

EXHAUST SYSTEMS

2. A test approved by the building official verifies proper operation of vented combustion *appliances*.

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.

**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 <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 <i>makeup air</i> is electrically interlocked and matched to exhaust)				
Total Exhaust Capacity (cfm): [2a+2b+2c]	—	—	—	—
3. <i>Makeup Air</i> 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 <i>Makeup Air</i> 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*.

- 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.

501.4.2.1 Makeup air ducts. *Makeup air* ducts shall be constructed and installed according to IMC Chapter 6 and Section 501.4.2.

501.4.2.2 Makeup air intake. *Makeup air* intake openings shall be located to avoid intake of exhaust air in accordance with IMC Section 401.4 and IFGC Section 503.8, and shall be covered with corrosion resistant screen of not less than 1/4 inch (6.4 mm) mesh. *Makeup air* intake openings shall be located at least 12 inches (305 mm) above adjoining grade level.

501.4.2.3 Makeup air location. *Makeup air* requirements of 175 cubic feet per minute (cfm) (0.084 m³/s)

and greater shall be introduced to the dwelling in one of the following locations:

- 1. In the space containing the vented *combustion appliances*.
- 2. In the space containing the exhaust system.
- 3. In a space that is freely communicating with the exhaust system and is *approved* by the building official.

501.4.2.4 Makeup air termination restriction. A *makeup air* opening shall not terminate in the return air plenum of a forced air heating system unless it is installed according to the heating appliance manufacturer's installation instructions.

501.4.2.5 Separate makeup air and combustion air openings. When both *makeup air* and *combustion air* openings are required, they shall be provided through separate openings to the outdoors, subject to IFGC Section 304, to determine requirements for air for *combustion* and ventilation:

Exception: Combination *makeup air* and *combustion air* systems may be approved by the building official where they are reasonably equivalent in terms of health, safety, and durability.

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.

dimension of the basement to avoid a short circuit of the air circulation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

Exception: Kitchen and bath fans that are not included as part of the mechanical ventilation system are exempt from these requirements.

R403.5.1 Alterations. Alterations to existing buildings are exempt from meeting the requirements of Section R403.5.

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 R403.5.2, 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: Total ventilation rate (cfm) = (0.02 × square feet of conditioned space) + (15 × (number of bedrooms + 1))
- b. Equation R403.5.2.1 Continuous ventilation rate: Continuous ventilation rate (cfm) = Total ventilation rate/2

R403.5.3 Continuous ventilation rate. Continuous ventilation rate (CVR) is a minimum of 50 percent of the total ventilation rate (TVR). The CVR shall not be less than 40 cfm (1133 L/min) and shall provide a con-

tinuous average cfm rate according to Table R403.5.2 or according to Equation R403.5.2 for every 1-hour period. The portion of the ventilation system that is intended to be continuous may have automatic cycling controls to provide the average flow rate for each hour.

R403.5.4 Intermittent ventilation rate. Intermittent ventilation rate means the difference between the total ventilation rate and the continuous ventilation rate.

R403.5.5 Balanced and HRV/ERV systems. All balanced systems shall be balanced so that the air intake is within 10 percent of the exhaust output. A heat recovery ventilator (HRV) or energy recovery ventilator (ERV) shall meet either:

- 1. The requirements of HVI Standard 920, 72 hours minus 13°F (-10°C) cold weather test; or
- 2. Certified by a registered professional engineer and installed per manufacturer's installation instructions.

An HRV or ERV intended to comply with both the continuous and total ventilation rate requirements shall meet the rated design capacity of the continuous ventilation rate specified in Section R403.5.3 under low capacity and meet the total ventilation rate specified in Section R403.5.2 under high capacity.

Exception: The balanced system and HRV/ERV system may include exhaust fans to meet the intermittent ventilation rate. Surface mounted fans shall have a maximum 1.0 sone per HVI Standard 915.

TABLE R403.5.1
MECHANICAL VENTILATION SYSTEM FAN EFFICACY

FAN LOCATION	AIR FLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)	AIR FLOW RATE MAXIMUM (CFM)
Range hoods	Any	2.8 cfm/watt	Any
In-line fan	Any	2.8 cfm/watt	Any
Bathroom, utility room	10	1.4 cfm/watt	< 90
Bathroom, utility room	90	2.8 cfm/watt	Any

For SI: 1 cfm = 28.3 L/min.

TABLE R403.5.2
NUMBER OF BEDROOMS

Conditioned space ¹ (in sq. ft.)	NUMBER OF BEDROOMS					
	1	2	3	4	5	6 ²
	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.