



Standard Specification for Kettles, Steam-Jacketed, 32 oz to 20 gal (1 to 75.7 L), Tilting, Table Mounted, Direct Connected, Steam, Gas Fired and Electric Fired Heated¹

This standard is issued under the fixed designation F 1603; 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.

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

1. Scope

1.1 This specification covers jacketed kettles that ~~utilize~~ 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

A 167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

A 176 Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip

A 240/A 240M Specification for ~~Heat-Resisting Chromium and Chromium-Nickel~~ Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

A 285/A 285M Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength

A 580/A 580M Specification for ~~Stainless Steel Wire~~² 516/A 516M Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service

A 580/A 580M Specification for ~~Stainless Steel Wire~~

B 456 Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium

D 3951 Practice for Commercial Packaging

F 760 Specification for Food Service Equipment Manuals

F 1166 ~~Practice for Human Engineering Design for Marine Systems, Equipment and Facilities~~

~~D 3951 Practice for Commercial Packaging~~ Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities

F 1785 Test Method for Performance of Steam Kettles

2.2 ANSI Standards:³

ANSI/UL 197 Commercial Electric Cooking Appliances

ANSI Z83.11 Gas Food Service Equipment—Kettles, Steam Cookers and Steam Generators

ANSI/NSF Std. 4 Commercial Cooking and Hot Food Storage Equipment

~~ANSI 223.1~~ ANSI Z223.1 National Fuel Gas Code

ANSI/NFPA 70 National Electrical Code

ANSI Z1.4 Sampling Procedures and Tables for Inspection by Attributes

¹ This specification is under the jurisdiction of ASTM Committee F26 on Food Service Equipment and is the direct responsibility of F26.02 on Cooking and Warming Equipment.

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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* Vol 01-03 volume information, refer to the standard's Document Summary page on the ASTM website.

³ *Annual Book of ASTM Standards*, Vol 01.04.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

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 Pressure Vessels

2.4 ~~Military Standards:~~

~~MIL-C-104 Crates: Wood, Lumber and Plywood Sheathed, Nailed and Bolted~~ Military Standards:⁵

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

~~MIL-STD-461 Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference~~
Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

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

Measurement of Electromagnetic Interference Characteristics of Subsystems and Equipment

~~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~~ Term Specific to This Standard:

3.1.1 *jacketed kettle*—*as used in this specification*, a tilting, deep sided vessel (steam jacketed) of 32 oz to 20 gal (1 to 75.7 L) capacity for cooking food in a liquid.

3.1.1.1 *Discussion*—These kettles can be mounted onto the purchaser's table or be specified already mounted on any of the stands or bases described in ~~4.1.2.2-4.1.2.5~~ 4.1.3. 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, capacity, size (capacity), grade, style and class.~~

4.1.1 ~~Capacity~~ Size (Capacity):

4.1.1.1 32 oz (1 L) capacity.

4.1.1.2 80 oz (2.4 L) capacity.

4.1.1.3 2½ to 3 gal (9.5 to 11.4 L) capacity.

4.1.1.4 5 to 6 gal (21 to 22.7 L) capacity.

4.1.1.5 10 to 12 gal (37.9 to 45.5 L) capacity.

4.1.1.6 20 gal (75.7 L) capacity.

4.1.2 ~~Style~~

4.1.2 Grade:

4.1.2.1 Grade 1—Maximum Working Pressure Rating of 15 to 25 psig (172.4 KPa) or less.

4.1.2.2 Grade 2—Maximum Working Pressure Rating of 26 to 55 psig (379.2 KPa) or less.

4.1.2.3 Grade 3—Maximum Working Pressure Rating of 56 to 90 psig (620.5 KPa) or less. 1515617e/astm-f1603-07

4.1.3 Style:

4.1.3.1 Style 1—For table mounting on a counter.

4.1.3.2

4.1.3.2 Style 2—Table mounted on an open leg equipment stand.

4.1.3.3

4.1.3.3 Style 3—Table mounted on an enclosed cabinet stand.

4.1.3.4

4.1.3.4 Style 4—Table mounted on a 28 to 30-in. (711 to 762-mm) high enclosed cabinet base.

4.1.3.5

4.1.3.5 Style 5—Table mounted on a 28 to 30-in. (711 to 762-mm) high enclosed cabinet base with a Class D steam source.

4.1.4

4.1.4 Class:

4.1.4.1

4.1.4.1 Class A—Directly connected to an external ~~heat~~steam source.

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

4.1.4.3

⁴ Annual Book of ASTM Standards, Vol 02.05.

⁴ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5900, <http://www.asme.org>.

⁵ Annual Book of ASTM Standards, Vol 15.07.

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>.

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

~~4.1.3.4~~

4.1.4.4 *Class D*—~~Separate ASME Code, Section IV~~—A separate ASME Code, Section IV steam generator.

5. Ordering Information

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

5.1.1 ASTM specification number and date of issue.

5.1.2 Quantity to be furnished.

~~5.1.3 Type.~~ 5.1.3 Size (capacity).

~~5.1.4 Style.~~ 5.1.4 Grade.

~~5.1.5 Class.~~ 5.1.5 Style.

5.1.6 Class.

5.1.7 Assurance that gas fired unit(s) will be installed in accordance with the installation instructions and the National Fuel Gas Code ANSI Z223.1.

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 for a tilting type kettle. required.~~

5.2.2 When required, the maximum allowable width for Style 2 through Style 5 (~~4.1.2.2-4.1.2.5~~ 4.1.3.2-4.1.3.5).

5.2.3 When required, for Style 1 kettles, the desired pouring height to the table top (7.2.2).

5.2.4 When two identical side by side kettles are desired in Style 2, 3, 4 or 5 (~~4.1.2.2-4.1.2.5~~ 4.1.3.2-4.1.3.5).

5.2.5 When a wire basket (~~7.1.7~~ 7.1.6) is required.

5.2.6 When Federal/Military procurement(s) is involved, refer to the supplement pages.

5.2.7 When Class B and C kettles are to be shipped from the factory without the supply of water in the jacket (7.3.2 and 7.3.3).

5.2.8 If type 430 corrosion-resistant steel is not desired for the enclosed cabinet Styles 3 and 4 (4.1.24.1.3).

~~5.2.9 Type of gas, if applicable: natural, propane or other (specify BTU per cubic foot):~~

~~5.2.10 Electrical power supply characteristics, if applicable: voltage, frequency, phase, kW input, or amp load, as applicable.~~

~~5.2.11 When other than manufacturer's standard, commercial, domestic packaging is required, specify packaging requirements (14.1)~~

~~5.2.9~~ 5.2.9 When a water faucet with a swing spout is required.

5.2.10 When fill level marks are to be etched on kettle interior.

5.2.11 When insulation is required on the outside of the kettle body or steam jacket.

5.2.12 Type of gas, if applicable: natural, propane or other (specify gas composition, heating value in BTU per cubic foot and specific gravity of gas).

5.2.13 Electrical power supply characteristics: voltage, frequency, phase, kW input, or amp load, as applicable.

~~5.2.14~~ 5.2.14 When other than manufacturer's standard, commercial, domestic packaging is required, specify packaging requirements (14.3).

5.2.125 When special or supplement requirements such as inspections, accessories, mounting patterns, utility connections, etc.

5.2.136 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:

6.2 *Kettle*—The kettle vessel shall be constructed of Type 304, 304L, 316, or 316L corrosion resistant steel conforming to Specifications ~~A167, A176 or A240~~ A 167, A 176, or A 240/A 240M.

6.3 *Steam Jacket*—Jacket shall be constructed of Type 304, 304L, 316, or 316L corrosion resistant steel conforming to Specifications A 167 ~~or A240~~ or A 240/A 240M.

6.3.1 *Class B Steam Jackets*—Class B jackets shall be fabricated from material conforming to Specification A 285/A 285M or A 516/A 516M material and skirted with Type 302 or 304 corrosion resistant steel conforming to Specifications A 167 ~~or A240~~ or A 240/A 240M.

6.4 *Exterior of Style 3, 4 and 5 Kettle Stands and Bases*—Unless otherwise specified, material shall be Types 302, 304, 316, or 430 corrosion resistant steel conforming to Specification A 240/A 240M or to Specifications A 167 ~~or A176~~ or A 176, as applicable, and thickness shall be 20 gauge minimum [0.0375 in. (1 mm) U.S. revised standard gauge].

6.5 *Kettle Mount/Support Base*—All exterior surfaces shall be chrome plated in accordance with Specification B 456 or Type 304, 316, or 316L ~~430~~ corrosion resistant steel conforming to Specifications ~~A167, A176 or A240~~ A 167, A 176, or A 240/A 240M, as applicable.

6.6 *Controls Console of Class B and C Kettles*—All exposed surfaces of the console and kettle base shall be Type 304, 316, or 430 corrosion resistant steel conforming to Specifications ~~A240, A167 or A176~~ A 240/A 240M, A 167, or A 176, as applicable.

7. Design and Construction

7.1 *General*—Jacketed kettles shall conform to ANSI/UL No. 197, ANSI Z83.11, ANSI/NSF Std. 4, ANSI Z223.1, ANSI/NFPA

70, as applicable. Kettle shall be delivered assembled, 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 46 in. (1150 mm).—Kettle shall be delivered assembled, 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 46 in. (1150 mm).

7.1.1 *Jacketed Steam Chamber*—The steam containing part of the kettle shall be ~~built~~ torated for the following allowable working pressure (WP):

7.1.1.1 *Direct Connected Kettles*—Minimum 25 psi (1.76 kg/cm²).

7.1.1.2 *Self-Generating Kettles*—Minimum 30 psi (2.19 kg/cm²).

7.1.1.3 *Design and construction of the steam chamber shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.*

7.1.1.3 *Design and construction of the steam chamber of Class A, Class B and Class C kettles shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 with a National Board Registration number.*

7.1.1.4 *Design and construction of the steam chamber of Class D steam generator shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section IV for Heating Boilers with CSD controls and National Board Registration.*

7.1.2 *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 A 167, A 176, or A 240/A 240M. The top of the casing shall be attached to the kettle's canopy with stainless steel fasteners or rivets. The bottom of the casing shall terminate below the steam jacket.

7.1.3 *Covers*—When specified, kettle shall be provided with a one piece lift-off cover. Cover design shall be such that there is no permanent distortion as a result of normal use, or accumulation of liquid or debris on the cover which could contaminate the food zone during opening or closing of the cover.

7.1.3

7.1.3.1 *Operating Handles*—Kettle rim shall have a lug(s) for a handle to tilt the kettle, if applicable.

7.1.4 *Safety Relief Valve*—Class B and Class C kettles shall be provided with a safety valve on the steam jacket or on the steam inlet pipe to the jacket. Valve shall be positioned so that its discharge port will vent steam downward. Valve shall be constructed in accordance with the applicable requirements of the ASME Boiler and Pressure Vessel Code Section VIII, Division 1 of Pressure Vessels. The relief pressure of the valve shall be equal to the maximum working pressure of the kettle and be set by its manufacturer.:

7.1.4.1 *Class B and Class C kettles shall be provided with a safety valve on the steam jacket or on the steam inlet pipe to the jacket. Valve shall be constructed in accordance with the applicable requirements of the ASME Boiler and Pressure Vessel Code Section VIII, Division 1 of Pressure Vessels.*

7.1.4.2 *Class D steam generators shall be provided with a safety valve on the steam jacket or on the steam outlet pipe. Valve shall be constructed in accordance with the applicable requirements of the ASME Boiler and Pressure Vessel Code Section IV.*

7.1.4.3 *Valve shall be positioned so that its discharge port will vent steam downward.*

7.1.4.4 *The relief pressure of the valve shall be equal to or less than the maximum working pressure of the kettle.*

7.1.5 *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 A 167, or chromium plated, in accordance with Specification B 456. 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.

7.1.6 *Basket Insert*—When specified, each kettle shall be provided with a basket insert. The length and diameter of the basket shall fit inside the insides of the kettle body and shall be fitted with handles. The basket shall be fabricated of Type 304 or 316 corrosion resistant steel perforated sheet metal conforming to Specifications A 167, A 176, A 240/A 240M, or Type 304 or 316 wire in accordance with Specification A 580/A 580M, as applicable. For wire baskets, the space between wires shall not be greater than 3/8 in. (9.5 mm). For perforated baskets, holes shall be ¼ in. (6.4 mm) or ⅜ in. (9.5 mm) diameter unless otherwise specified. A contour-fitted nylon bag with a stainless steel spreader ring shall be furnished with each basket.

7.1.7 *Tilt Mechanism*—The tilt mechanism, through its operating handle, shall provide the user a smooth pull against resistance to tilt a kettle that is filled to capacity. When the pull on the operating handle is relaxed the kettle shall return to its upright position. Kettle shall be tiltable to past 90° from normal operating position. All exterior surfaces shall be chrome plated per Specification B456:

7.1.7.1 *Hand Tilt Mechanism*—The tilt mechanism, through its operating handle, shall provide the user a smooth pull against resistance to tilt a kettle that is filled to capacity. When the pull on the operating handle is relaxed the kettle shall return to its upright position. Kettle shall be tiltable to past 90° from normal operating position.

7.1.7.2 *Crank Tilt Mechanism*—Shall be provided when specified. The tilt mechanism 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.

7.1.8 All exterior surfaces shall be chrome plated per Specification B 456 or Type 304 or 316 corrosion resistant steel.

~~7.1.6~~

7.1.9 Kettle Mount/Support Base—Design of the base shall be such that the kettle can be mounted on a counter top or equipment stand or an enclosed cabinet base.

~~7.1.7 Basket Insert~~—When specified, each kettle shall be provided with a basket strainer. The length and diameter of the basket shall fit inside the insides of the kettle body and shall be fitted with handles. The basket shall be fabricated of Type 304 or 316 corrosion resistant steel perforated sheet metal conforming to Specifications A167, A176, A240, or Type 304 or 316 wire in accordance with Specification A580, as applicable. For wire baskets, the space between wires shall not be greater than $\frac{3}{8}$ in. (9.5 mm). For perforated baskets, holes shall be $\frac{3}{8}$ in. (9.5 mm) diameter unless otherwise specified.

~~7.1.8~~

7.1.10 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 A 167, A 176, or A 240/A 240M, and it shall be located on the outside of the kettle and permit easy access to the controls.

7.1.11 Safety Cut-Off—Class B and Class C kettles shall be equipped with a device to de-energize the circuit to the heat source when the kettle is tilted. ~~Class B and Class 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.~~

7.1.12 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.

7.1.13 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.

7.1.13.1 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 $2\frac{1}{2}$ times the kettle’s water capacity, without deformation.

7.2.2 Style 1—Information about the pouring height and pour path for a kettle in the fully tilted position shall be available, if it is requested (5.2.3).

7.2.3 Style 2, 3 and 4, with Class A Kettle(s)—Table-top or front-mounted steam control valve(s) shall be provided for each direct steam kettle together with all necessary steam trap(s), strainer, check valve and piping. These shall all be pre-piped for a single point utility connection. ~~There shall be provided a hot and cold water valve and a water fill swing spout from which the kettle(s) can be filled directly shall be provided when ordered.~~

7.2.4 Style 2 and 3 Style 2—Stand shall have a slide-out combination drain drawer/pan support which is also removable. The drain drawer shall be furnished with a flexible drain hose and splash shield. Unit shall have adjustable feet.

7.2.5 Style 4—The unit shall have a full table top with a drain trough equipped with a drain connection. There shall also be a movable drain catch pan which fits into the drain trough and incorporates a splash shield.

7.2.6 Style 5—The unit shall be an assembly consisting of a kettle and a separate Class D steam generator which shall be located in a 28 to 30-in. (711 to 762-mm) high cabinet base under the kettle.

7.3 Steam Source:

7.3.1 Class A—External Steam Source—Tilting kettle shall pivot on attached vertical support arms which are mounted to a suitable table top. The steam supply to the steam jacket shall be through the support arms.

7.3.2 Class B, Gas Fired—Steam for the jacket shall be provided by a self-contained gas fired steam generator which uses a fixed amount of water containing the necessary additive(s) and rust inhibitor. The steam generator shall have a Btu input rating shall be 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 which uses electric elements submerged in a fixed amount of water containing the necessary additive(s) and rust inhibitor. Wattage rating of the heating elements shall be sufficient to enable the kettle to meet the performance requirement of Section 8.

7.3.4 Class D, Separate Steam Generator— The steam generator shall be designed, manufactured, inspected and tested in accordance with the ASME Boiler Code Section IV. The entire assembly shall have certification and listing in accordance with ANSI/UL 197 or ANSI/Z83.11/ANSI Z83.11 as applicable. The steam output of the generator shall be at the pressure and flow rate required by the kettle(s) to meet the performance requirements of Section 8.

7.4 Tilting Mechanism:

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

7.4.2 Tilt mechanism, when provided, shall be mounted on the trunion.

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

7.4.4 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 A 167 or A 176.

8. Performance Requirements

8.1 *Capacity*—The kettle shall be tested to determine compliance to the manufacturer’s stated capacity by filling the kettle with $70 \pm 5^\circ\text{F}$ ($21 \pm 2.8^\circ\text{C}$) water from a container of known capacity.

8.2 *Heating Time*—The water in a kettle filled to its rated capacity with $70 \pm 5^\circ\text{F}$ ($21 \pm 2.8^\circ\text{C}$) water and with the kettle cover in place shall, when tested in accordance with 10.2, reach 210°F (99°C) in no more than 10 min for sizes up through 6 gal (22.7 L) and in sizes over 10 gal reach 210°F (99°C) in no more than 15 min.

8.3 *Energy Utilization Test*—The kettle shall be tested in accordance with 10.3 to determine its energy utilization.

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*—Prior to the performance of the tests specified herein, two procedures shall be completed:

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

10.1.2 Both procedures should be done in accordance with the manufacturer’s instructions in the owner’s manual. Tests shall be performed in a $70 \pm 5^\circ\text{F}$ ($21 \pm 2.8^\circ\text{C}$) 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, Class A, B, C:*

10.2.2.1 For Class A kettles, connect the unit to a steam source that can provide the steam pressure and the steam flow rate specified by the manufacturer for operating the subject model. There shall be a pressure gauge and a 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 (manufacturer’s recommendation) with $70 \pm 5^\circ\text{F}$ ($21 \pm 2.8^\circ\text{C}$) tap water. A timer should be set at the time interval recommended by the manufacturer’s instructions to bring the water to 210°F (99°C).

10.2.2.3 At the conclusion of the test time, use a hand pyrometer or thermocouple to check the water temperature in the kettle.

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 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 pounds per hour will yield the amount of steam in pounds consumed by heating the water. To calculate the amount of energy used to heat the water, H_s , use the following equation:

$$H_s = W_s \times t \times h_s \quad (1)$$

where:

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

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

t = heating cycle time, h, and, and

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

10.3.2.2 To calculate the amount of energy H_L captured by the water in warming to 210°F , the following equation shall be used:

$$H_L = W \times SH \times \Delta T \quad (2)$$

where:

H_L = energy in the water, Btu (kJ),

W = lbs of water [1 gal = 8.35 lb (1 L = 1 kg)],

SH = specific heat, $\frac{\text{Btu}}{\text{lb} \cdot ^\circ\text{F}}$ (4.182 kJ/kg \cdot $^\circ\text{K}$), and