

APPENDIX F

COMBUSTION AIR REQUIREMENTS FOR GAS FURNACES/HEATERS & WATER HEATERS

1.0 PURPOSE

This appendix is based on Chapter 7 of the 1998 UMC (Uniform Mechanical Code) and is a quick reference to determine room volume or vent size requirements for *furnaces and water heaters* that draw combustion air from the room/space where they are located. This appendix does not apply to direct-vent appliances, closed combustion appliances drawing air from outdoors, listed cooking appliances, refrigerators and domestic clothes dryers. *This appendix is only a guide. Each installer is responsible for meeting all requirements of the local jurisdiction and applicable codes and regulations.*

2.0 DEFINITIONS (FROM UMC CHAPTER 2)

Confined Space: A room or space having a volume of less than 50 cubic feet per 1,000 Btu/h of the aggregate input rating of all fuel-burning open combustion furnaces/heaters and water heaters installed in that space.

Unconfined Space: A room or space having a volume of at least 50 cubic feet per 1,000 Btu/h of the aggregate input rating of all fuel-burning open combustion furnaces/heaters and water heaters installed in that space. Adjacent rooms communicating directly with the space and not separated by doors are considered part of the unconfined space.

Homes of Ordinary Tightness: Homes not of unusually tight construction.

Homes of Unusually Tight Construction: Homes with the following construction features: (a) walls and ceilings exposed to the outside atmosphere have a continuous water vapor retarder rated 1 perm or less, with all openings sealed; (b) weatherstripping on openable windows and doors; and (c) caulking or sealants are applied to areas such as joints around window and door frames, between sole plates and floors, between wall-ceiling joints, between wall panels, and at plumbing/wiring penetrations and other openings.

NFVA: Net Free Venting Area, which is the gross opening area minus blocking effect of screen and/or louvers (see “Louvers, Grilles and Screens” below).

3.0 UNIFORM MECHANICAL CODE (UMC) CRITERIA

Many combustion air code requirements are addressed in the footnotes on page D-3. Others are covered in this section, and formulas used to calculate room volume and vent size are presented in Section 4.0.

Louvers, Grilles and Screens. (UMC 702.3) Combustion air openings must be covered with 1/4-inch mesh (except ducts which terminate in an attic, which are not screened on either end). The blocking affect of louvers, grilles and screens must be deducted from the gross opening of a vent to determine the “net free” venting area (NFVA). When an NFVA is not identified on the vent, it may be estimate by multiplying the *total (gross) opening area* by the suggested “reduction factors” shown in the table below. (Also see the National Fuel Gas Code, Article 5.3.5.)

SUGGESTED SCREEN AND LOUVER REDUCTION FACTORS FOR COMBUSTION AIR VENTS

1/4" Screen (Hardware Cloth)	1/4 Screen with Metal Louvers	1/4 Screen with Wood Louvers	Insect Screen (Mesh under 1/4")	Insect Screen w/ Metal Louvers	Insect Screen w/ Wood Louvers
0.90 (90%)	0.75 (75%)	0.25 (25%)	0.50 (50%)	0.50 (50%)	0.25 (25%)

Prohibited Sources. (UMC 703.3) Vent openings and ducts cannot connect an appliance enclosure with a space in which the operation of a fan may adversely affect the flow of combustion air.

Combustion-Air Ducts. (UMC Section 704) Ducts must be galvanized steel or equivalent corrosion-resistant material approved for the use. A duct must have the same cross-sectional area as the free area of the opening to which it connects.

4.0 USING THE COMBUSTION AIR MATRIX

Column [A] in the Combustion Air Requirements matrix on page D-3 lists several Btu/hour Input Rating totals. Columns [B] through [E] list corresponding room volumes (cu. ft.) and vent sizes (sq. in. of NFVA). For Btu/h totals not shown, the required room volume or vent NFVA can be calculated using the applicable formula from the table below. (Note that an Upper vent only, with no Lower vent, is no longer allowed.)

Column	Application	Formula
[B]	All air from <i>indoors</i> , based on room size	50 cu. ft. of room volume per 1,000 Btu/h input.
[C]	All air from <i>indoors</i> , 1 upper vent <u>and</u> 1 lower vent to another room/space*	When the volume of the room/space containing an appliance is inadequate, an upper <u>and</u> a lower vent may be installed to communicate with an adjacent unconfined space. <u>Each</u> vent must provide 1 sq. in NFVA per 1,000 Btu/h input , with a <i>minimum</i> size of 100 sq. in. NFVA.
[D]	All air from <i>outdoors</i> , 1 upper vent or vertical duct <u>and</u> 1 lower vent or vertical duct*	<u>Each</u> opening and <i>vertical</i> duct must provide 1 sq. in NFVA per 4,000 Btu/h input.
[E]	All air from <i>outdoors</i> , 1 upper horizontal duct <u>and</u> 1 lower horizontal duct*	<u>Each</u> <i>horizontal</i> duct must provide 1 sq. in NFVA per 2,000 Btu/h input.

*See footnote 5 on page D-3 regarding placement of upper and lower vents and ducts. For ducts, also see the double-asterisk (**) note at the bottom of page D-3 advising that the minimum cross-sectional area of a duct is 3" (3"x3" rectangular, or 3" round).

The following table may be used to determine the cross-sectional area of a duct when the diameter or circumference is known. [Duct area equals πr^2 , or 3.1415 x the radius squared (radius is half the diameter). The area of a 4" diameter duct is: 3.1415 x 2 x 2 = 12.6 sq. in. When circumference is known, divide it by 3.1415 to determine the diameter, then calculate the area.]

Duct Diameter (in.)	3"	4"	5"	6"	7"	8"	9"	10"
Duct Area (sq. in.)	7.1	12.6	19.6	28.3	38.5	50.3	63.6	78.5
Duct Circumference (in.)	9.4	12.6	15.7	18.8	22.0	25.1	28.3	31.4

The matrix on page D-3 summarizes most combustion air venting options specified in Chapter 7 of the 1998 UMC. It is based on UMC Table 7-A, which contains some additional criteria.

COMBUSTION AIR REQUIREMENTS FOR GAS FURNACES/HEATERS AND WATER HEATERS

OPEN COMBUSTION FURNACE AND/OR WATER HEATER IN A ROOM OR SPACE	HOMES OF ORDINARY TIGHTNESS,* WITH APPLIANCES LOCATED IN A CONFINED SPACE,* AND ALL COMBUSTION AIR OBTAINED FROM <u>INDOORS</u>		HOMES OF UNUSUALLY TIGHT CONSTRUCTION,* OR OF INADEQUATE VOLUME , WITH ALL COMBUSTION AIR OBTAINED FROM <u>OUTDOORS</u>	
			1 UPPER OPENING OR VERTICAL DUCT <u>AND</u> 1 LOWER OPENING OR VERTICAL DUCT 1,2,3,4,5	TWO HORIZONTAL DUCTS 1,4
TOTAL INPUT	MINIMUM ROOM VOLUME	MINIMUM NFVA* PER VENT ⁴	MIN. NFVA* FOR <u>EACH</u> VENT/VERTICAL DUCT	MINIMUM NFVA* FOR <u>EACH</u> DUCT
[A] BTU/HR	[B] Cu. Ft.	[C] Sq. In.	[D] Sq. In.	[E] Sq. In.
20,000	1,000	100	7.1**	10.0
25,000	1,250	100	7.1**	12.5
30,000	1,500	100	7.5	15.0
35,000	1,750	100	8.8	17.5
40,000	2,000	100	10.0	20.0
45,000	2,250	100	11.3	22.5
50,000	2,500	100	12.5	25.0
55,000	2,750	100	13.8	27.5
60,000	3,000	100	15.0	30.0
65,000	3,250	100	16.3	32.5
70,000	3,500	100	17.5	35.0
75,000	3,750	100	18.8	37.5
80,000	4,000	100	20.0	40.0
85,000	4,250	100	21.3	42.5
90,000	4,500	100	22.5	45.0
95,000	4,750	100	23.8	47.5
100,000	5,000	100	25.0	50.0
105,000	5,250	105	26.3	52.5
110,000	5,500	110	27.5	55.0
115,000	5,750	115	28.8	57.5
120,000	6,000	120	30.0	60.0
125,000	6,250	125	31.3	62.5
130,000	6,500	130	32.5	65.0
135,000	6,750	135	33.8	67.5
140,000	7,000	140	35.0	70.0
145,000	7,250	145	36.3	72.5
150,000	7,500	150	37.5	75.0
155,000	7,750	155	38.8	77.5
160,000	8,000	160	40.0	80.0
165,000	8,250	165	41.3	82.5

¹Combustion air must be obtained air from outdoors or from spaces freely communicating with outdoors.

²Attic must be adequately vented to provide the required volume of combustion air. Attic must have at least 30" clear vertical height at apex. Vent openings must be protected from ceiling insulation (e.g., with sleeve 6" above it).

³Vertical duct must extend 6" above ceiling insulation, and may not be screened on either end.

⁴Upper vent/duct termination shall be installed within 12" of the ceiling, and lower vent/duct termination shall be within 12" of the floor. However, a pre-existing upper vent at any location higher than the draft hood is acceptable.

⁵Crawl space must have free flow of air and unobstructed openings to outdoors. Foundation vents should be screened with 1/4" mesh and provide at least twice the area of the required combustion-air vent NFVA.

*See definitions on page D-1. **The **minimum area for round ducts is 7.1 sq. in.**, because the minimum cross-sectional dimension of *any duct* is 3" (3"x3" rectangular, or 3" round), and the area of a 3" round duct (πr^2) is 7.07 sq. in.