NOTICE: This standard has either been superseded and replaced by a new version or withdrawn.
Contact ASTM International (www.astm.org) for the latest information

Designation: F2142 – 01 (Reapproved 2013)

An American National Standard

Standard Test Method for Performance of Drawer Warmers[1]

This standard is issued under the fixed designation F2142; 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 preheat, idle, and holding energy consumption and temperature uniformity of drawer warmers. The food service operator can use this evaluation to select a drawer warmer and understand its energy performance and temperature uniformity. A drawer warmer is described as a commercial kitchen appliance that consists of one or more heated drawers and which is used to hold hot food (usually no greater than 200°F) that has been cooked in a separate appliance, at a specified temperature.

1.2 This test method is applicable to freestanding and built-in electric drawer warmers equipped for:

1.2.1 Industry-standard 12 × 20 × 6–in. (nominal size) pans, or

1.2.2 Standard-oversized 15 × 20 × 5–in. (nominal size) pans.

1.3 The drawer warmer can be evaluated with respect to the following (where applicable):

1.3.1 Energy input rate (10.2),

1.3.2 Energy consumption rate at maximum setting (10.2),

1.3.3 Temperature calibration (10.3),

1.3.4 Preheat energy consumption and time (10.4),

1.3.5 Idle energy rate (10.5),

1.3.6 Holding energy rate (10.6), and

1.3.7 Temperature uniformity (10.6).

1.4 The values stated in inch-pound units are to be regarded as standard.

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 Document:*[2]

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

2.2 *NSF Standard:*[3]

Standard Number 4—Commercial Cooking, Rethermalization, and Powered Hot Food Holding and Transport Equipment

3. Terminology

3.1 *Definitions:*

3.1.1 *drawer pan, n*—that portion of the appliance in which food products are held. Industry-standard drawer pans are nominally 12 × 20 × 6 in. deep; standard-oversized drawer pans are nominally 15 × 20 × 5 in. deep.

3.1.2 *drawer pan centerpoint temperature, n*— the temperature as measured at the geometric center of the drawer pan using a single thermocouple.

3.1.3 *drawer warmer, n*—an appliance that consists of one or more 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 drawer warmer consumes energy (kW), typically reflected during preheat.

3.1.5 *holding energy rate, n*—the rate of energy consumed (Btu/h or kW) by the drawer warmer while keeping the heated food product (dinner rolls) warm.

3.1.6 *idle energy rate, n*—the rate of energy consumed (kW) by the drawer warmer while "idling" or maintaining the drawers at a calibrated 150°F set point.

3.1.7 *preheat energy, n*—amount of energy consumed by the drawer warmer while preheating the drawer pan(s) from ambient room temperature (75 ± 2.5°F) to 150°F, with the control(s) set to a calibrated 150°F.

iTeh Standards
(https://standards.iteh.ai)
Document Preview
ASTM F2142-01(2013)
https://standards.iteh.ai/catalog/standards/sist/3b50f49e-ed33-4a7a-a401-78bba77b5320/astm-f2142-012013

[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 June 1, 2013. Published August 2013. Originally approved in 2001. Last previous edition approved in 2007 as F2142 – 01 (2007). DOI: 10.1520/F2142-01R13.

[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.

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

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959. United States

3.1.8 *preheat rate, n*—average rate (°F/min) at which the drawer pan is heated from ambient temperature (75 ± 2.5°F) to 150°F, with the control(s) set to a calibrated 150°F.

3.1.9 *preheat time, n*—time required for the drawer warmer to preheat from ambient room temperature (75 ± 2.5°F) to 150°F, with the control(s) set to a calibrated 150°F.

3.1.10 *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 drawer warmer is connected to the appropriate metered energy source, and the energy input rate is determined to confirm that the appliance is operating within 5 % of the nameplate energy input rate.

4.2 The drawer pan temperature and energy consumption rate are determined with the drawer warmer controls set to the maximum setting.

4.3 The accuracy of the drawer warmer's temperature control is checked at 150°F and adjusted as necessary to within ±5°F.

4.4 The amount of energy and time required to preheat the drawer warmer from ambient (75 ± 2.5°F) to 150°F, based on a calibrated 150°F set point, is determined.

4.5 The rate of idle energy consumption is determined with the drawer warmer set to maintain 150°F and no food load in the drawer pans.

4.6 The rate of holding energy consumption, the drawer pan temperature, and the drawer pan temperature uniformity are determined with a food load and with the drawer warmer controls set to the calibrated 150°F set point.

5. Significance and Use

5.1 The energy input rate and thermostat calibration tests are used to confirm that the drawer warmer 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 drawer warmer can be ready for operation.

5.3 Idle energy rate and holding energy rate can be used by the food service operator to estimate energy consumption during operating periods and to consider energy consumption when choosing a drawer warmer.

5.4 The drawer pan temperature and drawer pan temperature uniformity can be used by an operator to choose a drawer warmer which meets their food holding needs.

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),* industry standard type T or type K thermocouple wire with a range of 0 to 350°F and an uncertainty of ±1°F.

6.4 *Watt-Hour Meter,* for measuring the electrical energy consumption of a drawer warmer, 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 %.

7. Reagents and Materials

7.1 *Dinner Roll,* shall be a nominal 3 in. square breadroll, approximately 2 in. tall, weighing 5.5 ± 1.0 lb per 60 rolls.

8. Sampling, Test Units

8.1 *Drawer Warmer*—Select a representative production model for performance testing.

9. Preparation of Apparatus

9.1 Install the drawer warmer according to the manufacturer's instructions and consistent with industry practices. Surrounding surfaces cannot add insulating factors, which may influence the test results. All sides of the drawer warmer shall have a minimum of 3 ft. of clearance from any sidewall, 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 ± 2.5°F within the testing environment.

9.2 Connect the drawer warmer 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.

9.3 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 drawer warmer 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 voltage selected by the manufacturer and/or tester shall be reported. If a drawer warmer 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.

9.4 Assure that the drawer warmer's vent (if applicable) is closed for all tests.

9.5 Place one thermocouple at the geometric center of each drawer pan in the drawer warmer, centered front to back, side to side, and top to bottom. This is the drawer pan centerpoint temperature.

9.6 For the temperature uniformity test, place an additional 5 thermocouples in each drawer pan in the drawer warmer as follows: Place one thermocouple 0.25 in. above the bottom of the drawer pan and centered front to back and side to side. Place one thermocouple on each sidewall of the drawer pan (total of four thermocouples). Locate the thermocouples in the center of each sidewall with the tip of each thermocouple suspended in the drawer pan 0.25 in. away from the surface of the drawer pan's sidewall. See example in Fig. 1.

iTeh Standards (https://standards.iteh.ai) Document Preview
ASTM F2142-01(2013)
https://standards.iteh.ai/catalog/standards/sist/3b50f49e-ed3...a75-a401-78bba77b5320/astm-f2142-012013

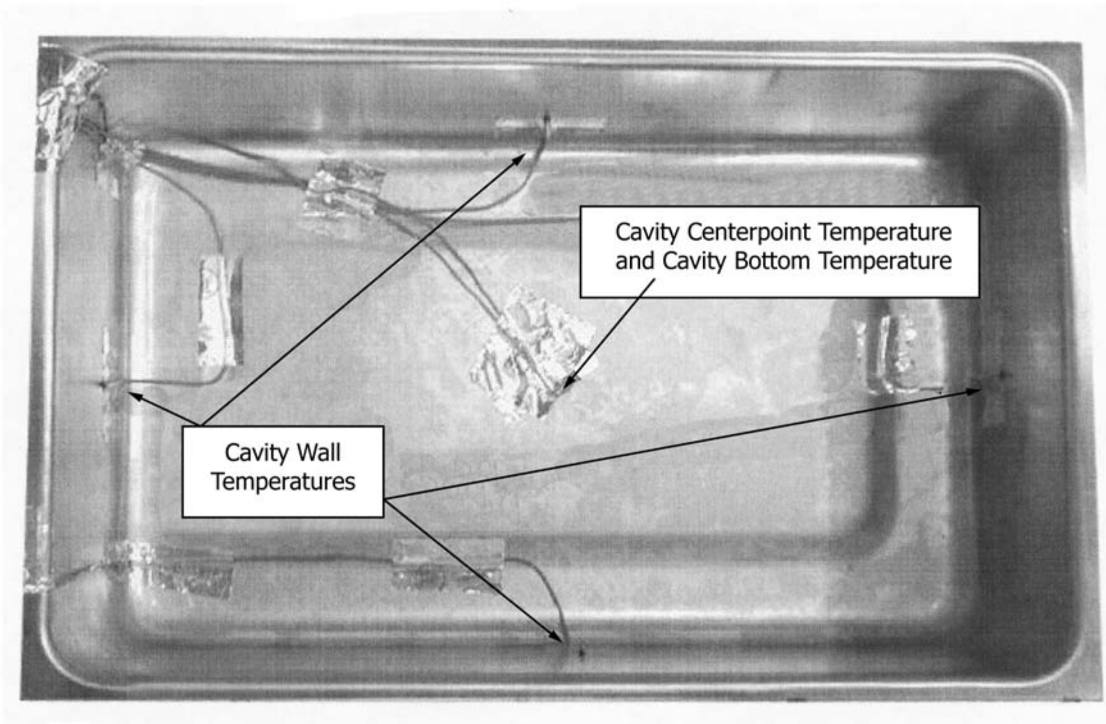

FIG. 1 Thermocouple Locations in Drawer Pan

iTeh Standards
(https://standards.iteh.ai)
Document Preview
ASTM F2142-01(2013)
https://standards.iteh.ai/catalog/standards/sist/3b50f49e-ed33-4a75-a301-7868a7f63529/astm-f2142-012013

10. Procedure

10.1 *General:*

10.1.1 For the drawer warmers, 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 each test run.

10.1.2 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 drawer warmer.

10.2 *Energy Input Rate and Energy Consumption Rate at Maximum Control Setting:*

10.2.1 Starting at ambient temperature, turn the drawer warmer on by setting the controls for each and every drawer in the drawer warmer to the highest or maximum setting.

10.2.2 Start recording time and energy consumption when the elements are energized and stop recording when the elements commence cycling. The drawer warmer must be fully on over the entire period, and the test period must end when any of the elements first cycles off.

10.2.3 Confirm that the measured input rate or power is within 5 % of the rated nameplate input or power. (It is the intent of the testing procedures herein to evaluate the performance of a drawer warmer 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 drawer warmer or supply another drawer warmer for testing.

10.2.4 Stabilize the drawer warmer by continuing to operate all of the drawers at their maximum control setting for a period of 1 h.

10.2.5 At the end of the stabilization period, begin recording time, idle energy consumption, and the centerpoint temperature of each drawer pan for a minimum of 3 h. Record the drawer pan temperature(s) at 1-min intervals during the 3-h test period and average these recorded temperatures.

10.2.6 In accordance with 11.3, calculate and report the drawer warmer energy input rate and rated nameplate input rate. Also calculate and report the energy consumption rate for the drawer warmer and the average centerpoint temperature for each drawer pan at the maximum control setting.

10.3 *Temperature Calibration:*

10.3.1 Set the controls for each and every drawer in the drawer warmer to maintain a drawer pan temperature of 150°F, based on the centerpoint temperature for each drawer. Stabilize the drawer warmer for 60 min after the elements commence cycling at the thermostat set point.

NOTE 2—If the temperature dial does not have a temperature scale (for example, 70 to 200°F), but instead a numbered setting dial (for example, 1 to 10), use a best guess estimate at what may be 150°F for the initial thermostat calibration setting and adjust as necessary thereafter.

10.3.2 Monitor and record the centerpoint drawer pan temperature every 30 s for a minimum of 1 h. Average these recorded temperatures.

10.3.3 As required (as indicated by the average temperature), adjust the temperature control(s) to attain an actual drawer pan temperature of 150 ± 5°F for each drawer. Repeat 10.3.2 to confirm that the pan temperature is 150 ± 5°F.

10.3.4 To facilitate further testing, mark on the dial the exact position of the thermostat control(s) that corresponds to an average drawer pan temperature of 150 ± 5°F . Record the final control setting.

10.4 *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 drawer warmer and each drawer pan at room temperature (75 ± 2.5°F).

10.4.1 Record the drawer pan centerpoint temperature(s) and ambient temperature at the start of the test. The pan temperature(s) shall be 75 ± 2.5°F at the start of the test.

10.4.2 Turn the unit on with control(s) set to maintain 150°F as determined in 10.3.4.

10.4.3 Begin recording time, energy consumption, and the centerpoint temperature of each drawer pan. Record the drawer pan temperature(s) a minimum of every 5 s during the course of preheat. At the end of the preheat cycle, stop recording the time, energy consumption, and temperature. Preheat is judged complete when the drawer pan centerpoint temperature for every drawer in the drawer warmer reaches 150°F, as indicated by the thermocouple.

10.4.4 In accordance with 11.5, calculate and report the preheat energy consumption and time.

10.5 *Idle Energy Rate:*

NOTE 4—The idle energy rate test may be conducted immediately following the preheat test (10.4). In addition, testing at PG&E's FSTC has determined that the ambient temperature during the idle energy consumption test can affect the energy usage; therefore, it is important to record the average ambient temperature during testing.

10.5.1 Preheat the drawer warmer to 150°F.

10.5.2 Stabilize the drawer warmer for 1 h following the end of the preheat.

10.5.3 At the end of the 1 h stabilization period, begin recording time, energy consumption, the centerpoint temperature of each drawer pan and the ambient temperature for a minimum of 3 h. Record the drawer pan temperatures at 1-min intervals during the 3-h test period and average these recorded temperatures.

10.5.4 Confirm that the average temperature of each drawer, based on the centerpoint temperature is 150 ± 5°F. If the average centerpoint temperature of every drawer is not 150 ± 5°F, the test is invalid and must be repeated.

10.5.5 In accordance with 11.6, calculate and report the drawer warmer idle energy rate.

10.6 *Holding Energy Rate and Temperature Uniformity with Food Product:*

NOTE 5—The holding energy rate and temperature uniformity with food product test may be conducted immediately following the idle energy rate test (10.5).

10.6.1 Preheat the drawer warmer to 150°F.

10.6.2 In a separate oven, heat 60 dinner rolls (for standard size (12 × 20 × 6–in.) pans; 80 dinner rolls for oversized (15 × 20 × 5–in.) pans) for each drawer in the drawer warmer. The dinner rolls shall be heated to an average internal temperature of 160 ± 2°F as measured with a thermocouple.

10.6.3 At the end of the preheat period, place 60 heated dinner rolls (standard size pans; 80 dinner rolls for oversized pans) into each drawer pan. The dinner rolls shall be evenly spread throughout the drawer and shall be placed into the drawer in two layers of 30 rolls each (standard size pans; 40 rolls per layer for oversized pans). Ensure that the thermocouple measuring the center point temperature in each pan continues to measure the air temperature and is not covered by any of the food product. Open and shut each drawer individually as it is loaded. Allow no more than 2 min to load each drawer.

10.6.4 After every drawer is loaded, allow the drawer warmer to stabilize for 1 h.

10.6.5 At the end of the 1 h stabilization period, begin recording time, energy consumption, the centerpoint temperature of each drawer pan and the additional five temperature points along the walls and bottom of each drawer pan for a minimum of 3 h. Record the drawer pan temperatures at 1-min intervals during the 3-h test period.

10.6.6 In accordance with 11.7, calculate and report the drawer warmer holding energy rate, the average, maximum, and minimum centerpoint temperature for each drawer pan and the average wall and bottom temperatures for each drawer pan.

11. Calculation and Report

11.1 *Test Drawer Warmer:*

11.1.1 Summarize the physical and operating characteristics of the drawer warmer. 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 Report the voltage for each test.

11.3 *Energy Input Rate and Energy Consumption Rate at Maximum Control Setting:*

11.3.1 Report the manufacturer's nameplate energy input rate in kW for the electric drawer warmer.

11.3.2 Calculate and report the measured energy input rate (kW) based on the energy consumed by the drawer warmer during the period of peak energy input according to the following relationship:

$$q_{input} = \frac{E \times 60}{t} \quad (1)$$

where:

q_{input} = measured peak energy input rate, kW,
E = energy consumed during period of peak energy input, kW·h, and
t = period of peak energy input, min.

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

11.3.4 Calculate and report the energy consumption rate (kW) at the maximum control settings based on:

$$q_{idle-max} = \frac{E \times 60}{t} \quad (2)$$

iTeh Standards (https://standards.iteh.ai) Document Preview