



Standard Test Method for Performance of Staff-Serve Hot Deli Cases¹

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1. Scope

1.1 This test method evaluates the energy consumption and performance of staff-serve hot deli cases with heated wells located within a fully or partially enclosed heated cavity. The food service operator can use this evaluation to select a staff served hot deli case and understand its energy consumption and performance.

1.2 This test method is applicable to electric powered, hot deli cases that have been designed for staff service of prepared hot food items that are held in open hotel pans.

1.3 The deli case can be evaluated with respect to the following (where applicable):

- 1.3.1 Energy input rate (10.2),
- 1.3.2 Holding capacity (10.3),
- 1.3.3 Holding temperature calibration (10.3),
- 1.3.4 Preheat energy rate, (10.4),
- 1.3.5 Idle energy rate (10.5), and
- 1.3.6 Holding energy rate (10.6).

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

1.5 *This test method may involve hazardous materials, operations, and equipment. 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 Document:²

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

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

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² Available from American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329, <http://www.ashrae.org>.

2.2 NSF Standards:³

NSF Listing Food Equipment and Related Components and Material
NSF/ANSI 4 Commercial Cooking, Rethermalization and Powered Hot Food Holding and Transport Equipment

3. Terminology

3.1 Definitions:

3.1.1 *calibrated setting, n*—temperature setting at which the lowest temperature of the food in the holding pans is at $142 \pm 2^\circ\text{F}$ ($61 \pm 1^\circ\text{C}$).

3.1.2 *capacity, n*—amount of food product that can be held in the unit's heated wells within standard 4-in. (102-mm) deep steam table pans.

3.1.3 *energy input rate, n*—peak rate at which a deli case consumes energy (kW), typically reflected during preheat.

3.1.4 *holding energy, n*—energy consumed by the deli case as it is used to hold cooked food product under full load conditions.

3.1.5 *holding energy rate, n*—average rate of energy consumption (kW) during the holding energy tests.

3.1.6 *idle energy rate, n*—rate of energy consumed (kW) by the deli case while holding or maintaining the appliance at the thermostat set point without any food product.

3.1.7 *preheat energy, n*—amount of energy consumed by the deli case while preheating the appliance from ambient room temperature ($73 \pm 3^\circ\text{F}$ ($22 \pm 2^\circ\text{C}$)) to a temperature at the calibrated setting.

3.1.8 *preheat rate, n*—average rate ($^\circ\text{F}/\text{min}$) at which the deli case is heated from ambient temperature ($73 \pm 3^\circ\text{F}$ ($22 \pm 2^\circ\text{C}$)) to holding temperature with the thermostat set to the calibrated setting.

3.1.9 *preheat time, n*—time required for the deli case to preheat from ambient room temperature ($73 \pm 3^\circ\text{F}$ ($22 \pm 2^\circ\text{C}$)) to the calibrated setting.

3.1.10 *staff-serve hot deli case, n*—(hereafter referred to as deli case) an appliance, with heated wells located in a fully or partially enclosed heated cavity, which is designed for the

³ Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140, <http://www.nsf.org>.

display and service of hot food product in standard hotel pans. Also known as hot food merchandisers, display merchandisers or hot display cases.

3.1.11 *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 deli case 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 Capacity is determined by loading the deli case's heated wells with 4-in. (100-mm) deep half-size steam table pans.

4.3 The calibrated setting is determined by using pre-cooked food product (macaroni and cheese) in 4-in. (100-mm) deep half-size steam pans and setting controls such that lowest temperature in the center of the food pans is $142 \pm 2^\circ\text{F}$ ($61 \pm 1^\circ\text{C}$).

4.4 The amount of energy and time required to preheat the deli case to calibrated setting is determined.

4.5 The idle energy rate is determined with the deli case set at calibrated setting and no food in the unit.

4.6 The deli case is used to hold 4-in. (100-mm) deep half-size steam pans filled with hot food for 3 h. Food temperature and deli case energy consumption are monitored during this testing.

5. Significance and Use

5.1 The energy input rate is used to confirm that the deli case is operating properly prior to further testing.

5.2 Capacity is used by food service operators to choose a deli case that matches their food holding requirements.

5.3 Preheat energy and time can be useful to food service operators to manage energy demands and to know how quickly the deli case can be ready for operation.

5.4 Holding energy rate and idle energy rate can be used by the food service operator to estimate deli case energy consumption.

6. Apparatus

6.1 *Analytical Balance Scale*, for measuring weights up to 20 lb (9 kg), with a resolution of 0.01 lb (0.005 kg) and an uncertainty of 0.01 lb (0.005 kg).

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

6.3 *Thermocouple(s)*, industry standard type T or type K thermocouple wire with a range of 0 to 250°F (−17 to 121°C) and an uncertainty of $\pm 1^\circ\text{F}$ ($\pm 0.5^\circ\text{C}$).

6.4 *Thermocouple Probe*, “fast response” type T or type K thermocouple probe, $\frac{1}{16}$ in. (1.6 mm) or smaller diameter, with a 3-s or faster response time, capable of immersion with a

range of 0 to 250°F (−17 to 121°C) and an uncertainty of $\pm 1^\circ\text{F}$ ($\pm 0.5^\circ\text{C}$). The thermocouple probe's active zone shall be at the tip of the probe.

6.5 *Watt-Hour Meter*, for measuring the electrical energy consumption of a deli case, 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 *Macaroni and Cheese*, a sufficient quantity of frozen, ready to cook, traditional macaroni and cheese, in half-size pans weighing approximately 4.5 lb (2.0 kg) obtained from a food distributor.

7.2 *Pans*, a sufficient quantity of stainless steel half-size steam pans, measuring 10 by 12 by 4 in. (250 by 300 by 100 mm) and weighing 1.8 ± 0.2 lb (0.8 ± 0.1 kg), to fill the deli case's heated wells.

7.3 *Small Pans*, a sufficient quantity of stainless steel $\frac{1}{3}$ -size steam pans, measuring 10 by 8 by 4 in. (250 by 200 by 100 mm) and weighing 1.5 ± 0.2 lb (0.7 ± 0.1 kg), to fill the deli case's heated wells as necessary.

8. Sampling and Test Units

8.1 *Deli Case*—Select a representative production model for performance testing.

9. Preparation of Apparatus

9.1 Install the deli case according to the manufacturer's instructions in an appropriate space. All sides of the deli case shall be a minimum of 12 in. (305 mm) from any side wall, side partition, or other operating appliance. The associated heating or cooling system for the space shall be capable of maintaining an ambient temperature of $73 \pm 3^\circ\text{F}$ ($22 \pm 2^\circ\text{C}$) within the testing environment.

9.2 The testing environment during energy tests shall be maintained in accordance with the section on performance for open top hot food holding equipment room specifications of NSF/ANSI 4. The NSF/ANSI 4 test room conditions are an ambient temperature of $73 \pm 3^\circ\text{F}$ ($22 \pm 2^\circ\text{C}$), no vertical temperature gradient exceeding 1.5°F/ft (2.5°C/m), and maximum air current velocity of 50 ft/min (0.25 m/s) across the surfaces of the test pans (partially enclosed units).

9.3 Connect the deli case to a calibrated energy test meter. A voltage regulator may be required during tests if the voltage supply is not within ± 2.5 % of the manufacturer's nameplate voltage.

9.4 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 1—It is the intent of the testing procedure in this test method to evaluate the performance of a deli case at its rated electric voltage. If the unit is rated dual voltage (that is, designed to operate at either 240 or 480 V with no change in components), the voltage selected by the manufacturer or tester, or both, shall be reported. If a deli case 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 Prepare the half and third-size pans for the holding energy rate test by attaching a temperature sensor in the center of each pan, 1.5 in. (38 mm) from the bottom. A convenient method is to have thermocouple probes with a stainless-steel protective sheath fabricated in the shape shown in Fig. 1. The sensing point is exposed and isolated thermally from the stainless-steel sheath. The probe is strapped to the pan using steel shim stock welded to the pan using a strain gage welder. The thermocouple lead is long enough to allow connection to the monitoring device while the pans are in the deli case.

10. Procedure

10.1 General:

10.1.1 Record the following for each test run:

10.1.1.1 Voltage while elements are energized,

10.1.1.2 Ambient temperature, and

10.1.1.3 Energy input rate during or immediately prior to the test.

10.1.2 For each test run, confirm that the peak input rate is within $\pm 5\%$ 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 deli case.

10.2 Energy Input Rate:

10.2.1 Set the temperature controls to the maximum setting.

10.2.2 Start recording time and energy consumption when the elements are energized and stop recording when the elements commence cycling.

10.2.3 Confirm that the measured input rate or power, (kW) is within 5% of the rated nameplate input or power (it is the intent of the testing procedures in this test method to evaluate the performance of a deli case 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 deli case or supply another deli case for testing.

10.3 Holding Temperature Calibration:

10.3.1 Determine the number of 4-in. (100 mm) deep half-size pans that will fit inside the holding wells of the deli case. If necessary, mix small (third-size) pans with the half-size pans to fill the wells. Use the minimum number of small pans when making this determination. Note the number of each size of pan used.

NOTE 2—The objective of this step is to determine the smallest number of pans required to fill the deli case. For example, if the wells are 10 by 32-in. (250 by 810-mm), then each well will contain two half-size pans and one third-size pan.

10.3.2 Preheat deli case for 1 h at the manufacturer's recommended settings. If not specified by the manufacturer, then set the controls halfway between the minimum and maximum settings.

10.3.3 Prepare enough macaroni and cheese to fill the number of containers determined in 10.3.1 by following directions on the food packages.

10.3.4 Quickly transfer 9.0 ± 0.01 lb (4.1 ± 0.005 kg) of macaroni and cheese to each half-size pan and 5.5 ± 0.01 lb (2.5 ± 0.005 kg) of macaroni and cheese to each small (third-size) pan. Place the filled pans into the deli case's heated wells. If any small pans are used, these shall be located as close to the center of the wells as possible.

10.3.5 The temperature for each pan of macaroni and cheese at the beginning of the test shall be $160 \pm 5^\circ\text{F}$ ($71 \pm 3^\circ\text{C}$).

10.3.6 Monitor the temperature of each pan and deli case energy consumption for 3 h.

10.3.7 If the lowest temperature is not $142 \pm 2^\circ\text{F}$ ($61 \pm 1^\circ\text{C}$), then adjust the controls as appropriate and repeat 10.3.6 until the lowest pan temperature is $142 \pm 2^\circ\text{F}$ ($61 \pm 1^\circ\text{C}$).

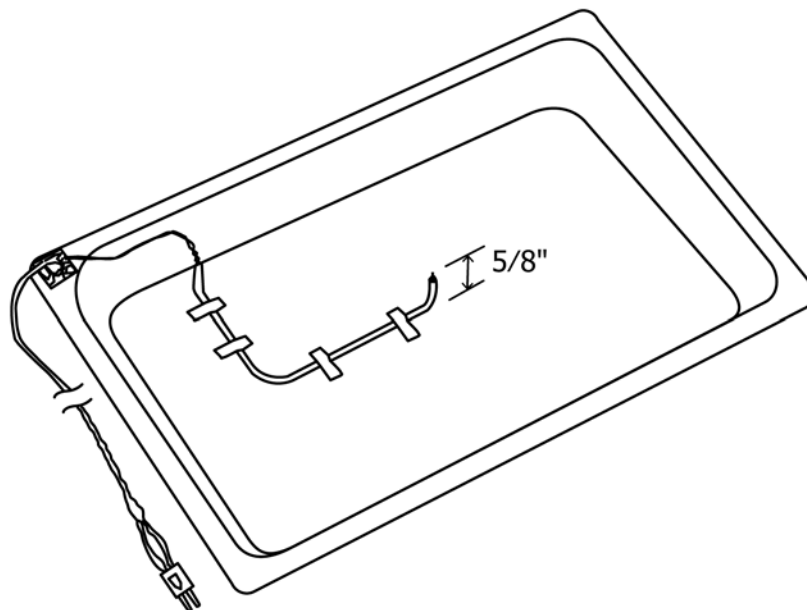


FIG. 1 Hotel Pan with Thermocouple Probe (not to scale)