d) The heat exchanger and appliance flue shall contain no traps or pockets in which condensation may collect.

37.3 Connections between the heat exchanger and the casing which encloses circulating air shall be constructed to prevent leakage of combustion products into the circulating air.

37.4 Provision shall be made to permit removal and replacement of the filters and oiling the motor and blower bearings without dismantling or removing any portion of the flue gas conveying system. For removal of the blower assembly, it is permissible to disconnect the flue gas conveying system.

38 Heating Boilers

38.1 A boiler shall be constructed, equipped, inspected, tested, and marked in accordance with the applicable Section of the ASME Boiler and Pressure Vessel Code, Section IV, Heating Boilers.

39 Water Heaters

39.1 Temperature-regulating control

39.1.1 A water heater shall be controlled by means of a temperature-regulating control.

39.1.2 A temperature-regulating control shall be capable of operation under rated electrical load or inherent load for 30,000 cycles of operation without any mechanical or electrical failure, impairment of operation, or apparent damage. Any change in calibration as a result of the operation test shall not exceed ±10°F (±5.6°C).

39.1.3 At the maximum setting allowed by a fixed stop, the temperature regulating control of a water heater shall limit the water temperature to not more than 194°F (90°C).

Exception: When the temperature-regulating control or controls and the limit control have cutout temperature tolerances not greater than ±5°F (±2.8°C), the maximum water temperature shall be 200°F (93.3°C).

39.1.4 An adjustable temperature regulating control shall be set at the factory to a control position corresponding to a 120°F (49°C) or lower setting. This setting is approximate in the case of a marking that reads ″Low-Medium-High″ or the equivalent, instead of directly in degrees Fahrenheit or Celsius.

39.1.5 A water heater equipped with a nonadjustable temperature-regulating control shall be set at 120°F (49°C) or lower.

Exception: A water heater equipped with a nonadjustable temperature-regulating control that is set above 120°F (49 °C) at the factory shall be provided with the Scald Hazard Label Marking described in 73.18 and shown in Figure 73.1.

39.2 Limit control

39.2.1 A water heater shall be provided with an automatic fuel shutoff system, e.g., temperature limit control, actuated by high-water temperature as an integral part of the heater. The shutoff system shall be of the manual reset type and shall be arranged to interrupt all fuel supply to the heater before the water has attained a temperature as specified in 22.3.7.

39.2.2 A manual-reset mechanism shall be accessible for resetting. A location behind an access cover in the jacket of the water heater is acceptable.

39.2.3 The automatic fuel shutoff system shall have no operating parts in common with the temperature-regulating device or control mentioned in 39.1.1, but a common mounting bracket or a common enclosure may be employed for both devices.

39.2.4 Immersion-type, temperature-limiting, devices shall be located so that the temperature-sensitive element is immersed in the water within the tank and controls the temperature of the water within the top 6 inches (152.4 mm) of the tank.

39.2.5 Surface-mounted, limit controls shall be mounted and located so that the temperature-sensitive element senses the water temperature within the top 6 inches (152.4 mm) of the tank. Such surface-mounted, temperature-sensitive elements shall be insulated or located so as to isolate them from flue gas heat or other ambient conditions that are not indicative of stored water temperature.

39.3 Water storage vessels

39.3.1 The water vessel shall withstand a hydrostatic test pressure of 300 psi (2.1 MPa), or its rated hydrostatic test pressure, whichever is greater, without developing leakage or visible permanent distortion, or the tank shall carry the symbol of the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1. The working pressure shall be not more than 50 percent of the hydrostatic test pressure. If the vessel is of steel, the inside surfaces shall be protected against corrosion by galvanizing, porcelain enameling, or the equivalent.

39.3.2 A storage vessel shall be equipped with a valve to facilitate emptying the tank.

39.3.3 Hot and cold water connections shall be clearly identified.

39.3.4 A storage tank shall have an opening for installation of a temperature-and-pressure relief valve. The opening:

a) Shall be located:

1) In the top of the tank, or

2) With its centerline in the upper 6 inches (152.4 mm) of the side.

b) Shall be separate from the openings for water connections.

c) Shall be threaded in conformity with the Standard for Pipe Threads General Purpose (Inch), ANSI/ASME B1.20.1-1983.

d) Shall accommodate a 3/4 inch (19.1 mm) or larger trade-size pipe. See ANSI/ASME B1.20.1-1983.

39.4 Materials contacting water

39.4.1 A nonmetallic material in contact with water shall comply with the requirements in the National Sanitation Foundation Standard for Plastic Piping System Components and Related Materials, NSF No. 14-1990, with regard to toxicity, waste, color, solubility, and odor.

39.5 Dip tubes

39.5.1 Dip tubes, if used, shall be provided with an antisiphoning hole located so that when the dip tube is installed, the hole will be within 6 inches (152.4 mm) of the top of the tank.

39.5.2 A dip tube having a specific gravity less than 1.0 shall be held in place by a positive means that will limit any vertical displacement to not more than 1/4 inch (6.4 mm).

39.5.3 A nonmetallic dip tube shall be investigated to determine its acceptability for the service, particularly with respect to solubility, brittleness, and resistance to deformation, collapse, and sagging, at temperatures likely to be encountered in service. See Nonmetallic Dip Tube Tests, Section 68.

39.5.4 Nonmetallic dip tubes shall be permanently marked with the manufacturer's name or identifying symbol and the lot number.

39.5.5 A nonmetallic material for a dip tube shall have a specific gravity greater than 0.94.

PERFORMANCE – ALL APPLIANCES

40 General

40.1 An appliance shall comply with the applicable requirements for performance as described herein using any grade or type of fuel recommended by the manufacturer of the appliance. Each size and type of appliance, or a number of sizes and types to be representative of the entire range of sizes and types are to be subjected to all or part of the tests prescribed herein. An appliance is to be tested with each optional piece of equipment (recommended for use by the manufacturer) which affects the performance of the equipment.

40.2 An appliance of a type not described specifically herein shall be tested in accordance with the intent of these requirements.

40.3 An appliance employing burners or parts which may be affected in their fuel-burning rate, operation, or calibration if the appliance is out of level shall perform in accordance with these requirements when the appliance is tested out of level at any and all angles of tilts of not more than:

a) Two degrees from the horizontal during the tests in Sections 49, 58 – 60, and 67, and

b) Three degrees from the horizontal during the Air Flow Test – Horizontal Appliances, Section 63.

40.4 In addition to the following tests, the appliance shall be tested in accordance with the requirements of 6.16, 6.17, 6.20, 14.1.7, 26.11, 39.1.2, and 39.3.1.

41 Flammability Test

41.1 Samples are to consist of at least three of each part, or of sections of each part as large as is practical to test. Sections should include the thinnest portions of the parts. Preferred sample size is 1/2 by 5 inches (12.7 by 127 mm) when practical and convenient.

41.2 The test flame is to be obtained by means of a Tirrill or Bunsen laboratory type burner having a nominal tube diameter of 3/8 inch (9.5 mm) and a length above the primary air inlets of approximately 4 inches (102 mm). The flame is to be adjusted to an overall height of 5 inches (127 mm) with an inner blue cone of 1-1/2 inches (38.1 mm). The area in which the test is to be conducted is to be shielded from drafts.

41.3 The part or section is to be arranged with the major axis of the sample area vertical, exposing thin sections to the maximum sweep of flame if practical. The test flame is to be applied to a lower edge of the specimen with the flame 20 degrees from the vertical. The flame is to be applied for 5 seconds and removed for 5 seconds until five such cycles of exposure have been completed. The specimen shall not continue to burn for more than 1 minute following the last exposure to the flame nor shall any material fall from the specimen during the test. Complete destruction of the sample is not acceptable.

41.4 An essentially identical set of samples is to be aged in a full-draft, circulating air oven at the aging temperature and time determined by the use of the finished part in accordance with Table 41.1.

41.5 The samples shall be removed from the oven at the end of exposure and subjected to the flammability test. The samples shall not show weakening, embrittlement, or other evidence of deterioration, which could prevent the intended operation of the assembly, and shall comply with the requirements of the flammability test.

Table 41.1
Aging temperature and time

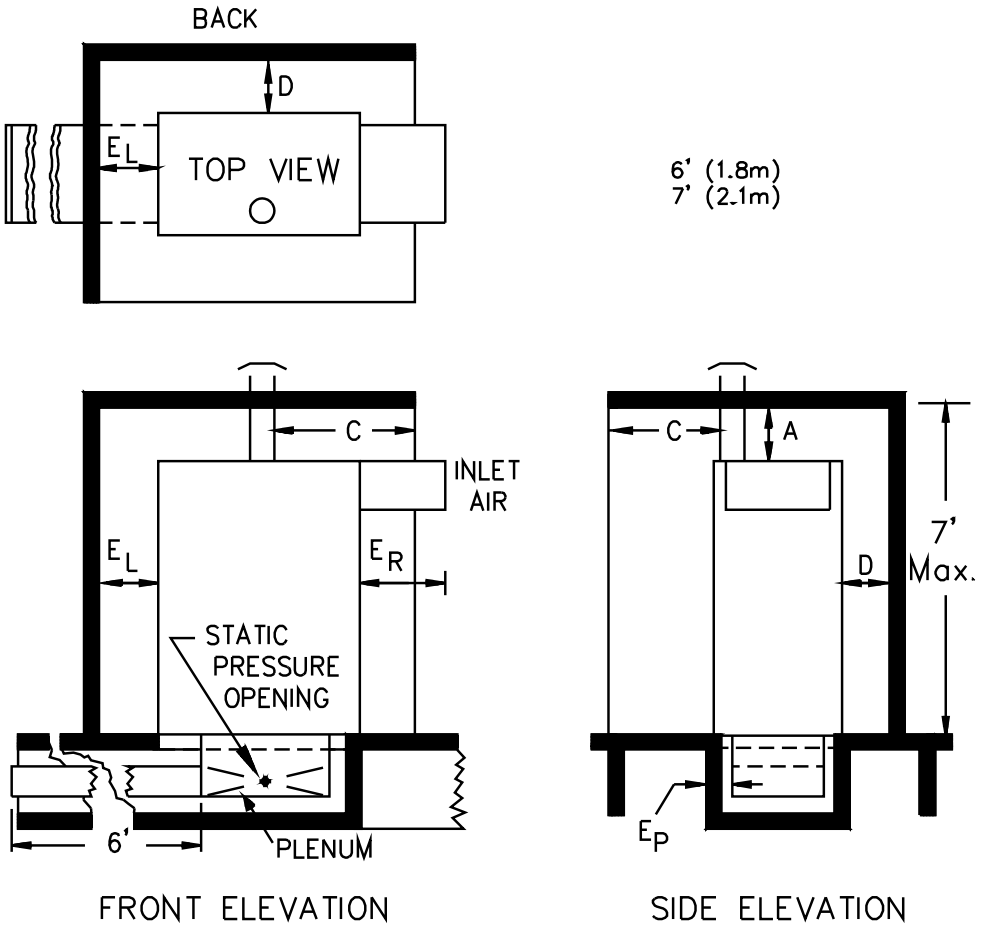
Intended use[a]	Maximum normal operating temperature		Aging temperature,		Aging time,
	°C	(°F)[b]	°C	(°F)	hours
Enclosure (indoor only)	65	(149)	90	(194)	168
Enclosure	75	(167)	90	(194)	1440
Enclosure	85	(185)	95	(203)	1440
Enclosure	95	(203)	105	(221)	1440
Enclosure	100	(212)	121	(250)	1440
Structural	50	(122)	75	(167)	1440
Structural	75	(167)	100	(212)	1440
Structural	100	(212)	121	(250)	1440

[a] If a material is used as both an enclosure and a structural part, it is to be subjected to the aging condition shown for structural parts.
[b] If normal operating temperature is between two values shown in table, the higher of these two values is used in determining the aging conditions.

42 Test Installation – Corner Location

42.1 A nonrecessed direct vent system appliance may be tested for installation in a room corner. The appliance is to be placed in a partial enclosure in the as-received condition, as described below. The distance from the chimney or vent connector and the distance from the back, side, and top of the appliance to the walls and ceiling of the enclosure are to be as indicated in Figure 42.1. If integral spacers are provided, the clearance may be other than specified, but not more than 2 inches (50.8 mm). When one side of the appliance may create a higher wall temperature than the other, that side of the appliance is to be directly opposite one wall.

Figure 42.1
Test enclosure – downflow furnace corner location clearances



A – From top of appliance.

C – From flue-gas outlet assembly.

D – From back of appliance, 0, 1, or 2 inches (0, 25, or 51 mm).

E_L – From left side of appliance 0, 1, or 2 inches (0, 25, or 51 mm) for left-hand corner installation, otherwise 24 inches (609.6 mm) or less.

E_P – Clearance from any side of supply plenum and warm-air duct within 3 feet (0.9 m) of appliance to be 0, 1/4, 1/2, 3/4, or 1 inch (0, 6.4, 12.7, 19.1, or 25.4 mm).

E_R – From right side of appliance, 0.1 or 2 inches (0.25 or 51 mm) for right-hand corner installation, otherwise 24 inches (610 mm) or less.

42.2 The ceiling height of the enclosure is to be that required to obtain the clearance from the top of the appliance to the ceiling specified by the manufacturer, but the ceiling height is to be not more than 7 feet (2.1 m).

42.3 The partial enclosure is to be formed by walls of nominal 1 inch (3/4 inch) (19.1 mm) wood boards or plywood 3/4 inch (19.1 mm) thick, set at right angles and finished in flat black. A ceiling and floor of equivalent construction are to be placed above and below the partial enclosure. The height of the walls is to be as shown. All joints are to be tight or sealed. The walls of the partial enclosure are to extend as shown.

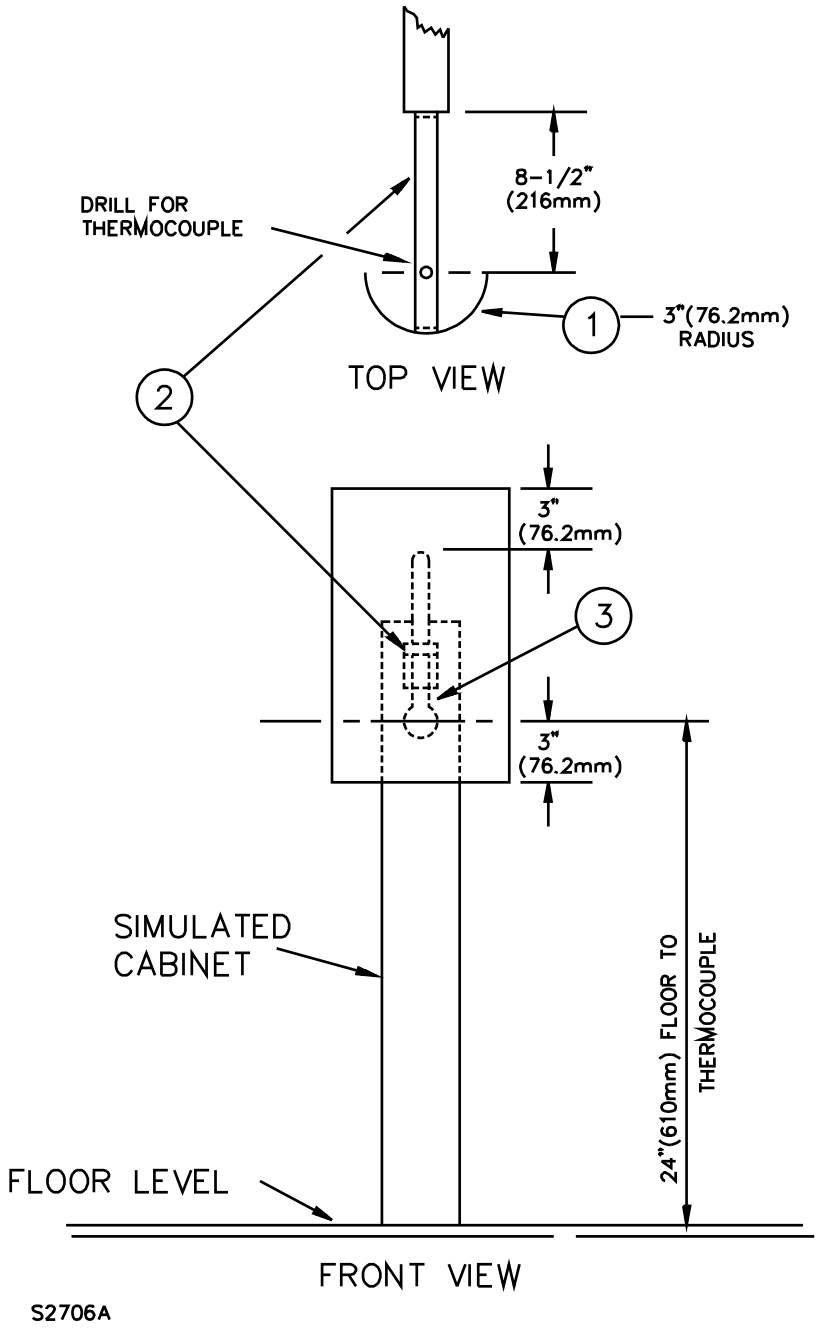
42.4 For a downflow furnace, a structure made of nominal 1 inch (3/4 inch) (19.1 mm) lumber or 3/4 inch (19.1 mm) plywood representing a floor and joint structure is to be placed around the warm-air outlet plenum and duct. The clearance between the plenum and duct and the enclosure is to be 0 or 1/4, 1/2, 3/4, or 1 inch (6.4, 12.7, 19.1, or 25.4 mm). The structure is to extend the full length of the duct. See Figure 42.1.

42.5 A thermocouple is to be placed centrally 15 inches (381 mm) in front of the appliance and 24 inches (610 mm) above the floor of the test enclosure as indicated in Figure 42.2.

Exception: For horizontal furnaces, the thermocouple for measuring room temperature is to be located midway between the floor and ceiling of the test enclosure.

42.6 The appliance is to be level. Leveling means, when provided, are to be removed if detachable, or, if not detachable, are to be adjusted to place the base of the appliance the minimum allowable distance above the floor.

Figure 42.2
Room temperature thermocouple



1. Bright aluminum No. 24 MSG or 0.020 inch (0.51 mm) minimum thick baffle, 6 inches (152.4 mm) longer than (3).

2. Bracket material, 1/8- by 1-inch (3.18 by 25.4 mm) strap iron.

3. Thermocouple, supported by bracket.

43 Test Installation – Upflow, Downflow, and Horizontal Furnaces for Alcove or Closet Location

43.1 Direct vent system appliances may be tested for installation in an alcove or closet. Appliances that provide for separation of the combustion system from indoor atmosphere by an installation method shall be tested in a simulated closet arranged to isolate the appliance from the interior atmosphere.

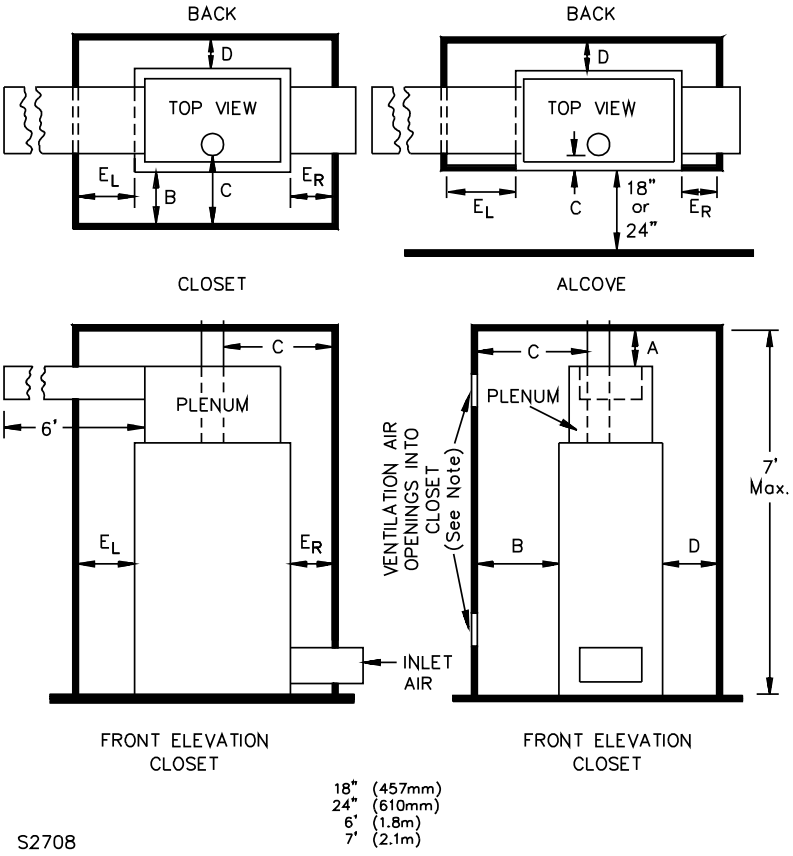
43.2 The furnace is to be installed in an enclosure, as described below, in the as-received condition, with clearances as specified by the manufacturer, to walls and ceiling of the test enclosure. Clearances to back and side walls are to be not more than 2 inches (50.8 mm). The specified clearances are to be maintained when the furnace is placed in the enclosure as close to such vertical walls as the construction of the appliance will permit. The ceiling height of the enclosure is to be that required to obtain the specified clearance from the top of the appliance to the ceiling, but in no case is the ceiling height to be more than 7 feet (2.1 m). See:

Figure 43.1 – Upflow appliances.

Figure 43.2 – Downflow appliances.

Figure 43.3 – Horizontal appliances.

Figure 43.1
Test enclosure for alcove or closet installation upflow heating appliances



A – From top of appliance casing or plenum.

B – From front of appliance.

C – From flue-gas outlet assembly.

D – From back of appliance, 2 inches (50.8 mm) or less.

E_L – From left side of appliance, 2 inches (50.8 mm) or less.

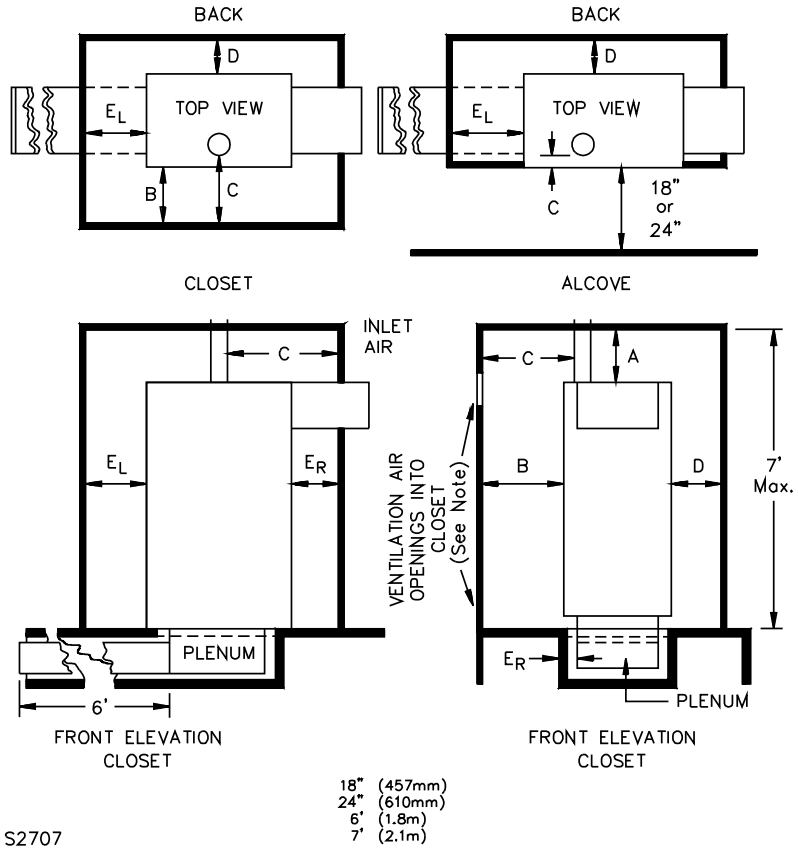
E_R – From right side of appliance, 2 inches (50.8 mm) or less.

E_P – Clearance from any side of supply plenum and warm-air duct within 3 feet (914 mm) of appliance, 0, 1/4, 1/2, 3/4, or 1 inch (0, 6.4, 12.7, 19.1, or 25.4 mm).

F – From bottom of suspended-type appliance.

Note – The ventilating openings and any door into a closet are intended to be extended to the outside of the manufactured home if the appliance is not of a design inherently separating the combustion system from the atmosphere of the manufactured home (direct vent system appliance).

Figure 43.2
Test enclosure for alcove or closet installation downflow heating appliance



A – From top of appliance casing or plenum.

B – From front of appliance.

C – From flue-gas outlet assembly.

D – From back of appliance, 2 inches (50.8 mm) or less.

E_L – From left side of appliance, 2 inches (50.8 mm) or less.

E_R – From right side of appliance, 2 inches (50.8 mm) or less.

E_P – Clearance from any side of supply plenum and warm-air duct within 3 feet (914 mm) of appliance, 0, 1/4, 1/2, 3/4, or 1 inch (0, 6.4, 12.7, 19.1, or 25.4 mm).

F – From bottom of suspended-type appliance.

Note – The ventilating openings and any door into a closet are intended to be extended to the outside of the manufactured home if the appliance is not of a design inherently separating the combustion system from the atmosphere of the manufactured home (a direct vent system appliance).