Designation: F2795 – 15

An American National Standard

Standard Test Method for Performance of Self-Contained Soft Serve and Shake Freezers[1]

This standard is issued under the fixed designation F2795; 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 performance of soft serve ice cream and shake freezers. The food service operator can use this test to evaluate and select an appropriate soft serve or shake freezer and understand its energy consumption and production capabilities.

1.2 This test method applies to the following types of soft serve and shake freezers: (any of which may or may not have a reservoir for liquid mix). Included in these test methods are conventional and heat-treatment freezers. The unit may include separate refrigeration systems for the frozen product and fresh mix and may be either air-cooled or water-cooled.

1.3 The soft serve/shake freezers will be tested for the following (where applicable):

1.3.1 Maximum power input, or maximum current draw,

1.3.2 Initial freeze-down energy consumption and duration,

1.3.3 Heavy-use energy consumption,

1.3.4 Production capacity,

1.3.5 Overrun,

1.3.6 Impact performance,

1.3.7 Idle energy rate, and

1.3.8 Heat treat cycle energy consumption (if applicable).

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered 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 *ASTM Standards:*[2]

F1604 Specification for Freezers, Ice Cream, Soft Serve, Shake

2.2 *Code of Federal Regulations:*[3]

21 CFR 135.110 Ice cream and frozen custard

2.3 *NSF/ANSI Standard:*[4]

NSF/ANSI 6 Dispensing freezers

2.4 *ASHRAE Guideline:*[5]

ASHRAE Guideline 2 - 2005 (RA90) Engineering Analysis of Experimental Data

3. Terminology

3.1 *Definitions:*

3.1.1 *air cooled, n*—a freezer which uses air passing over a main condenser in the freezer cylinder refrigeration system.

3.1.2 *combination, n*—a freezer employing two main compressors and two main condensers with one or two condenser fan motors and two separate freezer doors (that is, one for soft serve and another for shake), designed to dispense shake and soft serve product in the same footprint.

3.1.3 *freeze-down energy, n*—amount of energy consumed (kWh) by the soft serve or shake freezer while cooling the product to a servable temperature.

3.1.4 *freeze-down time, n*—time required for the soft serve or shake freezer while cooling the product to a servable temperature.

3.1.5 *heat treat–cool phase, n*—portion of the heat treat cycle which involves cooling the product from ≥150°F (≥65°C) to ≤41°F (≤5°C) within a period of 120 min or less.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, http://www.access.gpo.gov.

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

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

3.1.6 *heat treat–heat phase, n*—portion of the heat treat cycle which involves elevating product temperature from ≤41°F (5°C) to ≥150°F (66°C) within a period of 90 min.

3.1.7 *heat treat–hold phase, n*—portion of the heat treat cycle which involves holding the product above a ≥150°F (≥66°C) for a period of at least 30 min.

3.1.8 *heat-treatment freezers, n*—as defined in Specification F1604, operate as conventional freezers and heat all product to 150°F (66°C) minimum for at least 30 min daily to destroy undesirable microorganisms.

3.1.9 *ice cream or ice-cream (originally, iced cream), n*—a frozen dessert made from dairy products, such as milk and cream, combined with flavorings and sweeteners, such as sugar, and possible other ingredients. **(21 CFR 135.110)**

3.1.10 *idle energy rate, n*—the rate of energy consumed (kWh) by the soft serve or shake freezer while holding or maintaining the product in a ready-to-serve state without dispensing product.

3.1.11 *interval, n*—length of time for one operator to draw a portion of product from a soft serve or shake freezer.

3.1.12 *mix, n*—a fluid that contains 4 to 6 % butterfat and is a vanilla flavor.

3.1.13 *overrun, n*—the increase in volume due to incorporation of air while freezing soft serve and shake products under agitation, calculated by this formula:

$$\text{Overrun} = \frac{(\text{Weight of liquid mix} - \text{Weight of frozen product})}{\text{Weight of frozen product}} \quad (1)$$

3.1.14 *product, n*—mix that is frozen under agitation to specific temperature without syrup that is ready to serve.

3.1.15 *shake, n*—a sweet, cold beverage which is made from milk, ice cream, and flavorings or sweeteners such as fruit syrup or chocolate sauce.

3.1.16 *single spout freezer, n*—freezer employing a single spout with a single spout freezer door and dispense cylinder.

3.1.17 *spout adaptor, n*—a device which is attached to the freezer door spout to assist in the filling of sampling container.

3.1.18 *standby idle energy, n*—the rate of energy consumed (kWh) by the soft serve or shake freezer while holding or maintaining the product ≤41°F (≤5°C) without dispensing product. Also referred to as night mode in NSF/ANSI 6.

3.1.19 *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.

3.1.20 *twin single spout freezer, n*—a freezer employing either of the above configurations (Twin Twist freezer "A" or "B") but with two single spout doors which can only dispense from one Freezer Cylinder.

3.1.21 *twin twist freezer "A", n*—a freezer using two main compressors and two main condensers with one or two condenser fan motors and a freezer door (3 spout) which the center spout draws from both freezer cylinders.

3.1.22 *twin twist freezer "B", n*—a freezer with single main compressor, single main condenser fan motor, with a freezer door (3 spout) which the center spout draws product from both freezer cylinders.

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

3.1.24 *water cooled, n*—a freezer which uses water passing through a twin tube condenser in the freezer cylinder refrigeration system.

4. Summary of Test Method

4.1 This test method is designed to address freezers which have self-contained refrigeration system(s) for the main freezing cylinder(s) and may or may not contain a mix storage system as part of the unit.

4.2 Power input is determined to confirm that the soft serve or shake freezer is operating below maximum nameplate power rating.

4.3 The mix storage and freezing cylinder are loaded with 36 ± 2°F (2.2 ± 1°C) mix. The time and energy required to freeze down the product to an acceptable serving condition is monitored (as defined in 10.2.2).

4.4 Minimum Dispensing Interval Determination (as defined in 10.4).

4.5 Heavy-Use Power Rating, Energy Consumption and Production Capacity Test (as defined in 10.5).

4.6 Impact Draw Test (as defined in 10.6).

4.7 Ready-to-Serve Idle Test (as defined in 10.7).

4.8 Standby (Night Mode) Idle Test (as defined in 10.8).

4.9 Heat Treat Cycle Energy Consumption Test (if applicable) (as defined in 10.9).

5. Significance and Use

5.1 The freeze-down energy consumption and duration can be used to determine time and energy required for a freezer to be ready to serve when loaded with mix.

5.2 The minimum dispensing interval determination is used to determine the rate at which the product will be dispensed during the Heavy-Use Energy Consumption and Production Capacity Test (10.5). Measuring overrun during this test is critical to determining production capacity rating in gallons per hour.

5.3 Heavy-use energy consumption can be used by an operator to determine energy consumption during peak usage when selecting a soft-serve freezer. Measuring overrun during this test is critical to determining production capacity rating in gallons per hour.

5.4 Production capacity can be used by an operator in selecting a soft-serve or shake freezer that meets their production requirements. Measuring overrun during this test is critical to determining production capacity rating in gallons per hour.

5.5 Impact draw is used to determine the peak rate at which servable quality product (as defined in 10.2.2) can be dispensed from a soft-serve or shake freezer.

5.6 Idle energy rate is a precise indicator of a soft serve or shake freezer's energy performance under a stabilized ready-to-serve operating condition. This information enables the food service operator to consider energy performance when selecting soft-serve or shake equipment.

5.7 Stand-by (night mode) energy rate is a precise indicator of a soft-serve or shake freezer's energy performance under a simulated overnight operating condition. This information enables the food service operator to consider energy performance when selecting soft-serve or shake equipment, if applicable.

5.8 Heat Treat cycle energy consumption is a precise indicator of a soft serve or shake freezer's energy performance when operated in a heat treatment cycle. This information can be used by an operator to consider the energy requirement of using a heat treat cycle, if applicable.

6. Apparatus

6.1 *Analytical Balance Scale,* for measuring weights up to 25 lb (11.33 kg), with a resolution of 0.01 lb (0.004 kg) and an uncertainty of 0.01 lb (0.004 kg).

6.2 *Stop Watch,* with at least 1-s resolution.

6.3 *Thermocouple Probe,* calibrated industry standard type T thermocouples capable of immersion with a range of 0 to 212°F (–17.7 to 100°C) and an accuracy of ±1°F (±0.6°C). Thermocouples should be calibrated per ISO 17025 for the appropriate temperature range (19°F (–2.2°C) for soft serve, 26°F (–3.3°C) for shake).

6.4 *Watt-Hour Meter,* for measuring the electrical energy consumption, 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 %.

6.5 *Spout Adapter,* to facilitate measuring product temperature and filling container during the test which is made from an Acetal (POM) material and has a ID surface finish of 32√ . Use the appropriate length to properly fill containers from the bottom. A thermocouple should be installed in the geometric center of the spout adapter to measure dispensing temperature if a data acquisition system is used. See Fig. 1.

6.6 *Small Container,* a small container shall be a cup design and shall be 8 ± 1.0 fl. oz (237 ± 15 mL) in capacity, with rigid sides. Thirty (30) cups will be required for tests which are listed in this standard.

6.7 *Medium Container,* a medium container shall be a cup design and shall be 16 ± 1.0 fl. oz (475 ± 15 mL) in capacity, with rigid sides. Thirty (30) cups will be required for tests which are listed in this standard.

6.8 *Large Container,* a large container shall be a cup design and shall be 32 ± 1.0 fl. oz (946 ± 15 mL) in capacity, with rigid sides. Thirty (30) cups will be required for tests which are listed in this standard.

6.9 Container volume should be measured by fully filling the container with room temperature water and measuring its weight excluding the container. Water density of 8.338 lb/gal should be used for 60°F water (1000 kg/m^3 @ 10°C) or 8.329 lb/gal for 70°F (998 kg/m^3 @ 20°C) water. Exact cup volume should be recorded in fl. oz based on a conversion of 128 fl. oz per gallon (1 m^3 = 1 000 000 mL).

NOTE 1—Container volume is usually labeled to hold that amount of volume without spilling; actual container volume filled to the rim will be greater than the label.

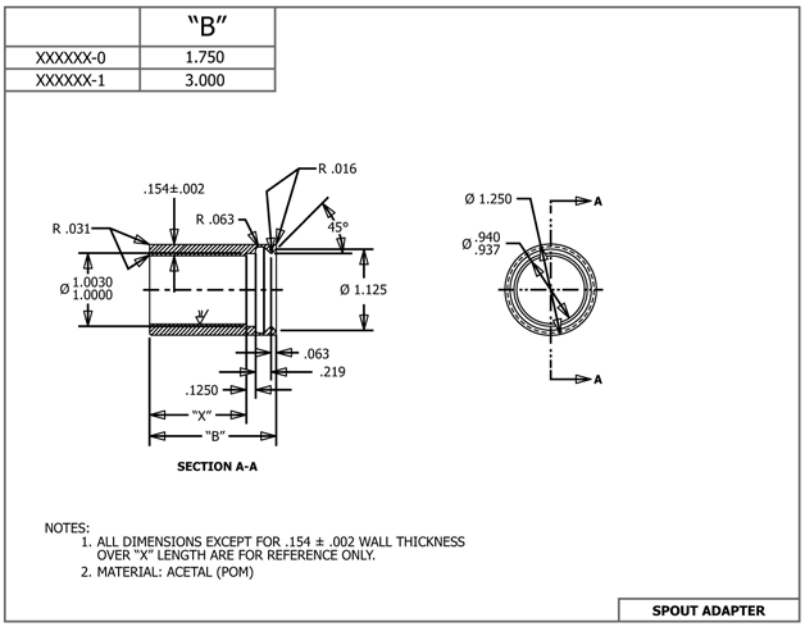

FIG. 1 Sample Spout Adapter Specification

7. Reagents and Materials

7.1 *Soft Serve Mix,* liquid mix shall consist of 4 to 6 % butterfat and have a vanilla flavor only. Mix can be stored either in hermetically sealed bags or in cartons and shall be refrigerated to 36 ± 2°F (2.2 ± 1°C) prior to all tests.

7.2 *Small Container,* for testing soft serve freezers with less than 10 gal/h (37.8 L/h) capacity.

7.3 *Medium Container,* for testing soft serve freezers with greater than 10 gal/h (37.8 L/h) capacity and shake freezers rated ≤20 gal/h (≤75.7 L/h).

7.4 *Large Container,* for impact testing of shake freezers rated more than 20 gal/h (75.7 L/h).

8. Sampling, Test Units

8.1 *Soft Serve or Shake Freezer*—Select a representative production model for performance testing.

9. Preparation of Apparatus

9.1 Install the soft serve or shake freezer so that there is 1 ft (30.48 cm) clearance maintained between a back wall and the back vertical plane of the soft serve or shake freezer. Both sides of the soft serve or shake freezer shall be a minimum of 1 ft (30.48 cm) from any side wall, side partition, or other operating soft serve freezer and a minimum of 3 ft (91.44 cm) clearance between the front vertical plane of the soft serve or shake freezer and any wall or side partition. (See Fig. 2.) Walls can be portable or suspended from ceiling. If manufacturer's instructions require additional clearance between soft serve or shake freezer and walls, then use manufacturer's clearance recommendations in place of clearances listed above. Record appliance placement relative to test room walls in results recording section. The associated heating or cooling system shall be capable of maintaining an ambient temperature of 75 ± 3°F (24 ± 2°C) during energy tests within the testing environment. Machine ambient temperature is measured 6 in. (15 cm) from air intake side of freezer, in line with the center of the condenser. Freezer to be installed in the temperature controlled room. Tests can start once all thermocouple temperatures are within the temperature specified for the ambient conditions of the room.

9.2 Connect the soft serve or shake freezer to a Watt-Hour 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 soft serve or shake freezer compressor(s) is 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 2—The purpose of the testing procedure is to evaluate the performance of a soft serve or shake freezer at its rated electric voltage. If a soft serve or shake freezer 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 or tester, or both, shall be recorded. The performance of a dual voltage soft serve or shake freezer may differ at the two voltages.

9.4 To facilitate monitoring product temperature during testing, locate a thermocouple probe in the center of the mix storage container(s), 1 ± 0.1 in. (25 ± 2 mm) above the bottom surface of the storage container(s). For all draw tests, locate an additional thermocouple probe in the geometric center of the draw spout adapter(s). For all non-draw tests, locate an

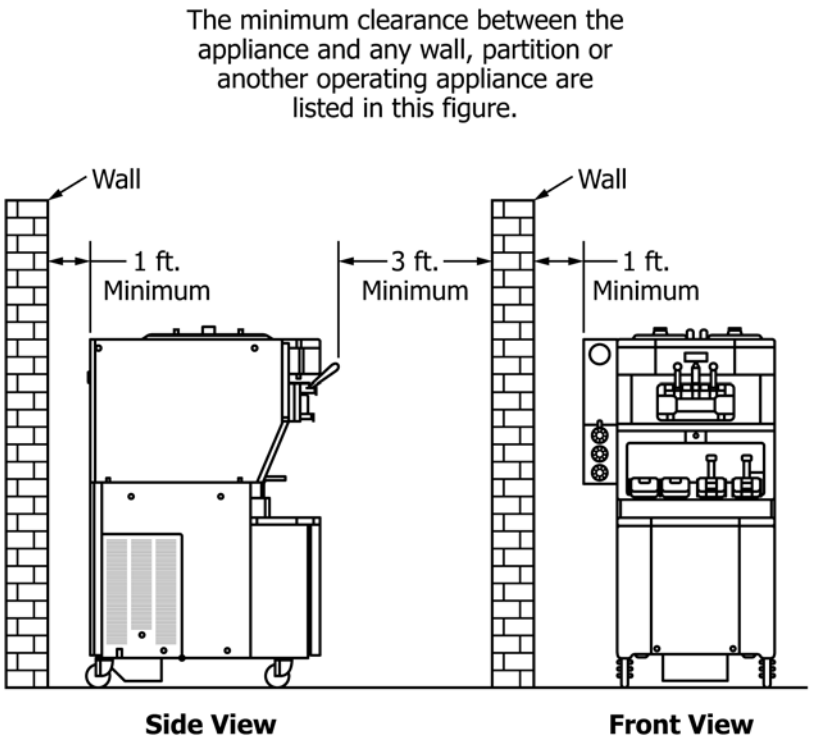

FIG. 2 Example of Appliance Placement

additional thermocouple probe in the product holding area of at least one of the dispenser heads (per NSF/ANSI 6).

9.5 For water cooled soft serve or shake freezers, the supplied water for the main condensing system must be 70 ± 2°F (21 ± 1°C).

10. Procedure

10.1 *General:*

10.1.1 The following shall be obtained and recorded for each run of every test.

10.1.1.1 Voltage.

10.1.1.2 Average air temperature over the complete test period.

10.1.1.3 Average relative humidity over the complete test period.

10.1.1.4 Water consumed (where applicable for water cooled freezers).

10.1.1.5 Average incoming water temperature over the complete test period (where applicable for water cooled freezers).

10.1.1.6 Average exit water temperature over the complete test period (where applicable for water cooled freezers).

10.1.1.7 Temperature of mix.

10.1.1.8 Temperature of dispensed product.

10.1.1.9 Weight of frozen product in the cup, when applicable.

10.1.2 For each test run, confirm that the maximum 10-s continuous amperage draw rate is not >110 % of the rated nameplate amperage. After 10 s, if the measured amperage is >110 % of the rated nameplate maximum amperage, terminate testing and contact the manufacturer. The manufacturer may make appropriate changes or adjustments to the soft serve or shake freezer.

10.2 *Freeze-Down Energy Consumption and Duration:*

NOTE 3—The freeze-down test should be conducted prior to soft serve or shake freezer operation on the day of the test. It is the intent of this procedure to determine the energy and time it takes the soft serve or shake freezer to freeze mix to a servable product.

10.2.1 Follow the manufacturer's recommended instructions for priming the soft serve or shake freezer prior to the freeze down test. Subsequent testing and results are not valid if the manufacturer's operating instructions are not completed. Start with the unit in a room at 75 ± 3°F (24 ± 2°C), fill the mix storage and freezing cylinder with refrigerated mix (36 ± 2°F (2.2 ± 1°C)) to the manufacturer's recommended level. During all tests, refill mix if the "Mix Low" indicator appears.

10.2.2 Record the temperature of the mix in the center of the mix storage container, 1 in. (25 mm) above the bottom surface of the mix storage container. Start the initial freezing process.

10.2.3 Freeze-down per manufacturer's instructions, in absence of specific instruction, is judged complete when the main compressor(s) or beater drive motor(s), or both, for freezing cylinder(s) have cycled off.

10.2.4 Confirm that the freezer is ready to serve by dispensing one 8 fl. oz (236.6 mL) portion of product. Record the coldest temperature in the spout adapter while dispensing or in the geometric center of the receiving container. If not using thermocouple in spout adapter, temperature measurement is acceptable within 30 s from the end of the draw. For soft serve, the temperature of the dispensed product shall be 19 ± 2°F (–7 ± 1°C); for shakes, the temperature of the dispensed product shall be 26 ± 2°F (–3 ± 1°C). If the product temperature is above the threshold criteria, repeat 10.2.1 – 10.2.5, adding an additional main compressor cycle (on then off again). If the temperature of the product is outside the specified limits stated above adjust the temperature or equipment settings and repeat 10.2.1 – 10.2.5. Note in test record that another compressor cycle or adjustments were part of this test.

10.2.5 Record energy consumption, elapsed time, and final mix storage container temperature when the motor(s) and main compressor(s) for freezing cylinder(s) has cycled off and verified that product is in the appropriate serving temperature range.

10.3 *Draw Rate:*

10.3.1 If the freezer door has an adjustable draw handle, set the draw rate to the manufacturer's recommended setting and record the draw rate. If the draw rate is not adjustable, record the draw rate.

10.3.2 Tare the selected container on the scale. Dispense product continuously for 10 s into the selected container.

10.3.3 Divide the weight of the dispensed product by 10 and record this as the draw rate (weight oz/s or g/s). Wait for the compressor to cycle off.

10.3.4 Repeat steps 10.3.1 and 10.3.2 two more times and record the draw rate each time. Take the sum of the three tests and divide by three. Record this number as the average draw rate.

10.3.5 Record the minimum temperature of the product in the third container to make sure it is at 19 ± 2°F (–7 ± 1°C) for soft serve product and 26 ± 2°F (–3 ± 1°C) for shake freezers (without syrup) product.

10.4 *Minimum Dispensing Interval Determination:*

NOTE 4—It is the intent of this procedure to determine the shortest interval between consecutive draws that still produces acceptable product. For freezers meeting the definition in 3.1.21, drawing of product is to take place from either the left or right spout with opposite side running in ready to serve mode (do not alternate). For freezers meeting the definition in 3.1.22, drawing of product is to take place alternating between the left and right spout (product not to be drawn from center spout).

10.4.1 Determine the appropriate container size (small, medium or large) for the minimum dispensing interval test, as determined in 7.2 – 7.4.

10.4.2 Fill the mix storage to the manufacturer's recommended full level with refrigerated mix [36 ± 2°F (2.2 ± 1°C)] after the freeze - down cycle has completed. During all tests, refill the mix if the "Mix Low" indicator appears. Record the temperature of the mix in the center of the mix storage container, 1 in. (25 mm) above the bottom of the mix storage container.

10.4.3 Allow the freezer to stabilize for 30 ± 2 min, in its ready to serve idle mode. If the main compressor is running at the end of the 30 ± 2 min, allow the main compressor to cycle off before starting the test.

10.4.4 Starting the dispensing test at the lower end of the acceptable temperature range is recommended.

10.4.5 Draw product into the appropriate container by holding the container close to the bottom of the spout adapter

to prevent forming air pockets. Slightly overfill the cup to assure it is full of product. Skim off excess amount above rim with a straightedge, leveling the soft serve to completely fill the cup to the upper surface of the container lip. Scrape the excess into the next container . Measure and record the weight of the dispensed product.

10.4.6 Maintain the manufacturer's recommended interval (or use a 30-s interval if not specified by the manufacturer) between the start of each draw. Monitor and record the minimum temperature of the soft serve or shake in each cup and number of cups drawn.

NOTE 5—Product temperature in spout adaptor between draws may exceed the maximum temperature, but will not affect the success of the test.

10.4.7 If the dispensed product temperature exceeds the maximum serving temperature (21°F (–6°C) for soft serve or 28°F (–2°C) for shakes) for three consecutive draws, then stop testing and record the elapsed time, number of total draws and final temperature. Increase the interval between draws, as appropriate and repeat 10.4.1 through 10.4.6.

10.4.8 Systematically decrease the interval between successive draws (by 2 or 5-s increments) and repeat steps 10.4.1 through 10.4.7 until the unit fails to produce 30 acceptable draws (that is, drawn product temperature exceeds maximum serving temperature for three consecutive draws).

10.4.9 Calculate the overrun based on the successful interval test (refer to 3.1.13 for formula).

10.4.10 Note the shortest time interval that still produced 30 acceptable cups of product. This interval will be used in the heavy-use energy consumption and production capacity test.

10.5 *Heavy-Use Energy Consumption and Production Capacity Test:*

NOTE 6—It is the intent of this procedure to determine the energy consumption and production capacity of the soft serve or shake freezer during heavy use.

NOTE 7—For freezers meeting the definition under section 3.1.22, draw product alternating between the left and right spout (product not to be drawn from the center spout). For freezers meeting the definition in 3.1.21 and having two power sources, draw product from the side which has the highest rated amperage draw (refer to name plate/data label for freezer ratings).

10.5.1 Fill the mix storage to the manufacturer's recommended full level with refrigerated mix [36 ± 2°F (2.2 ± 1°C)] after the freeze-down cycle has completed. During all tests, refill the mix if the "Mix Low" indicator appears. Record the temperature of the mix in the center of the mix storage, 1 in. (25 mm) above the bottom surface of the mix storage container.

10.5.2 Begin recording elapsed time and energy consumption as soon as the unit cycles off.

10.5.3 Draw 30 successive times using the interval between draws determined in 10.4.

10.5.4 Measure and record the lowest temperature in the spout adaptor or in each container of dispensed product.

10.5.5 Measure and record the weight of each container of product.

10.5.6 If the dispensed product temperature exceeds the maximum serving temperature (21°F (–6°C) for soft serve or 28°F (–2°C) for shakes) for three consecutive draws, the test is invalid and must be repeated. Adjust the interval between draws as appropriate and restart the testing procedure.

10.5.7 After 30 successive draws have been dispensed, record the total elapsed time, and energy consumption for the production capacity.

10.5.8 Record the time and energy consumption until the main compressor(s) or beater drive motor(s), or both, for freezing cylinder(s) have cycled off after the last draw. This is the recovery time and energy.

10.5.9 Repeat the test two more times following steps 10.5.1 – 10.5.7. Additional test runs may be necessary to obtain the required precision for the recorded test results (see Annex A1).

10.6 *Impact Draw Test For Soft Serve or Shake:*

NOTE 8—It is the intent of this procedure to determine the shortest interval between successive draws and still produce acceptable product.

NOTE 9—For freezers meeting the definition under section 3.1.22, draw product alternating between the left and right spout (product not to be drawn from the center spout).

10.6.1 Fill the mix storage to the manufacturer's recommended full level with refrigerated mix [36 ± 2 °F (2.2 ± 1°C)] after the freeze-down cycle has completed. During all tests, refill mix if the mix low indicator appears. Record the temperature of the mix in the center of the mix storage, 1 in. (25 mm) above the bottom surface of the mix storage.

10.6.2 Conduct the Impact Draw Test a minimum of three times for each serving size as specified in 10.6.6, 10.6.11, and 10.6.12 when testing a soft serve freezer. For a shake freezer, use a container as noted in 7.2 – 7.4, and fill cup to the lip without overflowing.

10.6.3 Allow the freezer to stabilize for 30 ± 2 min in its ready to serve idle mode. If the main compressor is running at the end of the 30 ± 2 min, allow the main compressor to cycle off before starting the test.

10.6.4 Adjust and record the draw rate per 10.3.

10.6.5 Begin recording elapsed time and energy consumption.

10.6.6 Use the large container to draw each successive 12 ± 1 oz (weight oz, or 0.75 ± 0.06 lb) (340 ± 28 g) portions of soft serve. Pause 5 s between each draw, until the average container temperature rises above the maximum serving temperature (21°F (–6°C) for soft serve or 28°F (–2°C) for shakes) for three consecutive draws. Measure and record the weight and temperature of each container of soft serve. The average weight for all servings to be 12 ± ½ oz (0.75 ± 0.03 lb) (340 ± 14 g).

NOTE 10—If one sample is 13 oz, the next sample should target 11 oz, to maintain the 12 oz average.

10.6.7 Complete dispensing the container where the temperature exceeded the maximum and record the total number of consecutive draws where the product remained under the maximum serving temperature. Record the number of acceptable draws per test.

10.6.8 Record the time and energy from immediately after the test to when the main compressor(s) or beater drive motor(s), or both, for freezing cylinder(s) have cycled off. This is the recovery time and energy.

10.6.9 After the unit cycles off, perform an overrun test using the procedure in 10.4.5.

10.6.10 Repeat the Impact Draw Test two more times starting at step 10.6.2 through 10.6.9.

10.6.11 Repeat 10.6.2 to 10.6.10 for soft serve, dispensing 9 ± 1.0 oz (weight oz, or 0.56 ± 0.06 lb) (255 ± 28 g) portions per medium container. The average weight for all servings to be 9 ± ½ oz (0.56 ± 0.03 lb) (255 ± 14 g).

NOTE 11—If one sample is 10 oz, the next sample should target 8 oz, to maintain the 9 oz average.

10.6.12 Repeat steps 10.6.2 to 10.6.10, for soft serve dispensing 6 ± 1.0 oz (weight oz, or 0.38 ± 0.06 lb) (454 ± 28 g) portions per small container. The average weight for all servings to be 6 ± ½ oz (0.38 ± 0.03 lb) (170 ± 14 g).

10.6.13 For a shake freezer use the appropriate container from 7.2 – 7.4 and repeat steps 10.6.2 through 10.6.10, filling the cup to the rim without overflowing.

10.6.14 For each scenario, record the total energy consumed, number, average temperature, and average weight of consecutive draws of acceptable product and the percentage overrun at the end of each impact draw test run. Do not include the temperature or weight of the last cup where the temperature exceeded the acceptable range.

10.7 *Ready-to-Serve Idle Test:*

NOTE 12—It is the intent of this procedure to determine the energy consumption and if applicable water consumption during a 4-h no draw period with product in a ready-to-serve state.

10.7.1 Fill the mix storage per 10.4.2.

10.7.2 Allow the freezer to stabilize, in its ready-to-serve idle mode, for at least 30 min or for one main compressor cycle (whichever is greater) after the freeze-down without drawing any product.

10.7.3 With the freezer in its ready-to-serve mode, monitor the elapsed time, mix storage temperature, energy consumption, and, if applicable, condenser water consumption. Record the totals, starting at the end of the main compressor cycle, after a minimum of 4 h. Make sure the freezer maintains its ready-to-serve mode for the duration of the test.

10.7.4 Confirm that the freezer is ready to serve by dispensing one 8 fl oz (237 mL) portion of product and measuring the temperature at the geometric center. For soft serve, the temperature of the dispensed product shall be 19 ± 2°F (–7 ± 1°C); for shakes, the temperature of the dispensed product shall be 26 ± 2°F (–3.3 ± 1°C). If temperature of the product is above the maximum serving temperature, the ready-to-serve idle mode has failed. Contact the manufacturer to make the appropriate adjustments to the freezer. If the temperature of the product is under the specified limits stated above, adjust the temperature or equipment settings and repeat 10.7.1 – 10.7.3.

10.7.5 Repeat the *Ready-to-Serve Idle Test* two more times.

10.8 *Standby (Night Mode) Idle Test (if applicable):*

NOTE 13—It is the intent of this procedure to determine the energy consumption and if applicable water consumption during a 4-h no-draw period with all mix in the mix storage and freezing cylinder maintained at a temperature ≤41°F (≤5°C).

10.8.1 Initiate this test immediately following the Ready-to-Serve Idle Energy Rate Test after the main compressor(s) has cycled off during the Ready-to-Serve Idle Test.

10.8.2 Follow the manufacturer's recommendations for placing the freezer in the standby idle mode, if the unit is equipped with this feature.

10.8.3 Fill the mix storage with fresh, refrigerated mix per 10.4.2.

10.8.4 With the freezer placed in its standby idle mode, monitor the elapsed time, mix storage mix temperature, energy consumption, and, if applicable, water consumption. Record the totals after a minimum of 4 to 8 h. Confirm the temperature of product in the freezing cylinder at conclusion of the test by dispensing 8 fl oz (237 mL) into a cup. Measure and record the temperature while dispensing or in the geometric center of the container, or both, to confirm it is ≤41°F (≤5°C).

10.8.5 Repeat the *Standby Idle Test* two more times.

10.9 *Heat Treat Cycle Energy Consumption Test (if applicable):*

NOTE 14—It is the intent of this procedure to determine the energy consumption and if applicable water consumption during a Heat Treat cycle.

10.9.1 If applicable, initiate this test immediately following the Ready-to-Serve Idle Test.

10.9.2 Follow the manufacturer's recommendations for placing the unit in the Heat Treat mode. The Heat Treat Cycle will be completed in approximately 4 h.

10.9.3 With the freezer placed in its heat treat mode, monitor the elapsed time to complete each phase of the Heat Treat Cycle, mix storage and freezing cylinder mix temperature, energy consumption, and, if applicable, water consumption. Confirm the temperature of product in the freezing cylinder at conclusion of the test by dispensing 8 oz (237 mL) into a cup. Measure and record the temperature while dispensing or in the geometric center of the container, or both, to confirm it is ≤41°F (≤5°C).

11. Calculation and Report

11.1 *Test Soft-Serve or Shake Freezer*—Using specifications outlined in Specification F1604 under the classification section, summarize the physical and operating characteristics of the freezer. Use additional text to describe any design 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 Record the voltage for each test.

11.2.3 Record the average ambient temperature for each test.

11.2.4 Record the average relative humidity for each test.

11.3 *Energy Input Rate:*

11.3.1 Record the manufacturer's nameplate power rating in kW.

11.3.2 Record the elapsed time (hh:mm:ss) and energy consumption (kWh) for each test.

11.4 *Freeze Down Energy Consumption and Time:*

11.4.1 Record the total elapsed time (hh:mm:ss) and energy consumed (kWh) during the Freeze Down Energy Consumption Test.

11.4.2 Record the incoming water temperature (°F (°C)), exit water temperature (°F (°C)) and water consumed (gal/h (L/h)) during the Freeze Down Energy Consumption and Time Test if the soft serve freezer is water cooled.

11.5 *Heavy-Use Power Rating, Energy Consumption and Production Capacity:*

11.5.1 Record the interval time used during the Heavy-Use Test.

11.5.2 Record the power rating and total energy consumed during the Heavy-Use Test, the production capacity per the energy consumed in kWh/lb (kWh/kg) and kWh/gal (kWh/l) of dispensed product , the average overrun, and the recovery time, based on an average of at least three separate test runs. Include recovery energy in the total energy consumption.

11.5.3 Record the average incoming water temperature (°F (°C)) and water consumed (gal/h (L/h)) during the Heavy-Use Power Rating, Energy Consumption and Production Capacity Tests if the soft serve freezer is water cooled.

11.5.4 Calculate and record the average power rating during the Heavy-Use Test based on:

$$q_{heavy} = \frac{E \times 60}{t} \tag{2}$$

where:

q_{heavy} = heavy-use energy rate, kW,
E = energy consumed during the test period, kWh, and
t = test period, min.

11.5.5 Calculate and record the production capacity based on volume:

$$PC_{volume} = \frac{(30\ \text{cups}) \times (\text{cup size (fl.oz)}) \times \left(\frac{\text{gal}}{128\ \text{fl.oz}}\right)}{\text{time (min)}} \times \frac{60\text{min}}{\text{h}} \tag{3}$$

where:

PC_{volume} = the production capacity of the soft serve freezer, gal/h (L/h), and
time = the total test time including interval between draws and the recovery time, min.

11.5.6 Calculate and record the production capacity based on weight:

$$PC_{weight} = \frac{(30\ \text{cups}) \times (\text{measured weight (wt. oz)}) \times \left(\frac{1\ \text{lb}}{16\ \text{wt.oz}}\right)}{\text{time (min)}} \times \frac{60\text{min}}{\text{h}} \tag{4}$$

where:

PC_{weight} = the production capacity of the soft serve or shake freezer, lb/h (kg/h),
time = the total test time including interval between draws and the recovery time, min.

11.5.7 Record the average overrun during the Heavy-Use Test.

$$Overrun = \frac{\text{Weight of liquid mix} - \text{Weight of frozen product}}{\text{Weight of frozen product}} \tag{5}$$

11.5.8 Record the container size used for the Heavy-Use Energy Consumption and Production Capacity Test.

11.6 *Impact Draw Test:*

11.6.1 For each scenario, record the number of consecutive draws of acceptable product, based on a minimum of three separate test runs.

11.6.2 Record the time and energy consumption required for the freezer to recover at the end of each Impact Draw Test.

11.6.3 Record the average overrun during each Impact Draw Test based on the formula in 11.5.4.

11.6.4 Record the average incoming water temperature (°F (°C)), exit water temperature (°F (°C)) and water consumed (gal/h (L/h)) during the Impact Draw Test if soft serve freezer is water cooled.

11.7 *Idle Energy Rate—Ready-to-Serve:*

11.7.1 Record the idle energy consumption based on a minimum of three test runs.

11.7.2 Calculate and record the ready-to-serve idle energy rate based on:

$$q_{idle} = \frac{E \times 60}{t} \tag{6}$$

where:

q_{idle} = idle energy rate, kWh,
E = energy consumed during the test period, kWh, and
t = test period, min.

11.7.3 Record the average mix storage temperature and freezing cylinder temperature during the Ready-to-Serve Idle Test.

11.7.4 Record the average incoming water temperature (°F (°C)), exit water temperature (°F (°C)) and water consumed (gal/h (L/h)) during the Ready-to-Serve Idle Test if the soft serve freezer is water cooled.

11.8 *Standby (Night Mode) Energy Rate:*

11.8.1 Record the average standby energy consumption based on a minimum of three test runs.

11.8.2 Calculate and record the standby energy rate based on:

$$q_{standby} = \frac{E \times 60}{t} \tag{7}$$

where:

$q_{standby}$ = standby energy rate, kWh,
E = energy consumed during the test period, kWh, and
t = test period, min.

11.8.3 Record the average mix storage temperature and freezing cylinder temperature during the Standby Idle Test.

11.8.4 Record the average incoming water temperature (°F (°C)), exit water temperature (°F (°C)) and water consumed (gal/h (L/h)) during the Standby Idle Test if soft serve freezer is water cooled.

11.9 *Heat Treat Cycle Energy Consumption Test*—Record the heat treat cycle energy consumption, based on the energy

consumed during the test period, heat phase, hold phase, cool phase. Also record the mix storage temperature (°F (°C)) and freezing cylinder temperature (°F (°C)) at the end of the heat phase and end of cool phase during the heat treat cycle test. Also record the maximum and minimum mix storage temperatures (°F (°C)) during the hold phase of the Heat Treat Cycle Test. Also record the incoming water temperature (°F (°C)) , exit water temperature (°F (°C)) and water consumed (gal/h (L/h)) during each phase of the heat treat cycle if the soft serve freezer is water cooled.

12. Precision and Bias

12.1 *Precision:*

12.1.1 *Repeatability (within laboratory, same operator and equipment)*—The repeatability of each recorded parameter is being determined.

12.1.2 *Reproducibility (multiple laboratories)*—The inter-laboratory precision of the procedure in this test method for measuring each recorded 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 recorded.

13. Keywords

13.1 capacity; energy consumption; freezing cylinder; frozen yogurt; ice cream; impact production; mix; mix storage; overrun; power rating; product; shake; soft serve

ANNEX

(Mandatory Information)

A1. PROCEDURE FOR DETERMINING THE UNCERTAINTY IN REPORTED TEST RESULTS

NOTE A1.1—This procedure is based on the ASHRAE method for determining the confidence interval for the average of several test results (ASHRAE Guideline 2 - 1986(RA90)). It should only be applied to test results that have been obtained within the tolerances prescribed in this method (for example, thermocouples calibrated, appliance operating within 5 % of rated input during the test run).

A1.1 For the heavy-use energy consumption and production capacity test results, the uncertainty in the averages of at least three test runs must be no greater than ±10 % before any of the parameters for that loading scenario can be reported.

A1.2 The uncertainty in a reported result is a measure of its precision. If, for example, the production capacity for the appliance is 30 lb/h, the uncertainty must not be greater than ±3 lb/h. Thus, the true production capacity is between 27 and 33 lb/h. This interval is determined at the 95 % confidence level, which means that there is only a 1 in 20 chance that the true production capacity could be outside of this interval.

A1.3 Calculating the uncertainty not only guarantees the maximum uncertainty in the reported results, but is also 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 lists 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, Cn
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—Section A1.5 shows how to apply this procedure.

A1.4.1 *Step 1*—Calculate the average and the standard deviation for the test result (cooking-energy efficiency or production capacity) using the results of the first three test runs, as follows:

A1.4.1.1 The formula for the average (three test runs) is as follows:

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

where:

Xa_3 = average of results for three test runs, and
X_1, X_2, X_3 = results for each test run.

A1.4.1.2 The formula for the sample standard deviation (three test runs) is as follows:

$$S_3 = \left(1 \sqrt{2}\right) \times \sqrt{(A_3 - B_3)} \quad \text{(A1.2)}$$

where:

S_3 = standard deviation of results for three test runs,
A_3 = $(X_1)^2 + (X_2)^2 + (X_3)^2$, and
B_3 = $(⅓) \times (X_1 + X_2 + X_3)^2$.

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

NOTE A1.4—The "A" quantity is the sum of the squares of each test result, and the "B" quantity is the square of the sum of all test results multiplied by a constant (⅓ 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.

A1.4.2.1 The formula for the absolute uncertainty (3 test runs) is as follows:

$$U_3 = C_3 \times S_3, \quad (A1.3)$$

$$U_3 = 2.48 \times S_3$$

where:

U_3 = absolute uncertainty in average for three test runs, and
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.

A1.4.3.1 The formula for the percent uncertainty (3 test runs) is as follows:

$$\%U_3 = (U_3 / Xa_3) \times 100\% \quad (A1.4)$$

where:

$\%U_3$ = percent uncertainty in average for three test runs,
U_3 = absolute uncertainty in average for three test runs, and
Xa_3 = average of three test runs.

A1.4.4 If the percent uncertainty, $\%U_3$, is not greater than ±10 % for the cooking-energy efficiency and production capacity, report the average for these parameters along with their corresponding absolute uncertainty, U_3, in the following format:

$$Xa_3 \pm U_3$$

A1.4.4.1 If the percent uncertainty is greater than ±10 % for the cooking energy efficiency or production capacity, proceed to Step 5.

A1.4.5 *Step 5*—Run a fourth test for each loading scenario whose percent uncertainty was greater than ±10 %.

A1.4.6 *Step 6*—When a fourth test is run for a given loading scenario, calculate the average and standard deviation for test results using a calculator or the following formulas:

A1.4.6.1 The formula for the average (four test runs) is as follows:

$$Xa_4 = (1/4) \times (X_1 + X_2 + X_3 + X_4) \quad (A1.5)$$

where:

Xa_4 = average of results for four test runs, and
X_1, X_2, X_3, X_4 = results for each test run.

A1.4.6.2 The formula for the standard deviation (four test runs) is as follows:

$$S_4 = \left(1/\sqrt{3}\right) \times \sqrt{(A_4 - B_4)} \quad (A1.6)$$

where:

S_4 = standard deviation of results for four test runs,
A_4 = $(X_1)^2 + (X_2)^2 + (X_3)^2 + (X_4)^2$, and
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.

A1.4.7.1 The formula for the absolute uncertainty (four test runs) is as follows:

$$U_4 = C_4 \times S_4, \quad (A1.7)$$

$$U_4 = 1.59 \times S_4$$

where:

U_4 = absolute uncertainty in average for four test runs, and
C_4 = the uncertainty factor for four 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.

A1.4.8.1 The formula for the percent uncertainty (four test runs) is as follows:

$$\%U_4 = (U_4 / Xa_4) \times 100\% \quad (A1.8)$$

where:

$\%U_4$ = percent uncertainty in average for four test runs,
U_4 = absolute uncertainty in average for four test runs, and
Xa_4 = average of four test runs.

A1.4.9 *Step 9*—If the percent uncertainty, $\%U_4$, is not greater than ±10 % for the cooking energy efficiency and production capacity, report the average for these parameters along with their corresponding absolute uncertainty, U_4, in the following format:

$$Xa_4 \pm U_4$$

A1.4.9.1 If the percent uncertainty is greater than ±10 % for the cooking energy efficiency or production capacity, proceed to Step 10.

A1.4.10 *Step 10*—The steps required for 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.

A1.4.10.1 The formula for the average (n test runs) is as follows:

$$Xa_n = (1/n) \times (X_1 + X_2 + X_3 + X_4 + \ldots + X_n) \quad (A1.9)$$

where:

n = number of test runs,
Xa_n = average of results n test runs, and
$X_1, X_2, X_3, X_4, \ldots X_n$ = results for each test run.

A1.4.10.2 The formula for the standard deviation (n test runs) is as follows:

$$S_n = \left(1/\sqrt{(n-1)}\right) \times \left(\sqrt{(A_n - B_n)}\right) \quad (A1.10)$$

where:

S_n = standard deviation of results for n test runs,
A_n = $(X_1)^2 + (X_2)^2 + (X_3)^2 + (X_4)^2 + \ldots + (X_n)^2$, and
B_n = $(1/n) \times (X_1 + X_2 + X_3 + X_4 + \ldots + X_n)^2$.

A1.4.10.3 The formula for the absolute uncertainty (n test runs) is as follows:

$$U_n = C_n \times S_n \quad (A1.11)$$

where:

U_n = absolute uncertainty in average for n test runs, and
C_n = uncertainty factor for n test runs (Table A1.1).

A1.4.10.4 The formula for the percent uncertainty (n test runs) is as follows:

$$\%U_n = (U_n / Xa_n) \times 100\% \qquad (A1.12)$$

where:

$\%U_n$ = percent uncertainty in average for n test runs,
U_n = absolute uncertainty in average for n test runs, and
Xa_n = average of n test runs.

(1) When the percent uncertainty, $\%U_n$, is less than or equal to ±10 % for the cooking energy efficiency and production capacity, report the average for these parameters along with their corresponding absolute uncertainty, U_n, in the following format:

$$Xa_n \pm U_n$$

NOTE A1.5—The researcher may compute a test result that deviates significantly from the other test results. Such a result should be discarded only if there is some physical evidence that the test run was not performed according to the conditions specified in this method. For example, a thermocouple was out of calibration, the appliance's input capacity was not within 5 % of the rated input, or the food product was not within specification. To assure that all results are obtained under approximately the same conditions, it is good practice to monitor those test conditions specified in this method.

APPENDIX

(Nonmandatory Information)

X1. RESULTS RECORDING SHEETS

Manufacturer: _____
Model: _____
Date: _____
Test Reference Number (optional): _____

Soft-Serve Freezer Characteristics (11.1)
Description of operational characteristics:
Freezer Type (Soft Serve or Shake or Combination): _____
Size[A] (rated capacity of finished product output) gal/h (L/h): _____
Freezer Group (number of freezer cylinders): _____
Freezer Mix Delivery System: _____
Freezer Compressor Freezing Cylinder (# of cylinders per compressor): _____
Freezer Style (Floor or Countertop): _____
Freezer Class (Air or Water Cooled): _____
Freezer Grade (Heat Treat or Nonheat Treat): _____
Designed Overrun Range of freezer %: _____
Additional description of operational characteristics which might better describe the unit:
_____
_____
_____

Apparatus (11.2 & 11.3)
__ Check if testing apparatus conformed to specifications of Section 9
Deviations:
_____
_____
_____

Test Voltage (V): _____
Ambient Temperature (°F (°C)): _____
Relative Humidity (%): _____
Manufacturer's Nameplate Power Rating (kW): _____
Manufacturer's Nameplate Circuit Ampacity and Max. Breaker Size (A/A): _____

Freeze Down Energy Consumption and Time (11.4)
Test Voltage (V): _____
Average Ambient Air (°F (°C)): _____
Average Relative Humidity (%) : _____
Total Elapsed Time (hh: mm: ss): _____
Energy Consumed (kWh): _____
Average Incoming Water Temperature (°F (°C)): _____
Average Exit Water Temperature (°F (°C)): _____
Water Consumed (gal (L)): _____
Note if extra Main Compressor Cycle was part of Freeze Down Energy Consumption Test (Y/N): _____

Heavy-Use Power Rating, Energy Consumption and Production Capacity (11.5)
Test Voltage (V): _____
Average Ambient Air (°F (°C)): _____
Average Relative Humidity (%): _____
Container Size Used during Test (oz (mL)): _____
Interval time between draws (hh: mm: ss): _____
Calculated Power Rating (kW): _____
Total Energy Consumed (kWh): _____

Average Incoming Water Temperature (°F (°C)): _____
Average Exit Water Temperature (°F (°C)): _____
Water Consumed (gal (L)): _____
Production Capacity per Energy Consumed (lb/kWh (L/kWh)): _____
Time for Recovery (hh: mm: ss): _____
Average Incoming Water Temperature (°F (°C)): _____
Average Exit Water Temperature (°F (°C)): _____
Water Consumed (gal (L)): _____
Calculated Production Capacity (gal/h (L/h)): _____
Average Consumption of Water (gal/h@°F (L/h@°C)): _____
Average Overrun (%): _____
Container Size Used during Test (ozs (mL)): _____

Impact Draw Test (11.6)
Test Voltage (V): _____
Average Ambient Air (°F (°C): _____
Average Relative Humidity (%): _____
Target weight during Test (12, 9, or 6 oz (340, 255, or 170g)): _____
Total weight during Test: _____
Average weight during Test: _____

Number of Consecutive Draws:	Test 1: _____	Test 2: _____	Test 3: _____
Time for Recovery (hh: mm: ss):	Test 1: _____	Test 2: _____	Test 3: _____
Energy Consumed (kWh):	Test 1: _____	Test 2: _____	Test 3: _____
Average Overrun (%):	Test 1: _____	Test 2: _____	Test 3: _____

Average of consecutive Draws (3 Tests): _____
Average of Time for Recovery (3 Tests) (hh: mm: ss): _____
Average of Energy Consumed (3 Tests) (kWh): _____

Idle Energy Rate—Ready-to-Serve (11.7)
Test Voltage (V): _____
Average Ambient Air (°F (°C)): _____
Average Relative Humidity (%): _____
Average Energy (kWh): _____
Average Mix Storage Temperature (°F (°C)): _____
Average Freezing Cylinder Temperature (°F (°C)): _____
Average Incoming Water Temperature (°F (°C)): _____
Average Exit Water Temperature (°F (°C)): _____
Average Water Consumed (gal/h (L/h)): _____

Standby (Night Mode) Energy Rate (11.8)
Test Voltage (V): _____
Average Ambient Air (°F (°C)): _____
Average Relative Humidity (%): _____
Average Energy (kW/h): _____
Average Mix Storage Temperature (°F (°C)): _____
Average Freezing Cylinder Temperature (°F (°C)): _____
Average Incoming Water Temperature (°F (°C)): _____
Average Exit Water Temperature (°F (°C)): _____
Average Water Consumed (gal/h (L/h)): _____

Heat Treat Cycle Energy Consumption Test (11.9)
Test Voltage (V): _____
Average Ambient Air (°F (°C)): _____
Average Relative Humidity (%): _____
Total Energy Consumption during Heat Treat Cycle (kWh): _____
Energy Consumption during Heat Portion of Heat Treat Cycle (kWh): _____
Average Incoming Water Temperature during Heat Portion of Heat Treat Cycle (°F (°C)): _____
Average Exit Water Temperature during Heat Portion of Heat Treat Cycle (°F (°C)): _____
Water Consumed during Heat Portion of Heat Treat Cycle (gal (L)): _____
Time to complete Heat Portion of Heat Treat Cycle (hh: mm: ss): _____
Mix Storage Temperature at the end of Heat Portion of Heat Treat Cycle (°F (°C)): _____
Freezing Cylinder Temperature at the end of Heat Portion of Heat Treat Cycle (°F (°C)): _____
Energy Consumption during Hold Portion of Heat Treat Cycle (kWh): _____
Average Incoming Water during Temperature Hold Portion of Heat Treat Cycle (°F (°C)): _____
Average Exit Water Temperature during hold Portion of Heat Treat Cycle (°F (°C)): _____
Water Consumed during Hold Portion of Heat Treat Cycle (gal (L)): _____
Time unit in Hold Portion of Heat Treat Cycle (hh: mm: ss): _____
Max./Min. Mix Storage Temperature during Hold Phase Portion of Heat Treat Cycle (°F/°F (°C/°C)): _____
Energy Consumption during Cool Portion of Heat Treat Cycle (kWh): _____
Average Incoming Water Temperature during Cool Portion of Heat Treat Cycle (°F (°C)): _____
Average Exit Water Temperature during Cool Portion of Heat Treat Cycle (°F (°C)): _____
Water Consumed during Cool Portion of Heat Treat Cycle (gal (L)): _____
Time to complete Cool Portion of Heat Treat Cycle (hh: mm: ss): _____
Mix Storage Temperature at the end of Cool Portion of Heat Treat Cycle (°F (°C)): _____
Freezing Cylinder Temperature at the end of Cool Portion of Heat Treat Cycle (°F (°C)): _____

[A] Per freezing cylinder. Combination freezers may require two size ratings, for example 15 soft serve/20 shake.