



**TABLE 304.1
COMBUSTION AIR REQUIREMENTS FOR GAS-FIRED
APPLIANCES WHEN THE COMBINED INPUT IS UP TO
AND INCLUDING 400,000 Btu/hr**

TOTAL INPUT OF APPLIANCES¹, THOUSANDS OF Btu/hr (kW)	REQUIRED FREE AREA OF AIR-SUPPLY OPENING OR DUCT, SQUARE INCHES (sq mm)	ACCEPTABLE APPROXIMATE ROUND DUCT EQUIVALENT DIAMETER², INCH (mm)
25 (8)	7 (4,500)	3 (75)
50 (15)	7 (4,500)	3 (75)
75 (23)	11 (7,000)	4 (100)
100 (30)	14 (9,000)	4 (100)
125 (37)	18 (12,000)	5 (125)
150 (45)	22 (14,000)	5 (125)
175 (53)	25 (16,000)	6 (150)
200 (60)	29 (19,000)	6 (150)
225 (68)	32 (21,000)	6 (150)
250 (75)	36 (23,000)	7 (175)
275 (83)	40 (26,000)	7 (175)
300 (90)	43 (28,000)	7 (175)
325 (98)	47 (30,000)	8 (200)
350 (105)	50 (32,000)	8 (200)
375 (113)	54 (35,000)	8 (200)
400 (120)	58 (37,000)	9 (225)

1. For total inputs falling between listed capacities, use next largest listed input.

2. If flexible duct is used, increase the duct diameter by one inch. *

*Flexible duct shall be stretched with minimal sags.

BTU Amount for Non-direct vent appliances _____



VENTILATION REQUIREMENTS
TABLE R403.5.2
NUMBER OF BEDROOMS

	1	2	3	4	5	6 2
Conditioned space ¹ (in sq. ft.)	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous	Total/ Continuous
1000-1500	60/40	75/40	90/45	105/53	120/60	135/68
1501-2000	70/40	85/43	100/50	115/58	130/65	145/73
2001-2500	80/40	95/48	110/55	125/63	140/70	155/78
2501-3000	90/45	105/53	120/60	135/68	150/75	165/83
3001-3500	100/50	115/58	130/65	145/73	160/80	175/88
3501-4000	110/55	125/63	140/70	155/78	170/85	185/93
4001-4500	120/60	135/68	150/75	165/83	180/90	195/98
4501-5000	130/65	145/73	160/80	175/88	190/95	205/103
5001-5500	140/70	155/78	170/85	185/93	200/100	215/108
5501-6000 2	150/75	165/83	180/90	195/98	210/105	225/113

1. Conditioned space includes the basement and conditioned crawl spaces.
2. If conditioned space exceeds 6000 sq. ft. or there are more than 6 bedrooms, use Equation R403.5.2

R403.5.2 Total Ventilation rate.

The mechanical ventilation system shall provide sufficient outdoor air to equal the total ventilation rate average for each 1- hour period in accordance with Table R403.5.2, or Equation 403.5.2, based on the number of bedrooms and square footage of conditioned space, including the basement and conditioned crawl spaces.

For the purposes of Table R403.5.2 and Section R403.5.3, the following applies:

a. Equation R403.5.2 Total ventilation rate:

$$\text{Total ventilation rate (cfm)} = (0.02 \times \text{square feet of conditioned space}) + (15 \times (\text{number of bedrooms} + 1))$$

b. Equation R403.5.2.1 Continuous ventilation rate: Continuous ventilation rate (cfm) = Total ventilation rate/2

Amount Total _____

Amount Continuous _____



**Table 501.4.1
Procedure to Determine Makeup Air Quantity for Exhaust Appliances in Dwelling Units**

Choose Which Applies				
	ONE OR MULTIPLE POWER VENT OR DIRECT VENT APPLIANCES OR NO COMBUSTION APPLIANCES^A	ONE OR MULTIPLE FAN-ASSISTED APPLIANCES AND POWER VENT OR DIRECT VENT APPLIANCES^B	ONE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANE OR ONE SOLID FUEL APPLIANC^C	MULTIPLE APPLIANCES THAT ARE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCES OR SOLID FUEL APPLIANCES^D
1. Use the Appropriate Column to Estimate House Infiltration				
a) pressure factor (cfm/sf)				
b) conditioned floor area (sf)				
(including unfinished basements)				
Estimated House Infiltration (cfm): [1a x 1b]				
2. Exhaust Capacity				
a) clothes dryer				
b) 80% of largest exhaust rating (cfm):				
(not applicable if recirculating system or if powered <i>makeup air</i> is electrically interlocked and matched to exhaust)				
c) 80% of next largest exhaust rating (cfm):	not applicable			
(not applicable if recirculating system or if powered makeup air is electrically interlocked and matched to exhaust)				
Total Exhaust Capacity (cfm): [2a+2b+2c]				
3. Makeup Air Requirement				
a) Total Exhaust Capacity (from above)				
b) Estimated House Infiltration (from above)				
Makeup Air Quality (cfm): [3a - 3b]				
(if value is negative, no makeup air is needed)				
4. For Makeup Air Opening Sizing, refer to Table 501.4.2.				

- A. Use this column if there are other than fan-assisted or atmospherically vented gas or oil *appliances* or if there are no *combustion appliances*.
- B. Use this column if there is one fan-assisted *appliance* per venting system. Other than atmospherically vented *appliances* may also be included.
- C. Use this column if there is one atmospherically vented (other than fan-assisted) gas or oil *appliance* per venting system or one solid fuel *appliance*.
- D. Use this column if there are multiple atmospherically vented gas or oil *appliances* using a common vent or if there are atmospherically vented gas or oil appliances and solid fuel appliances.



**Table 501.4.2
Makeup Air Opening Sizing Table for New and Existing Dwelling Units**

TYPE OF OPENING OR SYSTEM	ONE OR MULTIPLE POWER VENT OR DIRECT VENT APPLIANCES OR NO COMBUSTION APPLIANCES ^A	ONE OR MULTIPLE FAN- ASSISTED APPLIANCES AND POWER VENT OR DIRECT VENT APPLIANCES ^B	ONE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCE OR ONE SOLID FUEL APPLIANCE ^C	MULTIPLE APPLIANCES THAT ARE ATMOSPHERICALLY VENTED GAS OR OIL APPLIANCES OR SOLID FUEL APPLIANCES ^D	PASSIVE MAKEUP AIR OPENING DUCT DIAMETER ^{E,F,G}
	(cfm)	(cfm)	(cfm)	(cfm)	(inches)
Passive opening	1-36	1-22	1-15	1-9	3
Passive opening	37-66	23-41	16-28	10-17	4
Passive opening	67-109	42-66	29-46	18-28	5
Passive opening	110-163	67-100	47-69	29-42	6
Passive opening	164-232	101-143	70-99	43-61	7
Passive opening	233-317	144-195	100-135	62-83	8
Passive opening with motorized damper	318-419	196-258	136-179	84-110	9
Passive opening with motorized damper	420-539	259-332	180-230	111-142	10
Passive opening with motorized damper	540-679	333-419	231-290	143-179	11
Powered makeup air ^H	>679	>419	>290	>179	Not applicable

- A. Use this column if there are other than fan-assisted or atmospherically vented gas or oil *appliances* or if there are no *combustion appliances*.
- B. Use this column if there is one fan-assisted *appliance* per venting system. Other than atmospherically vented *appliances* may also be included.
- C. Use this column if there is one atmospherically vented (ther than fan-assisted) gas or oil *appliance* per venting system or one solid fuel *appliance*.
- D. Use this column if there are multiple atmospherically vented gas or oil *appliances* using a common vent or if there are atmospherically vented gas or oil *appliances* and solid fuel *appliances*.
- E. An equivalent length of 100 feet of round smooth metal duct is assumed. Subtract 40 feet for the exterior hood and ten feet for each 90-degree elbow to determine the remaining length of straight duct allowable.
- F. If flexible duct is used, increase the duct diameter by one inch. Flexible duct shall be stretched with minimal sags.
- G. Barometric dampers are prohibited in passive *makeup air* openings when any atmospherically vented *appliance* is installed.
- H. Powered *makeup air* shall be electrically interlocked with the largest exhaust system.



IFGC Appendix E, Worksheet E-1	
Residential Combustion Air Calculation Method (for Furnace, Boiler, and/or Water Heater in the Same Space)	
Step 1: Complete vented combustion appliance information: Furnace/Boiler: ___ Draft Hood ___ Fan Assisted ___ Direct Vent Input: _____ Btu/hr (Not fan Assisted) & Power Vent Water Heater: ___ Draft Hood ___ Fan Assisted ___ Direct Vent Input: _____ Btu/hr (Not fan Assisted) & Power Vent	
Step 2 Calculate the volume of the Combustion Appliance Space (CAS) containing combustion appliances. The CAS includes all spaces connected to one another by code compliant openings. CAS volume: _____ ft ³	
Step 3 Determine air Changes per Hour (ACH)¹ Default ACH values have been incorporated into Table E-1 for use with Method 4b (KAIR Method). If the year of construction or ACH is not known, use method 4a (Standard Method).	
Step 4: Determine Required Volume for Combustion Air. 4a. Standard Method Total Btu/hr input of all combustion appliances (DO NOT COUNT DIRECT VENT APPLIANCES) Input: _____ Btu/hr Use Standard Method column in Table E-1 to find Total Required Volume (TRV) TRV: _____ ft ³ If CAS Volume (from Step 2) <i>is greater than</i> TRV then no outdoor openings are needed. If CAS Volume (from Step 2) <i>is less than</i> TRV then go to STEP 5. 4b. Known Air Infiltration Rate (KAIR) Method Total Btu/hr input of all fan-assisted and power vent appliances (DO NOT COUNT DIRECT VENT APPLIANCES) Input: _____ Btu/hr Use Fan-Assisted Appliances column in Table E-1 to find Required Volume Fan Assisted (RVFA) RVFA: _____ ft ³ Total Btu/hr input of all non-fan-assisted appliances Input: _____ Btu/hr Use Non-Fan-Assisted Appliances column in Table E-1 to find Required Volume Non-Fan-Assisted (RVNFA) RVNFA: _____ ft ³ Total Required Volume (TRV) = RVFA + RVNFA TRV = _____ + _____ = _____ ft ³ If CAS Volume (from Step 2) <i>is greater than</i> TRV then no outdoor openings are needed. If CAS Volume (from Step 2) <i>is less than</i> TRV then go to STEP 5.	
Step 5: Calculate the ratio of available interior volume to the total required volume. Ratio = CAS Volume (from Step 2) <i>divided by</i> TRV (from Step 4a or Step 4b) Ratio = _____ / _____ = _____	
Step 6: Calculate Reduction Factor (RF). RF = 1 <i>minus</i> Ratio RF = 1 - _____ = _____	
Step 7: Calculate single outdoor opening as if all combustion air is from outside. Total Btu/hr input of all Combustion Appliances in the same CAS (EXCEPT DIRECT VENT) Input: _____ Btu/hr Combustion Air Opening Area (CAOA): Total Btu/hr <i>divided by</i> 3000 Btu/hr per in ² CAOA = _____ / _____ Btu/hr per in ² = _____ in ²	
Step 8: Calculate Minimum CAOA. Minimum CAOA = CAOA <i>multiplied by</i> RF Minimum CAOA = _____ x _____ = _____ in ²	
Step 9: Calculate Combustion Air Opening Diameter (CAOD) CAOD = 1.13 <i>multiplied by the square root of</i> Minimum CAOA CAOD = 1.13 x $\sqrt{\text{Minimum CAOA}}$ = _____ in	

¹If desired, ACH can be determined using ASHRAE calculation or blower door test. Follow procedures in Section 304.



IFGC Appendix E, Table E-1 Residential Combustion Air Required Volume (Required Interior Volume Based on Input Rating of Appliances)					
Input Rating (Btu/hr)	Standard Method (ft ³)	Known Air Infiltration Rate (KAIR) Method (ft ³)			
		Fan Assisted		Non-Fan-Assisted	
		1994 ¹ to Present	Pre 1994 ²	1994 ¹ to Present	Pre 1994 ²
5,000	250	375	188	525	263
10,000	500	750	375	1,050	525
15,000	750	1,125	563	1,575	788
20,000	1,000	1,500	750	2,100	1,050
25,000	1,250	1,875	938	2,625	1,313
30,000	1,500	2,250	1,125	3,150	1,575
35,000	1,750	2,625	1,313	3,675	1,838
40,000	2,000	3,000	1,500	4,200	2,100
45,000	2,250	3,375	1,688	4,725	2,363
50,000	2,500	3,750	1,875	5,250	2,625
55,000	2,750	4,125	2,063	5,775	2,888
60,000	3,000	4,500	2,250	6,300	3,150
65,000	3,250	4,875	2,438	6,825	3,413
70,000	3,500	5,250	2,625	7,350	3,675
75,000	3,750	5,625	2,813	7,875	3,938
80,000	4,000	6,000	3,000	8,400	4,200
85,000	4,250	6,375	3,188	8,925	4,463
90,000	4,500	6,750	3,375	9,450	4,725
95,000	4,750	7,125	3,563	9,975	4,988
100,000	5,000	7,500	3,750	10,500	5,250
105,000	5,250	7,875	3,938	11,025	5,513
110,000	5,500	8,250	4,125	11,550	5,775
115,000	5,750	8,625	4,313	12,075	6,038
120,000	6,000	9,000	4,500	12,600	6,300
125,000	6,250	9,375	4,688	13,125	6,563
130,000	6,500	9,750	4,875	13,650	6,825
135,000	6,750	10,125	5,063	14,175	7,088
140,000	7,000	10,500	5,250	14,700	7,350
145,000	7,250	10,875	5,438	15,225	7,613
150,000	7,500	11,250	5,625	15,750	7,875
155,000	7,750	11,625	5,813	16,275	8,138
160,000	8,000	12,000	6,000	16,800	8,400
165,000	8,250	12,375	6,188	17,325	8,663
170,000	8,500	12,750	6,375	17,850	8,925
175,000	8,750	13,125	6,563	18,375	9,188
180,000	9,000	13,500	6,750	18,900	9,450
185,000	9,250	13,875	6,938	19,425	9,713
190,000	9,500	14,250	7,125	19,950	9,975
195,000	9,750	14,625	7,313	20,475	10,238
200,000	10,000	15,000	7,500	21,000	10,500
205,000	10,250	15,375	7,688	21,525	10,763
210,000	10,500	15,750	7,875	22,050	11,025
215,000	10,750	16,125	8,063	22,575	11,288
220,000	11,000	16,500	8,250	23,100	11,550
225,000	11,250	16,857	8,438	23,625	11,813
230,000	11,500	17,250	8,625	24,150	12,075

¹The 1994 date refers to dwellings constructed under the 1994 Minnesota Energy Code. The default KAIR used in this section of the table is 0.20 ACH.

²This section of the table is to be used for dwellings constructed prior to 1994. The default KAIR used in this section of the table is 0.40 ACH.