



Standard Specification for Kettles, Steam-Jacketed, 20 to 200 gal (75.7 to 757 L), Floor or Wall Mounted, Direct Steam, Gas and Electric Heated¹

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This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers jacketed kettles that use steam as a heat source for cooking food in commercial and institutional food service establishments. This specification does not cover equipment used by food processors who normally package the food that they cook.

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

1.3 *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

[A36/A36M Specification for Carbon Structural Steel](#)

[A167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip](#)

[A176 Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip](#)

[A240/A240M Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications](#)

[A285/A285M Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength](#)

[A516/A516M Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service](#)

[A580/A580M Specification for Stainless Steel Wire](#)

[B456 Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium](#)

[D3951 Practice for Commercial Packaging](#)

[F760 Specification for Food Service Equipment Manuals](#)

[F1166 Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities](#)

[F1785 Test Method for Performance of Steam Kettles](#)

2.2 ANSI Standards:³

[ANSI/NFPA 70 National Electrical Code](#)

[ANSI/NSF Std. 4 Commercial Cooking and Hot Food Storage Equipment](#)

[ANSI/UL 197 Commercial Electric Cooking Appliances](#)

[ANSI Z1.4 Sampling Procedures and Tables for Inspection by Attributes](#)

[ANSI/Z83.11 Gas Foodservice Equipment—Kettles, Steam Cookers and Steam Generators](#)

[ANSI/Z223.1 National Fuel Gas Code](#)

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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 American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

2.3 ASME Standards:⁴

ASME Boiler and Pressure Vessel Code, Section IV Heating Boilers

ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 Pressure Vessels

2.4 Federal Standards:⁵

MIL-STD-167/1 Mechanical Vibration of Shipboard Equipment (Type I—Environmental and Type II—Internally Excited)

MIL-STD-461 Requirements For the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

~~MIL-STD-462 Electromagnetic Interference Characteristics, Measurement of~~

MIL-STD-1399/300 Interface Standard for Shipboard Systems Section 300A Electric Power, Alternating Current

~~MIL-V-173 Varnish, Moisture and Fungus Resistant~~

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *jacketed kettle*—*as used in this specification*, a cylindrical, deep-sided vessel (steam jacketed), with either a hemispherical or sloping bottom of 20 to 200-g (75.7 to 757-L) capacity for cooking food in a liquid. The kettle may be tilting or non-tilting (stationary cooking jacket).

⁴ Available from American Society for Mechanical Engineers, United Engineering Center, 345 E. 47th St., New York, NY 10017.

⁵ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS or Acquisition Streamlining and Standardization Information System (ASSIST), which is the official source of all documents listed in the DoD Index of Specifications and Standards. The ASSIST can be located at <http://dsp.dla.mil>.

3.1.1.1 Discussion—

Jacketed kettles may be floor or wall mounted. The energy in the steam moving through the jacket is transferred to the liquid and to the food by condensation of the steam on the vessel wall.

4. Classification

4.1 Jacketed kettles covered by this specification are classified by type, size (capacity), grade, style, and class.

4.1.1 Type:

4.1.1.1 *Type I*—Non-tilting.

4.1.1.2 *Type II*—Tilting.

4.1.2 Size (Capacity):

4.1.2.1 20-gal (75.7-L) capacity,

4.1.2.2 25-gal (94.6-L) capacity,

4.1.2.3 30-gal (113.6-L) capacity,

4.1.2.4 40-gal (151.4-L) capacity,

4.1.2.5 60-gal (227.2-L) capacity,

4.1.2.6 80-gal (302.8-L) capacity,

4.1.2.7 100-gal (378.5-L) capacity,

4.1.2.8 125-gal (472.1-L) capacity,

4.1.2.9 150-gal (567.8-L) capacity, and

4.1.2.10 200-gal (757.0-L) capacity.

4.1.3 Grade:

4.1.3.1 *Grade 1*—Maximum Working Pressure Rating of 15 to 25 psig (~~172.4~~ (103.4 to 172.4 KPa) or less.

4.1.3.2 *Grade 2*—Maximum Working Pressure Rating of 26 to 50 psig (~~344.7~~ (179.3 to 344.7 KPa) or less.

4.1.3.3 *Grade 3*—Maximum Working Pressure Rating of 51 to 90 psig (~~620.5~~ (351.6 to 620.5 KPa) or less.

4.1.4 Style:

4.1.4.1 *Style 1*—Floor mounted, pedestal.

4.1.4.2 *Style 2*—Floor mounted, with legs.

4.1.4.3 *Style 3*—Wall mounted.

4.1.4.4 *Style 4*—Cabinetized.

4.1.5 Class:

4.1.5.1 *Class A*—Directly connected to an external heat source.

4.1.5.2 *Class B*—Self-contained, gas-fired steam generator.

4.1.5.3 *Class C*—Self-contained, electric steam generator.

5. Ordering Information

5.1 An order for a kettle(s) under this specification shall specify the following information:

5.1.1 ASTM specification number and date of issue,

- 5.1.2 Quantity to be furnished,
- 5.1.3 Type,
- 5.1.4 Size (Capacity),
- 5.1.5 Grade,
- 5.1.6 Style,
- 5.1.7 Class, and
- 5.1.8 Assurance that gas fired unit(s) will be installed in accordance with the installation instructions and ANSI/Z223.1. that:
 - 5.1.8.1 Gas fired unit(s) will be installed in accordance with the installation instructions and ANSI/Z223.1.
 - 5.1.8.2 Electric heat unit(s) will be installed in accordance with the installation instructions and ANSI/NFPA 70.
- 5.2 The following options should be reviewed, and, if any are desired, they should also be included in the order:
 - 5.2.1 When a cover is required;
 - 5.2.2 Whether a two-thirds jacket or full jacket is desired on the non-tilting floor style or wall mounted style;
 - 5.2.3 When a draw-off assembly (7.1.5) of a size larger than 2-in. (50.8-mm) diameter is desired;
 - 5.2.4 When a draw-off assembly (7.1.5) is required for tilting kettles;
 - 5.2.5 When the clearance from the floor to the draw-off assembly is to be other than that specified in 7.1;
 - 5.2.6 When Federal or military procurement(s) requires compliance to the supplementary requirements;
 - 5.2.7 When the water faucet with a swing spout is required;
 - 5.2.8 When a strainer hook is required;
 - 5.2.9 When a water metering device is required, specifying the number required and whether it is to be attached to a wall bracket or a kettle bracket or a stand;
 - 5.2.10 When a graduated measuring stick is required;
 - 5.2.11 When fill level marks are to be etched on kettle interior;
 - 5.2.12 When a three-basket insert (7.1.9) is required;
 - 5.2.13 When insulation is required on the outside of the kettle body or steam jacket;
 - 5.2.14 If type 430 corrosion-resistant steel is not desired for the cabinetized style (4.1.4.4);
 - 5.2.15 The type of gas, if applicable: natural, propane, or other (specifying gas composition, heating value in Btu/ft³, and specific gravity of gas);
 - 5.2.16 Electrical power supply characteristics: voltage, frequency, phase, kW input, or amp load, as applicable;
 - 5.2.17 When other than manufacturer's standard, commercial, domestic packaging is required, specifying the packaging requirements (4.1.3.1);
 - 5.2.18 When special or supplementary, or both, requirements such as inspections, accessories, mounting patterns, utility connections, etc., are required;
 - 5.2.19 When specified, a certification to ensure that the samples representing each lot have been either tested or inspected as directed and that the requirements have been met. When specified, a copy of the certification or test results, or both, shall be furnished to the purchaser;
 - 5.2.20 The location for the tilt mechanism on tilt kettles, if other than the right-hand side; ~~and~~
 - 5.2.21 When an automatic tilt mechanism, powered by an electric motor is desired;
 - 5.2.22 When a pan carrier that holds a standard 12 by 20 by 2½-in. steaming pan is required.
 - 5.2.22.1 A pan carrier, when specified, shall maintain the top plane of the steamer pan substantially horizontal (within 61 in. (625 mm)) through the 90° rotation of kettle.
 - 5.2.23 Whether the operational steam valves and accessories listed in 7.3.1 are required.
 - 5.2.24 When specified, a certification to ensure that samples representing each lot have been either tested or inspected as directed and the requirements have been met. When specified, a copy of the certification or test results, or both, shall be furnished to the purchaser.

6. Materials

- 6.1 *General*—Steam jacketed kettles shall conform to the following requirements:
- 6.2 *Kettle*—The kettle shall be constructed of type 304, 304L, 316, or 316L corrosion-resistant steel conforming to Specification A167 or A240/A240M.
- 6.3 *Steam Jacket*—The jacket shall be constructed of type 304, 304L, 316, or 316L corrosion-resistant steel.
 - 6.3.1 *Class B and Class C Steam Jackets*—Jackets shall be fabricated from material conforming to Specification A285/A285M or Specification A516/A516M material and skirted with type 302 or 304 corrosion-resistant steel conforming to Specification A167 or A240/A240M.
- 6.4 *Style 3 Kettles*—Wall brackets and in-wall carriers for wall-mounted kettles shall be constructed of material conforming to Specification A36/A36M.

6.5 *Exterior of Style 4 Jacketed Kettles and Class B or Class C Kettles*—Unless otherwise specified, material shall be types 302, 304, 316, or 430 corrosion-resistant steel conforming to Specification A240/A240M, A167 or A176, as applicable, and the thickness shall be 20 gauge [0.0375-in. (1-mm) U.S. revised standard gauge] minimum.

7. Design and Construction

7.1 *General*—The kettle shall be delivered assembled and ready for connection to steam, water, electricity, or gas piping, as applicable. The kettles are to be equipped with a suitable drain and exhaust steam termination, if applicable. The height from the floor to the top rim of the kettle shall not exceed the following: 44 in. (1219 mm) for 20 to 40-gal (75.7 to 151.4-L) kettles and 51 in. (1295 mm) for 60 to 100-gal (227.2 to 378.5-L) kettles. If applicable, the clearance from the floor to the outlet of the draw-off valve shall be a minimum of 12 in. (304.8 mm).

7.1.1 *Jacketed Steam Chamber*—The steam containing part of the kettle shall be rated for the following allowable working pressures (WP):

7.1.1.1 *Direct Connected Kettles*—minimum 15 psi (103.4 Kpa), and

7.1.1.2 *Self-Generating Kettles*—minimum 15 psi (103.4 Kpa).

7.1.2 The design and construction of the kettle jacket shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 with a National Board Registration Number.

7.1.3 *Insulation Casing*—When insulation is required, it shall be contained in a cylindrical casing designed to conform to the kettle body and steam jacket. The clearance between the inner and outer liner of the casing shall be sufficiently wide to keep the exterior surface of the kettle from exceeding 140°F (60°C) during operation. The outer liner shall be corrosion-resistant steel conforming to Specification A167, A176, or A240/A240M. The top of the casing shall be attached to the kettle's canopy with stainless steel threaded fasteners or rivets. The bottom of the casing shall terminate below the steam jacket.

7.1.4 *Covers*—Cover shall be designed so that it will not deform as a result of normal use. Covers shall be provided with a handle as specified in 7.1.4.3. They shall be provided with a means of ensuring that condensation returns to the kettle.

7.1.4.1 *One-Piece Cover*—Non-tilting, 20, 30, and 40-gal (75.7, 113.6, and 151.4-L) kettles shall be provided with a one-piece hinged or lift-off cover. If applicable, the construction of the hinge shall be such that it will retain the cover in an open position.

7.1.4.2 *One-Piece, Spring-Assisted Cover*—Non-tilting kettles that are 60 gal (227.2 L) or larger shall have a one-piece cover with a spring-assisted lift device to keep the cover open over the kettle in any position.

7.1.4.3 *Handles*—The handle should be raised from the cover and located so as to prevent injury to the operator. The handle shall be stainless steel and attached to the cover in accordance with ANSI/NSF Std. 4. A heat-insulating grip shall be provided on the handle. The surface of the grip shall not exceed 120°F (48.9°C) during kettle operation when tested in accordance with Section 10.

7.1.5 *Draw-Off Assembly*—Unless otherwise specified, non-tilting kettles shall be provided with a minimum 2-in. (50.8-mm) diameter draw-off assembly located tangent with the lowest point inside the kettle. Tilting kettles shall not be provided with a draw-off assembly unless otherwise specified. The assembly shall consist of a tube, described in 7.1.5.1, and a sanitary valve, described in 7.1.5.2.

7.1.5.1 *Tube*—The draw-off tube shall be formed of one piece of seamless stainless steel tube and shall be welded to the bottom of the body and the steam jacket. The tube shall maintain the same section throughout its length and shall be flush with the round opening in the sanitary valve.

7.1.5.2 *Sanitary Valve*—The valve shall be of a minimum 2-in. (50.8-mm) diameter size, with a compression disc or plug construction. It shall be fabricated of type 304 or 316 corrosion-resistant steel, conforming to Specification A167, A176, or A240/A240M. It shall have either a bar-type handle, not less than 5 in. (127 mm) in length, or a round plastic grip, not less than 2½ in. (54 mm) in diameter. The valve shall be capable of being taken apart without the use of tools.

7.1.6 *Outlet Strainer and Strainer Hook*—The draw-off outlet of the kettle body shall be protected by a removable strainer fabricated of stainless steel, specified in 2.1. The strainer shall be perforated with nominal ¼-in. (6.4-mm) diameter holes located on maximum ⅝-in. (14.2-mm) centers and shall fit snugly into the outlet fitting and be retained as necessary. When specified, a stainless steel strainer hook with a loop or tee handle may be provided for removal of the strainer and shall be made from nominal ⅜-in. (8-mm) diameter rod, 6 in. (152.4 mm) minimum longer than the overall inside depth of the kettle body.

7.1.7 *Safety Relief Valve*—Each kettle shall be provided with a safety valve on the steam jacket or steam inlet pipe to the jacket. The valve shall be positioned so that its discharge port will vent steam downward. The valve shall be constructed in accordance with the applicable requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1. The relief pressure of the valve shall be equal to or less than the maximum working pressure of the kettle.

7.1.8 *Swing Spout Water Supply*—Each kettle shall be provided with a swing spout with a companion on/off valve when specified. The swing spout assembly should be made of stainless steel, conforming to Specification A167, or chromium plated, in accordance with Specification B456. The bracket and swing spout shall be positioned so that the outlet end of the spout is a minimum of ½ in. (13 mm) above the top rim of the kettle. The swing spout supplied with tilting kettles shall be mounted independent of the kettle body.

7.1.9 *Basket Inserts*—A three-basket strainer insert shall be furnished when specified. The length and outer circumference of the basket cluster shall fit the inside contour of the kettle body and shall be fitted with handles. The basket shall be fabricated of either

type 304 or 316 corrosion-resistant steel perforated sheet metal conforming to Specification **A167**, **A176**, or **A240/A240M** or type 304 or 316 wire per Specification **A580/A580M**. The space between wires shall not be greater than $\frac{3}{8}$ in. (9.5 mm) for wire baskets. Holes shall be $\frac{3}{8}$ -in. (9.5-mm) diameter, unless otherwise specified, for perforated baskets. A contour-fitted nylon bag with a stainless steel spreader ring shall be furnished with each basket.

7.1.10 *Tilt Mechanism*—The tilt mechanism on tilting kettles shall provide the smooth, quick-acting, self-locking, easy tilting operation of a liquid-filled kettle, of greater than 90° from normal operating position, and it shall hold the kettle at any position as it is being raised or lowered. Tilting shall be controlled by either a power mechanism or a crank handle, or a handwheel attached to the gear box. All exterior surfaces shall be chromium plated in accordance with Specification **B456** or made of corrosion-resisting steel conforming to Specification **A176**.

7.1.11 All exterior surfaces shall be chromium plated in accordance with Specification **B456** or made of corrosion-resisting steel conforming to Specification **A176**.

7.1.12 *Safety Cut-Off*—Type II, Class B and C kettles shall be equipped with a device to de-energize the heat source (electric power to the elements or gas to the burners) when the kettle is tilted.

7.1.13 *Thermostat*—Class B and C kettles shall have a control that will maintain a desired temperature in the liquid being heated in the kettle. It shall be marked with an “off” or “0” position, or it may have a separate “on/off” switch. An indicating light shall show when the heating system is energized.

7.1.14 *Control Box*—Controls for operation of the fuel supply shall be located in a protective housing designed to prevent the entry of spillage from the kettle. This housing shall be corrosion-resistant steel conforming to Specification **A167**, **A176**, or **A240/A240M**, and it shall be located on the outside of the kettle and permit easy access to the controls.

7.1.15 *Standards*—Jacketed kettles shall conform to ANSI/UL 197, ANSI/NSF Std. 4, and ANSI/NFPA 70 for electric-heated kettles and ANSI/Z83.11, ANSI/NSF Std. 4, ANSI/Z223.1, and ANSI/NFPA 70 for gas-heated kettles.

7.1.15.1 *Proof of Compliance*—Evidence of compliance with ANSI/UL 197, ANSI/Z83.11, ASME Boiler and Pressure Vessel Code, Section IV or VIII, or both, and ANSI/NSF Std. 4 shall be a listing in a third-party certification agency listing book, or a certified test report from a nationally recognized testing laboratory acceptable to the purchaser.

7.2 *General by Style:*

7.2.1 *Kettle Mountings*—Mountings shall be capable of supporting the weight of the kettle plus the weight of two and one half times the kettle’s water capacity, without deformation.

7.2.2 *Floor Mounted with Pedestal*—The flanged base of the pedestal shall be provided with a minimum of three equally spaced holes for floor hold down bolts. The pedestal shall be welded to the kettle’s steam jacket on stationary models.

7.2.3 *Floor Mounted with Legs*—All kettle sizes shall have a minimum of three legs. The legs may be braced as required. The bottom of each leg shall be fitted with an adjustable foot. The legs shall be capable of being fastened to the floor when specified.

7.2.4 *Wall Mounted*—Wall-mounted kettles shall be furnished with a mating wall bracket or in-wall carrier support bracket, or both.

7.2.4.1 *Wall Brackets*—The wall bracket shall have provisions for securing necessary valves, fittings, and piping. The front or top of the housing shall be provided with close-fitting openings for steam control valves, tilting handwheels, and other necessary controls. A removable access panel shall be provided for servicing enclosed components. The bracket shall have provisions for securing the kettle to the wall by bolting or welding. Brackets for stationary kettles shall be welded to the kettle body or insulation jacket. Brackets for tilting kettles shall be joined to the kettle at the trunnions. Each bracket designed for wall mounting by welding shall be provided with not less than one erection hole for holding the kettle in place while welding the bracket to the wall or bulkhead. Each bracket designed for wall mounting by bolting shall be provided with at least three bolt holes.

7.2.4.2 *In-Wall Carrier*—The in-wall carrier support shall consist of at least two horizontal in-floor supports and two vertical in-wall supports. The carrier shall be designed to support the fully loaded kettle and to stand any additional loading imposed when the contents of the kettle are in motion due to stirring, agitation, or pouring, as applicable. The vertical channels shall be provided with bolts or studs located and sized to receive the wall bracket specified in 7.2.4.1. All hardware necessary for wall mounting shall be provided with the supports.

7.2.5 *Cabinetized*—The cabinet shall have hinged doors with easy access to the draw-off valve. The cabinet shall have a control panel on the front.

7.3 *Steam Source:*

7.3.1 *Class A, External Steam Source*—The following threaded steam service valves and accessories shall be provided with each kettle when specified (5.2.2+5.2.23): for the steam inlet line, a shut-off valve; for the condensate discharge line, a gate-type stop valve, “Y” strainer, steam trap, and check valve. The steam flow ratings of the valves and accessories shall be sufficiently large to handle a minimum of 1.75 lb (0.8 kg)/h/gal (3.8-L) capacity.

7.3.2 *Class B, Gas Fired*—Steam for the jacket shall be provided by a self-contained gas-fired steam generator that uses a fixed amount of water. The steam generator shall have a Btu input rating sufficient to enable the kettle to meet the performance requirements of Section 8.

7.3.3 *Class C, Electric Fired*—Steam for the jacket shall be provided by a self-contained electric-fired steam generator that uses electric elements submerged in a fixed amount of water. The wattage rating of the heating elements shall be sufficient to enable the kettle to meet the performance requirements of Section 8.

7.4 *Tilting Mechanism (Type II kettles Only):*

7.4.1 Tilting kettles shall have a trunnion(s) to enable tilting.

7.4.2 The tilt mechanism shall be mounted on the trunnion.

7.4.3 The tilt mechanism shall be on the trunnion to the right unless specified otherwise.

7.4.4 A crank handle or hand wheel shall be provided unless the tilt mechanism is motorized.

7.4.5 All moving parts except the crank handle (or hand wheel) shall be enclosed in a suitable enclosure fabricated from corrosion resistant steel conforming to Specification [A167](#) or [A176](#).

8. Performance Requirements

8.1 *Capacity*—The kettle shall be tested to determine compliance with the manufacturer’s stated capacity by filling the kettle with 70 ± 5°F (21 ± 2.8°C) water from a container of known capacity.

8.2 *Heating Time*—When tested per ~~10.2~~, Test Method [F1785](#), the water in a kettle filled to its rated capacity with 70 ± 5°F (21 ± 2.8°C) water, and with the kettle cover in place, shall reach 210°F (99°C) in no more than 60 min for sizes up through 40 gal (151.4 L) and shall reach 210°F (99°C) in no more than 80 min for sizes over 40 gal.

8.3 *Energy Utilization Test*—The kettle shall be tested per ~~10.3~~ Test Method [F1785](#) to determine its energy ~~use~~ use and results reported.

9. Sampling and Quality Assurance

9.1 *Sampling*—When specified in the contract or purchase order, sampling for the inspection and tests contained in the main body of this specification shall be performed in accordance with ANSI Z1.4.

9.2 The kettles prepared for shipment shall be measured and inspected by the manufacturer for compliance with this specification.

10. Test Methods

10.1 *General*—The following two procedures shall be completed prior to the performance of the tests specified herein:

10.1.1 The kettles shall be brought to the normal operating condition, and they shall be preheated.

10.1.2 Both procedures should be conducted per the manufacturer’s instructions in the owner’s manual. The tests shall be performed in 70 ± 5°F (21 ± 2.8°C) ambient room temperature.

10.2 *Heating Time:*

10.2.1 *Significance and Use*—The purpose of testing is to demonstrate the kettle’s ability to heat a liquid satisfactorily when it is loaded to its recommended maximum capacity, as defined in the manufacturer’s product specification sheet.

10.2.2 *Procedure, Classes A, B, and C:*

10.2.2.1 For Class A kettles, connect the unit to a steam source that can provide the steam pressure and steam flow rate specified by the manufacturer for operating the subject model. There shall be a pressure gauge and steam flow rate meter in the steam supply line to the unit to verify these parameters. For Class B and Class C kettles, connect the unit to the utilities specified in the manufacturer’s product specification sheet.

10.2.2.2 Fill the preheated kettle to capacity (the manufacturer’s recommendation) with 70 ± 5°F (21 ± 2.8°C) tap water. Set a timer at the time interval recommended by the manufacturer’s instructions to bring the water to 210°F (99°C).

10.2.2.3 Use a thermocouple located at vertical center of kettle to check the water temperature in the kettle at the beginning and conclusion of the test time.

10.3 *Energy Utilization Test:*

10.3.1 *Significance and Use*—This test determines the energy required to heat water to a boil in a kettle filled to capacity.

10.3.2 *Class A Kettles*—This test should be conducted concurrently with the Class A heating time test. It is necessary to have a stopwatch, which should be started at the same time that the steam flow is started and stopped when the steam flow to the kettle is stopped.

10.3.2.1 The steam flow rate shall be recorded to ensure that the manufacturer’s recommended values are being maintained. The elapsed time expressed in a portion of an hour multiplied by the steam flow rate from the meter in lb/h will yield the amount of steam in lb consumed by heating the water. To calculate the amount of energy, H_s , used to heat the water, use the following equation:

$$H_s = 5 W_s t + 3 h_s \quad (1)$$

where:

H_s = amount of energy usage, Btu (kJ);

W_s = steam flow rate, lb/h (kg/h);

t = heating cycle time, h, and

h_s = latent heat, Btu/lb of steam (kJ/kg).