# Combustion and Make-Up Air submittal form

Single Family and two family dwellings

| | | | |
|---|---|---|---|
| **Site Address** | | | **Date** |
| **Contractor** | **Completed By (please print)** | **Signature** | |

## Section A

| **Ventilation Quantity** (Determine quantity by using Table R403.5.2 or Equation R403.5.2 | | | |
|---|---|---|---|
| Square feet (Conditioned area including Basement – finished or unfinished) | | Total required ventilation | |
| Number of bedrooms | | Continuous ventilation | |

*Directions - Determine the total and continuous ventilation rate by either using Table R403.5.2 or equation R403.5.2*
*The table and equation are below.*

| Table R403.5.2 | | | | | | |
|---|---|---|---|---|---|---|
| Total and Continuous Ventilation Rates (in cfm) | | | | | | |
| | Number of Bedrooms | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Conditioned space (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 | 150/75 | 165/83 | 180/90 | 195/98 | 210/105 | 225/113 |

**Equation R403.5.2**

(0.02 x square feet of conditioned space) + [15 x (number of bedrooms + 1)] = Total ventilation rate (cfm)

**Total ventilation** – The mechanical ventilation system shall provide sufficient outdoor air to equal the total ventilation rate average, for each one-hour period according to the above table or equation. For heat recovery ventilators (HRV) and energy recovery ventilators (ERV) the average hourly ventilation capacity must be determined in consideration of any reduction of exhaust or out outdoor air intake, or both, for defrost or other equipment cycling.

**Continuous ventilation** - A minimum of 50 percent of the total ventilation rate, <u>but not less than 40 cfm</u>, shall be provided, on a continuous rate average for each one-hour period. The portion of the mechanical ventilation system intended to be continuous may have automatic cycling controls providing the average flow rate for each hour is met.

**Section B**

| Ventilation Method<br>(Choose either balanced or exhaust only) | | | | | |
|---|---|---|---|---|---|
| ☐ Balanced, HRV (Heat Recovery Ventilator) or ERV (Energy Recovery Ventilator) – cfm of unit in low must not exceed continuous ventilation rating by more than 100%. | | | | ☐ Balanced fan system | |
| Low cfm: | | High cfm: | | Continuous fan rating in cfm (capacity must not exceed continuous ventilation rating by more than 100%) | |

*Directions - Choose the method of ventilation, balanced or exhaust only. Balanced ventilation systems are typically HRV or ERV's. Enter the low and high cfm amounts. Low cfm air flow must be equal to or greater than the required continuous ventilation rate and less than 100% greater than the continuous rate. (For instance, if the low cfm is 40 cfm, the ventilation fan must not exceed 80 cfm.) Automatic controls may allow the use of a larger fan that is operated a percentage of each hour.*

**Section C**

| Ventilation Fan Schedule | | | |
|---|---|---|---|
| Description | Location | Continuous | Intermittent |
| | | | |
| | | | |
| | | | |
| | | | |

*Directions - The ventilation fan schedule should describe what the fan is for, the location, cfm, and whether it is used for continuous or intermittent ventilation. The fan that is chose for continuous ventilation must be equal to or greater than the low cfm air rating and less than 100% greater than the continuous rate. (For instance, if the low cfm is 40 cfm, the continuous ventilation fan must not exceed 80 cfm.) Automatic controls may allow the use of a larger fan that is operated a percentage of each hour.*

**Section D**

| Ventilation Controls<br>(Describe operation and control of the continuous and intermittent ventilation) |
|---|
| |
| |
| |
| |
| |

*Directions - Describe the operation of the ventilation system. There should be adequate detail for plan reviewers and inspectors to verify design and installation compliance. Related trades also need adequate detail for placement of controls and proper operation of the building ventilation. If exhaust fans are used for building ventilation, describe the operation and location of any controls, indicators and legends. If an ERV or HRV is to be installed, describe how it will be installed. If it will be connected and interfaced with the air handling equipment, please describe such connections as detailed in the manufactures' installation instructions. If the installation instructions require or recommend the equipment to be interlocked with the air handling equipment for proper operation, such interconnection shall be made and described.*

**Section E**

| Make-up air | | | |
|---|---|---|---|
| | Passive (determined from calculations from Table 501.3.1) | | |
| | Powered (determined from calculations from Table 501.3.1) | | |
| | Interlocked with exhaust device (determined from calculation from Table 501.3.1) | | |
| | Other, describe: | | |
| Location of duct or system ventilation make-up air: Determined from make-up air opening table | | | |
| | Cfm | | Size and type (round, rectangular, flex or rigid) |

(NR means not required)

*Directions - In order to determine the makeup air, Table 501.3.1 must be filled out (see below). For most new installations, column A will be appropriate, however, if atmospherically vented appliances or solid fuel appliances are installed, use the appropriate column.* ***For existing dwellings, see IMC 501.3.3****. Please note, if the makeup air quantity is negative, no additional makeup air will be required for ventilation, if the value is positive refer to Table 501.3.2 and size the opening. Transfer the cfm, size of opening and type (round, rectangular, flex or rigid) to the last line of section D. The make-up air supply must be installed per IMC 501.3.2.3.*

Table 501.3.1

PROCEDURE TO DETERMINE MAKEUP AIR QUANITY FOR EXHAUST EQUIPMENT IN DWELLINGS

(Additional combustion air will be required for combustion appliances, see KAIR method for calculations)

| | One or multiple power vent or direct vent appliances or no combustion appliances<br>Column A | One or multiple fan-assisted appliances and power vent or direct vent appliances<br>Column B | One atmospherically vent gas or oil appliance or one solid fuel appliance<br>Column C | Multiple atmospherically vented gas or oil appliances or solid fuel appliances<br>Column D |
|---|---|---|---|---|
| 1.<br>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 x 1b] | | | | |
| 2. Exhaust Capacity<br>a) continuous exhaust-only ventilation system (cfm); (not applicable to balanced ventilation systems such as HRV) | | | | |
| b) clothes dryer (cfm) | 135 | 135 | 135 | 135 |
| c) 80% of largest exhaust rating (cfm); Kitchen hood typically<br>(not applicable if recirculating system or if powered makeup air is electrically interlocked and match to exhaust) | | | | |
| d) 80% of next largest exhaust rating (cfm); bath fan typically<br>(not applicable if recirculating system or if powered makeup air is electrically interlocked and matched to exhaust) | Not Applicable | | | |
| Total Exhaust Capacity (cfm);<br>[2a + 2b +2c + 2d] | | | | |
| 3. Makeup Air Quantity (cfm)<br>a) total exhaust capacity (from above) | | | | |
| b) estimated house infiltration (from above) | | | | |
| Makeup Air Quantity (cfm);<br>[3a – 3b]<br>(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 appliance or if there are no combustion appliances. (Power vent and direct vent appliances may be used.)
B. Use this column if there is one fan-assisted appliance per venting system. (Appliances 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.

**Makeup Air Opening Table for New and Existing Dwelling**
**Table 501.3.2**

| | One or multiple power vent, direct vent appliances, or no combustion appliances Column A | One or multiple fan-assisted appliances and power vent or direct vent appliances Column B | One atmospherically vented gas or oil appliance or one solid fuel appliance Column C | Multiple atmospherically vented gas or oil appliances or solid fuel appliances Column D | Duct diameter |
|---|---|---|---|---|---|
| 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 w/motorized damper | 318 – 419 | 196 – 258 | 136 – 179 | 84 – 110 | 9 |
| Passive opening w/motorized damper | 420 – 539 | 259 – 332 | 180 – 230 | 111 – 142 | 10 |
| Passive opening w/motorized damper | 540 – 679 | 333 – 419 | 231 – 290 | 143 – 179 | 11 |
| Powered makeup air | >679 | >419 | >290 | >179 | NA |

Notes:
A. 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.
B. If flexible duct is used, increase the duct diameter by one inch. Flexible duct shall be stretched with minimal sags. Compressed duct shall not be accepted.
C. Barometric dampers are prohibited in passive makeup air openings when any atmospherically vented appliance is installed.
D. Powered makeup air shall be electrically interlocked with the largest exhaust system.

## Section F

| Combustion air | | | |
|---|---|---|---|
| | Not required per mechanical code (No atmospheric or power vented appliances) | | |
| | Passive (see IFGC Appendix E, Worksheet E-1) | Size and type | |
| | Other, describe: | | |

*Explanation - If no atmospheric or power vented appliances are installed, check the appropriate box, not required. If a power vented or atmospherically vented appliance installed, use IFGC Appendix E, Worksheet E-1 (see below). Please enter size and type. Combustion air vent supplies must communicate with the appliance or appliances that require the combustion air.*

*Section F calculations follow on the next 2 pages.*

*Directions - The Minnesota Fuel Gas Code method to calculate to size of a required combustion air opening, is called the Known Air Infiltration Rate Method.* ***For new construction, 4b of step 4 is required to be filled out.***

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 or Power Vent __Direct Vent Input: _____Btu/hr
Water Heater:
__ Draft Hood ___ Fan Assisted or Power Vent __ Direct Vent Input: _____Btu/hr

**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: _____$ft^3$
L x W x H L W H

**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. (DO NOT COUNT DIRECT VENT APPLIANCES)

**4a.** Standard Method
Total Btu/hr input of all combustion 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 (DO NOT COUNT DIRECT VENT APPLIANCES)
Total Btu/hr input of all **fan-assisted and power 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 **Natural draft** appliances Input: _____ Btu/hr

Use Natural draft Appliances column in Table E-1 to find Required Volume Natural draft appliances (RVNDA) RVNFA: _____$ft^3$

Total Required Volume (TRV) = RVFA + RVNDA 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.**

**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 $in^2$ 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 √ Minimum CAOA = _____in. diameter
go up one inch in size if using flex duct

1 If desired, ACH can be determined using ASHRAE calculation or blower door test. Follow procedures in Section G304.

| IFGC Appendix E, Table E-1<br>Residential Combustion air (Required Interior Volume Based on Input Rating of Appliance) | | | | | |
|---|---|---|---|---|---|
| Input Rating (Btu/hr) | Standard Method | Known Air Infiltration Rate (KAIR) Method (cu ft) | | | |
| | | Fan Assisted or Power Vent | | Natural Draft | |
| | | 1994 to present | Pre-1994 | 1994 to present | Pre-1994 |
| 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 | 10,783 |
| 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 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.
2. This 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.