



Designation: **F2143–16 F2143 – 24**

An American National Standard

Standard Test Method for Performance of Refrigerated Buffet and Preparation Tables¹

This standard is issued under the fixed designation F2143; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers evaluation of the energy consumption of refrigerated buffet and preparation tables. The food service operator can use this evaluation to select a refrigerated buffet and preparation table and understand its energy performance.

1.2 This test method is applicable to electric self-contained refrigerators used for holding and displaying refrigerated food in an open area.

1.3 The refrigerated buffet and preparation table can be evaluated with respect to the following (where applicable):

1.3.1 Maximum power, or maximum current draw (10.1),

1.3.2 Thermostat calibration (10.4), and

1.3.3 Energy consumption (10.5).

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.*

1.6 *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 NSF Standard:²

[ANSI/NSF 7 Commercial Refrigerators and Freezers](#)

2.2 ASHRAE Guideline:³

[ASHRAE Guideline 2-1986 \(RA90\) Engineering Analysis of Experimental Data](#)

2.3 ANSI/ASHRAE Standards:⁴

[ANSI/ASHRAE 72-2014 Method of Testing Open Refrigerators for Food Stores](#)

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

³ Available from American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329, <http://www.ashrae.org>.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

2.4 *Food and Drug Administration, U.S. Public Health Service Regulation:*⁵
Food Code, 1999

3. Terminology

3.1 *Definitions:*

3.1.1 *production capacity, n*—maximum volumetric storage capacity (ft³ (m³)) at which the refrigerated buffet and preparation table's open display area can hold using a specified container filled to ½ in. of the container rim.

3.1.2 *refrigerated buffet and preparation table, n*—buffet/preparation table herein, equipment designed with a refrigerated open top or open condiment rail.

3.1.3 *refrigerated buffet table or unit, n*—equipment designed with mechanical refrigeration that is intended to receive refrigerated food and maintain food product temperatures and is intended for customer service such as a salad bar. A unit may or may not be equipped with a lower refrigerated compartment.⁶

3.1.4 *refrigerated food preparation unit, n*—equipment designed with a refrigerated open top or open condiment rail such as refrigerated sandwich units, pizza preparation tables, and similar equipment. The unit may or may not be equipped with a lower refrigerated compartment.⁶

3.1.5 *self-contained refrigerator, n*—a refrigerator whose condensing unit is attached as an integral component of the unit.⁶

3.1.6 *storage refrigerator or freezer, n*—a refrigerator or freezer designed for cold storage of nonfrozen or frozen foods.

3.1.7 *storage capacity, n*—maximum volumetric storage capacity (ft³ (m³)) as determined by the manufacturer at which the refrigerated buffet or preparation table's storage component can hold food.

3.1.8 *test method, n*—a definitive procedure for the identification, measurement, and evaluation of one or more qualities, characteristics, or properties of a material, product, system, or service that produces test results.

3.1.9 *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 Power is determined to confirm that the buffet/preparation table is operating within 5 % of the manufacturer's rated power.

4.2 Buffet/preparation table energy consumption is determined with the upper lid in the raised position while the unit is used to maintain the temperature of water being held in the refrigerated rail and with the upper lid in the lowered position without any pans in the refrigerated rail.

4.3 Production capacity is determined by measuring the amount of water that the refrigerated rail can hold, using a specified container filled to ½ in. of the container rim.

5. Significance and Use

5.1 The power test is used to confirm that the buffet/preparation table is operating properly prior to further testing.

5.2 Buffet/preparation table energy consumption is a precise indicator of buffet/preparation table energy performance under the test loading condition and under a simulated overnight operating condition. This information enables the food service operator to consider energy performance when selecting a buffet/preparation table.

⁵ Available from National Technical Information Service (NTIS), 5285 Port Royal Rd., Springfield, VA 22161, <http://www.ntis.gov>.

⁶ Available from National Technical Information Service (NTIS), 5301 Shawnee Rd., Alexandria, VA 22312, <http://www.ntis.gov>.

5.3 Production capacity is used by food service operators to choose a buffet/preparation table that matches their food output requirements.

6. Apparatus

6.1 *Analytical Balance Scale*, for measuring weights up to 25 lb, with a resolution of 0.01 lb and an uncertainty of 0.01 lb.

6.2 *Pans*, for holding water. Standard 4-in. (102-mm) deep GN 1/6-size steam table pans are pans shall be used in this test method. Pans shall have nominal dimensions of 6 × 6¹⁵/₁₆ × 4 in. (162 × 176 × 102 mm). Metal pans shall be used. If alternate pans are used, they shall conform as closely as possible to the pans described in 6.2. All alternate pans must be metal in material, and any deviations from 6.2 must be reported. The weight of the pan shall be 0.70 ± 0.07 lb. The buffet/preparation table manufacturer may provide alternative pans if the unit is designed specifically to only be used with the alternative pans. If alternative pans are used, they shall have nominal dimensions as close to that of the standard pans as is available. All pans must be equipped with thermocouples for temperature measurement. An example of a typical setup is shown in Fig. 1. The thermocouple lead shall be long enough to allow connection to the monitoring device while the pans are in the storage refrigerator.

6.3 *Electronic Humidity Sensor*, for measuring the relative humidity within the test environment with a range of 25 to 45 % and an uncertainty of ±2 %.

6.4 *Thermocouple Probe*, capable of immersion with a range of 30° to 50°F and an uncertainty of ±1°F; ±2°F. Preferably industry standard type T or type K thermocouples.

6.5 *Power Meter*, for measuring the electrical energy consumption of a buffet/preparation table, shall have a resolution of at least 1 W 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 1 W and a maximum uncertainty no greater than 10 %.

6.6 *Air Velocity Meter*, for measuring air velocity around the buffet/preparation table with an uncertainty of ±10 % at 100 ft/min (0.51 m/s) and capable of measuring air velocities at 50 ft/min (0.25 m/s).

7. Reagents and Materials

7.1 *Water*—Distilled water shall be used.

8. Sampling, Test Units

8.1 *Buffet/Preparation Table*—Select a representative production model for performance testing.

9. Preparation of Apparatus

9.1 Install the buffet/preparation table according to the manufacturer’s instructions. Position the buffet/preparation table so that

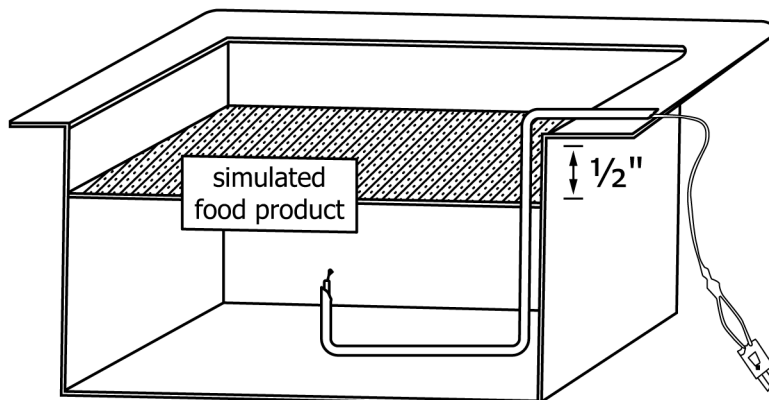


FIG. 1 Pan With Thermocouple Probe

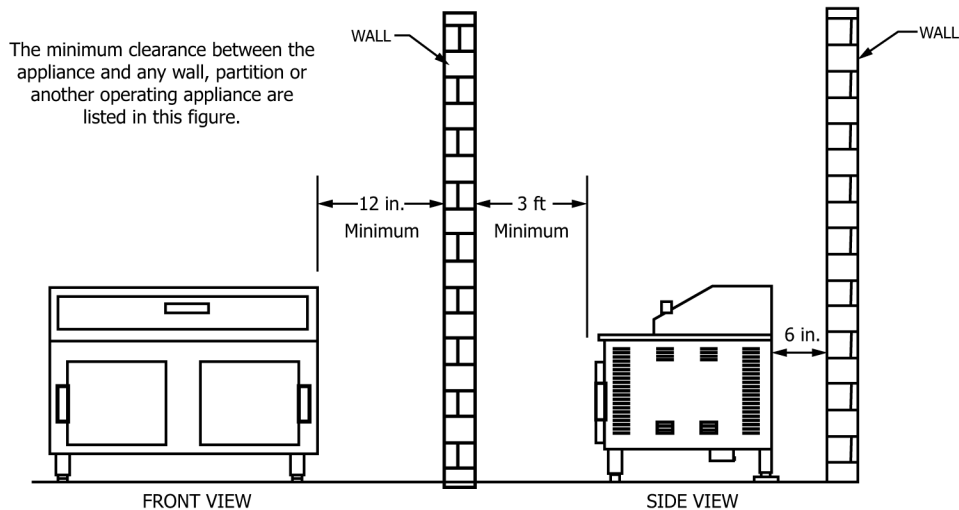


FIG. 2 Example of Appliance Placement

there is 6 in. (15.24 cm) clearance maintained between a back wall and the back vertical plane of the buffet/preparation table. In addition, both sides of the buffet/preparation table shall be a minimum of 12 in. (30.48 cm) from any side wall, or side partition (see Fig. 2). Walls can be portable or suspended from ceiling. There shall be a minimum of 3 ft (91.44 cm) of clearance between the front vertical plane of the buffet/preparation table and any wall or partition. Report appliance placement relative to test room walls in results reporting section. Use manufacturer-recommended clearances if they are greater than the clearances described above. Report any deviations from the prescribed clearances.

9.2 The testing environment during energy tests shall be maintained as follows: ambient temperature of $86 \pm 2^\circ\text{F}$ ($30 \pm 1^\circ\text{C}$), no vertical temperature gradient exceeding $1.5^\circ\text{F}/\text{ft}$ ($2.5^\circ\text{C}/\text{m}$), relative humidity of $35 \pm 5\%$ and maximum air current velocity of $50\text{ ft}/\text{min}$ ($0.25\text{ m}/\text{s}$) across the surfaces of the test pans while the buffet/preparation table is not operating.

9.3 Ambient temperatures shall be measured at two locations along a vertical line at the center line of the buffet/preparation table. The first shall be $5.9 \pm 2\text{ in.}$ ($150 \pm 50\text{ mm}$) above the highest point on the buffet/preparation table. The second shall be at the geometric center of the buffet/preparation table. Both points shall be located $36 \pm 2\text{ in.}$ ($914 \pm 50\text{ mm}$) out from the front face of the buffet/preparation table. It shall be verified that no location around the perimeter of the buffet/preparation table at the same heights as the two points has an average temperature lower than that specified for the test conditions.

9.4 Connect the buffet/preparation table to a calibrated energy test meter. A voltage regulator may be required during tests if the voltage supply is not within $\pm 2.5\%$ of the manufacturer's rated voltage.

9.5 Confirm (while the buffet/preparation table compressor(s) are energized) that the supply voltage is within $\pm 2.5\%$ of the operating voltage specified by the manufacturer during the entire test period. Record the test voltage throughout each test.

NOTE 1—It is the intent of the testing procedure herein to evaluate the performance of a buffet/preparation table at its rated voltage. If a unit is rated for dual voltage (that is, designed to operate at either 208 or 240 V with no change in components), the voltage selected by the manufacturer and/or tester shall be reported. If a buffet/preparation table is designed to operate at two voltages without a change in components, the performance of the unit (for example, holding energy rate) may differ at the two voltages.

9.6 If the buffet/preparation table is equipped with a refrigerated compartment, the compartment air temperature shall be monitored to evaluate the buffet/preparation table's ability to maintain the air temperature between 33°F (1°C) and 41°F (5°C). The compartment shall be empty, and three thermocouples shall be used to monitor air temperatures. If the buffet/preparation table is not equipped with a refrigerated compartment then skip steps 9.6.1 – 9.6.3.

9.6.1 For buffet/preparation tables with refrigerated compartments position thermocouple no. 1 when viewed from the front of the refrigerated table $5 \pm 0.25\text{ in.}$ ($127 \pm 6\text{ mm}$) from the left interior wall. Center the thermocouple in the compartment relative to the front and the back. For refrigerated compartments with overhead cooling, position the thermocouple $2 \pm 0.25\text{ in.}$ ($51 \pm 6\text{ mm}$) above the bottom horizontal plane of the compartment. For units where the evaporator is not suspended from the ceiling, the thermocouple shall be placed $5 \pm 0.25\text{ in.}$ ($127 \pm 6\text{ mm}$) down from the ceiling.

9.6.2 Position thermocouple no. 2 centered front-to-back, top-to-bottom, and left-to-right.

9.6.3 Position thermocouple no. 3 when viewed from the front of the refrigerated table 5 ± 0.25 in. (127 ± 6 mm) from the right interior wall and 5 ± 0.25 in. (127 ± 6 mm) above the internal floor of the compartment. Center the thermocouple in the compartment relative to the front and the back.

10. Procedure

NOTE 2—Prior to starting this test, the tester should read the operating manual and fully understand the operation of the appliance.

10.1 General:

10.1.1 Record the following for each test run: (1) voltage, (2) current, (3) power, (4) relative humidity, (5) ambient temperature, (6) pan water temperatures, and (7) refrigerated compartment air temperatures. All data points shall be measured continuously in 1 min intervals or less for each test. For (1) voltage, (2) current, and (3) power the recorded values shall be the average reading over each 1 min or shorter interval.

10.1.2 For each test run, confirm that the peak amperage draw rate is below the manufacturer's rated maximum amperage. If the measured amperage is greater than the rated maximum amperage, terminate testing and contact the manufacturer. The manufacturer may make appropriate changes or adjustments to the buffet/preparation table.

10.2 Pan Thermocouple Placement:

10.2.1 Determine whether standard, 4-in. (102-mm) deep $\frac{1}{6}$ -sized pans or manufacturer specified pans will be used to hold water in the display (rail) area of the buffet/preparation table. During the test, thermocouples will measure the temperature of the water in the pans. Place the pans in display area (rail) of the buffet/preparation table to determine thermocouple placement. Later, when the water is prepared, the pans will be filled with water to within $\frac{1}{2}$ in. (13 mm) of the pan's top rim. Note where $\frac{1}{2}$ in. (13 mm) is from the pan's top rim for determining placement of thermocouples.

10.2.2 Install a thermocouple at the geometric center of the water in the pans, top to bottom, side to side, and front to back, of every pan in the display area (rail). Thermocouple leads should be firmly attached to the pan to prevent movement. The thermocouple leads should be long enough to allow connection to the monitoring device while the pans are in the buffet/preparation table. See Fig. 3 for an example of standard pans with thermocouple probes.

<https://standards.iteh.ai/catalog/standards/astm/48bbb4e4-85ab-43c4-9012-1a15f682d35b/astm-f2143-24>

10.3 Stabilization/Run-in Time:

10.3.1 Establish and maintain the test room (test chamber) conditions of $86 \pm 2^\circ\text{F}$ ($30 \pm 1^\circ\text{C}$) ambient temperature, no vertical temperature gradient exceeding $1.5^\circ\text{F}/\text{ft}$ ($2.5^\circ\text{C}/\text{m}$), relative humidity of $35 \pm 5\%$ and maximum air current velocity of 50 ft/min (0.25 m/s) across the surfaces of the test pans while the buffet/preparation table is not operating.

10.3.2 Place the buffet/preparation table in test environment (test chamber).

10.3.3 Place the empty pans into the display area (rail) of the buffet/preparation table. If the manufacturer's instructions specify pans should not be empty while in the display area (rail) of the buffet/preparation table, follow the manufacturer's instructions for what is acceptable. If the unit is equipped with cover(s) for the display area, the cover(s) shall be open.

10.3.4 Allow the unit to run for ~~not less than 24 h.~~ 24 h. Repeat the steps in 10.3 for all subsequent tests.

10.4 Thermostat Calibration:

10.4.1 Establish and maintain the test room (test chamber) conditions of $86 \pm 2^\circ\text{F}$ ($30 \pm 1^\circ\text{C}$) ambient temperature, no vertical temperature gradient exceeding $1.5^\circ\text{F}/\text{ft}$ ($2.5^\circ\text{C}/\text{m}$), relative humidity of $35 \pm 5\%$ and maximum air current velocity of 50 ft/min (0.25 m/s) across the surfaces of the test pans while the buffet/preparation table is not operating.

10.4.2 If the unit is equipped with cover(s) for the display area, the cover(s) shall be open.

10.4.3 Pan Loading Procedure:

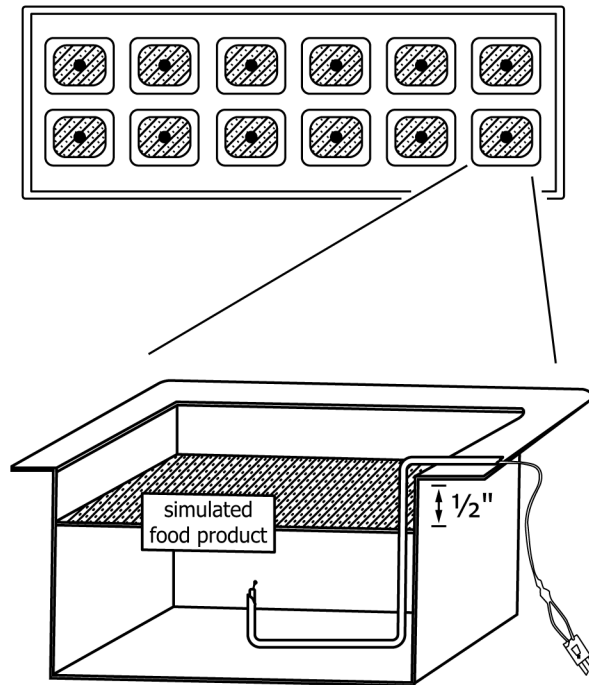


FIG. 3 Example of Standard Pans With Thermocouple Probes

iTeh Standards

10.4.3.1 Determine the weight of water required to fill one pan to within 1/2 in. (13 mm) of the pan's top rim.

10.4.3.2 Fill a container with enough water to fill every test pan with the determined weight of water.

10.4.3.3 Refrigerate and maintain the container of water at 35 ± 1°F.

10.4.3.4 Place the empty pans in the display area (rail) and ensure that thermocouples in the pans are positioned as described in 10.2. Empty pans must remain in the display area (rail) of the buffet/preparation table for 2 h before continuing.

10.4.3.4 Using the analytical balance scale, weigh the determined weight of water (±0.025 lb) from the refrigerated container of water into a separate container.

10.4.3.5 Carefully pour the measured water into one of the empty pans in the display area (rail) of the buffet/preparation table.

10.4.3.6 Repeat steps 10.4.3.5 and 10.4.3.4 until all test pans are filled with water. The total pan loading time, from removal of container filled with water from storage refrigerator to the last pan filled with water, shall be no longer than 50 s per pan in the display area (rail).

10.4.4 Record the water temperature of the pans placed in the display area (rail) and the air temperature of the under cabinet as the unit runs for not less than 4 h. If any temperature reading is below 33°F (1°C) or above 41°F (5°C) for any consecutive 15 min period, then adjust the thermostat accordingly and repeat the calibration. If not, then calibration of the thermostat is done. Repeat adjustment of the thermostat until no temperature reading is below 33°F (1°C) or above 41°F (5°C) for any consecutive 15 min period over the 4 h. If this is not achieved after repeated thermostat adjustment, then stop thermostat calibration and contact the manufacturer for assistance.

10.4.5 Indicate in the test report whether or not a defrost cycle occurred during the calibration. Through visual inspection, report if any ice buildup occurred on or inside the buffet/preparation table and if so, at what location(s) and to what degree.

10.5 Test:

10.5.1 Establish and maintain the test room (test chamber) conditions of 86 ± 2°F (30 ± 1°C) ambient temperature, no vertical