Combustion and Make-up Air Form

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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) 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**.
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) 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.**

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 Reduction Factor (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 in^2 =____in^2

Step 8: Calculate Minimum CAOA.
Minimum CAOA = CAOA ***multiplied by*** RF Minimum CAOA =____x____=____in^2

Step 9: Calculate Combustion Air Opening Diameter (CAOD)
CAOD = 1.13 ***multiplied by the square root*** of Minimum CAOA CAOD = 1.13 x Minimum CAOA = _____ in

Table 501.3.1 Procedure to Determine Makeup Air Quantity for Exhaust Equipment in Dwellings Use the Appropriate Column to Estimate House Infiltration				
	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 atmospherically vented gas or oil appliances or solid fuel appliances[D]
1a) 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 x 1b]				
2. Exhaust Capacity a) continuous exhaust-only ventilation systems (cfm): (not applicable to balanced ventilation systems such as HRV				
b) clothes dryer	135	135	135	135
c) 80% of largest exhaust rating (cfm): (not applicable if recirculating system or if powered makeup air is electrically interlocked and matched to exhaust)				
d) 80% of next largest exhaust rating (cfm): (not applicable if recirculating system or if powered makeup air is electrically interlocked and matched to exhaust)	not applicable			
Total Exhaust Capacity (cfm): [2a+2b+2c+2d]				
3. Makeup Air Requirement a) Total Exhaust Capacity (from above)				
b) Estimated House Infiltration (from above)				
Makeup Air Quantity (cfm): [3a – 3b] (if value is negative, no makeup air is needed)				
4. For Makeup Air Opening Sizing, refer to Table 501.3.2				

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 501.32 Makeup Air Opening Sizing Table for New and Existing Dwellings					
	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 atmospherically vented gas or oil appliances or solid fuel appliances[D]	Passive makeup air opening duct diameter[E, F, G]
Type of opening or system	(cfm)	(cfm)	(cfm)	(cfm)	(cfm)
Passive Opening	1-36	1-22	1-15	1-9	3
Passive Opening	33-66	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	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 appliance(s).
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.