8.6 Repeat 10.8.3-10.8.5 for medium and light load tests. For a light load, place the single pizza in the center of the oven. For a medium load, place a pizza in every other square foot of the oven deck, starting from the left rear corner of the oven and loading from rear to front and left to right.

10.8.7 For medium and heavy loads, calculate the average of the three final pizza temperatures and verify that it is 195 ± 3 °F. Record the average final pizza temperature. If the average final pizza temperature is more or less than 195 ± 3 °F, then repeat steps 10.8.3-10.8.5, adjusting the cook time until the specified final temperature is achieved. Record the adjusted cook time.

10.8.8 In accordance with 11.8, calculate and report the cooking energy efficiency, cooking energy rate, electric energy rate (if applicable for gas deck ovens), and production capacity. Follow the procedure in Annex A1 to determine whether more than three tests runs are required.

## 11. Calculation and Report

11.1 *Test Deck Oven*:

11.1.1 Summarize the physical and operating characteristics of the deck 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 deck ovens, report the voltage for each test.

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

11.3 *Gas Energy Calculations*:

11.3.1 For gas deck 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 Calculate the energy consumed based on the following:

$$E_{gas} = V \times HV \tag{1}$$

where:

$E_{gas}$ = energy consumed by the appliance,
$HV$ = higher heating value, energy content of gas measured at standard conditions, Btu/ft$^3$,

$V$ = 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,

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

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

$P_{cf}$ = pressure correction factor,

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

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

NOTE 12—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 deck oven and kW for an electric deck oven.

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

$$E_{input\ rate} = \frac{E \times 60}{t} \quad (2)$$

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

11.5 *Preheat Energy and Time*:

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

11.5.2 Generate a graph showing the deck oven cavity temperature versus time for the preheat period.

11.6 *Idle Energy Rate*:

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

$$E_{idle\ rate} = \frac{E \times 60}{t} \quad (3)$$

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

11.7 *Pilot Energy Rate*:

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

$$E_{pilot\ rate} = \frac{E \times 60}{t} \quad (4)$$

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

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

11.8.1 Calculate the cooking energy efficiency, ηcook, for heavy-, medium-, and light-load cooking tests based on the following:

$$\eta_{cook} = \frac{E_{food}}{E_{appliance}} \times 100 \quad (5)$$

where:
$\eta_{cook}$ = cooking energy efficiency, %,
$E_{food}$ = energy into food, Btu,
= $(W_{uncooked} \times C_p\ (P) \times (T_2 - T_1)) + ((W_{uncooked} - W_{cooked}) \times H_{fgt2})$,
$W_{uncooked}$ = total weight of test pizzas before they are cooked,
$W_{cooked}$ = total weight of cooked test pizzas,
$C_p\ (P)$ = the specific heat of pizzas based on the average specified pizza,
= 0.593 Btu/lb·°F
$H_{fgt2}$ = the heat of vaporization of water (Btu/lb) as found from a table of thermodynamic properties of water at saturation (see 1993 *ASHRAE Handbook of Fundamentals*, Chapter 6, Table 3),
= 970 Btu/lb
$T_2$ = the average final temperature of the pizza,
$T_1$ = the initial temperature of the pizza, and
$E_{appliance}$ = energy into the appliance including electric energy consumed by a gas deck oven, Btu.

NOTE 13—The conversion factor for electric energy is 3413 Btu / kWh.

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

$$E_{cook\ rate} = \frac{E \times 60}{t} \quad (6)$$

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

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

11.8.3 Calculate production capacity (pizzas/h) based on the following:

$$PC = \frac{P_{num} \times 60}{t} \quad (7)$$

where:
$PC$ = production capacity of the deck oven, pizzas/h,
$P_{num}$ = number of pizzas required for a heavy load, and
$t$ = cooking test period, min.

11.8.4 Calculate production rates (pizzas/h) for the medium- and light-load tests based on the following:

$$PR = \frac{P_{num} \times 60}{t} \quad (8)$$

where:

$PR$ = production rate of the deck oven for medium- and light-loads, pizzas/h,
$P_{num}$ = number of pizzas required for the medium- or light-load,
$t$ = cooking test period for the medium- or light-load, min.

11.8.5 Report the cook time and the three-run average value of the cooking energy efficiency, cooking energy rate, production capacity, and medium- and light-load production rates.

## 12. Precision and Bias

12.1 *Precision*:

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

12.1.1.1 For 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 reported parameter is being determined.

12.1.2 *Reproducibility (Multiple Laboratories)*:

12.1.2.1 The interlaboratory 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 cooking energy efficiency; deck oven; efficiency; energy; performance; pizza oven; production capacity; throughput

# ANNEX

**(Mandatory Information)**

## A1. PROCEDURE FOR DETERMINING THE UNCERTAINTY IN REPORTED TEST RESULTS

NOTE A1.1—The procedure described below is based on the method for determining the confidence interval for the average of several test results discussed in 6.4.3 of 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 (thermocouples calibrated and operating range within 5 % of rated input during the test run).

A1.1 For the cooking energy efficiency and production capacity procedures, results are reported for the cooking energy efficiency ($\eta_{cook}$) and the production capacity (*PC*). Each reported result is the average of results from at least three test runs. In addition, the uncertainty in these averages is reported. For each cooking energy efficiency test (light, medium and heavy), the uncertainty of $\eta_{cook}$ must be no greater than ±10 % before $\eta_{cook}$ for that test can be reported. For the heavy load test, the uncertainty of *PC* must also be no greater than ±10 % before *PC* for that test can be reported.

A1.2 The uncertainty in a reported result is a measure of its precision. If, for example, the $\eta_{cook}$ is 40 %, the uncertainty must not be larger than ±4 %. This means that the true $\eta_{cook}$ is within the interval between 36 and 44 %. This interval is determined at the 95 % confidence level, which means that there is only a 1 in 20 chance that the true $\eta_{cook}$ could be outside of this interval.

A1.3 Calculating the uncertainty not only guarantees the maximum uncertainty in the reported results, but also is 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 depends on 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.

**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 *Procedure*:

NOTE A1.2—See A1.5 for an example of applying this procedure

A1.4.1 *Step 1*—Calculate the average and the standard deviation for the $\eta_{cook}$ and *PC* using the results of the first three test runs.

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

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 $\eta_{cook}$, *PC*, and
$X_1, X_2, X_3$ = results for $\eta_{cook}$, *PC*.

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 $\eta_{cook}$, *PC*,
$A_3$ = $(X_1)^2 + (X_2)^2 + (X_3)^2$, and
$B_3$ = $(1/3) \times (X_1 + X_2 + X_3)^2$

NOTE A1.4—The A quantity is the sum of the squares of each test result, while the B quantity is the square of the sum of all test results multiplied by a constant (1/3 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.

The formula for the absolute uncertainty (three test runs) is as follows:

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

$$U_3 = 2.48 \times S_3 \quad \text{(A1.4)}$$

where:
$U_3$ = absolute uncertainty in average for $\eta_{cook}$, *PC*,
$C_3$ = 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.

The formula for the percent uncertainty (three test runs) is as follows:

$$\%U_3 = (U_3/Xa_3) \times 100\ \% \quad \text{(A1.5)}$$

where:
$\%U_3$ = percent uncertainty in average for $\eta_{cook}$, *PC*,
$U_3$ = absolute uncertainty in average for $\eta_{cook}$, *PC*, and
$Xa_3$ = average $\eta_{cook}$, *PC*.

A1.4.4 *Step 4*—If the percent uncertainty, $\%U_3$, is not greater than ±10 % for $\eta_{cook}$ then report the average for $\eta_{cook}$ and *PC* along with their corresponding absolute uncertainty, $U_3$ in the following format:

$$Xa_3 \pm U_3 \quad \text{(A1.6)}$$

If the percent uncertainty is greater than ±10 % for $\eta_{cook}$ then proceed to Step 5.

A1.4.5 *Step 5*—Run a fourth test for each $\eta_{cook}$ that resulted in the percent uncertainty being greater than ±10 %.

A1.4.6 *Step 6*—When a fourth test is run for a given $\eta_{cook}$, calculate the average and standard deviation for $\eta_{cook}$ and *PC* using a calculator or the following formulas:

The formula for the average (4 test runs) is as follows:

$$Xa_4 = (1/4) \times (X_1 + X_2 + X_3 + X_4) \quad \text{(A1.7)}$$

where:
$Xa_4$ = average of results for $\eta_{cook}$, *PC*, and
$X_1, X_2, X_3, X_4$ = results for $\eta_{cook}$, *PC*.

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

$$S_4 = (1/\sqrt{3}) \times \sqrt{(A_4 - B_4)} \quad \text{(A1.8)}$$

where:
$S_4$ = standard deviation of results for $\eta_{cook}$, *PC* (4 test runs),
$A_4$ = $(X_1)^2 + (X_2)^2 + (X_3)^2 + (X_4)^2$
$B_4$ = $(1/4) \times (X_1 + X_2 + X_3 + X_4)^2$

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.

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

$$U_4 = C_4 \times S_4 \quad \text{(A1.9)}$$
$$U_4 = 1.59 \times S_4$$

where:
$U_4$ = absolute uncertainty in average for $\eta_{cook}$, *PC*, and
$C_4$ = the uncertainty factor for 4 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.

The formula for the percent uncertainty (4 test runs) is as follows:

$$\%U_4 = (U_4/Xa_4) \times 100\ \% \quad \text{(A1.10)}$$

where:
$\%U_4$ = percent uncertainty in average for $\eta_{cook}$, *PC*,
$U_4$ = absolute uncertainty in average for $\eta_{cook}$, *PC*, and
$Xa_4$ = average $\eta_{cook}$, *PC*.

A1.4.9 *Step 9*—If the percent uncertainty, $\%U_4$, is no greater than ±10 % for $\eta_{cook}$ then report the average for $\eta_{cook}$ and *PC* along with their corresponding absolute uncertainty, $U_4$ in the following format:

$$Xa_4 \pm U_4 \quad \text{(A1.11)}$$

If the percent uncertainty is greater than ±10 % for $\eta_{cook}$ proceed to Step 10.

A1.4.10 *Step 10*—The step required or 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.

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

$$Xa_n = (1/n) \times (X_1 + X_2 + X_3 + X_4 + ... + X_n) \quad \text{(A1.12)}$$

where:
$n$ = number of test runs,
$Xa_n$ = average of results for $\eta_{cook}$, *PC*, and
$X_1, X_2, X_3, X_4, ... X_n$ = results for $\eta_{cook}$, *PC*.

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

$$S_n = (1/\sqrt{(n-1)}) \times (\sqrt{(A_n - B_n)}) \quad \text{(A1.13)}$$

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

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

$$U_n = C_n \times S_n \quad \text{(A1.14)}$$

where:
$U_n$ = absolute uncertainty in average for $\eta_{cook}$, *PC*, and
$C_n$ = uncertainty factor for *n* test runs (Table A1.1).

The formula for the percent uncertainty ($n$ test runs) is as follows:

$$\%U_n = (U_n/Xa_n) \times 100\ \% \quad \text{(A1.15)}$$

where:

$\%U_n$ = percent uncertainty in average for $\eta_{cook}$, *PC*.

When the specified uncertainty, $\%U_n$, is less than or equal to ±10 % report the average for $\eta_{cook}$ and *PC* along with their corresponding absolute uncertainty, $U_n$ in the following format:

$$Xa_n \pm U_n \quad \text{(A1.16)}$$

NOTE A1.5—In the course of running these tests, the tester may compute a test result that deviates significantly from the other test results. It may be tempting to discard such a result in an attempt to meet the ±10 % uncertainty requirement. This should be done only if there is some physical evidence that the test run from which that particular result was obtained was not performed according to the conditions specified in this method. For example, a thermocouple was out of calibration or the oven's input rate was not within 5 % of the rated input. To be sure all results were obtained under approximately the same conditions, it is good practice to monitor those test conditions specified in this test method.

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

A1.5.1 Three test runs for the full-energy input rate cooking efficiency test yielded the following $\eta_{cook}$ results:

| Test | $\eta_{cook}$, % |
|---|---|
| 1 | 33.8 |
| 2 | 31.3 |
| 3 | 30.5 |

A1.5.2 *Step 1*—Calculate the average and standard deviation of the three test results for the $\eta_{cook}$.

The average of the three test results are as follows:

$$Xa_3 = (1/3) \times (X_1 + X_2 + X_3) \quad \text{(A1.17)}$$

$$Xa_3 = (1/3) \times (33.8 + 31.3 + 30.5)$$

$$Xa_3 = 31.9\ \%$$

For the standard deviation of the three test results, first calculate $A_3$ and $B_3$ as follows:

$$A_3 = (X_1)^2 + (X_2)^2 + (X_3)^2 \quad \text{(A1.18)}$$

$$A_3 = (33.8)^2 + (31.3)^2 + (30.5)^2$$

$$A_3 = 3052$$

$$B_3 = (1/3) \times [(X_1 + X_2 + X_3)^2]$$

$$B_3 = (1/3) \times [(33.8 + 31.3 + 30.5)^2]$$

$$B_3 = 3046$$

The new standard deviation for $\eta_{cook}$ is as follows:

$$S_3 = (1/\sqrt{2}) \times \sqrt{(3052 - 3046)} \quad \text{(A1.19)}$$

$$S_3 = 1.73\ \%$$

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

$$U_3 = 2.48 \times S_3 \quad \text{(A1.20)}$$

$$U_3 = 2.48 \times 1.73$$

$$U_3 = 4.29\ \%$$

A1.5.4 *Step 3*—Calculate percent uncertainty as follows:

$$\%U_3 = (U_3/Xa_3) \times 100\ \% \quad \text{(A1.21)}$$

$$\%U_3 = (4.29/31.9) \times 100\ \%$$

$$\%U_3 = 13.5\ \%$$

A1.5.5 *Step 4*—Run a fourth test. Since the percent uncertainty for the $\eta_{cook}$ is greater than ± 10 %, the precision requirement has not been satisfied. An additional test is run in an attempt to reduce the uncertainty. The $\eta_{cook}$ from the fourth test run was 31.8 %.

A1.5.6 *Step 5*—Recalculate the average and standard deviation for $\eta_{cook}$ using the fourth test result:

The new average $\eta_{cook}$ is as follows:

$$Xa_4 = (1/4) \times (X_1 + X_2 + X_3 + X_4) \quad \text{(A1.22)}$$

$$Xa_4 = (1/4) \times (33.8 + 31.3 + 30.5 + 31.8)$$

$$Xa_4 = 31.9\ \%$$

For the new standard deviation, first calculate $A_4$ and $B_4$.

$$A_4 = (X_1)^2 + (X_2)^2 + (X_3)^2\ (X_4)^2 \quad \text{(A1.23)}$$

$$A_4 = (33.8)^2 + (31.3)^2 + (30.5)^2 + (31.8)$$

$$A_4 = 4064$$

$$B_4 = (1/4) \times [(X_1 + X_2 + X_3 + X_4)^2]$$

$$B_4 = (1/4) \times [(33.8 + 31.3 + 30.5 + 31.8)^2]$$

$$B_4 = 4058$$

The new standard deviation for $\eta_{cook}$ is as follows:

$$S_4 = (1/\sqrt{3}) \times \sqrt{(4064 - 4058)} \quad \text{(A1.24)}$$

$$S_4 = 1.41\ \%$$

A1.5.7 *Step 6*—Recalculate the absolute uncertainty using the new average and standard deviation as follows:

$$U_4 = 1.59 \times S_4 \quad \text{(A1.25)}$$

$$U_4 = 1.59 \times 1.41$$

$$U_4 = 2.24\ \%$$

A1.5.8 *Step 7*—Recalculate the percent uncertainty as follows:

$$\%U_4 = (U_4/Xa_4) \times 100\ \% \quad \text{(A1.26)}$$

$$\%U_4 = (2.24/31.9) \times 100\ \%$$

$$\%U_4 = 7\ \%$$

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

$$\eta_{cook} = 31.9 \pm 2.24\ \% \quad \text{(A1.27)}$$

The *PC* and its absolute uncertainty can be calculated and reported following the same steps, assuming the ±10 % precision requirement has been met for the corresponding $\eta_{cook}$.

# APPENDIX

## (Nonmandatory Information)

## X1. Results Reporting Sheets

Manufacturer ____________________

Model ____________________

Serial # ____________________

Date ____________________

Test Reference Number
(optional) ______________________________

**Section 11.1 Test Oven**
Description of operational characteristics:

________________________________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

Physical Dimensions

Size of oven: ____________ Height, in. by ____________ Width, in. by ____________ Depth, in.

Oven deck width: ____________ in.

Oven deck depth: ____________ in.

Nominal oven deck width: ____________ ft

Nominal oven deck depth: ____________ ft

**Section 11.2 Apparatus**

_____ Check if testing apparatus conformed to specifications in Section 6.

Deviations:

________________________________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

**Section 11.3 Energy Input Rate**

Test Voltage (V) ____________________

Gas Heating Value (Btu/ft$^3$) ____________________

Rated (Btu/h or kW) ____________________

Measured (Btu/h or kW) ____________________

Percent Difference between Measured and Rated (%) ____________________

Fan / Control Energy Rate (kW, gas ovens only) ____________________

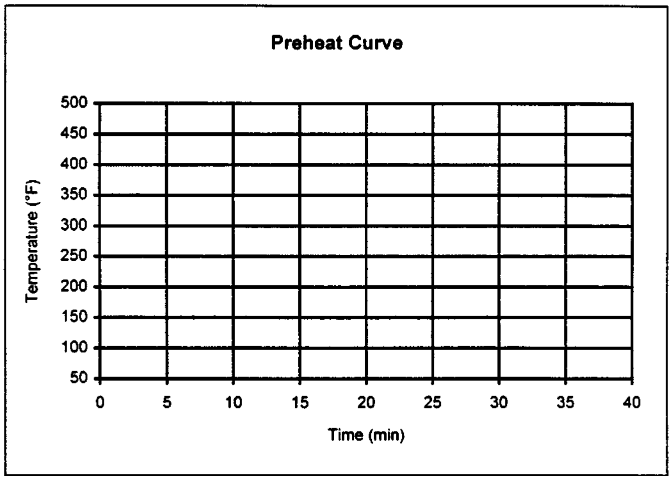
**Section 11.4 Preheat Energy and Time**

Test Voltage (V) ____________________

Gas Heating Value (Btu/ft$^3$) ____________________

Energy Consumption (Btu or kWh) ____________________

Time from ________ °F to 475 °F (min) ____________________




**Section 11.5 Idle Energy Rate**

Test Voltage (V) ____________________

Gas Heating Value (Btu/ft$^3$) ____________________

Idle Energy Rate (Btu/h or kW) ____________________

**Section 11.6 Pilot Energy Rate**

Gas Heating Value (Btu/ft$^3$) ____________________

Pilot Energy Rate (Btu/h) ____________________

**Section 11.7 Cooking Energy Efficiency and Cooking Energy Rate**

**Cook Time Determination:**

Cook time: _______________ min

**Light Load:**

Test Voltage (V) ____________________

Gas Heating Value (Btu/ft$^3$) ____________________

Cooking Energy Efficiency (%) ____________________

Cooking Energy Rate (Btu/h or kW) ____________________

Electric Energy Rate (kW, gas ovens only) ____________________

Energy into food, $E_{food}$(Btu) ____________________

Energy into the appliance, $E_{appliance}$(Btu) ____________________

Final cooktime (min) ____________________

Production Rate (pizzas/h) ____________________

**Medium Load:**

Test Voltage (V) ____________________

Gas Heating Value (Btu/ft$^3$) ____________________

Cooking Energy Efficiency (%) ____________________

Cooking Energy Rate (Btu/h or kW) ____________________

Electric Energy Rate (kW, gas ovens only) ____________________

Energy into food, $E_{food}$(Btu) ____________________

Energy into the appliance, $E_{appliance}$(Btu) ____________________

Final cooktime (min) ____________________

Production Rate (pizzas/h) ____________________

**Heavy Load:**

Test Voltage (V) ____________________

Gas Heating Value (Btu/ft$^3$) ____________________

Cooking Energy Efficiency (%) ____________________

Cooking Energy Rate (Btu/h or kW) ____________________

Electric Energy Rate (kW, gas ovens only) ____________________

Energy into food, $E_{food}$(Btu) ____________________

Energy into the appliance, $E_{appliance}$(Btu) ____________________

Final cooktime (min) ____________________

Production Capacity (pizzas/h) ____________________