



Mechanical eClass
Lesson 2
Sizing Ducts and Return Grills
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June 9, 2004

M918.2 Minimum duct sizes. The minimum unobstructed total area of the outside and return air ducts or openings to a forced-air warm-air furnace shall be not less than 2 square inches per 1,000 BTU/h¹ (4402 mm²/kW) output rating capacity of the furnace and not less than that specified in the furnace manufacturer's installation instructions. The minimum unobstructed total area of supply ducts from a forced-air warm-air furnace shall not be less than 2 square inches for each 1,000 BTU/h (4402 mm²/kW) output rating capacity of the furnace and not less than that specified in the furnace manufacturer's installation instructions.

EXCEPTION: The total area of the supply air ducts and outside and return air ducts shall not be required to be larger than the minimum size required by the furnace manufacturer's installation instructions.

Example: Gas-fired 85,000 BTU² furnace with a 2 ½ ton air conditioner installed.

The duct size for this system will be based upon the output rating of the furnace. Section 918.2 states that 2 square inches of duct area is required for each 1000 BTU of output rating. This furnace has 85,000 BTU output, therefore; $2 \times 85 = 170$ square inches duct size

M918.3 Heat pumps. The minimum unobstructed total area of the outside and return air ducts or openings to a heat pump shall be not less than 6 square inches per 1,000 BTU/h (13 208 mm²/kW) output rating or as indicated by the conditions of listing of the heat pump. Electric heat pumps shall be tested in accordance with UL 559 or UL 1995.

Example: 3.5 ton heat pump.

The duct for this system must be sized by using 6 square inches of clear duct area for each 1000 BTU of cooling. Each ton of cooling contains 12,000 BTU. Multiply the tonnage, 3.5, by the total BTU per ton and this will give you the total BTU rating.

$$3.5 \times 12000 = 42000$$

Multiply 6×42 to determine the duct size of 252 square inches. The clear area of the duct must be at least 252 square inches. This measurement also includes the opening in the floor at the bottom of the return.

The actual return grill size is not covered by the NC Mechanical Code but, the generally accepted formula for determining the filter grill size is 1 square inch of grill area for each 2 CFM³ of air flow. If the actual airflow is unknown, use 400 CFM for each ton of cooling.

¹ British Thermal Units per Hour

² British Thermal Units

³ Cubic Feet per Minute

Example: 3 ton heat pump

A 3-ton heat pump has approximately 1200 CFM of air flow. To calculate the filter grill size, divide the airflow, (CFM), by 2.

$1200 / 2 = 600$ square inches

One filter grill or the total area of all grills must equal at least 600 square inches of area to adequately supply the system with the air needed to operate.

1 ton of cooling = 12,000 BTU

1 ton of cooling = 400 CFM (approximate)

Heat Pump Size (Tons)	Minimum Duct Size (Square inches)	Minimum Return Size (Square inches)
1	72	200
1 ½	108	300
2	144	400
2 ½	180	500
3	216	600
3 ½	252	700
4	288	800
5	360	1000

M918.10 Return air intake (non-engineered systems). If only one central return air grill is installed, it shall be of proper size. The size shall be sufficient to return a volume of air compatible with the CFM requirements and temperature rise limitations specified by the equipment manufacturer. The face velocity of return air grilles shall not exceed 450 fpm. At least one separate return shall be installed on each level of a multi-level structure. For split-level and split foyer structures one return may serve more than one level if located near the levels served and the total area of the levels does not exceed 1600 square feet. Return air grilles shall not be located in bathrooms. The return air from one residential living unit shall not be mixed with return air from other living units.

In buildings with 1600 square feet or less of conditioned area, a central return is permitted. When the building contains more than 1600 square feet of conditioned area, additional returns shall be provided. Each return shall not serve more than 1600 square feet of area and shall be located in the area it serves. Return air may travel through the living space to the return air intake if there are not restrictions, such as solid doors, to the air movement. When panned joists are used for return air the structural integrity shall be maintained. Air capacity for joists 16 inches on center shall be a maximum of 375 CFM for 8 inch joists and 525 CFM for 10 inch joists. Wiring located in spaces used for return air ducts shall comply with the North Carolina Electrical Code.