51.3 Any opening through which a warm-air duct passes from the enclosure is to be of such size that the edges of the opening will clear the duct by 5/16 inch (7.9 mm), and this space is to be filled with insulating material and sealed.

51.4 The size of the outlet duct is to be calculated for approximately 900 feet per minute (275 m/minute) of standard air, 0.075 pound per cubic foot (1.2 kg/m^3) with the designed temperature rise through the appliance and based on an outlet equivalent to 75 percent of the rated input [Btu per hour (0.293 x W)]. Specific heat of air is to be taken as 0.243 Btu per pound (565 J/kg).

51.5 The outlet duct area may be calculated by means of the following formula:

$$A_1 = (Btu/h)\ input \times \frac{0.11}{T_F} \quad or \quad A_2 = W \times \frac{1.05954}{T_c}$$

Where:

A_1 = area in square inch; A_2 = area in cm^2.

T_F = 85°F or the designed temperature rise.

T_c = 47.2°C or the designed temperature rise.

$(Btu/h)_i$ = Rated input in Btu/h

W = Rated input in watts

The area for an 85°F (47.2°C) temperature rise may be used in tests for other temperature rises.

51.6 The test duct is to be rectangular in shape, with a width approximately equivalent to the corresponding dimension of the plenum or plenum collar, but the aspect ratio is not to exceed four to one.

51.7 The warm-air duct outlet is to be arranged to discharge away from the cold-air inlet of the appliance; also away from the air inlet to the test enclosure for closet installation. The inlet and outlet ducts should be positioned from 90 to 180 degrees apart.

51.8 A horizontal heating appliance is to be tested with the outlet duct arranged as indicated in Figure 53.3.

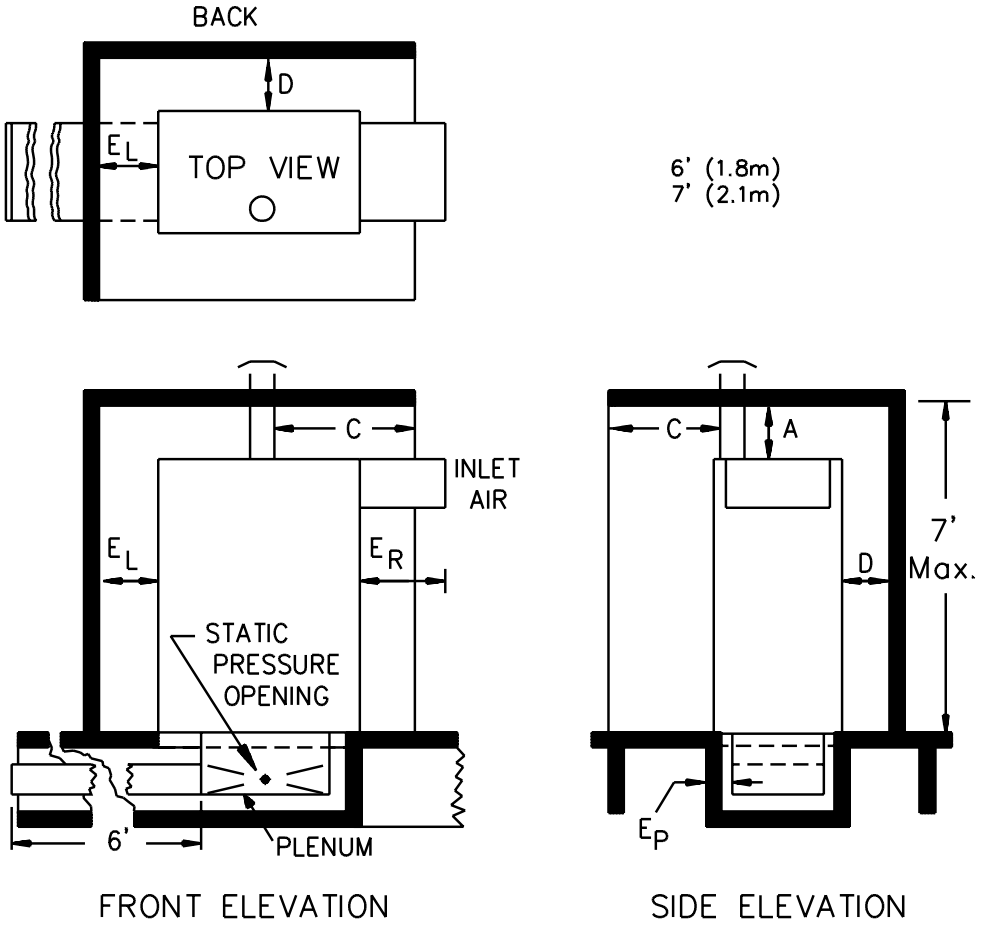
51.9 A thermocouple grid (see 50.7.1) is to be located in each warm-air outlet duct in a plane within 6 inches (152.4 mm) downstream from the position closest to the plenum where any thermocouple will not see any surface of the heat exchanger. The duct is to extend at least 6 inches (152.4 mm) beyond the thermocouple grid.

51.10 The cross-sectional area and shape of an air-inlet duct are to be equivalent to the cold-air inlet of the appliance. If a central heating appliance is of the direct vent type, the return-air inlet of the heating appliance need not be extended to the exterior of the alcove or closet, provided that compliance with 17.2 is obtained.

52 Corner Installation For Central Furnaces

52.1 A nonrecessed appliance of a construction inherently providing separation of the combustion system from the atmosphere of the manufactured home or recreational vehicle may be tested for installation in a room corner. The appliance is to be placed in a partial enclosure in the as-received condition. 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 52.1. 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 52.1
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 (610 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.

52.2 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).

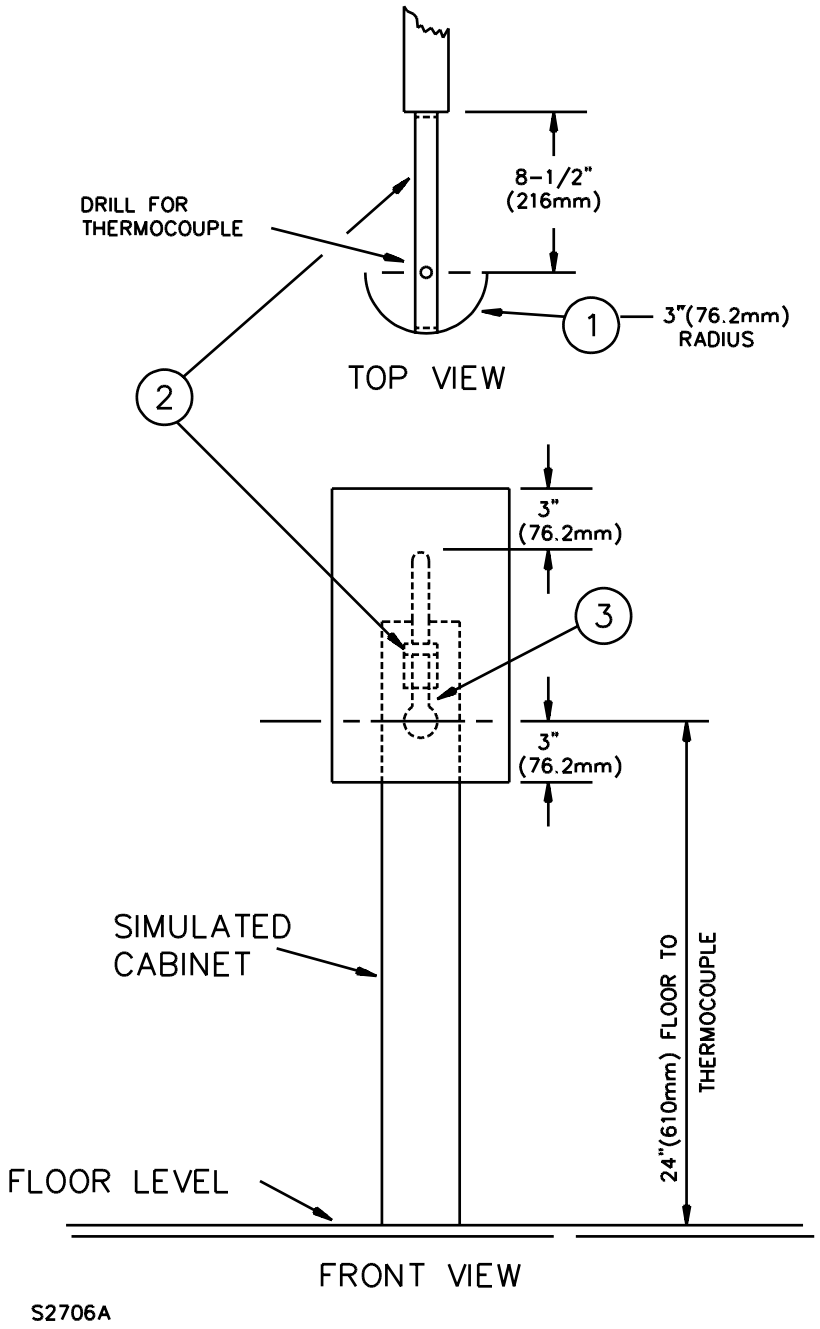
52.3 The partial enclosure is to be formed by walls of 1-inch wood boards (3/4 inch thick) or 3/4-inch (19.1-mm) thick plywood, set at right angles and finished in flat black. A ceiling and floor of equivalent construction are to be placed above and below the partial enclosure. The height of the walls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

52.4 For a downflow furnace, a structure made of 1-inch trade size lumber (3/4 inch thick) or 3/4-inch (19.1-mm) thick plywood representing a floor and joist 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), as specified by the manufacturer. The structure is to extend the full length of the duct. See Figure 52.1.

52.5 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 52.2.

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

Figure 52.2
Room temperature thermocouple



1. Bright aluminum baffle [No. 24 MSG or 0.020 inch (0.51 mm) minimum thick), 6 inches (152 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.

52.6 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.

53 Alcove or Closet Installation for Appliance Furnaces

53.1 An appliance of a construction inherently providing separation of the combustion system from the atmosphere of the manufactured home or recreational vehicle may be tested for installation in an alcove or closet. Other appliances may be tested only in a simulated closet arranged to isolate the appliance from the manufactured (mobile) home or recreational vehicle atmosphere.

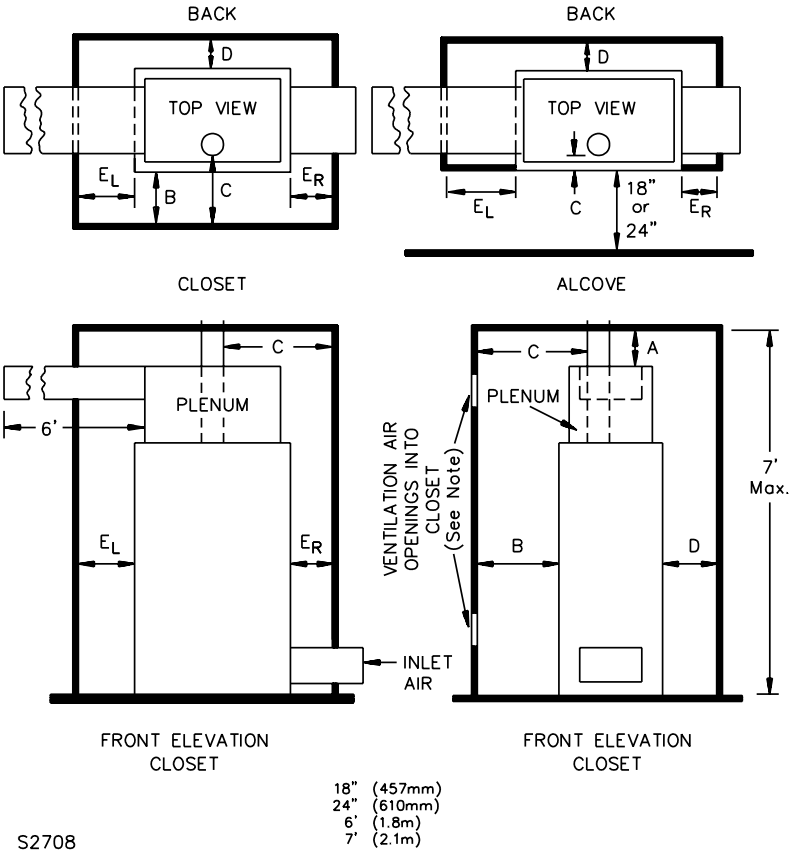
53.2 The appliance is to be installed in an enclosure, as described below, in the as-received condition, with clearances as specified by the manufacturer, to walls and ceiling of the test enclosure. Clearances to back and side walls are to be not more than 2 inches (50.8 mm). The specified clearances are to be maintained when the appliance 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:

a) Figure 53.1 – Upflow appliances.

b) Figure 53.2 – Downflow appliances.

c) Figure 53.3 – Horizontal appliances.

Figure 53.1
Test enclosure for alcove or closet installations



NOTES

Description of dimension symbols and abbreviations for heating appliances.

A – Clearance above top of appliance.

B – From front of appliance. Prefix ″C″ to numeral indicates suitability for installation in closet only; prefix ″A,″ suitability for installation in alcove only; no prefix indicates installation to be in a room only.

C – From flue gas outlet assembly.

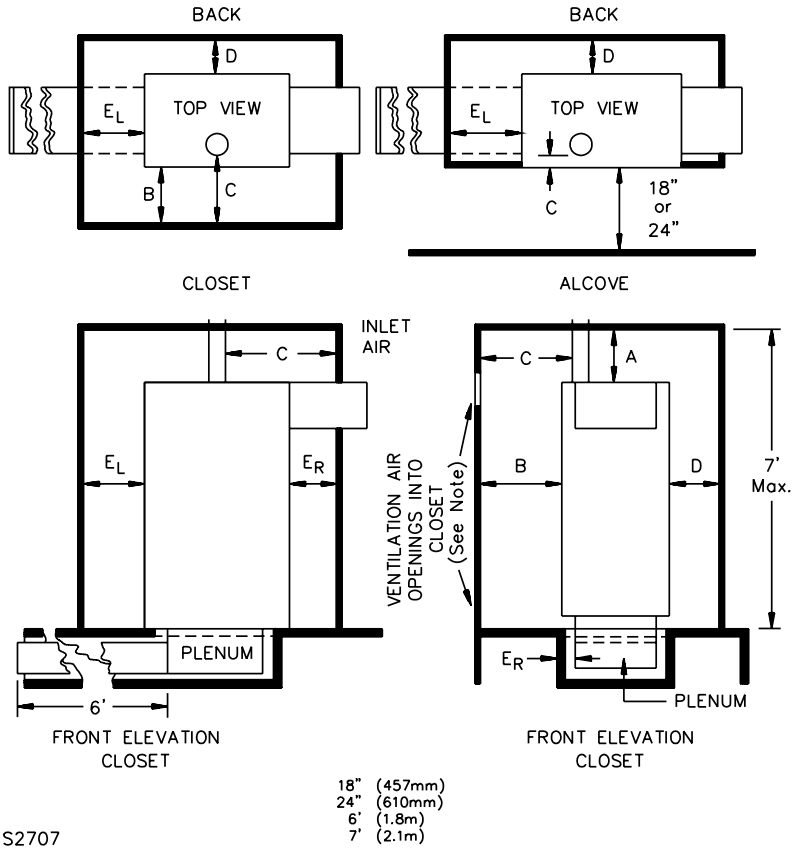
D – From back of appliance.

E^L – From left side of appliance.

E^R – From right side of appliance.

E^P – From any side of appliance pienum (downflow appliances have plenum beneath). ″E^P″ is only specified for appliances to be equipped with external plenums for connection to duct systems; its omission when A^D is specified indicates appliance equipped with integral plenum and if appliance is otherwise installed, clearances specified are not valid.

Figure 53.2
Test enclosure for alcove or closet installations



NOTES

Description of dimension symbols and abbreviations for heating appliances.

A – Clearance above top of appliance.

B – From front of appliance. Prefix ″C″ to numeral indicates suitability for installation in closet only; prefix ″A,″ suitability for installation in alcove only; no prefix indicates installation to be in a room only.

C – From flue gas outlet assembly.

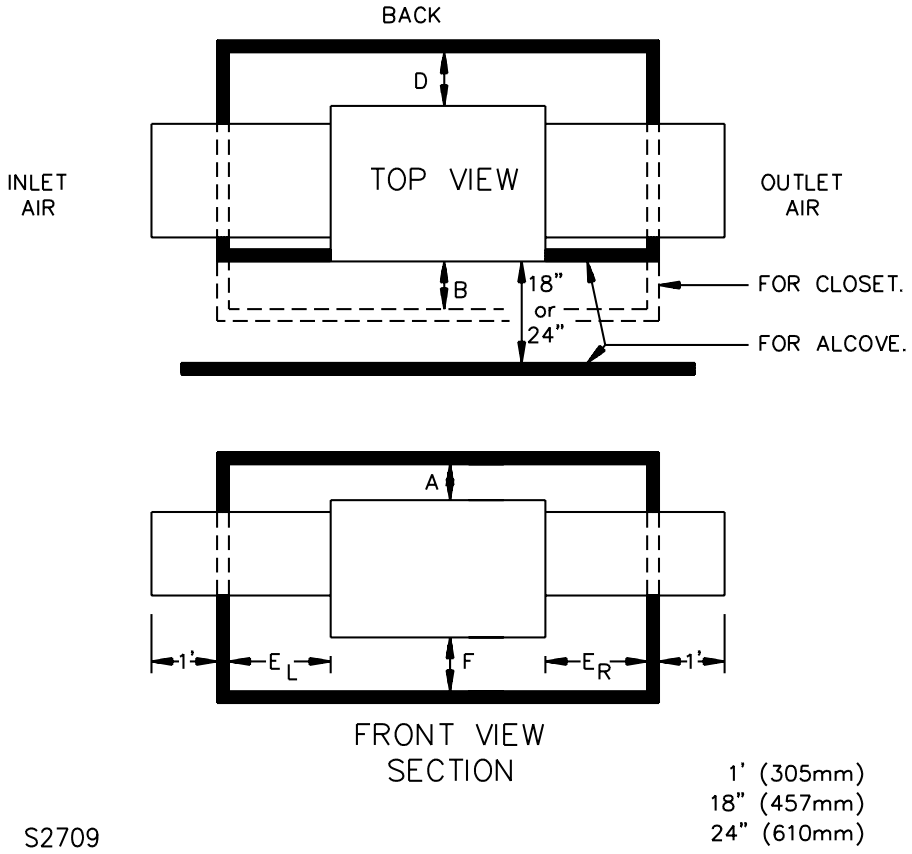
D – From back of appliance.

E^L – From left side of appliance.

E^R – From right side of appliance.

E^P – From any side of appliance pienum (downflow appliances have plenum beneath). ″E^P″ is only specified for appliances to be equipped with external plenums for connection to duct systems; its omission when A^D is specified indicates appliance equipped with integral plenum and if appliance is otherwise installed, clearances specified are not valid.

Figure 53.3
Test enclosure for alcove or closet installations



NOTES

Description of dimension symbols and abbreviations for heating appliances.

A – Clearance above top of appliance.

B – From front of appliance. Prefix ″C″ to numeral indicates suitability for installation in closet only; prefix ″A,″ suitability for installation in alcove only; no prefix indicates installation to be in a room only.

C – From flue gas outlet assembly.

D – From back of appliance.

E^L – From left side of appliance.

E^R – From right side of appliance.

E^P – From any side of appliance pienum (downflow appliances have plenum beneath). ″E^P″ is only specified for appliances to be equipped with external plenums for connection to duct systems; its omission when A^D is specified indicates appliance equipped with integral plenum and if appliance is otherwise installed, clearances specified are not valid.

53.3 The walls, floor, and ceiling of the enclosure are to be made of 1-inch trade size wood boards (3/4 inch thick) or 3/4-inch (19.1-mm) thick plywood. The walls are to be vertical and at right angles. The interior surfaces of the walls, floor, and ceiling are to be finished in flat black. All joints in the enclosure are to be sealed.

53.4 For alcove installation test, the enclosure is to be three-sided, leaving the front side of the appliance casing exposed. Any remaining opening around the casing from side to side and from floor to ceiling is to be closed with 3/4-inch (19.1 mm) plywood if the appliance is not provided with a frame or panel for this purpose. The side walls are to terminate flush with the front of the appliance, and a wall is to be placed opposite the open side of the enclosure at a distance of 18 or 24 inches (467 or 610 mm), as specified by the manufacturer for testing purposes. If it is evaluated that such an installation may create higher temperatures at some locations, an appliance may also be tested with one side wall of the enclosure extended 18 inches (457 mm) beyond the front of the appliance, in which case there is to be no wall placed opposite the front of the appliance.

53.5 For closet installation test, a simulated door is to be provided for the enclosure. Such door is to be made of 3/4-inch (19.1-mm) thick plywood, the interior surfaces of which are to be finished in flat black. If the door is to be provided with openings, they are to be placed at locations with respect to the appliance in accordance with the manufacturer's installation instructions.

53.6 For a downflow appliance, a structure made of nominal 1-inch trade size lumber (3/4 inch thick) or 3/4-inch (19.1-mm) plywood representing a floor and joist 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), as specified by the manufacturer. The structure is to extend the full length of the duct. See Figure 53.2.

53.7 The room temperature is to be measured by a thermocouple not larger than 24 AWG (0.21 mm^2), suitably shielded from direct radiation. For alcove installation, the 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, except that for a horizontal heating appliance, the thermocouple is to be located midway between the floor and ceiling of the test enclosure. For closet installation, the thermocouple is to be placed in the center of the lower ventilating opening into the closet when the manufacturer's instructions recommend that such openings be provided; otherwise the thermocouple is to be placed as specified above for alcove installation.

53.7 revised February 2, 2009

53.8 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.

54 Wall Furnace Installation

54.1 A wall furnace is to be installed in or on a test wall as intended in accordance with the manufacturer's published instructions furnished with the furnace and with commonly observed practice. The height of the test wall is to be 6 feet, 6 inches (2.0 m) and the front and back panels are to be of 1/4-inch (6.4-mm) thick plywood. The wall studs are to be of a depth to accommodate the required spacing between panels and are to be placed to accommodate the width of the wall furnace. Additional studs of appropriate width and extending from the floor plate to the ceiling plate are to be placed 16 inches (406 mm) (on center) outside the studs forming the space in which the appliance is installed. A side wall and ceiling of 3/4-inch (19.1-mm) plywood are to be provided. See Figure 51.1.

54.2 The room temperature is to be the arithmetic average as measured by two thermocouples shielded against radiation, each to be at an elevation 24 inches (610 mm) above the floor of the test structure and located in the test structure so as not to be affected by other than room temperature.

55 Recessed Furnace Installation

55.1 An appliance of a construction inherently providing separation of the combustion system from the atmosphere of the manufactured home or recreational vehicle may be tested for recessed installation in a wall or under a cabinet counter top. The installation is to be at the clearances recommended by the appliance manufacturer.

55.2 For installation of a central furnace, a return air opening shall be provided in the test enclosure. The location and minimum area of the opening shall be as recommended by the manufacturer of the appliance.

BOILER AND WATER HEATER TEST INSTALLATION

56 General

56.1 A boiler or a water heater is to be tested for installation in a corner, alcove or closet or recessed location in a manner similar to that prescribed for warm air appliances or at manufacturer's recommended clearances if less than standard clearances.

56.2 The room temperature is to be measured by a thermocouple placed centrally 15 inches (381 mm) in front of the appliance and 24 inches (610 mm) above the floor of the test structure, as indicated in Figure 52.2.

Exception: For a closet installation, the thermocouple is to be placed in the center of the lower ventilation opening into the closet when the manufacturer's instructions recommend that such opening be provided.