4.32.32

A vent damper device shall bear a plate of Class II marking material on which shall appear the following:

a) The water heater manufacturer's part number of the vent damper device.

b) A distinctive number that will identify each individual vent damper device or a separate date code marking.

   If a separate date code marking is used, it shall consist of at least four consecutive digits determined as follows:

   i) The first and second digits shall indicate the calendar year in which the vent damper device is manufactured (e.g., 16 for 2016); and

   ii) The third and fourth digits shall indicate the week in which the vent damper device was manufactured (e.g., 03 for the third week of the year). For purposes of this marking, a week shall begin at 0001 hours on Sunday and end at 2400 hours on Saturday.

   A date code may be used for more than one week; however, it shall not be used for more than four consecutive weeks or for more than two weeks into the next calendar year.

   Additional numbers, letters or symbols may follow the four digit number specified in Items b) i) and b) ii). If additional numbers are used, they must be separated from the date code.

c) The inlet, outlet, or direction of vent gas flow.

d) On mechanically actuated vent damper devices, type and range of motive power which will permit normal functioning of the vent damper device.

4.32.33

The following marking (as applicable) shall be affixed to the water heater on Class III marking material (unless otherwise noted).

A water heater requiring special vent or marked Category II, III, or IV shall beat a marking that states:

"This water heater requires a special venting system. Refer to the installation instructions for parts list and method of installation."

4.32.34

A vent damper device shall bear a Class III marking attached to the vent damper device or a marking on the carton in which it is supplied, stating clearly and legibly: "WARNING − Follow instructions for proper installation". The word "WARNING" shall be in letters having a minimum height of 0.240 in (6.10 mm).* The remainder of the warning shall be in letters having a minimum uppercase letter height of 0.120 in (3.05 mm) with a minimum vertical spacing between lines of 0.046 in (1.17 mm).† Lowercase letters shall be compatible with the uppercase letter size specification.

* *This letter height corresponds to 24-point type.*

† *This letter height and line spacing correspond to 12-point type.*

4.32.35

A flue damper device shall bear a Class III marking on which shall appear the following:

a) The water heater manufacturer's part number of the flue damper device;

b) Unless the device can be installed only in the correct position, the inlet, outlet, or direction of flue gas flow; and

c) On mechanically actuated flue damper devices, type and range of motive power which will permit normal functioning of the flue damper device.

4.32.36

A flue damper device shall bear a Class III marking attached to the device stating clearly and legibly: "WARNING – Follow instructions for proper installation." The word "WARNING" shall be in letters having a minimum height of 0.240 in (6.10 mm).* The remainder of the warning shall be in letters having a minimum uppercase letter height of 0.120 in (3.05 mm) with a minimum vertical spacing between lines of 0.046 in (1.17 mm).† Lowercase letters shall be compatible with the uppercase letter size specification.

* *This letter height corresponds to 24-point type.*

† *This letter height and line spacing correspond to 12-point type.*

Δ

4.32.37

The water heater casing and vent terminal(s) of a direct vent appliance shall be marked "HOT" on Class II marking material located on or adjacent to areas of excessive temperature, unless such surfaces comply with Clause 5.17, Wall, floor, and ceiling temperatures.

4.32.38

Also see Clauses 4.6.2, 4.8.3, 4.12, Opening for relief valves, 4.13.3, 4.14.5, 4.29.4, and 4.29.46.

5 Performance

5.1 General

5.1.1

The water heater shall be installed and operated in accordance with the manufacturer's instructions unless specifically required otherwise by the Method of Test.

5.1.2

Water heaters submitted for examination under this Standard shall be tested with the type(s) of gas selected by the manufacturer.

5.1.3

When a thermocouple is specified for the measurement of air, water, flue, or vent gas temperatures, a thermocouple or an equivalent temperature-measuring device complying with the *Performance Test Codes, Supplement on Instruments and Apparatus, Part 3, Temperature Measurement*, ANSI/ASME PTC 19.3, shall be used.

5.1.4

When a water heater with a vent damper device is submitted for examination, the manufacturer shall specify whether the appliance is for use only with the vent damper device or for use both with and without the vent damper device.

If the appliance is for use only with the vent damper device, the vent damper device shall be in place for all tests specified herein.

If the appliance is for use both with and without the vent damper device, the tests specified in Clauses 5.22.3, 5.22.4, 5.22.5, and 5.22.6 shall be conducted both with and without the vent damper device in place. The tests specified in Clauses 5.4, Combustion, 5.19, Flue gas temperature, and 5.23.2

shall be conducted without the vent damper device in place. All other tests specified herein shall be conducted with the vent damper device in place.

All appliance performance tests for which an electrically operated or mechanically actuated vent damper device is specified to be in place shall be conducted with the damper open to the minimum degree that would permit the appliance's automatic valve to open.

5.1.5

When a water heater equipped with a flue damper device is submitted for examination, the flue damper device shall be in place for all tests specified herein, with the exception of Clauses 5.25.5 and 5.25.6, which are tests of the flue damper device itself and which may be conducted separately.

All appliance performance tests shall be conducted with the damper open to the minimum degree that would permit the appliance's automatic valves to remain open.

5.1.6

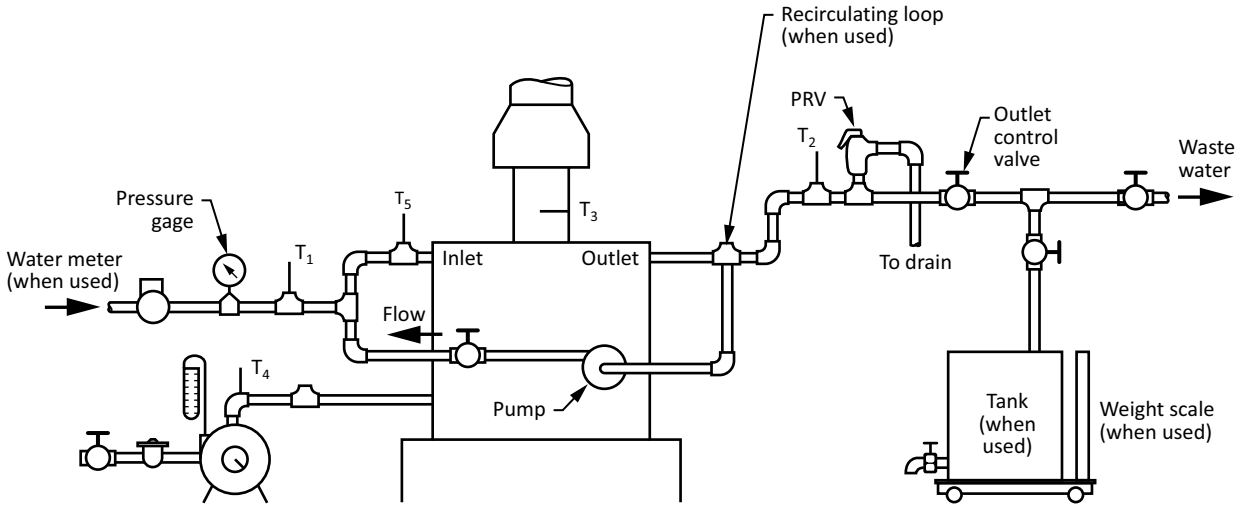
Direct vent water heaters may take many forms; so for their testing, principles must be established for the guidance of the testing agency which will permit compliance with basic standards for safe operation and acceptable performance, without restricting their design to preconceived forms. With this in mind, the principles stated within this Standard shall be used by the testing agency in determining the acceptability of direct vent appliances.

Direct vent water heaters are appliances for permanent attachment to or incorporation in the structure of a building, manufactured home (mobile home), or recreational vehicle, and may be partly or entirely enclosed in combustible construction. Having designed for this condition by the manufacturer, it is proper that the appliance be tested as a unit when installed in accordance with the manufacturer's published instructions and with commonly observed practice. Also see Clauses 1.2 and 5.1.9.

5.1.7

Instantaneous and circulating water heaters may use a re-circulating line with pump (see Figure 4, Arrangement for testing water-tube type instantaneous and circulating water heaters) to control inlet water temperature as specified by the manufacturer, consistent with field application. For all water heaters except booster heaters, the specified inlet water temperature shall not be less than 70 °F (21 °C) or more than 120 °F (49 °C). The temperature rise through the appliance shall be as specified by the manufacturer consistent with the application unless otherwise specified in this Standard. Booster heaters shall have a specified inlet water temperature of 110 °F (43.5 °C) to 140 °F (60 °C).

Figure 4
Arrangement for testing water-tube type instantaneous and circulating water heaters
(See Clauses 5.1.7 and 5.15.2.)



Legend:
T_1 = Location for temperature measurement in supply water line.
T_2 = Location for temperature measurement in outlet water line.
T_3 = Location for temperature measurement in flue.
T_4 = Location for temperature measurement in gas line.
T_5 = Location for temperature measurement in inlet water line.

5.1.8

During the conduct of the tests specified in Clauses 5.4.1, 5.17, Wall, floor, and ceiling temperatures, 5.22, Draft hoods, and 5.26, Wind test, the water heater shall be installed in either an alcove or a closet, as specified by the manufacturer, with clearances from the walls and ceiling in accordance with the manufacturer's installation instructions. For alcove installations, the side walls shall extend 18 in (457 mm) beyond the front of the appliance. Appliances not of the direct vent type for installation in manufactured homes (mobile homes) shall be installed in a closet. Mounting brackets for securing the appliance to the vehicle structure shall not be considered as a part of the appliance for establishing clearances.

During the conduct of the tests specified in Clauses 5.4.1, 5.17, 5.22, and 5.26, an appliance designed for outdoor installation shall be installed in a structure comprised of a rear wall and one side wall extending 8 ft (2.44 m) from the floor or 2 ft(610 mm) above the appliance jacket, whichever is greater. The side wall shall be placed to the right or left at the discretion of the testing agency. The clearances to the rear wall and the side wall shall be specified by the manufacturer.

No ceiling or overhang shall be provided.

Appliances intended for wall mounting shall be mounted on one of the test walls in accordance with the manufacturer's instructions.

Walls and ceilings of enclosures of combustible material shall be constructed of nominal 1 inch thick pine boards or 3/4 inch thick plywood set at 90 degrees (1.57 rad) and finished in dull black on the

interior surfaces. Flooring of combustible material shall be constructed of nominal 1 inch thick pine flooring covered with one thickness of building paper superimposed by nominal 1 inch tongue-and-groove oak flooring finished with clear varnish. (See Clause 5.17 for details of thermocouple construction and location.)

For direct vent appliances, the wall through which the vent-air intake system passes shall be constructed with nominal 2 inch thick studs spaced 16 in (406 mm) on center covered on both sides by 3/4 inch thick plywood finished in dull black. The width of the studs shall provide a total wall thickness as specified by the manufacturer. The vent air intake terminal shall be installed through this wall in accordance with the manufacturer's instructions and the portion of the vent-air intake terminal located within the wall shall be enclosed on the top, bottom, and sides, as close as the configuration of the appliance will permit, with nominal 2 inch thick wood framing of the same width as used to construct the wall.

Instantaneous appliances provided with a metal cabinet shall be installed as specified by Clause 5.17.2 or 5.17.3.

The height of the enclosure for appliances for installation in manufactured homes (mobile homes) shall not exceed 6 ft 6 in (1.98 m) above the floor.

For closet installation tests of appliances, other than for installation in manufactured homes (mobile homes), a simulated door shall be provided.

This door shall have openings as follows:

a) for appliances with draft control devices, two (2) openings located so that the lower edge of the lower opening is 6 in (15.2 cm) above the floor level of the enclosure and the upper edge of the upper opening is 6 in (15.2 cm) below the ceiling of the enclosure;
b) for appliances not having draft control devices an opening located so that the lower edge of the opening is 6 in (15.2 cm) above the floor level of the enclosure.

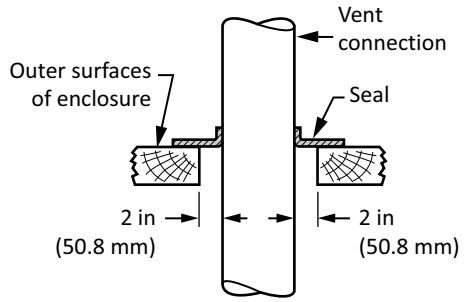
The free area of each of the two openings shall be 1 square inch per 1,000 Btu/hr (22 cm^2/kW) of appliance input rating. The height of each opening shall be one half of the width. The closet door shall be located at the manufacturer's specified clearance from the front of the appliance jacket. The manufacturer may specify another reference point for the front clearance provided it is included in the markings as required by Clause 4.32.12 c), and also included in the manufacturer's installation instructions.

Water heaters not of the direct vent type shall be tested with a clearance of 6 in (152 mm), or less if so marked, between the surfaces of single wall connectors and the walls and ceiling of the test enclosure an opening having a diameter 4 in (102 mm) larger than the diameter of the vent connector shall be provided. The 2 in (50.8 mm) annulus thus formed shall be sealed on the outer surface.

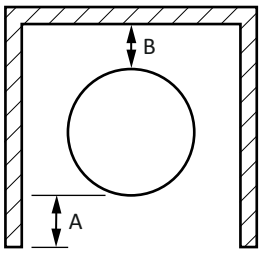
Appliances not of the direct vent type with vertical flue outlets shall be tested with vent arrangement Style I as shown in Figure 5, Enclosure types and clearance nomenclature for alcove and closet installation tests for water heaters, unless otherwise specified herein. Appliances not of the direct vent type with horizontal flue outlets shall be tested with vent arrangement Style II as shown in Figure 5, unless otherwise specified herein.

Figure 5
Enclosure types and clearance nomenclature for alcove and closet installation tests for water heaters

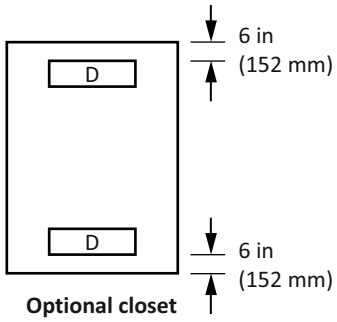
(See Clauses 5.1.8 and 5.17.1.)



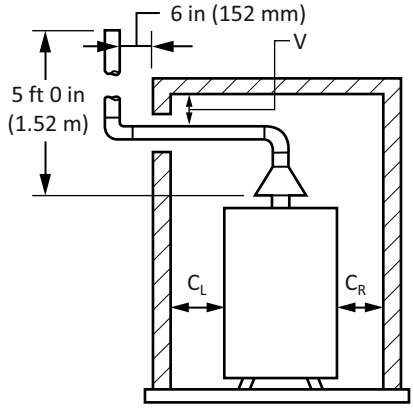
Method of sealing annulus around vent connector



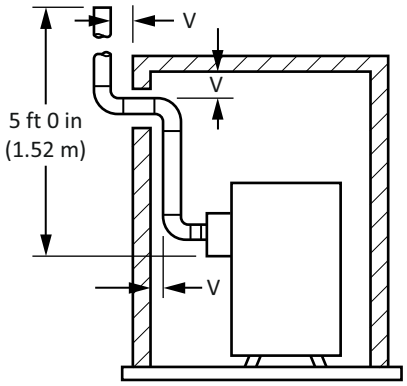
Top view



Optional closet construction



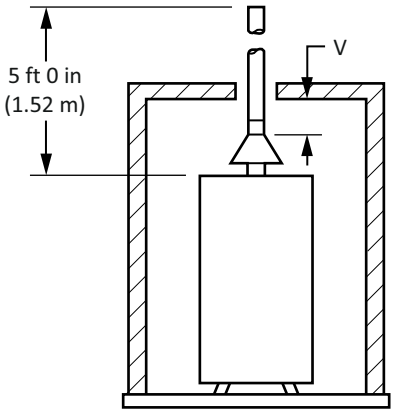
Front elevation vent arrangement style I



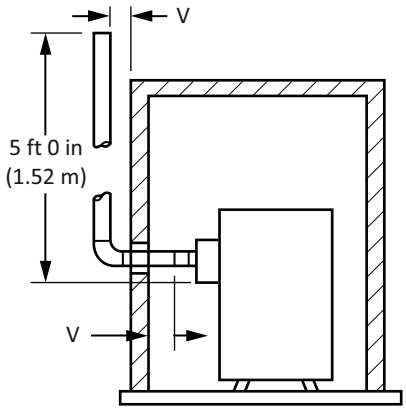
Side elevation vent arrangement style II

Symbol Designation

A — From front of water heater
B — From back of water heater
CL — From left side of water heater
CR — From right side of water heater
D — Area of each opening – 1 sq. in. for each 1000 Btu per hour (22 cm^3/kW) input, but not less than 100 in^2 (645icm^2). Width to height ratio; 2:1
V — From single wall vent connector or draft hood. If less than 6 in (1.52 mm), marking per 4.31.12-d) and -f is required.



Front elevation vent arrangement style IA



Side elevation vent arrangement style IIA

For closet installation tests of appliances for installation in manufactured homes (mobile homes), the means provided for access of combustion and ventilation air into the appliance closet and for venting the flue gases shall be in place. (See Clause 4.1.21.)

5.1.9

During tests for compliance with this Standard a water heater shall not be connected to a vent connector but shall depend for venting of the flue gases solely on the principles of design incorporated in it, unless otherwise specified herein. The fact that appliances are tested without flue connections shall not be interpreted as an indication that flue connections are not necessary when appliances are installed under actual operating conditions.

A direct vent or power vent appliance shall be tested with its vent and air supply systems in place.

An instantaneous appliance, except of the direct vent type, for installation in a manufactured home (mobile home), which uses either Item a) a listed venting system as specified by the manufacturer (see Clause 4.1.21), or b) a venting system supplied by the manufacturer as a part of the appliance, shall be tested with the venting system in place, unless otherwise specified herein.

5.1.10

A draft hood, if provided, shall be in place during all performance tests, unless otherwise specified herein.

5.1.11

Temperature-limiting devices, when provided, shall be in place during all tests.

5.1.12

For purposes of test under this Standard for instantaneous type water heaters for installation in manufactured homes (mobile homes), the manufacturer shall provide any special means recommended in the installation instructions for providing combustion air from outside the vehicle. This special means shall be in place during all performance tests.

5.1.13

Water heaters having controls providing automatic multi-rate control of the input rating for automatic modulating controls which permit the main burner gas to be turned on at a reduced rate shall also be tested at the minimum input rating under Clauses 5.6, Burner and pilot operating characteristics, 5.7, Piloted ignition systems, 5.9, Direct ignition systems, 5.22.6, and 5.23.6.

Water heaters that have controls that allow automatic operation below the specified minimum input rate (see Clause 5.3.4) through the adjustment of water flow shall also comply with the test specified in Clause 5.6.9.

Appliances having automatic modulating controls that act to reduce the input rating after ignition of the main burner shall also be tested at the minimum input rating under Clauses 5.6.1, 5.6.4, 5.6.6, 5.6.7, and 5.22.6.

The appliance shall also comply with the applicable provisions of the combustion tests specified in Clause 5.4.1 when operating at the minimum input rating. If the minimum test input rating (see Clause 5.3.4) is less than 50 percent of the normal input rating, the maximum permissible carbon monoxide concentration in an air-free sample of the products of combustion shall be determined from the following formula:

$$\frac{\text{normal input rating}}{\text{minimum test input rating}} \times .01$$

Tests at the minimum input rating (see Clause 5.3.4) shall be conducted at normal inlet test pressure only.

5.1.14

Special performance provisions applicable to instantaneous water heaters for installation in manufactured homes (mobile homes) are outlined under Clauses 1.1 g), 5.1.8, 5.1.9, 5.1.10, 5.1.12, 5.2 g) and h), 5.17.2, 5.17.3, 5.20, Temperature of manually operated parts, 5.22.1, 5.22.6, 5.26, Wind test, and 7.1, Items unique to the United States.

5.1.15

Special performance provisions applicable to instantaneous water heaters for installation in recreational vehicles are outlined under Clauses 1.1 f) and h), 5.2 g), 5.20, Temperature of manually operated parts, and 7.1.

5.1.16

Special performance provisions applicable to direct vent water heaters are outlined under Clause 5.1.6, 5.1.9, 5.17.1, 5.26, Wind test, 5.34.2, and 5.35, Direct vent systems.

5.1.17

Special performance provisions applicable to water heaters for outdoor installation are outlined under Clauses 5.1.9, 5.1.10, 5.19.1, prefatory note of 5.23.2, Draft tests for water heaters equipped with power burners, 5.26, Wind test, and 5.34.1.

5.1.18

Unless otherwise specified, water heaters for combination water/space heating that have separate water and space heating circuits shall be tested with the space heating circuit empty of working fluid.

5.1.19

Special performance provisions applicable to combination water/space heaters are outlined under Clauses 5.1.18, 5.30.3, and 5.30.4.

5.1.20

Special performance provisions applicable to Category I, Category II, Category, III, and Category IV water heaters are outlined under Clauses 5.5, Category determination, and 5.32, Venting systems for Category II, III, or IV water heaters.

5.2 Test gases

In conducting the performance tests specified herein, test gases with characteristics approximately as shown in Table 11, Characteristics of test gases, shall be used.

Table 11
Characteristics of test gases
(See Clause 5.2.)

		Heating value		Sp Gr
		(Btu/ft³)	(MJ/m³)	(Air = 1.0)
Gas A	(Natural)	1075	(40.1)	0.65
Gas B	(Manufactured)	535	(19.9)	0.38
Gas C	(Mixed)	800	(29.8)	0.50
Gas D	(n-Butane)	3200	(119.2)	2.00
Gas E	Propane HD-5)	2500	(93.1)	1.55
Gas F	(Propane-Air)	700	(26.1)	1.16
Gas G	(Butane-Air)	1400	(52.5)	1.42
Gas H	(Propane-Air)	1400	(52.2)	1.30

a) A water heater for use with natural gas shall have the tests specified herein conducted with Test Gas A. Additional tests shall be conducted with either Test Gas G or, at the manufacturer's option, Test Gas H, with no change whatever in burner equipment, test pressures, orifices, or air shutter setting used for natural gas and shall comprise those tests specified in Clauses 5.6, Burner and pilot operating characteristics, and 5.7, Piloted ignition systems. Compliance with these supplemental tests does not imply that the appliance has been examined under this Standard for use with LP gas-air mixtures.

b) An appliance for use with manufactured gas shall have the tests specified herein conducted with Test Gas B.

c) An appliance for use with mixed gas shall have the tests specified herein conducted with Test Gas C.

d) An appliance for use with natural, manufactured, and mixed gases shall be tested with Test Gases A and G or H, as specified in Clause 5.2 a), and Test Gas B.
The tests specified in Clauses 5.4, Combustion, 5.5, Burner and pilot operating characteristics, and 5.7, Piloted ignition systems, shall also be conducted with Test Gas C (1) when the appliance is equipped with different burners for natural and manufactured gas, or (2) when a third burner is supplied specifically for use with mixed gas. In the former case, the burner equipment employed for the mixed gas tests shall be that specified by the manufacturer.

e) An appliance for use with liquefied petroleum gases shall have the tests specified herein conducted with Test Gas E. The tests specified in Clauses 5.6, Burner and pilot operating characteristics, 5.7.2, 5.7.6, 5.7.8 and 5.7.10 (or Clauses 5.9.4, 5.9.5, 5.9.6, and 5.9.7) shall also be conducted with Test Gas D with no change whatever in burner equipment.

f) An appliance for use with LP gas-air mixtures shall have the tests specified herein conducted with Test Gas H. The tests specified in Clauses 5.4.1, 5.6, Burner and pilot operating characteristics, 5.7.3, 5.7.7, 5.7.9, and 5.7.11 (or Clauses 5.9.4, 5.9.5, 5.9.6, and 5.9.7) shall also be conducted with Test Gas F with no change in the appliance except for main burner and pilot orifices and air shutter adjustment.

g) An instantaneous appliance for manufactured home (mobile home) or recreational vehicle installation convertible for use with natural gas and liquefied petroleum gases shall be tested as

specified in Clause 5.2 a) and e). Conversion from one gas to the other shall be made in accordance with the manufacturer's instructions.

h) When use with more than one type of gas is desired, the tests specified in Clauses 5.10, Efficiency, through 5.20, Temperature of manually operated parts, 5.22, Draft hoods, 5.23, Draft tests for water heaters equipped with power burners, 5.26, Wind test, 5.34, Rain test, and 5.36, Marking material adhesion and legibility, need be conducted with only one test gas provided there are no changes in the appliance or input rating which, in the opinion of the testing agency, would affect the results of these tests.

5.3 Test pressures and burner adjustments

5.3.1

Unless otherwise stated, each test specified herein shall consist of a series of three tests: one at normal inlet test pressure, one at reduced inlet test pressure and one at increased inlet test pressure, as shown in Table 10, Inlet pressure test.

When the manifold pressure at the increased inlet test pressure is not greater than the manifold pressure at normal inlet test pressure, tests at the increased inlet test pressure need not be conducted. However, tests at normal inlet test pressure shall be conducted whenever tests at the increased inlet test pressure are specified.

The increased inlet test pressure shall be the greater of that listed in Table 10 or the marked maximum inlet gas pressure for the type of gas for which the appliance is certified. This pressure shall not exceed the lowest rated inlet pressure of the control(s).

5.3.2

The inlet test pressures stated in Clause 5.3.1 shall be the pressure immediately ahead of all controls. The regulator outlet pressure, at normal inlet test pressure, shall be approximately that recommended by the water heater manufacturer.

5.3.3

Except as noted in Clause 5.3.4, burners shall be adjusted to their Btu ratings at normal inlet test pressure, unless otherwise specified herein. Burners shall be adjusted so they will be at the manufacturer's hourly Btu rating (± 2 percent) 15 minutes after being placed in operation from a room temperature start. The manifold pressure shall be within 10 percent of that printed on the rating plate. Primary air shall be set to give a good flame. No readjustment of hourly Btu input or primary air shall be made during a series of tests with any one test gas.

5.3.4

The minimum input rating for test purposes, on water heaters provided with controls that will reduce the input rating by automatic means, shall be 87 percent of the minimum input rating specified by the manufacturer. The manufacturer's specified minimum input rating shall not be less than 20 percent of the manufacturer's specified normal input rating.

5.4 Combustion

5.4.1

A water heater shall not produce flue gases that contain carbon monoxide in excess of 0.04 percent, on an air-free basis, in a sample of the flue gases when adjusted to have an input rate of 106.25 percent of