TABLE 501.4.1
PROCEDURE TO DETERMINE MAKEUP AIR QUANTITY FOR EXHAUST APPLIANCES IN DWELLING UNITS

	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]
1. Use the Appropriate Column to Estimate House Infiltration				
a) pressure factor (cfm/sf)	0.15	0.09	0.06	0.03
b) conditioned floor area (sf)				
(including unfinished basements)				
Estimated House Infiltration (cfm): [1a × 1b]				
2. Exhaust Capacity				
a) clothes dryer	135	135	135	135
b) 80% of largest exhaust rating (cfm):				
(not applicable if recirculating system or if powered *makeup air* 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 *appliance*s 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 (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.*
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.

501.4.2 Makeup air supply.
Makeup air shall be provided by one of the following methods:
1. Passive *makeup air* shall be provided by passive openings according to the following:
    1.1. Passive *makeup air* openings from the outdoors shall be sized according to IMC Table 501.4.2.
    1.2. Barometric dampers are prohibited in passive *makeup air* openings when any atmospherically vented *appliance* is installed.
    1.3. Single passive openings larger than 8 inches (204 mm) diameter, or equivalent, shall be provided with a motorized damper that is electrically interlocked with the largest exhaust system.

2. Powered *makeup air* shall be provided if the size of a single opening or multiple openings exceeds 11 inches (280 mm) diameter, or equivalent, when sized according to IMC Table 501.4.2. Powered *makeup air* shall comply with the following:
    2.1. Powered *makeup air* shall be electrically interlocked with the largest exhaust system.
    2.2. Powered makeup air shall be matched to the airflow of the largest exhaust system.

3. *Makeup air* shall be provided by a combination of passive openings and powered means according to IMC Table 501.4.2 and the following:
    3.1. Passive makeup air openings shall comply with item 1.

    3.2. Powered *makeup air* shall be supplied for the quantity of airflow in excess of the passive *makeup air* opening provided, and it shall be electrically interlocked with the 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 (Not fan assist) ____ Fan Assisted & Power Vent ____ Direct Vent	Input: ____Btu/hr
	Water Heater: __ Draft Hood (Not fan assist) ____ Fan Assisted & Power Vent ____ Direct Vent	Input: ____Btu/hr
Step 2:	**Calculate the volume of the <u>Combustion Appliance Space</u> (CAS) containing combustion appliances.**	
	The CAS includes all spaces connected to one another by code compliant openings	CAS volume: ____ ft³
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) Use Standard Method column in Table E-1 to find <u>Total Required Volume </u>(TRV) If CAS Volume (from Step 2) **is greater than** TRV, then no outdoor openings are needed. If CAS Volume (from Step 2) **is less than** TRV, then go to **Step 5.**	Input: ____Btu/hr TRV: ____ft³
	4b. <u>Known Air Infiltration Rate</u> (KAIR)Method Total Btu/hr input of all fan-assisted and power vent appliances (DO NOT COUNT DIRECT VENT APPLIANCES) Use fan-Assisted Appliances column in table E-1 to find Required Volume Fan Assisted (RVFA)	Input: _____Btu/hr RVFA: _____ ft³
	Total Btu/hr input of all non-fan-assisted appliances Use Non-Fan-Assisted Appliances column in Table E-1 to find Required Volume Non-Fan-Assisted (RVNFA)	Input: _____Btu/hr RVNFA:_____ft³ TRV = ___ + ___ = ___ft³
	Total Required Volume (TRV) = RVFA + RVNFA If CAS Volume (Step 2) **is greater than** TRV, then no outdoor openings are needed. If CAS Volume (Step 2) **is less than** 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) **divided by** TRV (from Step 4a or Step 4b) Ratio = ____ /_____= _____	
Step 6:	**Calculate <u>Reduction Factor</u> (RF).**	
	RF = 1 **minus** 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 **divided by** 3000 Btu/hr per in² CAOA = _____/ 3000 Btu/hr per in² = _____ in²	
Step 8:	**Calculate Minimum CAOA.**	
	Minimum CAOA = CAOA **multiplied by** RF Minimum CAOA =_____x _____ = _____in²	
Step 9:	**Calculate <u>Combustion Air Opening Diameter</u> (CAOD)**	
	CAOD = 1.13 **multiplied by the square root of** minimum CAOA CAOA = 1.13 x √‾ Minimum CAOA =____in	

[1] If 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 Interior Volume Based on Input Rating of Appliance)

Input Rating (Btu/hr)	Standard Method (ft³)	Known Air Infiltration Rate (KAIR) Method (ft³)			
		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	1,675	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	16,875	8,438	23,625	11,813
230,000	11,500	17,250	8,625	24,150	12,075

[1] The 1994 data refers to dwelling construction under the Minnesota Energy Code. The default KAIR used in this section of the table is 0.20 ACH.

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