Exterior walls must be of $^3/_4$ in plywood and finished with dull black. Wall configuration distances must be in accordance with the manufacturer's instructions and must include overhangs and perpendicular corner type installations. For test purposes, a 4 ft (1.2 m) depth shall be provided for overhangs.

A grid of bead-type thermocouples must be installed onto the exterior, black wall surface at a distance of no more than 3 in (76 mm) apart. The grid must also extend to the perpendicular wall. (See Figure 6, Test enclosure configuration.)

The appliance must be fired until equilibrium temperatures have been reached, after which time the temperatures on the exterior wall surface must be recorded.

9.6 Temperature at discharge air opening and surface temperatures

9.6.1
Gravity type wall furnaces (other than for recreational vehicle installation)

a) When tested according to the following Method of Test, the average temperature of the air at the discharge air opening(s), which is above 36 in (914 mm) from the bottom of the appliance and is located in the upper $^1/_3$ of the appliance, shall not exceed 280°F (138 °C) above room temperature.

Method of Test

The average discharge air temperature shall be measured after 1 hour of appliance operation in an open room at normal inlet test pressure.

A test device, as shown in Figure 7, Typical device for measuring discharge air temperatures, shall be used to determine the average outlet air temperature. When two adjacent sides of the discharge air opening are 12 in (305 mm) or greater, the test device shall have 12 in (305 mm) sides. When both dimensions are less than 12 in (305 mm), the device shall be the size of the discharge air opening. When one side of the discharge air opening is 12 in (305 mm) or more, and the other side is less than 12 in (305 mm), the smaller side of the test device shall equal the smaller dimension of the discharge air opening, and the other side of the test device shall not be longer than the larger dimension of the discharge air opening and in addition shall not be longer than a size that would provide an area of 144 in^2 (0.09 m^2) for the device. The test device shall be contoured to fit the discharge air opening. Five (5) parallel connected bead-type 24 AWG (0.20 mm^2) thermocouples shall be positioned on the thermocouple support wires as shown in Figure 7. A distance of 1 in (25.4 mm) between the thermocouples and the discharge air opening shall be maintained.

When a discharge air opening exceeds an area of 144 in^2 (0.09 m^2) as described above, the test device shall be located over that section of the discharge air opening which will result in the highest average discharge air temperature.

b) When tested according to the following Method of Test, surfaces of a discharge air opening(s), which are located in the upper $^1/_3$ of the appliance and less than 36 in (914 mm) from the bottom of the appliance, and parts within 2 in (50.8 mm) of this opening(s) that can be contacted by the probe shown in Figure 6, Accessibility probe for heated surfaces, shall not exceed 280°F (138 °C) above room temperature.

Guards and surfaces of the top, front, and sides of an appliance which can be contacted by the probe shown in Figure 6, other than those surfaces described in the preceding paragraph, shall not have temperatures exceeding the following:

i) 140°F (60 °C) above room temperature on any surface up to and including 18 in (457 mm) above the bottom of the appliance;

ii) 180°F (82 °C) above room temperature on any surface above 18 in (457 mm) from the bottom of the appliance.

Discharge air openings, parts directly exposed to radiation from flames or glowing surfaces through front openings, and parts within 2 in (50.8 mm) of these discharge air and front openings are exempt from this provision.

Method of Test

The appliance shall be operated as specified in (a) above, and the temperatures of the appliance surfaces and guard, if used, shall be determined by means of one of the probes shown in Figure 10, Temperature-measuring probe.

9.6.2

Fan-type wall furnaces (other than for recreational vehicle installation)

a) The average temperature of the air at the discharge air opening(s) shall not exceed 130°F (54.5 °C) above room temperature during conduct of the following Method of Test.

Method of Test

The appliance shall be operated in an open room at normal inlet test pressure for at least 15 minutes, after which a fuming or smoking material shall be introduced downstream of the circulating air blower to form a dense smoke. Those openings or portions of openings through which smoke is emitted shall be considered the discharge air opening(s).

The appliance shall be operated for a total of at least 1 hour and the average discharge air temperature shall be determined as specified in Clause 9.6.1(a).

b) Guards and surfaces of the top, front, and sides of an appliance that can be contacted by the probe shown in Figure 6, Accessibility probe for heated surfaces, other than surfaces of the discharge air opening(s) determined in (a) above, and parts within 2 in (50.8 mm) of these openings, shall not have temperatures exceeding 140°F (78 °C) above room temperature on any surface when tested as specified in the following Method of Test.

Method of Test

The appliance shall be operated as specified in Clause 9.6.1(a) and the temperatures of the appliance surfaces and guards, if used, shall be determined by one of the means of the probes shown in Figure 10, Temperature-measuring probe.

9.6.3

Wall furnaces for recreational vehicle installation

a) Surface temperature of fan-type appliances under normal operating conditions

The average temperature of the surfaces within the discharge air opening shall not exceed 140°F (60 °C) above room temperature when tested as specified in the following Method of Test.

Method of Test

The appliance shall be installed as specified in Clause 9.5, Wall, floor, and ceiling temperatures. Sixteen bead-type 24 AWG (0.20 mm^2) iron-constantan thermocouples shall be welded or brazed on the metal casing surface closest to the intersection of 4 vertical and 4 horizontal lines that divide the vertical front surface of the appliance into 25 equal areas. The appliance shall be operated at normal inlet test pressure and at normal voltage with any filters removed, until the vertical front surface has reached equilibrium conditions (average temperature change of less than 1 degree in 5 minutes). The 8 thermocouples indicating the highest temperature shall be connected in parallel, and the resultant temperature recorded shall not exceed 140°F (60 °C) above room temperature.

b) Surface temperature of gravity type appliances under normal operating conditions

The average temperature of the surfaces within the discharge air opening shall not exceed 210°F (99 °C) above room temperature when tested as specified in the following Method of Test.

Method of Test

The appliance shall be tested as specified in Clause 9.6.3(a), and the resultant temperature recorded shall not exceed 210°F (99 °C) above room temperature.

c) Discharge air and surface temperature under abnormal blockage condition

The spot temperature of the discharge air and the metal casing surface temperature of unblocked portions of an appliance for recreational vehicle installation shall not exceed 280°F (138 °C) above room temperature, and the spot temperature on the cotton sheet blanket covering the blocked portion of the appliance shall not exceed 240°F (115.5 °C) above room temperature when determined as specified in the following Method of Test.

Method of Test

Bead-type 24 AWG (0.20 mm^2) iron-constantan thermocouples for individual temperature determinations shall be placed in the center of the discharge air openings in the same plane as the surface of the surrounding jacket. Thermocouples shall be spaced 3 in (76.2 mm) apart in a horizontal row to measure spot discharge air temperatures. The thermocouple arrangement shall be located in the discharge air openings so as to measure those areas where it is deemed the highest temperatures will occur. Thermocouples shall also be welded or brazed on the metal casing surfaces adjacent to the discharge air openings and arranged in the manner prescribed above. Additional thermocouples may be installed at the discretion of the testing agency. The appliance shall be placed in operation at normal inlet test pressure and operated until equilibrium discharge air temperatures are attained.

The entire length of the inlet and discharge air openings shall then be progressively blocked from bottom to top until the temperature limit control(s) acts to shut off the main burner gas supply. If the limit control(s) is not of the manual reset type, the appliance shall be allowed to cycle on the limit control until the surface and cotton sheet blanket temperatures do not increase for 3 successive burner cycles.

Progressive blockage shall be obtained by placing a 100 percent cotton sheet blanket* folded in 4 layers directly over the circulating air openings of the appliance in increments of not less than 1 in (25.4 mm). Twenty-four AWG (0.20 mm^2) iron-constantan bead-type thermocouples shall be sewn with cotton thread to the surface of the blanket in the areas of highest temperature. The thermocouple beads shall be located on the side facing the appliance and $^3/_4$ in (19 mm) apart with 1 in (25.4 mm) of the lead wires exposed to the heat source.

This test procedure shall then be repeated, except that the entire length of the inlet and discharge air openings shall be progressively blocked (1) from top to bottom, and (2) from each side toward the opposite side. In the event all thermocouples are covered by this blockage, the unblocked portion of the discharge air openings shall be probed with a bead-type 24 AWG (0.20 mm^2) iron-constantan thermocouple to determine the maximum spot discharge air temperature.

When unusual appliance designs or control applications are involved, blockage tests other than those described above may be applied at the discretion of the testing agency.

Any discharge air or metal casing surface temperature in excess of 280°F (138 °C) above room temperature or any cloth temperature in excess of 240°F (115.5 °C) above room temperature is considered as not complying with this provision.

* *The density of the cotton sheet blanket shall be 1.9 ft^2/oz (6.2 m^2/kg).*

9.6.4

Baseboard type heaters shall comply with Clause 9.6.3 when tested as specified in Clause 9.6.3.

9.6.5
A wall furnace shall remain in continuous operation without a limit control functioning to shut off the gas supply when the appliance is operated at normal inlet test pressure for at least 1 hour at room temperature [70°F ± 10°F (21 °C ± 5.5 °C)].

9.6.6
When tested as specified in the following Method of Test, the temperatures of all parts that the operator is normally expected to handle in normal operation of the wall furnace shall not exceed room temperature by more than 60°F (15.5 °C) for metallic parts or 80°F (26.5 °C) for non-metallic parts.

Method of Test
Temperatures of handled parts shall be measured by means of 24 AWG (0.20 mm^2) iron-constantan thermocouples in firm contact (such as by cementing or taping) with the surfaces of these parts. Temperatures shall be taken on all portions of handled parts that are grasped during normal use.

This test shall be conducted concurrently with the test specified in Clause 9.5.1. The appliance shall be operated at normal inlet test pressure for 1 hour. At the end of this time, the surface temperatures of handled parts shall not exceed room temperature by more than 60°F (15.5 °C) for metallic parts or 80°F (26.5 °C) for non-metallic parts.

9.6.7
The primary temperature limit control shall act to shut off the gas supply to the main burner(s) when or before the average temperature of the discharge air reaches 250°F (121 °C) in accordance with the following Method of Test.

Method of Test
Five bead-type 24 AWG (0.20 mm^2) thermocouples shall be placed in each discharge air opening, in a plane 1 in (25.4 mm) from the grille(s). These thermocouples shall be located along diagonals drawn between opposite corners of each grille as follows: one at the intersection of the diagonals, and two on each diagonal, located $^2/_3$ of the distance from the center to the grille corners. (In the case of other than rectangular grilles, the five thermocouples shall be located at the discretion of the testing agency in such a manner as to obtain substantially an average discharge air temperature.)

The appliance shall be placed in operation and a preliminary test conducted to determine the degree of blocking of the cold air inlet required to produce the discharge air temperature that will cause the primary limit control to function. The cold air inlet blockage shall then be relieved slightly and the appliance operated until substantially equilibrium discharge air temperatures have been attained.

The cold air inlet shall then be gradually blocked over a period of 10 minutes until the effective area is reduced to 5 percent of its original area. The appliance shall then be operated until the primary temperature limit control acts to shut off the gas supply to the main burner(s). The average discharge air temperature at this instant shall not exceed 250°F (121 °C).

9.7 Evaluation of clothing ignition potential
During conduct of the following Method of Test, a wall furnace shall be designed so it will not readily ignite clothing or flammable materials brought in contact with the appliance.

Method of Test

Safety screens and guards provided as a part of the appliance by the manufacturer as specified in Clause 4.1.5 shall be in place during this test.

One hundred percent white terry cloth test material with a pile weave on both sides, nominal 8 ounces per square yard, and preconditioned at 30 percent relative humidity, or less, at 75°F (24 °C) for at least 24 hours, shall be used. Test samples shall consist of a single layer of the test material 6 in (152 mm) wide and equal in length to the height of the appliance.

A test sample shall be draped on a probe as shown in Figure 11, Probe for evaluation of clothing ignition potential. The appliance shall then be operated as specified in Clause 9.6.1 at the end of which time the probe, with its handle maintained in a horizontal position at all times and its axis at any vertical height with respect to the appliance, shall be advanced toward the appliance from any direction, including from above, until the frame of the probe contacts any surface or guard. The probe shall then be maintained in that position for 30 seconds. No flaming of the test material shall occur.

A previously unused test sample shall be used for each evaluation.

9.8 Wind tests

9.8.1

The gas at the pilot burner(s) shall be capable of being ignited when the vent-air intake terminal is exposed to a wind having a nominal velocity of 10 mph (4.47 m/s) as tested in accordance with the following Method of Test.

Method of Test

The test shall be conducted at normal inlet test pressure.

The appliance shall be installed in the test wall structure as specified in Clause 9.1. Deflector walls shall be installed against the test wall structure so the wind from the wind apparatus will not affect that section of the appliance normally located within the room.

A draft produced by a blower having sufficient capacity to develop a 0.04 in wc (10 Pa) static pressure nominal velocity of 10 mph shall be directed against the outside surface of the test structure on which the vent-air intake terminal is attached. The blower shall be located so the wind is directed perpendicularly to the surface of the wall structure. Static pressure shall be measured by means of static pressure taps encompassing the area of the vent terminal. The static pressures at these points shall indicate uniform pressure distribution. At the discretion of the testing agency, additional tests may be conducted with the same fan setting as determined above, with the draft directed from other directions.

With the appliance subjected to the above wind conditions, the gas at the pilot burner(s) shall be capable of being ignited.

9.8.2

During conduct of the following Method of Test, the pilot(s) and main burner(s) shall not become extinguished, and the gas at the main burner(s) shall ignite from the pilot(s) without excessive delay, when the vent-air intake terminal is exposed to a wind having a nominal velocity of 40 mph.

Method of Test

The test shall be conducted at normal inlet test pressure.

The Method of Test specified in Clause 9.8.1 shall be applied except the blower shall be capable of producing a 0.66 in wc (164 Pa) static pressure nominal velocity of 40 mph on the surface of the test wall and the pilot(s) ignited before the appliance is subjected to the wind. With the pilot burner(s) operating alone and with the pilot burner(s) and main burner(s) operating simultaneously under the above wind conditions, the pilot(s) and main burner(s) shall not become extinguished during a 10-minute period.

The main burner valve shall then be shut off. After a period of at least 30 seconds the valve shall be turned on and the gas at the main burner(s) shall ignite from the pilot(s) without excessive delay. An automatically controlled appliance shall also comply with this test when the main burner(s) is turned on and off by the automatic controls.

At the discretion of the testing agency, additional tests may be conducted with the same fan setting and distance as determined above, with the wind directed from other directions.

9.9 Vent and vent-air intake terminals

9.9.1

A vent-air intake terminal shall be sufficiently rigid in construction and supported so it will withstand a load of 150 lb (68.0 kg) without extensive damage or alteration of its position with respect to the wall furnace. Following application of this load, the appliance shall comply with the combustion test specified in the following Method of Test.

Method of Test

A vertical suspension load of 150 lb (68.0 kg) shall be evenly distributed, without impact, over the vent-air intake terminal.

The load shall then be removed and shall not have caused substantial distortion of any part of the vent-air intake terminal or alteration of its position relative to the appliance so the appliance would not operate satisfactorily.

The appliance shall then be operated at normal inlet test pressure until equilibrium conditions are attained, at which time a sample of the flue gases shall be secured and analyzed as specified in Clause 9.3.1. The concentration of carbon monoxide, based on an air-free sample of the flue gases, shall not exceed 0.04 percent.

9.9.2

The vent-air intake terminal for horizontal installations shall be sufficiently rigid in construction so as not to become damaged to the extent that it would be unsafe for use when subjected to impact as specified in the following Method of Test. Following impact of the vent-air intake terminal, the wall furnace shall comply with the combustion test specified in the following Method of Test.

Method of Test

The impact shall be produced by a pendulum consisting of a cloth bag filled with 25 lb (11.3 kg) of sand suspended from a steel cable or rope. The bag shall be formed from a flat section of burlap, canvas, or suitable material. A suitable plastic liner may be used to prevent sand loss. All sides and corners of the cloth shall be drawn up as tightly as possible around the sand and the excess material tied as close as

possible at the top of the bag. The bag shall have an at-rest position not more than 1 in (25.4 mm) from the edge of the bag to the nearest edge of the vent-air intake terminal. The point of impact shall be opposite the center of gravity of the bag. The distance of swing [angle 45 degrees (0.79 rad)] shall be measured as the angle (see Figure 14, Arrangement of sandbag and vent terminal for impact test, side views A and B) between the pendulum arm with the bag at its at-rest position and the pendulum arm at its elevated position. The length of the pendulum is that distance measured from the point of rotation to the center of gravity of the bag.

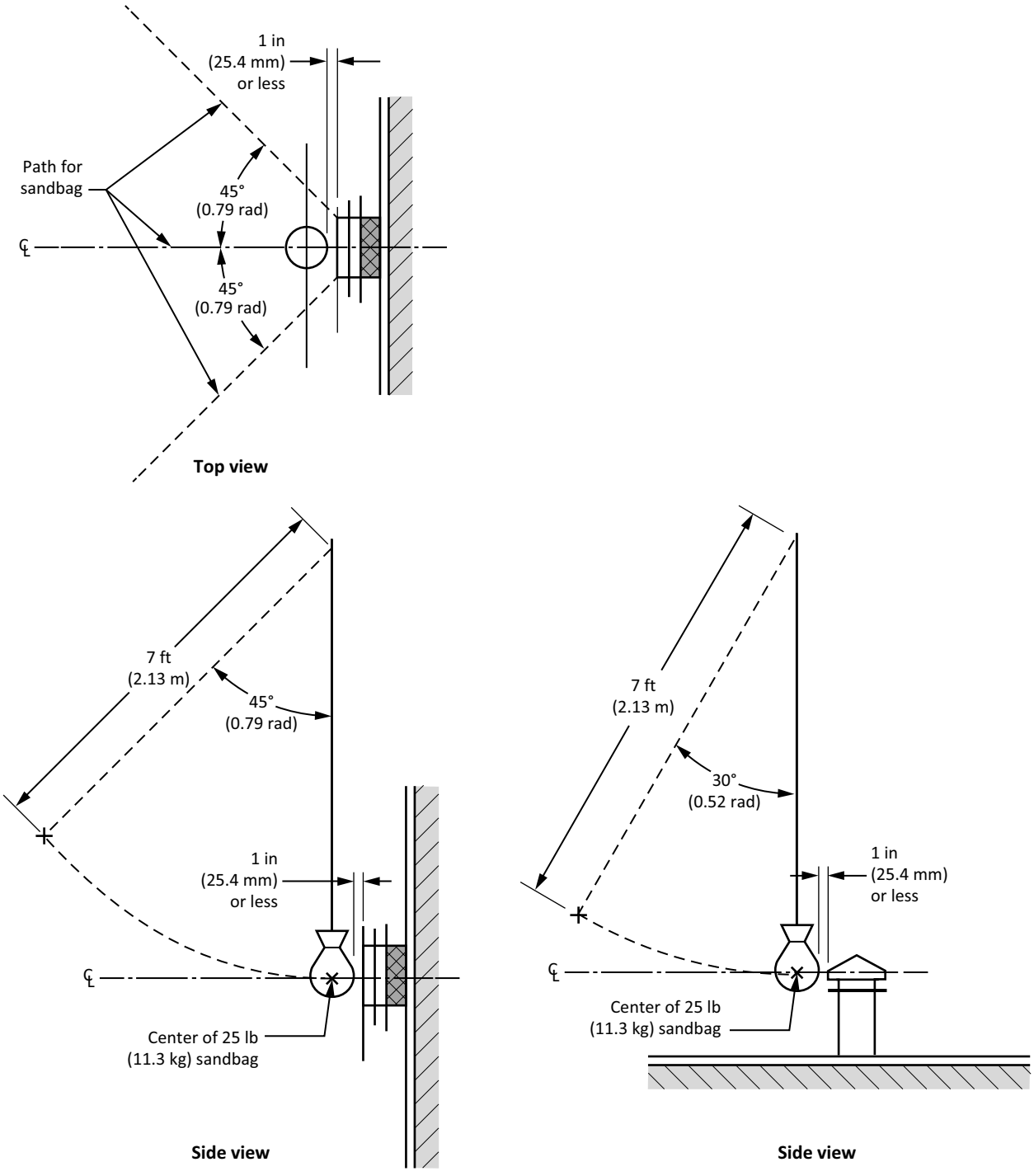
On a horizontal vent-air intake terminal, one impact shall be made at each of the following points, as shown in Figure 14a:

a) the center of the vertical front surface of the vent-air intake terminal;
b) the leading edge on the left side of the vent-air intake terminal, pendulum rotated left, at an angle of 45 degrees (0.79 rad) from the point described in (a); and
c) the leading edge on the right side of the vent-air intake terminal, pendulum rotated right, at an angle of 45 degrees (0.79 rad) from the point described in (a).

Following each impact, the appliance shall be operated at normal inlet test pressure until equilibrium conditions are attained at which time a sample of the flue gases shall then be secured and analyzed as specified in Clause 9.3.1. In each case, the concentration of carbon monoxide, based on an air-free sample of the flue gases, shall not exceed 0.04 percent.

At the option of the manufacturer, the vent or vent-air intake terminal may be replaced following each impact and combustion test.

Figure 14
Arrangement of sandbag and vent terminal for impact test
(See Clause 9.9.2.)



a) Horizontal caps

b) Vertical caps

9.9.3

When tested as specified in the following Method of Test, vertical vent and vent-air intake terminals shall be constructed so no water will accumulate in the wall furnace when subjected to a simulated rainstorm.

Method of Test

The vent or vent-air intake terminal shall be secured to a suitable water-tight container and placed on the test platform of the rain test apparatus described in Figure 15, Arrangement of spray heads and associated piping for simulated rainstorm test, and Figure 16, Spray head assembly and details of construction, in the position with respect to the spray heads deemed most critical by the testing agency.

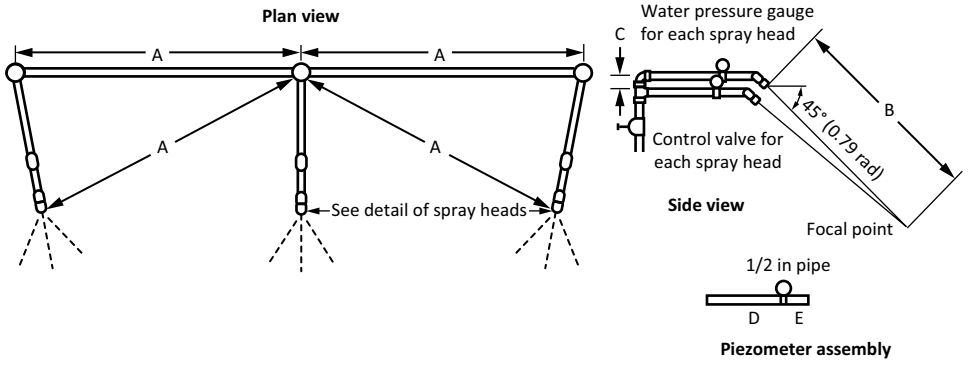
The rain test apparatus shall then be placed in operation and each spray head adjusted by means of the control valve to operate at 5 psi (34.5 kPa). The spray head unit shall be adjusted to varying elevations and horizontal distances from the test platform to determine the most critical location. The exposure at the position deemed most critical by the testing agency shall be maintained throughout the test.

After adjustment of the spray head unit, the rain test apparatus shall be operated for a period of 30 minutes.

The above test procedure shall be repeated with the terminal located in any other position(s) with respect to the spray heads deemed necessary by the testing agency.

Following application of the simulated rainstorm, there shall be no appreciable amount of water having entered the vent-air intake assembly.

Figure 15
Arrangement of spray heads and associated piping for simulated rainstorm test
(See Clause 9.9.3.)

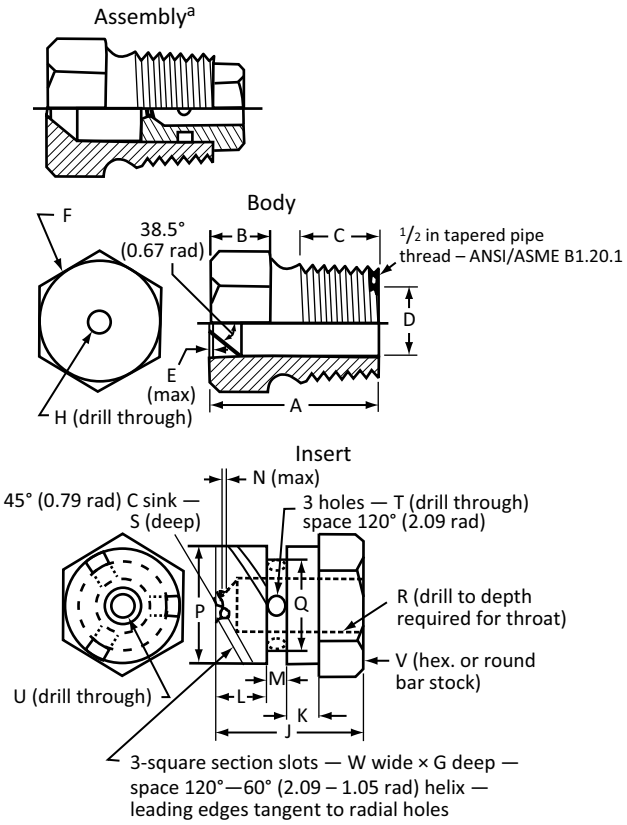


Item	Inch	(mm)
A	28	(711)
B	55	(1397)
C	2 1/4	(57)
D	9	(229)
E	3	(76)

Figure 16
Spray head assembly and details of construction
(See Clause 9.9.3.)

Item	Inch	(mm)	Item	Inch	(mm)
A	1 7/32	(30.96)	M	3/32	(2.38)
B	7/16	(11.11)	N	1/32	(0.79)
C	9/16	(14.29)	P	0.575	(14.60)
D	0.578	(14.68)		0.576	(14.63)
	0.580	(14.73)	Q	0.453	(11.51)
E	1/64	(0.40)		0.454	(11.53)
F	c	c	R	1/4	(6.35)
G	0.06	(1.52)	S	1/32	(0.79)
H	(No. 9)[b]	(5.00)	T	(No. 35)[b]	(2.79)
J	23/32	(18.26)	U	(No. 40)[b]	(2.49)
K	5/32	(3.97)	V	5/8	(15.88)
L	1/4	(6.35)	W	0.06	(1.52)

[a] — Molded nylon rain-test spray heads are available from Underwriters Laboratories Inc.
[b] — ANSI/ASME B94.11 drill size.
[c] — Optional — To serve as wrench grip.



9.9.4

Impact test for vent-air intake piping

The vent-air intake piping shall be sufficiently rigid in construction so as not to open up, break apart, or become damaged to the extent that it would be unsafe for use when subjected to impact in accordance with the following Method of Test. Following impact of the vent-air intake piping, the appliance shall comply with the combustion test outlined in the Method of Test.

Method of Test

The impact shall be produced by a pendulum consisting of a cloth bag filled with sand to a weight of 20 lb (9.1 kg) suspended from a steel cable or rope. The bag shall be formed from a flat section of burlap, canvas, or suitable material. A suitable plastic liner may be used to prevent sand loss. All sides and corners of the cloth shall be drawn up as tightly as possible around the sand and the excess material tied as close as possible at the top of the bag. The bag shall have an at-rest position not more than 1 in (25.4 mm) measured from the edge of the bag to the nearest edge of the vent-air intake piping. The point of impact shall be opposite and on the same horizontal plane as the center of gravity of the bag at rest. The distance of swing is required to raise the center of gravity of the bag to an elevation of 9 in (229 mm) above the center of gravity of the bag at its at rest position. (See Figure 17, Impact test for vent-air intake piping.)