



Standard Test Method for Performance of Water-Bath Rethermalizers¹

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1. Scope

1.1 This test method covers the energy consumption and rethermalizing performance of floor-model and countertop water-bath rethermalizers. The food service operator can use this evaluation to select a water-bath rethermalizer and understand its energy consumption and production capacity.

1.2 This test method is applicable to floor and countertop model gas and electric units.

1.3 The water-bath rethermalizer can be evaluated with respect to the following (where applicable):

- 1.3.1 Energy input rate (10.2),
- 1.3.2 Preheat energy consumption, time, and rate (10.4),
- 1.3.3 Idle energy rate (10.5),
- 1.3.4 Pilot energy rate (10.6),
- 1.3.5 Retherm energy rate (10.8),
- 1.3.6 Production capacity (10.8), and
- 1.3.7 Retherm-energy efficiency (10.8).

1.4 This test method is not intended to answer all performance criteria in the evaluation and selection of a water-bath rethermalizer.

1.5 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.6 *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.*

1.7 *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.*

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. Referenced Documents

2.1 *ASTM Standards*:²

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

2.2 *ANSI Standard*:³

ANSI Z83.11 Gas Food Service Equipment

2.3 *ASHRAE Documents*:⁴

ASHRAE Handbook of Fundamentals Chapter 6, Table 2—Thermodynamic; Chapter 6, Table 2—Thermodynamic Properties of Water at Saturation

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

2.4 *NSF Standards*:⁵

NSF Listing-Food Equipment and Related, Components and Material

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

3. Terminology

3.1 *Definitions*:

3.1.1 *auto-fill, n*—water height sensor device that activates a fresh water fill solenoid when the water level in the rethermalizer drops below a predetermined height.

3.1.2 *energy input rate, n*—peak rate at which a water-bath rethermalizer consumes energy (Btu/h (kJ/h) or kW).

3.1.3 *idle energy rate, n*—average rate of energy consumed (Btu/h or kW) by the rethermalizer while holding or maintaining the water vat at the thermostat(s) set point.

3.1.4 *over-flow drain, n*—drain for eliminating the excess foam and starch created during the rethermalizing process.

3.1.5 *pilot energy rate, n*—average rate of energy consumption (Btu/h (kJ/h)) by a water-bath rethermalizer's continuous pilot (if applicable).

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 American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

⁴ Available from American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329.

⁵ Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140.

3.1.6 *preheat energy, n*—amount of energy consumed (Btu or kWh) by the rethermalizer while heating the water vat from ambient room temperature to the calibrated thermostat(s) set point.

3.1.7 *preheat rate, n*—average rate (°F/min) at which the water vat temperature is heated from ambient temperature to the rethermalizer's calibrated thermostat(s) set point.

3.1.8 *preheat time, n*—time required for the water vat to heat from ambient room temperature to the calibrated thermostat(s) set point.

3.1.9 *production capacity, n*—maximum rate (lb/h (kg/h)) at which water-bath rethermalizer can bring the refrigerated clam chowder to a specified rethermalized condition.

3.1.10 *retherm energy, n*—total energy consumed by the rethermalizer as it is used to reheat bags of refrigerated clam chowder.

3.1.11 *retherm-energy efficiency, n*—quantity of energy required to warm the specified food product (clam chowder soup), expressed as a percentage of the quantity of energy input to the water-bath rethermalizer during the reheating period.

3.1.12 *retherm energy rate, n*—average rate of energy consumed by the rethermalizer while reheating bags of refrigerated clam chowder.

3.1.13 *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 a test results.

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

3.1.15 *water-bath rethermalizer, n*—appliance, including a rethermalizing vessel, in which water is placed to such a depth that the food is essentially supported by displacement of the water rather than by the bottom of the vessel, which is designed for the purpose of reheating pre-cooked food contained in vacuum-sealed, boilable bags.

4. Summary of Test Method

4.1 The water-bath rethermalizer under test is connected to the appropriate metered energy source. The measured energy input rate is determined and checked against the rated input before continuing with testing.

4.2 The water temperature in the rethermalizing zone of the water-bath rethermalizer is monitored at a location chosen to represent the average temperature of the water while the water-bath rethermalizer maintains a specified rethermalizing temperature.

4.3 Preheat energy, time, and rate are determined while the water-bath rethermalizer is operated with the thermostat(s) set to specified temperature.

4.4 The idle energy is determined while the water-bath rethermalizer is operated in a ready-to-use state with the thermostat(s) set to the calibrated temperature. The rate of pilot energy consumption also is determined when applicable to the water-bath rethermalizer under test.

4.5 Energy consumption and time are monitored while the water-bath rethermalizer is used to reheat three full loads of refrigerated, prepackaged clam chowder soup. Retherm-energy efficiency, retherm energy rate, and production capacity are determined from these tests.

5. Significance and Use

5.1 The energy input rate test is used to confirm that the water-bath rethermalizer under test is operating in accordance with its nameplate rating.

5.2 The water-bath rethermalizer temperature calibration is used to ensure that the water-bath rethermalizer being tested is operating at the specified temperature. Temperature calibration also can be used to evaluate and calibrate the thermostat control dial(s).

5.3 Preheat energy and time can be useful to food service operators to manage energy demands, and to estimate the amount of time required for preheating a water-bath rethermalizer.

5.4 Idle energy rate and pilot energy rate can be used to estimate energy consumption during non-rethermalizing periods.

5.5 Production capacity is used by food service operators to choose a water-bath rethermalizer that matches their particular food output requirements.

5.6 Retherm-energy efficiency is a precise indicator of the water bath rethermalizer's energy performance under full-load condition. This information enables the operator to consider energy performance when selecting a water-bath rethermalizer.

6. Apparatus

6.1 *Analytical Balance Scale*, for measuring weights up to 15 lb (6.8 kg), with a resolution of 0.01 lb (0.004 kg) and an uncertainty of 0.01 lb (0.004 kg).

6.2 *Barometer*, for measuring absolute atmospheric pressure, to be used for adjustment of measured gas volume to standard conditions. Shall have a resolution of 0.2 in. Hg (670 Pa) and an uncertainty of 0.2 in. Hg (670 Pa).

6.3 *Canopy Exhaust Hood*, 4 ft (1.2 m) in depth, wall-mounted with the lower edge of the hood 6 ft, 6 in. (1.98 m) from the floor and with the capacity to operate at a nominal net exhaust ventilation rate of 300 cfm per linear foot (460L/s per linear metre) of active hood length. This hood shall extend a minimum of 6 in. (152 mm) past both sides and the front of the rethermalizing appliance and shall not incorporate side curtains or partitions. Makeup air shall be delivered through face registers or from the space, or both.

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

6.5 *Flow Meter*, for measuring total water consumption of the appliance. Shall have a resolution of 0.01 gal (0.04 L) and an uncertainty of 0.01 gal (0.04 L) at a flow rate as low as 0.2 gpm (0.8 lpm).

6.6 *Gas Meter*, for measuring the gas consumption of a water-bath rethermalizer, shall be a positive displacement type with a resolution of at least 0.01 ft^3 (0.0003 m^3) and a maximum uncertainty no greater than 1 % of the measured value for any demand greater than 2.2 ft^3 (0.06 m^3) per hour. If the meter is used for measuring the gas consumed by the pilot lights, it shall have a resolution of at least 0.01 ft^3 (0.0003 m^3) and a maximum uncertainty no greater than 2 % of the measured value.

6.7 *Pressure Gage*, for monitoring gas pressure. Shall have a range of 0 to 15 in. H_2O (0 to 3.7 kPa), a resolution of 0.5 in. H_2O (125 kPa), and a maximum uncertainty of 1 % of the measured value.

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

6.9 *Thermocouple Probe(s)*, industry standard type T or type K thermocouples capable of immersion, with a range of from 50 to 400°F (10 to 204°C) and an uncertainty of $\pm 1^\circ\text{F}$ ($\pm 0.5^\circ\text{C}$).

6.10 *Temperature Sensor*, for measuring natural gas temperature in the range of 50 to 100°F (10 to 38°C) with an uncertainty of $\pm 1^\circ\text{F}$ ($\pm 0.5^\circ\text{C}$).

6.11 *Watt-Hour Meter*, for measuring the electrical energy consumption of a water-bath rethermalizer, 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 %.

7. Reagents and Materials

7.1 *Water* used shall have a maximum hardness of three grains per gallon. Distilled water may be used.

7.2 *New England Clam Chowder Soup*, refrigerated, ready to use, in nominal 1-gal (3.8-L) vacuum packed bags or “chubs,” weighing $6.0 \pm 0.2 \text{ lb}$ ($2.72 \pm 0.09 \text{ kg}$) per bag. The clam chowder shall be stabilized in a refrigerator at $38 \pm 2^\circ\text{F}$ ($3 \pm 1^\circ\text{C}$).

NOTE 1—Generic brand New England Clam Chowder has been proven to be an acceptable product for testing by the Food Service Technology Center.

8. Sampling and Test Units

8.1 *Water-Bath Rethermalizer*—Select a representative production model for performance testing.

9. Preparation of Apparatus

9.1 Measure the water-bath rethermalizer’s vat’s rethermalizing capacity. The water-bath rethermalizer’s rethermalizing vat may be shaped in such a way that simple measurements do not yield the true rethermalizing capacity. In this case, fill the water-bath rethermalizer with water till the bottom edge of the rethermalizing capacity is reached. Then, measure the volume of water required to fill the rethermalizing capacity to the top.

9.2 Install the appliance according to the manufacturer’s instructions under a 4-ft (1.2-m) deep canopy exhaust hood mounted against the wall, with the lower edge of the hood 6 ft,

6 in. (1.98 m) from the floor. Position the water-bath rethermalizer with the front edge of the water in the rethermalizing vat inset 6 in. (152 mm) from the front edge of the hood at the manufacturer’s recommended working height. The length of the exhaust hood and active filter area shall extend a minimum of 6 in. (152 mm) past the vertical plane of both sides of the water-bath rethermalizer. In addition, both sides of the water-bath rethermalizer shall be a minimum of 3 ft (0.9 m) from any sidewall, side partition, or other operating appliance. The exhaust ventilation rate shall be 300 cfm per linear foot (460 L/s per linear metre) of hood length. The associated heating or cooling system shall be capable of maintaining an ambient temperature of $73 \pm 3^\circ\text{F}$ ($22 \pm 2^\circ\text{C}$) within the testing environment when the exhaust ventilation system is operating.

9.3 The testing environment during energy tests shall be maintained in accordance with the section on performance for open top hot food holding equipment room specifications of NSF/ANSI 4. NSF/ANSI 4 test room conditions are ambient temperature of $73 \pm 3^\circ\text{F}$ ($22 \pm 2^\circ\text{C}$), no vertical temperature gradient exceeding $1.5^\circ\text{F}/\text{ft}$ ($2.5^\circ\text{C}/\text{m}$), and maximum air current velocity of 50 ft/min (0.25 m/s).

9.4 Connect the water-bath rethermalizer to a calibrated energy test meter. For gas installations, install a pressure regulator downstream from the meter to maintain a constant pressure of gas for all tests. Install instrumentation to record both the pressure and temperature of the gas supplied to the water-bath rethermalizer and the barometric pressure during each test so that the measured gas flow can be corrected to standard conditions. For electric installations, a voltage regulator may be required during tests if the voltage supply is not within $\pm 2.5 \%$ of the manufacturer’s “nameplate” voltage.

9.5 For an electric water-bath rethermalizer, confirm (while the water-bath rethermalizer elements are energized) that the supply voltage is within $\pm 2.5 \%$ of the operating voltage specified by the manufacturer. Record the test voltage for each test.

NOTE 2—It is the intent of the testing procedure in this test method to evaluate the performance of a water-bath rethermalizer at its rated electric voltage. If the unit is rated dual voltage (that is, designed to operate at either 240 or 480 V with no change in components), the voltage selected by the manufacturer or tester, or both, shall be reported. If a water-bath rethermalizer 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.

9.6 For a gas water-bath rethermalizer, adjust (during maximum energy input) the gas supply pressure downstream from the appliance’s pressure regulator to within $\pm 2.5 \%$ of the operating manifold pressure specified by the manufacturer. Make adjustments to the water-bath rethermalizer following the manufacturer’s recommendations for optimizing combustion. Proper combustion may be verified by measuring air-free CO in accordance with ANSI Z83.11.

9.7 Make the water-bath rethermalizer ready for use in accordance with the manufacturer’s instructions. Clean the water-bath rethermalizer’s vat by “boiling” with the manufacturer’s recommended cleaner and water and then rinsing the inside of the rethermalizing-vat thoroughly before starting each test procedure.