

listed and rated in combination for capacity and efficiency by a nationally recognized testing agency(ies). Rating procedures shall be based on U.S. Department of Energy test procedures.

(b) *Installation and instructions.* (1) The installation of each appliance shall conform to the terms of its listing as specified on the appliance and in the manufacturer's instructions. The installer shall include the manufacturer's installation instructions in the manufactured home. Appliances shall be secured in place to avoid displacement and movement from vibration and road shock.

(2) Operating instructions shall be provided with the appliance.

(c) Fuel-burning air conditioners shall also comply with § 280.707.

(d) The appliance rating plate shall be so located that it is easily readable when the appliance is properly installed.

(e) Every installed appliance shall be accessible for inspection, service, repair and replacement without removing permanent construction.

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§ 3280.715 Circulating air systems.

(a) *Supply system.* (1) Supply air ducts, fittings, and any dampers contained therein must be made of galvanized steel, tin-plated steel, or aluminum, or must be listed as Class 0 or Class 1 air ducts and air connectors in accordance with UL 181-2003, Factory-Made Air Ducts and Air Connectors (incorporated by reference, see § 3280.4). Class 1 air ducts and air connectors must be located at least 3 feet from the furnace bonnet or plenum. Air connectors must not be used for exterior manufactured home duct connection. A duct system integral with the structure must be of durable construction that can be demonstrated to be equally resistant to fire and deterioration as required by this section. Furnace supply plenums must be constructed of metal that extends a minimum of 3 feet from the heat exchanger measured along the centerline of airflow. Ducts constructed from sheet metal must be in accordance with the following table:

MINIMUM METAL THICKNESS FOR DUCTS ¹

Duct type	Diameter 14 in. or less	Width over 14 in.
Round	0.013	0.016
Enclosed rectangular013	.016
Exposed rectangular016	.019

¹ When "nominal" thicknesses are specified, 0.003 in. shall be added to these "minimum" metal thicknesses.

(2) *Sizing of ducts for heating.* (i) Ducts shall be so designed that when a labeled forced-air furnace is installed and operated continuously at its normal heating air circulating rate in the manufactured home, with all registers in the full open position, the static pressure measured in the casing shall not exceed 90% of that shown on the label of the appliance. For upflow furnaces the static pressure shall be taken in the duct plenum. For external heating or combination heating/cooling appliances the static pressure shall be taken at the point used by the agency listing or certifying the appliance.

(ii) When an evaporator-coil specifically designed for the particular furnace is installed between the furnace and the duct plenum, the total static pressure shall be measured downstream of the coil in accordance with the appliance label and shall not exceed 90 percent of that shown on the label of the appliance.

(iii) When any other listed air-cooler coil is installed between the furnace and the duct plenum, the total static pressure shall be measured between the furnace and the coil and it shall not exceed 90 percent of that shown on the label of the furnace.

(iv) The minimum dimension of any branch duct shall be at least 1½ inches, and of any main duct, 2½ inches.

(3) *Sizing of ducts.* (i) The manufactured home manufacturer shall certify the capacity of the air cooling supply duct system for the maximum allowable output of ARI certified central air conditioning systems. The certification shall be at operating static pressure of 0.3 inches of water or greater. (See § 3280.511).

(ii) The refrigerated air cooling supply duct system including registers must be capable of handling at least 300 cfm per 10,000 btuh with a static pressure no greater than 0.3 inches of water when measured at room temperature.

In the case of application of external self contained comfort cooling appliances or the cooling mode of combination heating/cooling appliances, either the external ducts between the appliance and the manufactured home supply system shall be considered part of, and shall comply with the requirements for the refrigerated air cooling supply duct system, or the connecting duct between the external appliance and the mobile supply duct system shall be a part of the listed appliance. The minimum dimension of any branch duct shall be at least 1½ inches, and of any main duct, 2½ inches.

(4) *Airtightness of supply duct systems.* A supply duct system shall be considered substantially airtight when the static pressure in the duct system, with all registers sealed and with the furnace air circulator at high speed, is at least 80 percent of the static pressure measured in the furnace casing, with its outlets sealed and the furnace air circulator operating at high speed. For the purpose of this paragraph and § 3280.715(b) pressures shall be measured with a water manometer or equivalent device calibrated to read in increments not greater than ¼ inch water column.

(5) *Expandable or multiple manufactured home connections.* (i) An expandable or multiple manufactured home may have ducts of the heating system installed in the various units. The points of connection must be so designed and constructed that when the manufactured home is fully expanded or coupled, the resulting duct joint will conform to the requirements of this part.

(ii) The manufacturer must provide installation instructions for supporting, mechanically fastening, sealing, and insulating each crossover duct. The instructions must indicate that no portion of the crossover duct is to be in contact with the ground, and must describe the means to support the duct without compressing the insulation and restricting airflow.

(6) Air supply ducts shall be insulated with material having an effective thermal resistance (R) of not less than 4.0 unless they are within manufactured home insulation having a minimum effective value of R-4.0 for floors or R-6.0 for ceilings.

(7) Unless installed in a basement, supply and return ducts, fittings, and crossover duct plenums exposed directly to outside air, such as those under-chassis crossover ducts or ducts connecting external heating, cooling, or combination heating/cooling appliances, must be insulated with material having a minimum thermal resistance of R-8 in all Thermal Zones. All such insulating materials must have a continuous vapor barrier retarder having a perm rating of not more than 1 perm. Where ducts are exposed underneath the manufactured home, they must comply with paragraph (a)(5)(ii) of this section, and shall be listed for exterior use.

(b) *Return air systems*—(1) *Return air openings.* Provisions shall be made to permit the return of circulating air from all rooms and living spaces, except toilet room(s), to the circulating air supply inlet of the furnace.

(2) *Duct material.* Return ducts and any diverting dampers contained therein shall be in accordance with the following:

(i) Portions of return ducts directly above the heating surfaces, or closer than 2 feet from the outer jacket or casing of the furnace shall be constructed of metal in accordance with § 3280.715(a)(1) or shall be listed Class 0 or Class 1 air ducts.

(ii) Return ducts, except as required by paragraph (a) of this section, shall be constructed of one-inch (nominal) wood boards (flame spread classification of not more than 200), other suitable material no more flammable than one-inch board or in accordance with § 3280.715(a)(1).

(iii) The interior of combustible ducts shall be lined with noncombustible material at points where there might be danger from incandescent particles dropped through the register or furnace such as directly under floor registers and the bottom return.

(iv) Factory made air ducts used for connecting external heating, cooling or combination heating/cooling appliances to the supply system and return air system of a manufactured home shall be listed by a nationally recognized testing agency. Ducts applied to external heating appliances or combination heating/cooling appliances

supply system outlets shall be constructed of metal in accordance with §3280.715(a)(1) or shall be listed Class 0 or Class 1 air ducts for those portions of the duct closer than 2 feet from the outer casing of the appliance.

(v) Ducts applied to external appliances shall be resistant to deteriorating environmental effects, including but not limited to ultraviolet rays, cold weather, or moisture and shall be resistant to insects and rodents.

(3) *Sizing.* The cross-sectional areas of the return air duct shall not be less than 2 square inches for each 1,000 Btu per hour input rating of the appliance. Dampers shall not be placed in a combination fresh air intake and return air duct so arranged that the required cross-sectional area will not be reduced at all possible positions of the damper.

(4) *Permanent uncloseable openings.* Living areas not served by return air ducts or closed off from the return opening of the furnace by doors, sliding partitions, or other means shall be provided with permanent uncloseable openings in the doors or separating partitions to allow circulated air to return to the furnace. Such openings may be grilled or louvered. The net free area of each opening shall be not less than 1 square inch for every 5 square feet of total living area closed off from the furnace by the door or partition serviced by that opening. Undercutting doors connecting the closed-off space may be used as a means of providing return air area. However, in the event that doors are undercut, they shall be undercut a minimum of 2 inches and not more than 2½ inches, as measured from the top surface of the floor decking to the bottom of the door and no more than one half of the free air area so provided shall be counted as return air area.

(c) *Joints and seams.* Joints and seams of sheet metal and factory-made flexible ducts, including trunks, branches, risers, crossover ducts, and crossover duct plenums, shall be mechanically secured and made substantially airtight. Slip joints in sheet metal ducts shall have a lap of at least one inch and shall be mechanically fastened. Tapes or caulking compounds shall be permitted to be used for sealing mechanically secure joints. Sealants and tapes

shall be applied only to surfaces that are dry and dust-, dirt-, oil-, and grease-free. Tapes and mastic closure systems for use with factory-made rigid fiberglass air ducts and air connectors shall be listed in accordance with UL Standard 181A-1994, with 1998 revisions. Tapes and mastic closure systems used with factory-made flexible air ducts and air connectors shall be listed in accordance with UL Standard 181B-1995, with 1998 revisions.

(d) *Supports and protection.* Ducts must be securely supported. Nails or other fasteners must not be driven or penetrate through duct walls. Where vertical ducts are installed within closets or rooms, they must be enclosed with materials equivalent to those used in the closet or room construction.

(e) *Registers and grilles.* Fittings connecting the registers and grilles to the duct system must be constructed of metal or material that complies with the requirements of Class 1 or 2 ducts under UL 181-1996 with 1998 revisions, Factory Made Air Ducts and Connectors. Air supply terminal devices (registers) when installed in kitchen, bedrooms, and bathrooms must be equipped with adjustable closeable dampers. Registers or grilles must be constructed of metal or conform with the following:

(1) Be made of a material classified 94V-0 or 94V-1, when tested as described in UL 94-1996, with 2001 revisions, Test for Flammability of Plastic Materials for Parts in Devices and Appliances, Fifth Edition; and

(2) Floor registers or grilles shall resist without structural failure a 200 lb. concentrated load on a 2-inch diameter disc applied to the most critical area of the exposed face of the register or grille. For this test the register or grille is to be at a temperature of not less than 165 °F and is to be supported in accordance with the manufacturer's instructions.

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