



Designation: F3689 – 24

Standard Test Method for Performance of Compartmentalized Heated Bin Cabinets¹

This standard is issued under the fixed designation F3689; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This test method evaluates the preheat energy consumption and idle energy consumption of compartmentalized heated bin cabinets. The food service operator can use this evaluation to select a compartmentalized heated bin cabinet and understand its energy performance and temperature uniformity. A compartmentalized heated bin cabinet is described as an open-front countertop compartmentalized commercial kitchen appliance that is used to hold hot food ingredients (usually no greater than 180°F) in dedicated bins that have been cooked in a separate appliance at a specified temperature.

1.2 This test method is applicable to compartmentalized heated bin cabinets.

1.3 The compartmentalized heated bin cabinet can be evaluated with respect to the following (where applicable):

- 1.3.1 Energy input rate (9.2),
- 1.3.2 Temperature calibration (9.3),
- 1.3.3 Preheat energy consumption and time (9.4),
- 1.3.4 Energy consumption (idle energy rate) (9.5),
- 1.3.5 Temperature Uniformity (Bin to Bin) (9.5).

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 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.

Current edition approved Sept. 1, 2024. Published November 2024. DOI: 10.1520/F3689-24.

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 Standard:³

NSF/ANSI 4-2009 Commercial Cooking, Rethermalization, and Powered Hot Food Holding and Transport Equipment

3. Terminology

3.1 Definitions:

3.1.1 *compartmentalized heated bin cabinet, n*—a countertop, heated, and compartmented open-front appliance that is designed to maintain the temperature of hot food that has been cooked in a separate appliance held in removable individual bins.

3.1.1.1 *Discussion*—This includes modular, dedicated, and universal holding cabinets. Does not refer to heated merchandising cabinets, cook-and-hold appliances, or fully enclosed holding cabinets with fixed doors or non-removal compartmentalized bins, or both.⁴

3.1.2 *cook-and-hold appliance, n*—a multiple-mode appliance intended for cooking food that may be used to hold the temperature of the food that has been cooked in the same appliance.

3.1.3 *drawer warmer, n*—an appliance that consists of one or more integrated heated drawers and that is designed to hold hot food that has been cooked in a separate appliance at a specified temperature.

3.1.4 *energy input rate, n*—peak rate at which a compartmentalized heated bin cabinet consumes energy (kW), typically reflected during preheat.

3.1.5 *heated glass merchandising bins, n*—an appliance with a heated compartment that is designed to display and maintain the temperature of hot food that has been cooked in a separate appliance.

3.1.6 *holding bin, n*—the container, usually made of plastic, which fits within the appliance, in which food products are held heated.

3.1.6.1 *Discussion*—Does not refer to fixed drawers in a cabinet.

3.1.7 *hot food holding cabinet, n*—a fully enclosed appliance with one or more solid or transparent doors, that is

³ Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48105, <http://www.nsf.org>.

⁴ Does not include equipment covered under other DOE and CA standards.

designed to maintain the temperature of hot food that has been cooked in a separate appliance.

3.1.8 *idle energy rate—dry, n*—the rate of energy consumed (kW) by the compartmentalized heated bin cabinet while “idling” the holding cavity at the control set point without the use of food reagent.

3.1.9 *preheat energy, n*—amount of energy consumed by the compartmentalized heated bin cabinet while preheating the bin from ambient room temperature ($75 \pm 5^\circ\text{F}$) to 180°F , with the control(s) set to a calibrated 180°F .

3.1.10 *preheat rate, n*—average rate ($^\circ\text{F}/\text{min}$) at which the compartmentalized heated bin cabinet is heated from ambient temperature ($75 \pm 5^\circ\text{F}$) to 180°F , with the control(s) set to a calibrated 180°F .

3.1.11 *preheat time, n*—time required for the compartmentalized heated bin cabinet to preheat from ambient room temperature ($75 \pm 5^\circ\text{F}$) to 180°F , with the control(s) set to a calibrated 180°F .

3.1.12 *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 compartmentalized heated bin cabinet 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 accuracy of the compartmentalized heated bin cabinet temperature control is checked at 180°F and adjusted as necessary to within $\pm 5^\circ\text{F}$.

4.3 The amount of energy and time required to preheat the compartmentalized heated bin cabinet to 180°F , based on a calibrated 180°F set point, is determined.

4.4 The rate of idle energy consumption is determined with the compartmentalized heated bin cabinet set to maintain 180°F with no food load.

5. Significance and Use

5.1 The energy input rate and thermostat calibration tests are used to confirm that the compartmentalized heated bin cabinet 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 compartmentalized heated bin cabinet can be ready for operation.

5.3 Energy consumption (idle energy rate) can be used by the food service operator to estimate energy consumption during operating periods.

6. Apparatus

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

6.2 *Stop Watch*, with a 1-s resolution.

6.3 *Thermocouple(s)*, calibrated exposed junction industry standard type thermocouple probes, with a range of at least 0 to 250°F and an uncertainty of $\pm 2^\circ\text{F}$.

6.4 *Watt-Hour Meter*, for measuring the electrical energy consumption of a compartmentalized heated bin cabinet, shall have a resolution of at least 10 W·h 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 W·h and a maximum uncertainty no greater than 10 %.

6.5 *Holding Bin*, the container, usually made of plastic, which fits within the appliance, in which food products are held heated. Size specified by bin cabinet manufacturer.

7. Sampling, Test Units

7.1 *Compartmentalized Heated Bin Cabinet*—Select a representative production model for performance testing.

8. Preparation of Apparatus

8.1 Install the compartmentalized heated bin cabinet according to the manufacturer’s instructions in an appropriate space. All sides of the compartmentalized heated bin cabinet shall be a minimum of 3 ft 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 $75 \pm 5^\circ\text{F}$ within the testing environment.

8.2 Connect the compartmentalized heated bin cabinet 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.

8.3 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 herein to evaluate the performance of a heated bin cabinet at its rated 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 unit should be tested under both voltages and the voltage with the higher consumption shall be reported. The voltage selected by the manufacturer may be noted. If a compartmentalized heated bin cabinet 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.

8.4 For the preheat test and the idle test, select bins to have a thermocouple adhered to the floor of the bin cavity in the geometric center, as shown in Fig. 1. For units that have less than 10 individual bins, thermocouples should be placed in every bin. For units with individual bins numbering greater than 10, all corner bins should be measured, and evenly space thermocouples in the remaining bins as the example shown in Fig. 2.

8.4.1 If there are an odd number of bins choose the configuration that measures more bins.

8.4.2 If interior spatial constraints prohibit the placement of thermocouples as specified above, alternate locations shall be selected to comply with the intent of the standard.

8.4.3 If there exist optional lids to individual bins, all tests should be conducted with no lids.

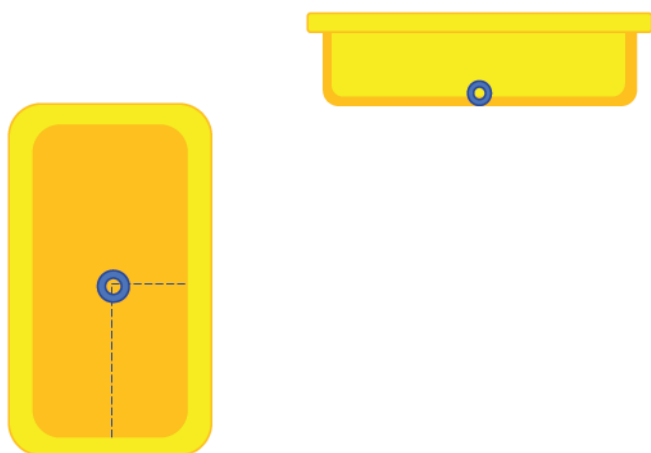


FIG. 1 Placement of Thermocouples in Bins

NOTE 2—The intent is for the thermocouples to measure the inside surface temperature of the bin cavity as seen in Fig. 1, spread out across multiple levels and positions of the cabinet.

8.5 All tests will use holding bins that are specified by the manufacturer for the bin cabinet. All positions of the cabinet should be occupied with empty bins, evenly spacing measured and unmeasured bins.

9. Procedure

9.1 General:

9.1.1 For the compartmentalized heated bin cabinet, record the following for each test run:

- 9.1.1.1 Voltage while elements are energized,
- 9.1.1.2 Ambient temperature,
- 9.1.1.3 Energy input rate during or immediately prior to each test run, and

9.1.1.4 Temperatures of the individual bins.

9.1.2 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 compartmentalized heated bin cabinet.

9.2 Energy Input Rate:

9.2.1 Set the temperature controls to $180 \pm 5^\circ\text{F}$ and turn on the compartmentalized heated bin cabinet.

9.2.2 Start recording time and energy consumption when the elements are energized and stop recording when the elements commence cycling (not when the compartmentalized heated bin cabinet's ready light comes on).

9.3 Temperature Calibration:

9.3.1 Install thermocouples adhered to the inside floor of the bin cavity in the geometric center, as shown in Fig. 1. For units that have less than 10 individual bins, thermocouples should be placed in every bin. For units with individual bins numbering greater than 10, all corner bins should be measured, and evenly space thermocouples for the remaining bins as example shown in Fig. 2.

9.3.1.1 If there are an odd number of bins choose the configuration that measures more bins.

9.3.1.2 If interior spatial constraints prohibit the placement of thermocouples as specified above, alternate locations shall be selected to comply with the intent of the standard.

9.3.2 Set the controls to maintain an average bin temperature of $180 \pm 5^\circ\text{F}$. Stabilize for 60 min after the elements commence cycling at the thermostat set point.

9.3.3 Monitor and record the bin temperatures for a minimum of 1 h after stabilization. Average these recorded temperatures.

9.3.4 As required (as indicated by the average temperature), adjust the temperature control(s) to attain an actual average holding bin temperature of $180 \pm 5^\circ\text{F}$. Repeat 9.3.3 to confirm that the cavity temperature is $180 \pm 5^\circ\text{F}$.

9.3.5 To facilitate further testing, save and note the setting of the thermostat control(s) that corresponds to an average holding cavity temperature of $180 \pm 5^\circ\text{F}$. Record the final control settings.

9.4 Preheat Energy Consumption and Time:

NOTE 3—The preheat test should be conducted as the first appliance operation on the day of the test, starting with the holding bins at room temperature ($75 \pm 5^\circ\text{F}$).

9.4.1 Assure that all bins are empty, bins are measured as mentioned above in 8.4.

9.4.2 Record bin cavity temperature and ambient temperature at the start of the test. The cavity temperature shall be $75 \pm 5^\circ\text{F}$ at the start of the test.

9.4.3 Turn the unit on with control(s) set to maintain an average of 180°F , as determined in 9.3.5.

9.4.4 Record the cavity temperature over a minimum of 1-s intervals during the course of preheat.

9.4.5 Record the energy and time to preheat the compartmentalized heated bin cabinet. Preheat is judged complete when the average temperature of all the measured bins reaches an average of 180°F , as indicated by the thermocouples.

9.5 Energy Consumption (Idle Energy Rate):

NOTE 4—The idle test may be conducted immediately following the preheat test (9.4).

9.5.1 Preheat the compartmentalized heated bin cabinet to $180 \pm 5^\circ\text{F}$ as directed in 9.4.

9.5.2 Stabilize the compartmentalized heated bin cabinet for a minimum of 1 h after the preheat has completed.

9.5.3 After a minimum 1-h stabilization period, wait for the heater(s) to cycle off, immediately start monitoring elapsed time, bin temperature(s) and energy consumption.

9.5.4 The idle energy rate test shall be run for a minimum of 3 h and include a minimum of 10 complete thermal cycles. After the test period (either 3 h or 10 cycles, whichever is longer), wait for the heater(s) to cycle off then end the test. Record the total elapsed time and energy consumption of the bin. If the unit has multiple heating control zones, the unit shall be considered to have completed 10 cycles when all zones have completed 10 cycles. If the discrete cycles are not discernable, a 3-h period shall be used.

NOTE 5—Idle energy consumption rate can be used to calculate real-world energy usage. It has been determined at Southern California Edison's Foodservice Technology Center that the energy consumption of an empty compartmentalized heated bin cabinet can be fully loaded with