### 5.1.4

When a pool 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 5.23.5 and 5.23.6, 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.

### 5.1.5

During tests for compliance with this Standard, a pool 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 vent connections is not to be interpreted as an indication that vent connections are not recommended when appliances are installed under actual operating conditions.

An appliance for outdoor installation with the venting system provided as part of the appliance shall be tested with the venting system in place.

### 5.1.6

A convection type pool heater shall be tested when installed in a typical pool supplied by the appliance manufacturer. The installation shall be in accordance with the appliance manufacturer's installation instructions. Unless otherwise specified, all performance tests shall be conducted with the test pool filled to the maximum possible level and also at the minimum level permitted by the water level sensing control specified in Clause 5.1.13. If a water level sensing control is not supplied with the appliance, the testing laboratory may choose to conduct performance tests at any minimum level deemed appropriate.

### 5.1.7

Draft hoods, when provided, shall be in place during all performance tests.

### 5.1.8

Temperature limiting devices shall be in place during all performance tests.

### 5.1.9

On a pool heater for installation with mechanical means for water circulation, the inlet water temperature, unless otherwise specified, shall be 70 ± 5 °F (21 ± 3 °C) for all tests specified herein.

### 5.1.10

Pool heaters of other than the convection type shall be tested for operation at an outlet water temperature not to exceed 140 °F (60 °C), as determined under Clause 5.12.2.

a) 140 °F (60 °C), as determined under Clause 5.12.2 for pool heaters intended to temper the entire flow of the primary circulating pool loop water prior to re-entering the pool.
b) 210 °F (99 °C), as determined under Clause 5.12.2 for pool heaters intended to temper a portion of the primary circulating loop water diverted through the pool heater by mechanical means and then re-enter and mix with the primary circulating loop water prior to entering the pool at 140 °F (60 °C) or below.

### 5.1.11

Convection type pool heaters shall be tested for operation at an outlet water temperature not in excess of 140 °F (60 °C), as determined under Clause 5.12.3.

### 5.1.12

In tests conducted on an indirect type pool heater, all running water tests refer to water flow through the secondary heat exchanger.

### 5.1.13

On a convection type pool heater, unless otherwise specified, all performance tests shall be conducted with no disturbance of the water except by thermal convection and with the pool test temperature maintained at 103 ± 5 °F (39.5 ± 3 °C), as determined in Clause 5.12.6 b).

### 5.1.14

Pool heaters having controls providing automatic multi-rate control of the input rating or 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 5.5, Burner and pilot operating characteristics; 5.6, Piloted ignition systems; 5.8, Direct ignition systems, 5.19.1 b) and 5.20.6.

Appliances having automatic modulating controls which act to reduce the input rating after ignition of the main burner gas shall also be tested at the minimum input rating under Clauses 5.5.2, 5.5.3, 5.5.4, 5.5.5, 5.5.7 c), 5.5.7 d), 5.6.11, 5.19.6, and 5.20.6.

The appliance shall also comply with the applicable clauses of the combustion test outlined under Clause 5.4.2 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:

$$\frac{\text{nominal input rating}}{\text{minimum test input rating}} \times 0.01$$

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

### 5.1.15

Room temperature, wherever specified, shall be the arithmetic average temperature of the test area determined by measurement with four 24 AWG (0.20 mm$^2$) iron-constantan bead-type thermocouples with junctions shielded against radiation, located approximately at 90 degree (1.57 rad) positions on a circle circumscribing the pool heater or appliance enclosure under test, in a horizontal plane approximately at the vertical midpoint of the appliance or test enclosure, and with the junctions approximately 24 in (610 mm) from the sides of the appliance or test enclosure, and located so as not to be affected by other than room air.

### 5.1.16

A pool heater for outdoor installation, in addition to complying with all of the clauses of this part of the standard, shall comply with Clause 5.27, Outdoor installation. (Also see Clauses 5.1.5, 5.16, Wall, floor, and ceiling temperatures; 5.17, Flue gas temperature, and 5.20.1.)

### 5.1.17

Special performance Clauses applicable to close proximity heaters are outlined in Clauses 5.4.7, 5.4.8, 5.15, Evaluation of burn hazard potential of exterior surfaces, and 5.21, Evaluation of fabric ignition potential.

### 5.1.18

Accessories shall be tested only as an integral part of pool heater for which they are supplied.

## 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 | (4.01) | 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 | (52.2) | 1.42 |
| Gas H (Propane-Air) | 1400 | (52.2) | 1.30 |

a) A pool 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, at normal inlet test pressure with no change whatever in the natural gas adjustments and shall comprise those tests specified in Clauses 5.5.2 and 5.5.9. Under conditions of these tests with test Gas G, yellow-tipped flames are considered acceptable as long as carbon is not being deposited. Resonance encountered during conduct of burner operating characteristics tests with test Gas G is not to be considered cause for rejection. 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 5.6, 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 5.5, Burner and pilot operating characteristics, and 5.6.2, 5.6.6, 5.6.8, and 5.6.10 (or 5.8.4, 5.8.6, and 5.8.7) 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 test specified herein conducted with test Gas H. The tests specified in Clauses 5.4.2, 5.5, Burner and pilot operating characteristics, and 5.6.2, 5.6.6, 5.6.8, and 5.6.10 (or 5.8.4, 5.8.5, 5.8.6, and 5.8.7) 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) When use with more than one type of gas is desired, the tests specified in Clauses 5.10, Thermal efficiency, through 5.20, Draft tests for pool heaters equipped with power burners, and 5.27, Outdoor installation, 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 test pressures.

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

The increased inlet test pressure shall be the greater of that listed in Table 10, Inlet test pressures, 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 specified in Clause 5.3.1 shall be the pressures immediately ahead of all controls. The regulator outlet pressure, at normal inlet test pressure, shall be approximately that specified by the pool heater manufacturer.

### 5.3.3

Burners shall be adjusted to their Btu ratings at normal inlet test pressure, unless otherwise specified herein. After the pool heater has been operated for 15 minutes starting with all parts at room temperature, the burner adjustments shall be within ± 2 percent of the manufacturer's specified hourly Btu input rating. 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 pool 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.

## Δ 5.4 Combustion

### 5.4.1

On a pool heater for installation with mechanical means for water circulation, all tests specified in this Clause shall be conducted with any device that has been provided to maintain water flow rate removed or adjusted in such a manner to prevent bypassing of water around the heat exchanger. Water flow through the appliance shall be regulated to provide an outlet water temperature of 110 ± 5 °F (43.3 ± 3 °C).

### 5.4.2

When tested in accordance with the following Method of Test, the pool heater shall not produce carbon monoxide in excess of:

a) 0.02 percent in an air-free sample of the flue gases when tested at normal and reduced inlet test pressures in a room having approximately a normal oxygen supply; and
b) 0.04 percent with the appliance adjusted to have an input rate of 106.25 percent of the manufacturer's specified input rate.

#### Method of Test

Three samples of the flue gases shall be secured at a point immediately preceding their discharge from the flue outlet of the appliance. After 15 minutes of appliance operation at normal inlet test pressure, the first sample shall be taken. The appliance shall then be adjusted to have an input rate of 106.25 percent of the manufacturer's specified input rate. This condition shall be obtained by changing the outlet pressure of the regulator. (When the outlet pressure cannot be readily adjusted, this increase in input rate may be obtained with the regulator removed or locked in its full open position.) The second sample of flue gases shall be secured after 5 minutes at this input rate. The outlet pressure of the appliance regulator shall then be returned to its normal setting to provide the manufacturer's specified input rate. The gas supply pressure to the appliance shall be adjusted to the reduced inlet pressure shown in Table 10, Inlet test pressures. After 5 minutes of operation at this pressure, the third sample of flue gases shall be secured.

These samples shall be analyzed for carbon dioxide and carbon monoxide. The carbon monoxide reading shall be equated to an air-free basis.

### 5.4.3

Pool heaters provided with a power burner or induced draft shall not produce carbon monoxide in excess of 0.04 percent in an air-free sample of the flue gases when operated at normal inlet test pressure and reduced supply voltage according to the following Method of Test.

#### Method of Test

With the appliance at room temperature, the pilot shall be ignited and the supply voltage reduced to 85 percent of the appliance rating plate voltage. With the appliance operating at normal input rating and normal inlet test pressure, after 15 minutes of operation, a combustion sample shall be secured and analyzed for carbon monoxide.

### 5.4.4

Pool heaters for use with natural gas shall not produce carbon monoxide in an air-free sample of the flue gases in excess of 0.04 percent when adjusted and operated in a room having approximately a normal oxygen supply with test Gas A at 4.0 in wc (995 Pa) inlet test pressure according to the following Method of Test.

### Method of Test

When the manifold pressure at the 4.0 in wc (995 Pa) inlet test pressure adjustment is not less than that obtained at normal inlet test pressure during conduct of the combustion tests outlined under Clause 5.4.2, this test need not be conducted.

The normal input shall be obtained at 4.0 in wc (995 Pa) inlet test pressure, with test Gas A, by means of the orifice. Auxiliary gas adjustment means, if provided, shall be in the wide open position. A sample of the flue gases shall be secured with the appliance operating at this adjustment pressure and as specified in Clause 5.4.2 and analyzed.

### 5.4.5

When tested in accordance with the following Method of Test, a pool heaters for use with manufactured gas shall not produce carbon monoxide in excess of 0.04 percent in an air-free sample of the flue gases when adjusted and operated in a room having approximately a normal oxygen supply with test Gas B at 3.0 in wc (747 Pa) pressure.

### Method of Test

When the manifold pressure at the 3.0 in wc (747 Pa) inlet test pressure adjustment is not less than that obtained at normal inlet test pressure during conduct of the combustion tests outlined under Clause 5.4.2, this test need not be conducted.

The normal input shall be obtained at 3.0 in wc (747 Pa) inlet test pressure with test Gas B, by means of the orifice. Auxiliary gas adjustment means, if provided, shall be in the wide open position. A sample of the flue gases shall be secured with the appliance operating at this adjustment pressure as specified in Clause 5.4.2 and analyzed.

### 5.4.6

There shall be no leakage of flue gases through door cracks or any openings through which flue gas might pass through the jacket to the outside of the pool heater during conduct of the following Method of Test.

### Method of Test

This test shall be conducted in conjunction with Clause 5.19.7. A fuming or smoking material, such as titanium tetrachloride, shall be introduced into the combustion chamber at the burner port level in sufficient amount to determine that, if flue gases are discharged through door cracks or other openings, their presence will be revealed by the smoke. If the discharge of smoke is not continuous, the appliance shall be considered as complying with this Clause.

### 5.4.7

A close proximity heater shall not produce a concentration of carbon monoxide in excess of 0.04 percent in an air-free sample of the flue gases when the combustion air opening is blocked to any degree up to and including complete closure. If flame outage occurs during blockage of the combustion air opening, all gas shall shut off as specified in the following Method of Test.

### Method of Test

The appliance shall be operated at normal inlet test pressure for at least 15 minutes. The area of the combustion air inlet shall then be gradually decreased to the lowest point at which the combustion continues. A sample of the flue gases shall then be secured and analyzed as specified in Clause 5.4.2.

In the event of outage, the blocked condition shall be maintained for 3 minutes, after which there shall be no flow of fuel gas to either the pilot or main burner(s).

### 5.4.8

A close proximity heater shall not produce a concentration of carbon monoxide in excess of 0.04 percent in an air-free sample of the flue gases when the venting system is blocked to any degree up to and including complete closure. If flame outage occurs during blockage of the combustion air opening, all gas shall shut off as specified in the following Method of Test.

### Method of Test

The appliance shall be operated at normal inlet test pressure for at least 15 minutes. The area of the venting system shall then be gradually decreased to the lowest point at which combustion continues. A sample of the flue gases shall then be secured an analyzed as specified in Clause 5.4.2.

In the event of outage, the blocked condition shall be maintained for 3 minutes, after which there shall be no flow of fuel gas to either the pilot or main burner(s).

## 5.5 Burner and pilot operating characteristics

### 5.5.1

Burners and pilots shall operate without depositing carbon during conduct of any of the tests specified in this Standard.

Under conditions of these tests, yellow-tipped flames are considered acceptable as long as carbon is not being deposited.

At the completion of all tests, the combustion chamber shall be examined for evidence of carbon.

An additional test for carbon deposit shall be conducted on the pilot without the main burner(s) in operation.

### 5.5.2

Pilot(s) and main burner flames shall not flash back during this or any of the other tests specified in this Standard.

### Method of Test

The appliance shall be operated for a period of 15 minutes at normal inlet test pressure. Then the main burner shall be turned off and back on with the main burner operating control. The test shall be repeated at the reduced inlet test pressure.

If the appliance is equipped with other than snap action main burner gas controls, this test shall be repeated with the gas rate to the main burner adjusted to deliver ⅓ of normal input rate.

In the event the control system shuts off the main burner gas before the gas rate is adjusted to deliver ⅓ the normal input rate, the test shall be conducted at the lowest input rate at which the control

system will permit burner operation. In any event, the shutoff point of the control system shall not exceed 87 percent of the minimum input rate.

For any appliance including those equipped with automatic multi-rate or automatic modulating controls that provide for ignition and operation at a reduced input rate and act to reduce the input rate after ignition of the main burner gas, the test shall be conducted at 87 percent of the minimum input rate.

### 5.5.3

Under the conditions of the following Method of Test, burners shall not expel the gas through air openings in mixer faces.

### Method of Test

The appliance shall be operated at the inlet test pressures specified in Clause 5.3.1 and at the input rate specified in Clause 5.3.4.

A flame shall be played on the mixer face in such a manner that any gas expelled from the mixer head would be ignited.

If the appliance is equipped with other than snap action main burner gas controls, this test shall be repeated with the gas rate to the main burner adjusted to deliver 1/3 the normal input rate.

In the event the control system shuts off the main burner gas supply before the gas rate is adjusted to deliver 1/3 of the normal input rate, the test shall be conducted at the lowest input rate at which the control system will permit burner operation.

### 5.5.4

Main burner flames of a pool heater shall not become extinguished during conduct of the following Method of Test.

### Method of Test

Burners for use with natural, manufactured, and mixed gases, or natural and mixed gases, shall be operated with test Gas A only.

Water, at a temperature of 40 ± 2 °F (4.5 ± 1 °C), shall be supplied to the appliance.

This appliance shall be operated at the normal inlet test pressure until condensation of the flue gases within the combustion chamber ceases, or for a period of time sufficient to demonstrate that it would continue to operate in a normal manner.

### 5.5.5

When ignition is made in a normal manner by means of the main burner operating control, flames shall not flash outside the combustion space.

### 5.5.6

Pilot(s) and main burner flames shall not flash back or become permanently extinguished when subjected to an external draft with the door or access panel open during conduct of the following Method of Test.

### Method of Test

The appliance shall be operated for a period of 15 minutes at normal inlet test pressure.

A 3 mph (1.34 m/s) wind shall then be directed for a period of 1 minute alternately against the front, sides, and back of the appliance by means of a fan or blower. This test shall be applied with or without the main burner(s) in operation.

### 5.5.7

For pool heaters provided with a power burner or induced draft, there shall be no back pressure at the burner mixer face and the burners shall effectively ignite without delayed ignition when tested as specified in the following Method of Test.

#### Method of Test

This test shall be conducted at the burner adjustment specified in Clause 5.3.3 and under the following conditions:

a) normal inlet test pressure with the supply voltage adjusted to deliver 110 percent of the appliance rating plate voltage;
b) normal inlet test pressure with the supply voltage adjusted to deliver 85 percent of the appliance rating plate voltage;
c) reduced inlet test pressure with the supply voltage adjusted to deliver 85 percent of the appliance rating plate voltage; and
d) reduce inlet test pressure with the supply voltage adjusted to deliver 110 percent of the appliance rating plate voltage.

Under each of the above conditions it shall be determined there is no back pressure at the burner mixer face (see Clause 5.5.3).

### 5.5.8

For pool heaters equipped with Bunsen-type pilots, ignition of gas at the main burner(s) shall take place in a normal manner even though the pilot gas is burning at the orifice when tested as specified in the following Method of Test.

#### Method of Test

Pilot flashback shall be induced with an external flame if necessary. The pilot gas supply shall be reduced to an amount just sufficient to maintain the safety shutoff device in the open position. The main gas valve shall be opened and ignition observed.

### 5.5.9

Flames of atmospheric type burners shall not abnormally lift off the burner ports when the appliance is tested at rated input under normal operating conditions.

Intermittent dancing or fluttering of flames at the burner ports is acceptable on ignition of the main burner gas, when the burner is cold and when the appliance is tested under increased and reduced inlet test pressures.

## 5.6 Piloted ignition systems

### 5.6.1

The time after the initiation of gas flow to prove the ignition source shall not exceed the ignition means flame-establishing period specified in Table 2, Maximum safety control timings, when operated at normal inlet test pressure.

For purposes of this test, the control manufacturer's specified maximum flame-establishing period shall be used.

### 5.6.2

When tested in accordance with the following Method of Test, the pilot(s) shall effect safe ignition of gas at the main burner(s) after gas reaches the main burner port(s).

Continuous pilots shall not become extinguished and remain extinguished when the gas to the main burner(s) is turned on and off in a normal manner. This Clause does not apply to interrupted type pilots or to intermittent type pilots when the gas to the main burner(s) is turned off.

### Method of Test

This test shall be conducted over the range of inlet test pressures specified in Clause 5.3.1 for each type of gas selected.

At least 25 successive ignition tests shall be conducted. The thermostat shall be manually cycled to provide a 30 second on time, beginning with the initial ignition of main burner gas, and a 30 second off time, beginning after any post purge function ceases. Failure to effect safe ignition after gas reaches the main burner port(s) in any one instance, continued extinction of the pilot, or a lockout of the automatic ignition system shall be considered as noncompliance with this Clause.

For a continuous pilot, these tests shall be repeated using the manual shutoff valve provided to cycle the main burner gas on and off. Movement of the handle shall be in a smooth continuous motion.

### 5.6.3

When an interrupted ignition source is provided, the time required for the main burner flame to be proved from the initiation of main gas flow shall not exceed the main burner flame-establishing period specified in Table 2, Maximum safety control timings, when the pool heater is operated at normal inlet test pressure.

For purposes of this test, the control manufacturer's specified maximum main burner flame-establishing period for the automatic gas ignition system shall be used.

### 5.6.4

The time required for the automatic gas ignition system to shut off the gas supply following loss of the supervised flame shall not exceed the flame failure response time and the valve closing time specified in Table 2, Maximum safety control timings.

For purposes of the following Method of Test, the control manufacturer's specified maximum flame failure response time shall be used.

### Method of Test

This test shall be conducted at normal inlet test pressure.

The action of the thermostat shall be nullified. On an appliance for installation with mechanical means for water circulation, the flow of water through the appliance shall be regulated to deliver outlet water at the maximum outlet water temperature determined under Clause 5.12.3 with the water system adjusted as specified in Clause 5.12.3.