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An American National Standard

Standard Test Method for Performance of Rack Conveyor Commercial Dishwashing Machines[1]

This standard is issued under the fixed designation F1920; 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 and water consumption of rack conveyor, commercial dishwashing machines, hereafter referred to as dishwashers. Dishwashers may have remote or self-contained booster heater. This procedure does not address cleaning or sanitizing performance.

1.2 This test method is applicable to both hot water sanitizing and chemical sanitizing rack conveyor machines, which include both single tank and multiple tank machines. Rackless conveyors (i.e. flight type machines) are included. Dishwasher tank heaters are evaluated separately from the booster heater. Machines designed to be interchangeable in the field from high temp and low temp (i.e. Dual Sanitizing Machines) and vice versa, shall be tested at both settings. Machines should be set for factory settings. If a dishwasher includes a prewash tank heater as an option, energy should be submetered separately for the prewash tank heater. This test method may be used for dishwashers with steam coil tank or booster heat, but not dishwashers with steam injection tank or booster heat. When the test method specifies to use the data plate or manufacturer's recommendations, instructions, specifications, or requirements, the information source shall be used in the following order of preference and documented in the test report: data plate, user manual, communication with manufacturer.

1.3 The following procedures are included in this test method:

1.3.1 *Procedures to Confirm Dishwasher is Operating Properly Prior to Performance Testing:*

1.3.1.1 Maximum energy input rate of the tank heaters (10.5).

1.3.1.2 Maximum energy input rate of the booster heater, if applicable (10.6).

1.3.1.3 Final sanitizing rinse water consumption calibration (10.7).

1.3.1.4 Booster temperature calibration, if applicable (10.2).

1.3.1.5 Wash tank temperature calibration (10.3).

1.3.1.6 Wash tank pump and conveyor motor calibration (10.4).

1.3.2 *Energy Usage and Cycle Rate Performance Tests:*

1.3.2.1 Washing energy performance test (10.8).

1.3.2.2 Tank heater idle energy rate (10.9).

1.3.2.3 Booster idle energy rate, if provided (10.10).

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, health, and environmental 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 *ASTM Standards:*[2]

D3588 Practice for Calculating Heat Value, Compressibility Factor, and Relative Density of Gaseous Fuels

F858 Specification for Hot Water Sanitizing Commercial Dishwashing Machines, Single Tank, Conveyor Rack Type

F861 Specification for Commercial Dishwashing Racks

2.2 *NSF Standards:*

NSF/ANSI 3 Commercial Warewashing Equipment[3]

NSF/ANSI 170 Glossary of Foodservice Terms[3]

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

2.3 *ASHRAE Standard:*
ASHRAE Guideline 2–1986 (RA90) Engineering Analysis of Experimental Data[4]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *ambient temperature, n*—defined in NSF/ANSI 170-2014; Section 3.3.

3.1.2 *auxiliary rinse, n*—defined in NSF/ANSI 170-2014; Section 3.5.

3.1.3 *average tank temperature, n*—temperature of the wash tank measured within ½ in. of the factory installed thermostat bulb. The temperature is measured and averaged during the 25 rack (50 racks for flight type) loaded ambient temperature (per 9.1) washing test. The temperature is averaged over the entire period starting with the entry of the first loaded dish rack and ending when both wash tank and booster elements have cycled off after the last rack is washed. Stabilization loads should not be included in the average wash tank temperature.

3.1.4 *batch, n*—a group of five dishloads as described in 3.1.10.

3.1.4.1 *Discussion*—The dishracks are grouped into batches to better simulate typical in-kitchen operation and facilitate consistent application of the washing energy use test.

3.1.5 *booster heater, n*—water heater for taking supply hot water (typically 140°F (60°C)) up to 180°F+ (82°C+) for sanitizing rinse; the booster heater may be separate from dishwasher or integral. Booster Heater is defined in NSF/ANSI 170-2014; Section 3.224.1.

3.1.6 *chemical sanitizing (low temp) machine, n*—a machine that applies a chemical sanitizing solution to the surfaces of dishes to achieve sanitization.

3.1.7 *chemical sanitizing rinse, n*—defined in NSF/ANSI 170-2010; Section 3.170.

3.1.8 *conveyor machine, n*—a dishwashing machine that employs a conveyor or similar mechanism to carry dishes through a series of wash and rinse sprays within the machine.

3.1.9 *cycle rate, n*—maximum production rate of a dishwasher when washing dishloads in accordance with the Cycle Rate Performance test.

3.1.10 *dishload, n*—peg-type, polypropylene dishrack of a specified weight, loaded with ten 9-in. plates of a specified weight, used to put a thermal load on the dishwasher during the washing energy test.

3.1.11 *dishwasher, n—for this test method*, a machine that uniformly washes, rinses, and sanitizes eating and drinking utensils and cookware.

3.1.12 *dual sanitizing machine, n*—a machine designed to operate as either a Chemical Sanitizing or Hot Water Sanitizing machine.

3.1.13 *empty dish rack, n*—dish rack without any dishware placed in the dish rack.

3.1.14 *energy saver mode, n*—operational setting that is designed to reduce energy during idle mode through temporary shut-down of certain machine components (pumps or belt motors) or reduction of certain temperature set points.

3.1.15 *factory settings, n*—a setting that has been programmed or adjusted at the factory and is representative of the way that model is set up initially. These settings are the default settings for the machine and may or may not be user adjustable.

3.1.16 *flight type conveyor, n*—a conveyor machine where the dishes are loaded directly on the conveyor rather than transported within a rack. This machine is also referred to as a rackless conveyor.

3.1.17 *flow pressure, n*—defined in NSF/ANSI 170-2014; Section 3.76.

3.1.18 *fresh water, n*—defined in NSF/ANSI 170-2014; Section 3.85.

3.1.19 *heat recovery dishwasher, n*—warewashing equipment with heat recovery systems; a heat exchanger that recovers energy from other sources for the purpose of heating potable water. This includes but is not limited to drain water heat exchangers, wash compartment heat exchangers, exhaust heat exchangers, and supplemental heat pumps.

3.1.20 *hot water sanitizing (high temp) machine, n*—a machine that applies hot water to the surfaces of dishes to achieve sanitization.

3.1.21 *hot water sanitizing rinse, n*—defined in NSF/ANSI 170-2010; Section 3.171.

3.1.22 *idle mode, n*—for all dishwasher types, the dishwasher is in idle mode when it is not actively running but is still powered on and ready to wash dishes while maintaining the tank or tanks at the required temperature.

3.1.23 *line pressure, n*—defined in NSF/ANSI 170-2014; Section 3.115.

3.1.24 *multiple tank conveyor, n*—a conveyor type machine that includes one or more tanks for wash water and one or more tanks for pumped rinse water, followed by a sanitizing rinse. This type of machine may include a pre-washing section before the washing section and an auxiliary rinse section, for purposes of reusing the sanitizing rinse water, between the power rinse and sanitizing rinse section. Multiple tank conveyor dishwashers can be either chemical or hot water sanitizing, with an internal or external booster heater for the latter.

3.1.25 *non-recirculating pumped sanitizing rinse, n*—defined in NSF/ANSI 170-2014; Section 3.131.

3.1.26 *post-sanitizing rinse, n*—defined in NSF/ANSI 170-2014; Section 3.174.

3.1.27 *prewashing unit, n*—defined in NSF/ANSI 170-2014; Section 3.150.

3.1.28 *pumped rinse, n*—defined in NSF/ANSI 170-2014; Section 3.154.

3.1.29 *rack, n*—defined in NSF/ANSI 170-2014; Section 3.157.

3.1.30 *rated temperature, n*—dishwasher's rated data plate minimum operating tank temperature as determined by NSF/ANSI 3.

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

3.1.31 *recirculating sanitizing rinse, n*—defined in NSF/ANSI 170-2014; Section 3.162.

3.1.32 *recovery time, n*—time from the end of washing a dishload to until the wash tank heaters have cycled off.

3.1.33 *sanitization, n*—defined in NSF/ANSI 170-2014; Section 3.178.

3.1.34 *sanitizing rinse, n*—defined in NSF/ANSI 170-2010; Section 3.173.

3.1.35 *sanitizing solution, n*—defined in NSF/ANSI 170-2014; Section 3.179.

3.1.36 *single tank conveyor, n*—a conveyor machine that includes a tank for wash water followed by a sanitizing rinse (pumped or fresh water). This type of machine does not have a pumped rinse tank. This type of machine may include a prewashing section ahead of the washing section and an auxiliary rinse section, for purposes of reusing the sanitizing rinse water, between the wash and sanitizing rinse sections. Single tank conveyor dishwashers can be either chemical or hot water sanitizing, with an internal or external booster heater for the latter.

3.1.37 *tank heater idle energy rate, n*—rate of energy consumed by the dishwasher while "holding" or maintaining the wash tank water at the thermostat(s) set point during the time period specified.

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

3.1.39 *user adjustable, n*—setting that can be changed by an end user without having access to features reserved for appliance technicians. A password usually separates user adjustable and technician adjustable features in digital appliance controls. Nonuser adjustable manual controls require a panel to be removed to access that feature.

3.1.40 *washing, n*—defined in NSF/ANSI 170-2014; Section 3.222.

3.1.41 *water heater, n*—defined in NSF International/American National Standards Institute (NSF/ANSI) 170-2014: Glossary of Food Equipment Terminology; Section 3.224.

4. Summary of Test Method

4.1 The booster temperature (for high temperature machines) is calibrated and verified.

4.2 The maximum energy input rate of the tank heater and the booster heater, if applicable, is measured to confirm that the dishwasher is operating at the manufacturer's rated input. If the measured input rate is not within 5 % of the rated input or the rating printed on the heating element, all further testing ceases.

NOTE 1—It is the intent of the testing procedure herein to evaluate the performance of a dishwasher at its rated gas pressure or electric voltage. If an electrical unit is rated dual voltage, that is, designed to operate at either 208 or 240 volts (V) with no change in component, the voltage selected by the manufacturer or the tester, or both, shall be reported. If a dishwasher is designed to operate at two voltages without a change in the resistance of the heating elements, the performance of the unit, for example, cycle rate, may differ at the two voltages. Therefore the tests may be performed at both voltages and the results reported accordingly.

4.3 Water consumption is adjusted in accordance with manufacturer's rated water consumption per NSF/ANSI 3. Report the measured consumption and confirm that it is within 5 % of the listing on the data plate. If the difference is greater than 5 %, terminate testing and contact the manufacturer. The manufacturer may make appropriate changes or adjustments to the dishwasher or provide another unit for testing.

4.4 The tank heater energy rate is determined at idle, that is, when the tank temperature is being maintained, but no washing is taking place.

4.5 Booster heater idle energy rate is determined.

4.6 Dishwasher and booster energy consumption per rack of dishes is determined during a heavy-use scenario by washing racks loaded with a specified quantity of dishes

4.7 Water consumption is monitored during testing to determine the rate of water usage.

5. Significance and Use

5.1 The maximum energy input rate test is used to confirm that the dishwasher is operating at the manufacturer's rated input prior to further testing. This test method also will indicate any problems with the electric power supply, gas service pressure, or steam supply flow or pressure.

5.2 Tank and booster temperatures, as well as water consumption, are adjusted to NSF specifications to insure that the test is applied to a properly functioning dishwasher.

5.3 Because much of a dishwasher's operating period is spent in the idle condition, tank heater and booster idle energy consumption rate(s) are important parts of predicting dishwasher's energy consumption.

5.4 The washing energy performance test determines energy usage per rack. This is useful both as a measure for comparing the energy performance of one dishwasher to another and as a predictor of the dishwasher's energy consumption.

5.5 Water-consumption characterization is useful for estimating water and sewage costs associated with dishwashing machine operation.

6. Apparatus

NOTE 2—For all instruments, the specifications may be better than specified. Values provided are intended to be the minimum or maximum (depending on which is the worst case for the parameter) allowable.

6.1 *1 or 2 watt-hour (Wh) Meters,* for measuring the electrical energy consumption of the tank heaters, pump motor, and booster heater, if applicable, shall have a resolution of at least 10 Wh and a maximum accuracy no greater than 1.5 % of the measured value for any demand greater than 100 watts (W). For any demand less than 100 W, the meter shall have a resolution of at least 10 Wh and a maximum accuracy no greater than 10 % of the measured value.

6.2 *1 or 2 Gas Meters,* for measuring the gas consumption of tank heater, or booster heater, if applicable, or both, shall have a resolution of at least 0.1 cubic feet (ft^3) (0.003 m^3), a maximum accuracy no greater than 1 % of the measured value for any demand greater than 2.2 ft^3/h (0.06 m^3/h), and shall be capable of measuring flows between at least 0 and 250 ft^3/h