Home Upgrade

Energy Upgrade California®

MECHANICAL VENTILATION STANDARDS

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RHA program design+management

Note: As a participating contractor in Home Upgrade, it is the contractor's responsibility to adhere to all federal, state and local ordinances and regulations. Applicable regulations include (but are not limited to) those issued by the following organizations and publications: Environmental Protection Agency (EPA), Federal Occupational Safety and Health Administration (OSHA), Division of Occupational Safety and Health (Cal/OSHA), California Energy Commission (CEC), California Public Utilities Commission (CPUC), Department of Energy (DOE), American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Natural Gas Appliance Testing (NGAT), California Energy Efficiency Standards (Title-24) and California Residential Code (CRC).

All participating contractors must adhere to the requirements set forth by the program per the participating contractor agreement, customer application, Inspection Guidelines, Processing Guidelines, Installation Standards and any other program documents and notifications related to program guidelines and requirements. It is the responsibility of the Participating contractor to know the ventilation requirements set forth by the local jurisdiction and adhere to the code regulations if they conflict with the program's recommended ventilation practices.

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Chapter1: Mechanical Ventilation

A. Feasibility

1. Installation of a mechanical ventilation fan/system is required when final CFM50 is < 70% Building Airflow Standard (BAS).
2. When final CFM50 is < 70% BAS, installation is not required when:
   a. Continuous whole-house mechanical ventilation airflow requirement is ≤ 15 CFM.
   b. Installation of ventilation ducting or electrical supply to ventilation equipment is not feasible.
   c. There is an *existing* whole-house ventilation system that:
      1) Operates properly
      2) Is suitable for continuous operation
      3) Provides the required airflow
      4) Has sound level acceptable to the customer

B. Equipment and Materials

1. Ventilation fans/systems must be:
   a. UL Listed (or equivalent) and Home Ventilating Institute (HVI) Certified.
   b. ENERGY STAR® certified, and Title 24 compliant.
   c. Designed for continuous operation, with permanently-lubricated motor (new and existing).
   d. Warrantied for a minimum of one year.
2. Ducts must be in compliance with manufacturer's specification and ASHRAE 62.2-2016.
3. Airflow measuring devices must be:
   a. Capable of accurately measuring fan/system airflow for the type of unit being evaluated (exhaust, supply, or balanced).
   b. Operated and used in conformance with manufacturer's instructions.
4. The following are examples of airflow measuring devices.
   a. Least Cost
      1) TEC Duct Blaster® as a Powered Capture Hood
         a) Measures flows of 10 to 300 CFM.
         b) Use existing duct tester (TEC or Retrotec)
      2) TEC Exhaust Fan Flow Meter™
         a) Measures **exhaust**-only flows of 10 to 124 CFM.
         b) Additional device used with duct tester digital gauge (TEC or Retrotec).
   b. Medium Cost
      1) Large Vane Anemometer with flow funnel (outside fan grille)
         a) Measures flows of up to 75 CFM (must have averaging or snapshot capability, with display showing airflow in CFM).
         b) Must take multiple readings across the fan without funnel; single reading acceptable with properly-sized funnel.

2) Mini-Vane Anemometer and Hot Wire Anemometer (inside duct)
   a) Inside of duct: must stay at least 3 duct diameters from transitions in duct.
   b) Outside of grille: Multiple measurements must be made and averaged, then multiplied by NFVA of the grille to convert from FPM to CFM.
3) Averaging Flow Sensor (e.g., Dwyer Series PAFS-1000 Averaging Flow Sensor or Kele DPFS Series differential pressure flow sensor) or Pitot Tube with digital gauge (inside of duct)
   a) Must stay at least three duct diameters from transitions in duct
   b) Online tool to perform calculations is at: http://www.residentialenergydynamics.com/REDCalcFree/Tools/PitotTubeAirFlow

c. Highest Cost
1) TEC FlowBlaster®: Measures flows of 10 to 300 CFM.
2) Retrotec Flow Finder®: Measures flows of 6 to 323 CFM.
3) Flow Capture Hood (Skirt must be appropriately sized for grille.): Measures flows of up to 1500 CFM.

C. General Requirements

1. Obtain a permit prior to installation when required by the local jurisdiction.
2. Install the mechanical ventilation system (fan, controls, and ducting) in accordance with manufacturer's instructions, ASHRAE 62.2-2016, and local code.

Mechanical Ventilation Calculator: *See Appendix A for a description and directions for using the program's Mechanical Ventilation Calculator. The standards and formulas described in the following sections have been incorporated into the calculator for ease of use.*

Step 1: Determine if MV is Required or Recommended

D. Building Air Standard (BAS) Evaluation

1. The program standards for recommending or requiring mechanical ventilation is based on ASHRAE 62-89.

Table 1-1. Program Standards for Mechanical Ventilation

Condition	Mechanical Ventilation Program Requirement
Final CFM50 is ≥70% and <100% of BAS cfm50	Mechanical ventilation must be **recommended** to the customer as part of the work scope.
Final CFM50 is < 70% of BAS cfm50	Mechanical ventilation must be **installed** as part of the work scope.

BAS cfm50 is the greater of: a) 0.35 x volume ÷ 60 x LBL N-factor OR b) 15 x # of occupants x LBL N-factor. The Home Upgrade MV calculator does the calculations for you. For more information, please contact your ICF Account Manager.

Step 2: Determine the Minimum Continuous Mechanical Ventilation Airflow Requirement

E. Initial Whole-House Ventilation Airflow Requirement

1. The initial required ventilation airflow is determined by using Equation 1-1 below or Table 1-2 below.
2. Equation 1-1 and Table 1-2 assume two persons in the first bedroom (or studio apartment), and one person per additional bedroom. When higher occupant density is known, add 7.5 CFM for each additional person.

Equation 1-1:	Initial Ventilation Airflow Requirement (CFM) = (0.03 x Sq. Ft.) + (7.5 x [# BR + 1])

Sq. Ft. = Sq. Ft. of living space, from interior room measurements or exterior wall measurements

BR = Number of bedrooms in the home

Table 1-2. Initial Ventilation Airflow Requirement

Floor Area Sq. Ft.	Number of Bedrooms				
	0–1	2	3	4	5
< 500	30 CFM	38 CFM	45 CFM	53 CFM	60 CFM
501 – 1000	45 CFM	53 CFM	60 CFM	68 CFM	75 CFM
1001 – 1500	60 CFM	68 CFM	75 CFM	83 CFM	90 CFM
1501 – 2000	75 CFM	83 CFM	90 CFM	98 CFM	105 CFM
2001 – 2500	90 CFM	98 CFM	105 CFM	113 CFM	120 CFM
2501 – 3000	105 CFM	113 CFM	120 CFM	128 CFM	135 CFM
3001 – 3500	120 CFM	128 CFM	135 CFM	143 CFM	150 CFM
3501 – 4000	135 CFM	143 CFM	150 CFM	158 CFM	165 CFM
4001 – 4500	150 CFM	158 CFM	165 CFM	173 CFM	180 CFM
4501 – 5000	165 CFM	173 CFM	180 CFM	188 CFM	195 CFM

F. Local Exhaust Adjustment

1. The new construction code airflow requirements for kitchen and bathroom exhaust systems are:
   a. 100 CFM for the kitchen range hood.
   b. 50 CFM in **full** bathrooms (those with a shower, bathtub, spa, or similar source of moisture). The adjustment does not apply to “half baths.”
2. An adjustment must be made for existing kitchen and bathroom ventilation that has lower airflow than the code requirement.
3. The “Local Exhaust Adjustment” eliminates the need to upgrade local exhaust fans when existing local ventilation airflow is too low.

4. Measuring existing fan airflow is optional (see Section B, Item 4 regarding airflow measuring devices). If existing airflow is less than code requirement, the local exhaust "deficit" is the difference between required and existing airflow. The deficit increases the whole-house mechanical ventilation airflow requirement. If airflow is not measured, it is assumed that existing exhaust airflow equals zero.
5. When existing fan airflow *equals or exceeds* the code requirement, the local exhaust adjustment is zero.
6. **Kitchen Ventilation Airflow Adjustment:**
   a. Measure the airflow of existing exhaust fan (range hood or ceiling/wall fan). The result is the "Measured CFM".
   b. "Kitchen CFM Adjustment" is calculated using Equation 1-2.
      1) If "Measured CFM" exceeds 100, **use 100** (any CFM above 100 is disregarded).
      2) If there is no operable exhaust fan present or if airflow has not been measured, **"Measured CFM" = 0.**
      3) If an operable window is present in the kitchen, a 20 cfm airflow credit is subtracted from the 100cfm kitchen airflow requirement.

Equation 1-2:	Kitchen CFM Adjustment = (100 CFM – Measured CFM – 20cfm if operable window is present) x .25

7. **Bathroom Ventilation Airflow Adjustment**
   a. Measure airflow of existing exhaust fan in each "full" bathroom (one with a shower, bathtub, spa, or similar source of moisture; ignore half-baths). The result is the "Measured CFM".
   b. The "Bathroom CFM Adjustment" is calculated using Equation 1-3.
      1) If "Measured CFM" exceeds 50, ***use 50*** (any CFM above 50 is disregarded).
      2) When no operable exhaust fan is present or if fan airflow has not been measured, "Measured CFM" = 0.
      3) If an operable window is present in the bathroom, a 20 cfm airflow credit is subtracted from the 50cfm bathroom airflow requirement.
   c. Equation 1-3 is applied to **each** *full* bathroom in the home.
   d. The *sum* of the "Bathroom CFM Adjustment" equations for all bathrooms is the "**Total** Bathroom CFM Adjustment".

Equation 1-3:	Bathroom CFM Adjustment = (50 CFM – Measured CFM – 20cfm if operable window is present) x .25

8. **Total Local Exhaust Airflow Adjustment**
   a. The Total Local Airflow Adjustment is calculated using Equation 1-4.

Equation 1-4:	Total Local CFM Adjustment = Kitchen CFM Adjustment + Total Bathroom CFM Adjustment

G. Infiltration Credit—Single Family Homes

1. The Infiltration Credit is optional:
   a. The credit may be claimed in single family homes if a blower door test is performed.
   b. The credit is *not* allowed for multi-family buildings with vertically-attached dwelling units.[1]
2. The Infiltration Credit will adjust the Minimum Continuous Mechanical Ventilation Airflow Requirement in Equation 1-6.
3. Credit may be taken for shell leakage CFM50 measured with final blower door test results obtained after all shell measures and duct sealing have been installed.
4. Per ASHRAE 62.2-2016, §4.1.2, blower door testing must be performed in accordance with RESNET 800, Sec. 802.5 or ASTM E779-10 or CGSB 149.10-M86.
5. The Energy Conservatory provides a "Quick Form" for the RESNET One-Point Test at: http://energyconservatory.com/wp-content/uploads/2015/01/resnet_form.pdf

Infiltration Credit – Step 1:

1. Perform a final blower door test after infiltration measures have been installed.
   a. Measure the CFM leakage at 50 Pa of house pressure and record the reading.

Infiltration Credit – Step 2:

2. Select the appropriate **"S" Factor** from Table 1-3 (for the infiltration credit calculation).

Table 1-3 "S" Factor

# of Stories	S Factor	# of Stories	S Factor	# of Stories	S Factor
1	1.00	2	1.32	3	1.55
1.5	1.18	2.5	1.44		

   a. The "S" Factor applies to single-family dwellings and dwelling units that are only horizontally-attached to other units in a multi-family complex.
   b. # of Stories equals all above and below grade finished areas.
   c. If the basement is finished in a manner similar to the rest of the house, it is included. If unfinished and unconditioned, it is not included as a "story".
   d. For a two-story townhouse, the two-story "S" Factors applies.

[1] ASHRAE 62.2-2016, §4.1.2. allows the Infiltration Credit to be claimed for horizontally-attached single family dwelling units (e.g., duplex, triplex, etc.). However, the blower door reading is reduced by the ratio of exterior envelope surface area that is not attached to garages or other dwelling units to the total surface area of the dwelling.

Infiltration Credit – Step 3:

3. Select the **Weather and Shielding Factor (WSF)** from Table 1-4 by locating the weather station that is geographically closest to the dwelling's location.

Table 1-4 Weather and Shielding Factor (WSF)

Weather Station	Nearby City	WSF
Bakersfield Meadows Field	Bakersfield	0.43
Bishop Airport	Bishop	0.55
Blythe Riverside County Airport	Blythe	0.48
Burbank–Glendale–Pasadena Airport	Burbank	0.39
Camarillo (AWOS)	Camarillo	0.43
Chino Airport	Chino	0.45
Fresno Yosemite International Airport	Fresno	0.45
Fullerton Municipal	Fullerton	0.34
Jack Northrop Field H	Hawthorne	0.38
Lancaster General William Fox Field	Lancaster	0.62
Lemoore Reeves NAS	Lemoore	0.50
Long Beach Daugherty Field	Long Beach	0.38
Los Angeles International Airport	Los Angeles	0.42
Needles Airport	Needles	0.51
Oxnard Airport	Oxnard	0.45
Palm Springs International Airport	Palm Springs	0.45
Palm Springs Thermal Airport	Palm Springs	0.46
Twentynine Palms	Palm Springs	0.50
Palmdale Airport	Palmdale	0.57
Paso Robles Municipal Airport	Paso Robles	0.53
Point Mugu National Air Field	Point Mugu	0.45
March Air Force Base	Riverside	0.43
Riverside Municipal Airport	Riverside	0.42
San Luis County Regional Airport	San Luis Obispo	0.51
Santa Ana John Wayne Airport	Santa Ana	0.36
Santa Barbara Municipal Airport	Santa Barbara	0.44
Lompoc (AWOS)	Santa Maria	0.55
Santa Maria Public Airport	Santa Maria	0.52
Santa Monica Municipal Airport	Santa Monica	0.39
Van Nuys Airport	Van Nuys	0.39
Porterville (AWOS)	Visalia	0.42
Visalia Municipal (AWOS)	Visalia	0.43

Infiltration Credit – Step 4:

4. Apply the "S" Factor and WSF to the Infiltration Credit using Equation 1-5.

Equation 1-5:	Infiltration Credit = 0.052 x CFM_{50} blower door reading x "S" Factor x Weather and Shielding Factor

   a. The infiltration credit is applied to reduce whole-house MV minimum airflow, using Equation 1-6.

   b. If the Infiltration Credit does not apply, its value in the equation = 0.

H. Minimum Continuous Mechanical Ventilation Airflow Requirement

1. The Minimum Continuous Mechanical Ventilation Airflow Requirement is the required minimum *continuous* airflow for the whole-house mechanical ventilation system.
2. It is calculated using Equation 1-6, and is the lowest acceptable fan airflow.
3. If the requirement is 15 CFM or less, a whole-house mechanical ventilation fan/system is *not* required.

Equation 1-6:	Minimum Continuous Mechanical Ventilation Airflow Requirement = Initial Fan CFM (Eq. 1-1 or Table 1-1) + Total Local CFM Adjustment (Eq. 1-4) - Infiltration Credit CFM (Eq. 1-5)

I. New Fans

1. Lead-safe practices must be employed when working with pre-1978 painted materials per state codes T8 Section 1532.1 and T17 Section 36000, et seq.
2. All units must provide the Required CFM at 0.25 iwc. of static pressure and not exceed maximum sound levels (sones) shown in Table 1-5.

Table 1-5. Maximum Sone Levels

Operation Mode	Sones
Whole Building—Continuous or Intermittent [1]	1.0
Bath or Kitchen—Intermittent	3.0
In-Line Fans Outside the Living Space [2]	N/A

[1] A 1.2 sone wall-mount *supply* fan is allowed, when a 1.0 sone wall-mount supply fan is needed but not available.

[2] Sone maximum does not apply to "in-line" fans, when mounted outside the living space (e.g., in the attic) and ≥ 4' of ductwork separates the fan from the inlet/outlet grille in the living space.

3. Fan airflow must be verified using an approved airflow measuring device (see Section B, Item 4 regarding airflow measuring devices), operated in accordance with measuring device manufacturer's instructions.
4. Existing Fans. An existing fan may be used if it conforms to the following criteria:

   a. Meet minimum airflow requirement (as determined by actual measurement),

b. Sound level is acceptable to owner,

c. It is rated by the manufacturer for *continuous* operation, and

d. It is in good working order.

5. Whole-house MV fan CFM in *Bathroom* Location

a. If the whole-house mechanical ventilation fan is installed in a bathroom, it must operate at a minimum of 50 CFM when the bathroom is occupied.

b. When the whole-house ventilation requirement is less than 50 CFM, a two-speed fan with sensor/switch must be installed, so that airflow automatically elevates to at least 50 CFM when the bathroom is occupied.

6. Existing Exhaust/Supply Ducts

a. Diameter (or rectangular cross-sectional area) must be at least the minimum specified by the fan manufacturer, if known, or per Table 1-6 (next page).

b. Length must not exceed the maximum allowed, with the duct terminating outside the building in a wall or roof terminal.

c. Duct must be:

1) Repaired or replaced if damaged, or replaced if undersized.

2) Properly supported and free of sharp bends and loose connections.

3) Repaired/sealed as needed to bring it into conformance with the manufacturer's duct specifications.

7. New Ducts

a. Shall be installed, supported, and sealed in accordance with manufacturer's instructions and local code.

b. Shall conform to the requirements of Table 1-6 (next page) for minimum diameter and maximum length.

8. Duct Materials

a. Rigid metal or PVC, for best airflow characteristics.

b. Flexible metal, next-best for airflow.

c. Flexible vinyl: acceptable only for two-foot isolation connector at the fan (for ease of alignment and sound absorption).

9. Bends and 90° Elbows

a. Install ducts with the shortest possible length and fewest possible bends and elbows.

b. Install straight duct the first 2' to 3' from the fan before the first bend or elbow.

c. Make turns with radius at the centerline no less than one duct diameter.

d. Duct elbows should:

1) Have a maximum 90-degree bend, but avoided where possible.

2) Be limited to 3 elbows for duct diameters 4" or larger.

3) Not be used in 3" diameter duct.

e. Long-Radius Bends

1) Use bends and 45° offsets instead of 90° elbows, when possible, to create long-radius bends.

2) Short, sharp bends must **not** be used.

f. When determining diameter and length requirements:

1) Bends of 45° or less constitute the equivalent of half of a 90° elbow (two of them count as one elbow).

2) Each bend greater than 45° constitutes the equivalent of one 90° elbow.

Table 1-6. Maximum Duct Length (ft.) with No Elbows

		FLEX Metal Duct								SMOOTH Metal and PVC Duct							
	Fan CFM* ➔	50	80	100	125	150	200	250	300	50	80	100	125	150	200	250	300
Minimum Duct Diameter	3"	NA	NA	NA	NA	NA	NA	NA	NA	5'	NA	NA	NA	NA	NA	NA	NA
	4"	56'	4'	NA	NA	NA	NA	NA	NA	114'	31'	10'	NA	NA	NA	NA	NA
	5"	No Limit	81'	42'	16'	2'	NA	NA	NA	No Limit	152'	91'	51'	28'	4'	NA	NA
	6"	No Limit	No Limit	158'	91'	55'	18'	1'	NA	No Limit	No Limit	No Limit	168'	112'	53'	25'	9'
	7"	No Limit	No Limit	No Limit	No Limit	161'	78'	40'	19'	No Limit	No Limit	No Limit	No Limit	No Limit	148'	88'	54'
	≥ 8"	No Limit	No Limit	No Limit	No Limit	No Limit	189'	111'	69'	No Limit	No Limit	No Limit	No Limit	No Limit	No Limit	198'	133'
Key	**The table assumes no elbows. Make the following deductions:** • Subtract 15 feet for each 90° elbow. • Subtract 7.5 feet for each 45° offset. **For these components, use manufacturer's specs. If not available, use these guidelines:** • Subtract 30 feet for a wall cap with bird screen and damper. • Subtract 35 feet for a low-profile soffit vent with bird screen and damper. • Subtract 60 feet for a low-profile roof cap for round duct with bird screen and damper. **NA** = Not Allowed; **No Limit** = At this duct diameter, there is no limit on the maximum duct length. *CFM @ 0.25 iwc. For airflows not listed, use the next higher value (e.g., for 60 CFM, use column for 80 CFM).																

J. Safety Considerations

1. Depressurization by a mechanical ventilation exhaust system must not negatively impact a vented open-combustion appliance located within, and drawing combustion air from inside the building envelope.
    a. When house depressurization is an issue:
        1) A supply (positive pressure) ventilation system, or a balanced ventilator (ERV or HRV), *must* be installed instead of exhaust ventilation.
        2) Passive inlet venting may be installed to provide pressure relief.
        3) Mechanical ventilation must *not* be installed that will worsen a CAS test failure that cannot be corrected.
2. Following installation of *exhaust* mechanical ventilation, conduct CAS testing on all combustion appliances that could be affected by depressurization caused by the mechanical ventilation system.

K. Post-Installation

1. Fan controls must be labeled to describe their function.
2. The system must be tested after installation to ensure proper operation of all functions.
3. Provide customer with:
    a. A demonstration with verbal operating instructions for the ventilation system.
    b. Manufacturer's written instructions and warranty.
    c. Education on the importance of operating the ventilation system as designed.

Chapter2: Intermittent Mechanical Ventilation

The primary equation in ASHRAE 62.2 for whole-house mechanical ventilation airflow is for *continuous* ventilation (operating 24/7) at the lowest allowable fan capacity. *Intermittent* fan operation requires increased airflow to compensate for the time the fan is not operating. This chapter provides guidelines for calculating intermittent fan airflow and runtime.

There are two strategies for scheduling intermittent mechanical ventilation:

A) Intermittent MV - Hours-Per-Day (H-P-D)

B) Intermittent MV - Minutes-Per-Hour (M-P-H)

A. Intermittent Mechanical Ventilation - Hours-Per-Day (H-P-D)

1. The Intermittent H-P-D strategy allows for longer periods of no fan operation.
2. Intermittent H-P-D Fan airflow is based on the Minimum Continuous Mechanical Ventilation Airflow Requirement from Chapter 1 and the desired number of hours of runtime. The resulting increased fan airflow is determined using Table 2-1 or by using the program's Intermittent MV H-P-D calculator. Fewer hours of runtime require higher airflows.
3. Fan must cycle on at least one hour every three hours and operate at least eight hours per day.
4. A programmable controller must be installed to operate the mechanical ventilation fan for the desired runtime schedule.

Table 2-1. Hours-Per-Day (H-P-D) Fan CFM and Runtime

	Whole-House Mechanical Ventilation Intermittent Hours-per-Day Airflow Requirement															
Whole-House MV Continuous Airflow Requirement	24 hours per day	23 hours per day	22 hours per day	21 hours per day	20 hours per day	19 hours per day	18 hours per day	17 hours per day	16 hours per day	15 hours per day	14 hours per day	13 hours per day	12 hours per day	11 hours per day	10 hours per day	9 hours per day	8 hours per day	less than 8 hrs/day
	30 cfm	35 cfm	35 cfm	35 cfm	40 cfm	40 cfm	40 cfm	45 cfm	45 cfm	50 cfm	55 cfm	60 cfm	60 cfm	70 cfm	75 cfm	80 cfm	90 cfm	not allowed
	35 cfm	40 cfm	40 cfm	40 cfm	45 cfm	45 cfm	50 cfm	50 cfm	55 cfm	60 cfm	60 cfm	65 cfm	70 cfm	80 cfm	85 cfm	95 cfm	105 cfm	not allowed
	40 cfm	45 cfm	45 cfm	50 cfm	50 cfm	55 cfm	55 cfm	60 cfm	60 cfm	65 cfm	70 cfm	75 cfm	80 cfm	90 cfm	100 cfm	110 cfm	120 cfm	not allowed
	45 cfm	50 cfm	50 cfm	55 cfm	55 cfm	60 cfm	60 cfm	65 cfm	70 cfm	75 cfm	80 cfm	85 cfm	90 cfm	100 cfm	110 cfm	120 cfm	135 cfm	not allowed
	50 cfm	55 cfm	55 cfm	60 cfm	60 cfm	65 cfm	70 cfm	75 cfm	75 cfm	80 cfm	90 cfm	95 cfm	100 cfm	110 cfm	120 cfm	135 cfm	150 cfm	not allowed
	55 cfm	60 cfm	60 cfm	65 cfm	70 cfm	70 cfm	75 cfm	80 cfm	85 cfm	90 cfm	95 cfm	105 cfm	110 cfm	120 cfm	135 cfm	150 cfm	165 cfm	not allowed
	60 cfm	65 cfm	70 cfm	70 cfm	75 cfm	80 cfm	80 cfm	85 cfm	90 cfm	100 cfm	105 cfm	115 cfm	120 cfm	135 cfm	145 cfm	160 cfm	180 cfm	not allowed
	65 cfm	70 cfm	75 cfm	75 cfm	80 cfm	85 cfm	90 cfm	95 cfm	100 cfm	105 cfm	115 cfm	120 cfm	130 cfm	145 cfm	160 cfm	175 cfm	195 cfm	not allowed
	70 cfm	75 cfm	80 cfm	80 cfm	85 cfm	90 cfm	95 cfm	100 cfm	105 cfm	115 cfm	120 cfm	130 cfm	140 cfm	155 cfm	170 cfm	190 cfm	210 cfm	not allowed
	75 cfm	80 cfm	85 cfm	90 cfm	90 cfm	95 cfm	100 cfm	110 cfm	115 cfm	120 cfm	130 cfm	140 cfm	150 cfm	165 cfm	180 cfm	200 cfm	225 cfm	not allowed
	80 cfm	85 cfm	90 cfm	95 cfm	100 cfm	105 cfm	110 cfm	115 cfm	120 cfm	130 cfm	140 cfm	150 cfm	160 cfm	175 cfm	195 cfm	215 cfm	240 cfm	not allowed
	85 cfm	90 cfm	95 cfm	100 cfm	105 cfm	110 cfm	115 cfm	120 cfm	130 cfm	140 cfm	150 cfm	160 cfm	170 cfm	190 cfm	205 cfm	230 cfm	255 cfm	not allowed
	90 cfm	95 cfm	100 cfm	105 cfm	110 cfm	115 cfm	120 cfm	130 cfm	135 cfm	145 cfm	155 cfm	170 cfm	180 cfm	200 cfm	220 cfm	240 cfm	270 cfm	not allowed
	95 cfm	100 cfm	105 cfm	110 cfm	115 cfm	120 cfm	130 cfm	135 cfm	145 cfm	155 cfm	165 cfm	180 cfm	190 cfm	210 cfm	230 cfm	255 cfm	285 cfm	not allowed
	100 cfm	105 cfm	110 cfm	115 cfm	120 cfm	130 cfm	135 cfm	145 cfm	150 cfm	160 cfm	175 cfm	185 cfm	200 cfm	220 cfm	240 cfm	270 cfm	300 cfm	not allowed
	105 cfm	110 cfm	115 cfm	120 cfm	130 cfm	135 cfm	140 cfm	150 cfm	160 cfm	170 cfm	180 cfm	195 cfm	210 cfm	230 cfm	255 cfm	280 cfm	315 cfm	not allowed
	110 cfm	115 cfm	120 cfm	130 cfm	135 cfm	140 cfm	150 cfm	160 cfm	165 cfm	180 cfm	190 cfm	205 cfm	220 cfm	240 cfm	265 cfm	295 cfm	330 cfm	not allowed
	115 cfm	120 cfm	130 cfm	135 cfm	140 cfm	150 cfm	155 cfm	165 cfm	175 cfm	185 cfm	200 cfm	215 cfm	230 cfm	255 cfm	280 cfm	310 cfm	345 cfm	not allowed
	120 cfm	130 cfm	135 cfm	140 cfm	145 cfm	155 cfm	160 cfm	170 cfm	180 cfm	195 cfm	210 cfm	225 cfm	240 cfm	265 cfm	290 cfm	320 cfm	360 cfm	not allowed
	125 cfm	135 cfm	140 cfm	145 cfm	150 cfm	160 cfm	170 cfm	180 cfm	190 cfm	200 cfm	215 cfm	235 cfm	250 cfm	275 cfm	300 cfm	335 cfm	375 cfm	not allowed
	130 cfm	140 cfm	145 cfm	150 cfm	160 cfm	165 cfm	175 cfm	185 cfm	195 cfm	210 cfm	225 cfm	240 cfm	260 cfm	285 cfm	315 cfm	350 cfm	390 cfm	not allowed
	135 cfm	145 cfm	150 cfm	155 cfm	165 cfm	175 cfm	180 cfm	195 cfm	205 cfm	220 cfm	235 cfm	250 cfm	270 cfm	295 cfm	325 cfm	360 cfm	405 cfm	not allowed
	140 cfm	150 cfm	155 cfm	160 cfm	170 cfm	180 cfm	190 cfm	200 cfm	210 cfm	225 cfm	240 cfm	260 cfm	280 cfm	310 cfm	340 cfm	375 cfm	420 cfm	not allowed
	145 cfm	155 cfm	160 cfm	170 cfm	175 cfm	185 cfm	195 cfm	205 cfm	220 cfm	235 cfm	250 cfm	270 cfm	290 cfm	320 cfm	350 cfm	390 cfm	435 cfm	not allowed
	150 cfm	160 cfm	165 cfm	175 cfm	180 cfm	190 cfm	200 cfm	215 cfm	225 cfm	240 cfm	260 cfm	280 cfm	300 cfm	330 cfm	360 cfm	400 cfm	450 cfm	not allowed
	155 cfm	165 cfm	170 cfm	180 cfm	190 cfm	200 cfm	210 cfm	220 cfm	235 cfm	250 cfm	270 cfm	290 cfm	310 cfm	340 cfm	375 cfm	415 cfm	465 cfm	not allowed
	160 cfm	170 cfm	175 cfm	185 cfm	195 cfm	205 cfm	215 cfm	230 cfm	240 cfm	260 cfm	275 cfm	300 cfm	320 cfm	350 cfm	385 cfm	430 cfm	480 cfm	not allowed
	165 cfm	175 cfm	180 cfm	190 cfm	200 cfm	210 cfm	220 cfm	235 cfm	250 cfm	265 cfm	285 cfm	305 cfm	330 cfm	360 cfm	400 cfm	440 cfm	495 cfm	not allowed
	170 cfm	180 cfm	190 cfm	195 cfm	205 cfm	215 cfm	230 cfm	240 cfm	255 cfm	275 cfm	295 cfm	315 cfm	340 cfm	375 cfm	410 cfm	455 cfm	510 cfm	not allowed

(The Intermittent H-P-D table has been abbreviated for this document.)

B. Intermittent Mechanical Ventilation—Minutes-Per-Hour (M-P-H)

1. The Intermittent M-P-H strategy allows for less fan runtime per hour and assumes that the fan will operate at least once every hour.
2. Intermittent M-P-H fan airflow is based on the Minimum Continuous Mechanical Ventilation Airflow Requirement from Chapter 1 and the desired minutes-per-hour runtime. The resulting increased fan airflow is determined by using Table 2-2 or by using the program's Intermittent MV M-P-H calculator.
3. A programmable controller must be installed to operate the mechanical ventilation equipment for the desired runtimes.

Table 2-2. Minutes-Per-Hour (M-P-H) Fan CFM and Runtime

		Whole-House Mechanical Ventilation Intermittent Minutes-Per-Hour Airflow Requirement										
	60 minutes per hour	55 minutes per hour	50 minutes per hour	45 minutes per hour	40 minutes per hour	35 minutes per hour	30 minutes per hour	25 minutes per hour	20 minutes per hour	15 minutes per hour	10 minutes per hour	5 minutes per hour
Whole-House MV Continuous Airflow Requirement	30 cfm	35 cfm	40 cfm	40 cfm	45 cfm	55 cfm	60 cfm	75 cfm	90 cfm	120 cfm	180 cfm	360 cfm
	35 cfm	40 cfm	45 cfm	50 cfm	55 cfm	60 cfm	70 cfm	85 cfm	105 cfm	140 cfm	210 cfm	420 cfm
	40 cfm	45 cfm	50 cfm	55 cfm	60 cfm	70 cfm	80 cfm	100 cfm	120 cfm	160 cfm	240 cfm	480 cfm
	45 cfm	50 cfm	55 cfm	60 cfm	70 cfm	80 cfm	90 cfm	110 cfm	135 cfm	180 cfm	270 cfm	540 cfm
	50 cfm	55 cfm	60 cfm	70 cfm	75 cfm	90 cfm	100 cfm	120 cfm	150 cfm	200 cfm	300 cfm	600 cfm
	55 cfm	60 cfm	70 cfm	75 cfm	85 cfm	95 cfm	110 cfm	135 cfm	165 cfm	220 cfm	330 cfm	660 cfm
	60 cfm	70 cfm	75 cfm	80 cfm	90 cfm	105 cfm	120 cfm	145 cfm	180 cfm	240 cfm	360 cfm	720 cfm
	65 cfm	75 cfm	80 cfm	90 cfm	100 cfm	115 cfm	130 cfm	160 cfm	195 cfm	260 cfm	390 cfm	780 cfm
	70 cfm	80 cfm	85 cfm	95 cfm	105 cfm	120 cfm	140 cfm	170 cfm	210 cfm	280 cfm	420 cfm	840 cfm
	75 cfm	85 cfm	90 cfm	100 cfm	115 cfm	130 cfm	150 cfm	180 cfm	225 cfm	300 cfm	450 cfm	900 cfm
	80 cfm	90 cfm	100 cfm	110 cfm	120 cfm	140 cfm	160 cfm	195 cfm	240 cfm	320 cfm	480 cfm	960 cfm
	85 cfm	95 cfm	105 cfm	115 cfm	130 cfm	150 cfm	170 cfm	205 cfm	255 cfm	340 cfm	510 cfm	1020 cfm
	90 cfm	100 cfm	110 cfm	120 cfm	135 cfm	155 cfm	180 cfm	220 cfm	270 cfm	360 cfm	540 cfm	1080 cfm
	95 cfm	105 cfm	115 cfm	130 cfm	145 cfm	165 cfm	190 cfm	230 cfm	285 cfm	380 cfm	570 cfm	1140 cfm
	100 cfm	110 cfm	120 cfm	135 cfm	150 cfm	175 cfm	200 cfm	240 cfm	300 cfm	400 cfm	600 cfm	1200 cfm
	105 cfm	115 cfm	130 cfm	140 cfm	160 cfm	180 cfm	210 cfm	255 cfm	315 cfm	420 cfm	630 cfm	1260 cfm
	110 cfm	120 cfm	135 cfm	150 cfm	165 cfm	190 cfm	220 cfm	265 cfm	330 cfm	440 cfm	660 cfm	1320 cfm
	115 cfm	130 cfm	140 cfm	155 cfm	175 cfm	200 cfm	230 cfm	280 cfm	345 cfm	460 cfm	690 cfm	1380 cfm
	120 cfm	135 cfm	145 cfm	160 cfm	180 cfm	210 cfm	240 cfm	290 cfm	360 cfm	480 cfm	720 cfm	1440 cfm
	125 cfm	140 cfm	150 cfm	170 cfm	190 cfm	215 cfm	250 cfm	300 cfm	375 cfm	500 cfm	750 cfm	1500 cfm
	130 cfm	145 cfm	160 cfm	175 cfm	195 cfm	225 cfm	260 cfm	315 cfm	390 cfm	520 cfm	780 cfm	1560 cfm
	135 cfm	150 cfm	165 cfm	180 cfm	205 cfm	235 cfm	270 cfm	325 cfm	405 cfm	540 cfm	810 cfm	1620 cfm
	140 cfm	155 cfm	170 cfm	190 cfm	210 cfm	240 cfm	280 cfm	340 cfm	420 cfm	560 cfm	840 cfm	1680 cfm
	145 cfm	160 cfm	175 cfm	195 cfm	220 cfm	250 cfm	290 cfm	350 cfm	435 cfm	580 cfm	870 cfm	1740 cfm
	150 cfm	165 cfm	180 cfm	200 cfm	225 cfm	260 cfm	300 cfm	360 cfm	450 cfm	600 cfm	900 cfm	1800 cfm
	155 cfm	170 cfm	190 cfm	210 cfm	235 cfm	270 cfm	310 cfm	375 cfm	465 cfm	620 cfm	930 cfm	1860 cfm
	160 cfm	175 cfm	195 cfm	215 cfm	240 cfm	275 cfm	320 cfm	385 cfm	480 cfm	640 cfm	960 cfm	1920 cfm
	165 cfm	180 cfm	200 cfm	220 cfm	250 cfm	285 cfm	330 cfm	400 cfm	495 cfm	660 cfm	990 cfm	1980 cfm
	170 cfm	190 cfm	205 cfm	230 cfm	255 cfm	295 cfm	340 cfm	410 cfm	510 cfm	680 cfm	1020 cfm	2040 cfm
	175 cfm	195 cfm	210 cfm	235 cfm	265 cfm	300 cfm	350 cfm	420 cfm	525 cfm	700 cfm	1050 cfm	2100 cfm
	180 cfm	200 cfm	220 cfm	240 cfm	270 cfm	310 cfm	360 cfm	435 cfm	540 cfm	720 cfm	1080 cfm	2160 cfm
	185 cfm	205 cfm	225 cfm	250 cfm	280 cfm	320 cfm	370 cfm	445 cfm	555 cfm	740 cfm	1110 cfm	2220 cfm
	190 cfm	210 cfm	230 cfm	255 cfm	285 cfm	330 cfm	380 cfm	460 cfm	570 cfm	760 cfm	1140 cfm	2280 cfm
	195 cfm	215 cfm	235 cfm	260 cfm	295 cfm	335 cfm	390 cfm	470 cfm	585 cfm	780 cfm	1170 cfm	2340 cfm
	200 cfm	220 cfm	240 cfm	270 cfm	300 cfm	345 cfm	400 cfm	480 cfm	600 cfm	800 cfm	1200 cfm	2400 cfm

C. Fan Controllers

1. Intermittent MV systems must be controlled by a timer that is programmed to operate the fan during all required run-times.
2. The controller must be installed as prescribed by the manufacturer.
3. Controller must be set to the speed and run-time needed to achieve proper whole-house ventilation.

Appendix A:
Mechanical Ventilation Calculator

A. MV Calculator - Step 1: Determine if MV is Recommended or Required

1. Step 1 utilizes ASHRAE 62.89 to determine whether mechanical ventilation is required.
2. Calculator inputs for step 1:
   a. project type: Advanced Home Upgrade or Home Upgrade
   b. structure details
   c. occupant details
   d. pre-retrofit or default building leakage
   e. post-retrofit building leakage.
3. The calculator determines the post-retrofit percent of the Building Air Standard (BAS) and indicates if ventilation is adequate or if installation of mechanical ventilation is recommended or required.
   (Sample data has been entered in the example below. Blue text indicates auto-calculated results.)

Step 1: Use the form below to calculate building air leakage % reduction and to determine the need for mechanical ventilation.

Enter data in white cells only.

Project Type:	Advanced Home Upgrade

Structure Information

Year Built	1956
# of Stories	1
Average Ceiling Height	8
Conditioned Floor Area	2355
Volume	18840
# of bedrooms	4
# of occupants	3

Building Air Sealing

Pre-Retrofit CFM50 (if tested)			
Default cfm50	SLA:	8	4933
30% reduction target:			3453
Post-Retrofit CFM 50			1850
Fan Ring Used			Ring A
Building Air Leakage Reduction %			62%
Post-Retrofit ACHn			0.24
Post-Retrofit $BAS_{(building)}$			110
Post-Retrofit $BAS_{(occupant)}$			75
Post-Retrofit $BAS_{(CFM50)}$			2693
Post-Retrofit CFM50 as % of $BAS_{(CFM50)}$			69%

Mechanical Ventilation is Required. Proceed to Step 2.

B. MV Calculator - Step 2: Determine the Minimum Continuous Airflow Requirement

1. Step 2 utilizes ASHRAE 62.2 -2016 to determine the minimum mechanical ventilation airflow requirement.
2. Structure and occupant details and post-retrofit building leakage are automatically transferred from Step 1.
3. Calculator inputs for Step 2:
   a. Existing local ventilation details for the kitchen and bathrooms.
   b. Weather and Shielding Factor from the WSF table below the calculator.
4. The calculator determines the **Minimum Continuous Mechanical Ventilation Airflow Requirement.**

(Sample data has been entered in the example below. Blue values indicate auto-calculated results.)

Step 2: If Mechanical Ventilation is required in Step 1, use this form to calculate the Minimum Continuous Mechanical Ventilation Airflow Requirement.

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Enter data in white cells only. **Click button to reset form**

Mechanical Ventilation Airflow Calculation:

#1 - Occupant calculation	38
#2 - Conditioned Floor Area calculation	71

#3 - Local Ventilation adjustment

Tip: Measuring existing local ventilation airflow will reduce the Minimum Continuous MV Airflow Requirement.

	Does the room exist?	Measured Airflow "0" if not measured	Operable window? Yes or No *	Adjustment
Kitchen	Yes	65	No	35
Bath #1: (with shower or tub)	Yes	0	Yes	30
Bath #2: (with shower or tub)	Yes	0	No	50
Bath #3: (with shower or tub)				

* Operable window credit is allowed when permitted by the Authority Having Jurisdiction.

Subtotal: 115

Total Local Ventilation Adjustment: 29

#4 - Infiltration credit

Post-Retrofit CFM 50	1850
S-Factor	1.00
Weather and Shielding Factor (see Weather and Shielding Factor table below)	**0.38**

Infiltration Credit: 37

Minimum Continuous Mechanical Ventilation Airflow Requirement: 100 cfm

Use the Weather and Shielding Factor (WSF) chart below to determine the WSF to be used in the Infiltration Credit section of the calculator.

Weather and Shielding Factor (WSF)

Select the Weather and Shielding Factor (WSF) associated with the weather station that is geographically closest to the dwelling's location.

Weather Station	Nearby City	WSF
Bakersfield Meadows Field	Bakersfield	0.43
Bishop Airport	Bishop	0.55
Blythe Riverside County Airport	Blythe	0.48
Burbank–Glendale–Pasadena Airport	Burbank	0.39
Camarillo (AWOS)	Camarillo	0.43
Chino Airport	Chino	0.45
Fresno Yosemite International Airport	Fresno	0.45
Fullerton Municipal	Fullerton	0.34
Jack Northrop Field H	Hawthorne	0.38
Lancaster General William Fox Field	Lancaster	0.62
Lemoore Reeves NAS	Lemoore	0.50
Long Beach Daugherty Field	Long Beach	0.38
Los Angeles International Airport	Los Angeles	0.42
Needles Airport	Needles	0.51
Oxnard Airport	Oxnard	0.45
Palm Springs International Airport	Palm Springs	0.45
Palm Springs Thermal Airport	Palm Springs	0.46
Twentynine Palms	Palm Springs	0.50
Palmdale Airport	Palmdale	0.57
Paso Robles Municipal Airport	Paso Robles	0.53
Point Mugu National Air Field	Point Mugu	0.45
March Air Force Base	Riverside	0.43
Riverside Municipal Airport	Riverside	0.42
San Luis County Regional Airport	San Luis Obispo	0.51
Santa Ana John Wayne Airport	Santa Ana	0.36
Santa Barbara Municipal Airport	Santa Barbara	0.44
Lompoc (AWOS)	Santa Maria	0.55
Santa Maria Public Airport	Santa Maria	0.52
Santa Monica Municipal Airport	Santa Monica	0.39
Van Nuys Airport	Van Nuys	0.39
Porterville (AWOS)	Visalia	0.42
Visalia Municipal (AWOS)	Visalia	0.43

C. MV Calculator - Step 3A: Intermittent MV - Hours Per Day (H-P-D) Runtime

This step is used to calculate the Minimum Intermittent Mechanical Ventilation Airflow Requirement based on the customer's desired number of Hours-Per-Day (H-P-D) of operation. Do not use this step if MV scheduling has been based on Intermittent MV – Minutes-Per-Hour (Step 3B).

1. Whole-House Intermittent H-P-D Mechanical Ventilation Requirements:
   a. Intermittent whole-house mechanical ventilation requires increased fan airflow (greater cfm) depending on the number of hours of fan operation per day.
   b. The fan controller must be programmed to cycle "ON" at least 1 hour every 3 hours.
   c. The fan controller must be programmed to operate at least 8 hours per day.
2. Calculator inputs for step 3A:
   a. The Minimum Continuous Airflow Requirement will automatically transfer from Step 2.
   b. Enter desired number of hours per day in the calculator.
   c. The intermittent Hours-Per-Day airflow requirement is auto-calculated from the table below.

(Sample data has been entered in the example below. Blue values indicate auto-calculated results.)

Step 3A: Use this form to calculate the Minimum Intermittent Mechanical Ventilation Airflow Requirement based on the desired number of **Hours-Per-Day (H-P-D)** of operation. Enter desired number of hours of operation on row 9.

Whole-House INTERMITTENT H-P-D Mechanical Ventilation Airflow Requirements:
1. Intermittent whole-house mechanical ventilation requires increased fan airflow (greater cfm) depending on the number of hours of fan operation per day.
2. The fan controller must be programmed to cycle ON at least 1 hour every 3 hours.
3. The fan controller must be programmed to operate at least 8 hours per day.

Whole-House Mechanical Ventilation Continuous Airflow Requirement (from the MV calculator): 100 cfm

Desired number of hours of whole-house mechanical ventilation per day: 12 hours per day

Whole-House Mechanical Ventilation Intermittent Hours-Per-Day Airflow Requirement: 200 cfm

MV Continuous Airflow Requirement	Whole-House Mechanical Ventilation Intermittent Hours-Per-Day Airflow Requirement															
	24 hours per day	23 hours per day	22 hours per day	21 hours per day	20 hours per day	19 hours per day	18 hours per day	17 hours per day	16 hours per day	15 hours per day	14 hours per day	13 hours per day	12 hours per day	11 hours per day	10 hours per day	9 hours per day	8 hours per day	less than 8 hrs/day
30 cfm	30 cfm	35 cfm	35 cfm	35 cfm	40 cfm	40 cfm	40 cfm	45 cfm	45 cfm	50 cfm	55 cfm	60 cfm	60 cfm	70 cfm	75 cfm	80 cfm	90 cfm	not allowed
35 cfm	35 cfm	40 cfm	40 cfm	40 cfm	45 cfm	45 cfm	50 cfm	50 cfm	55 cfm	60 cfm	60 cfm	65 cfm	70 cfm	80 cfm	85 cfm	95 cfm	105 cfm	not allowed
40 cfm	40 cfm	45 cfm	45 cfm	50 cfm	50 cfm	55 cfm	55 cfm	60 cfm	60 cfm	65 cfm	70 cfm	75 cfm	80 cfm	90 cfm	100 cfm	110 cfm	120 cfm	not allowed
45 cfm	45 cfm	50 cfm	50 cfm	55 cfm	55 cfm	60 cfm	60 cfm	65 cfm	70 cfm	75 cfm	80 cfm	85 cfm	90 cfm	100 cfm	110 cfm	120 cfm	135 cfm	not allowed
50 cfm	50 cfm	55 cfm	55 cfm	60 cfm	60 cfm	65 cfm	70 cfm	75 cfm	75 cfm	80 cfm	90 cfm	95 cfm	100 cfm	110 cfm	120 cfm	135 cfm	150 cfm	not allowed
55 cfm	55 cfm	60 cfm	60 cfm	65 cfm	70 cfm	70 cfm	75 cfm	80 cfm	85 cfm	90 cfm	95 cfm	105 cfm	110 cfm	120 cfm	135 cfm	150 cfm	165 cfm	not allowed
60 cfm	60 cfm	65 cfm	70 cfm	70 cfm	75 cfm	80 cfm	80 cfm	85 cfm	90 cfm	100 cfm	105 cfm	115 cfm	120 cfm	135 cfm	145 cfm	160 cfm	180 cfm	not allowed
65 cfm	65 cfm	70 cfm	70 cfm	75 cfm	80 cfm	85 cfm	90 cfm	95 cfm	100 cfm	105 cfm	115 cfm	120 cfm	130 cfm	145 cfm	160 cfm	175 cfm	195 cfm	not allowed
70 cfm	70 cfm	75 cfm	75 cfm	80 cfm	85 cfm	90 cfm	95 cfm	100 cfm	105 cfm	115 cfm	120 cfm	130 cfm	140 cfm	155 cfm	170 cfm	190 cfm	210 cfm	not allowed
75 cfm	75 cfm	80 cfm	80 cfm	85 cfm	90 cfm	95 cfm	100 cfm	105 cfm	115 cfm	120 cfm	130 cfm	140 cfm	150 cfm	165 cfm	180 cfm	200 cfm	225 cfm	not allowed
80 cfm	80 cfm	85 cfm	90 cfm	90 cfm	95 cfm	100 cfm	110 cfm	115 cfm	120 cfm	130 cfm	140 cfm	150 cfm	160 cfm	175 cfm	195 cfm	215 cfm	240 cfm	not allowed
85 cfm	85 cfm	90 cfm	95 cfm	100 cfm	105 cfm	110 cfm	115 cfm	120 cfm	130 cfm	140 cfm	150 cfm	160 cfm	170 cfm	190 cfm	205 cfm	230 cfm	255 cfm	not allowed
90 cfm	90 cfm	95 cfm	100 cfm	105 cfm	110 cfm	115 cfm	120 cfm	130 cfm	140 cfm	150 cfm	160 cfm	170 cfm	180 cfm	200 cfm	220 cfm	240 cfm	270 cfm	not allowed
95 cfm	95 cfm	100 cfm	105 cfm	110 cfm	115 cfm	120 cfm	130 cfm	135 cfm	145 cfm	155 cfm	165 cfm	180 cfm	190 cfm	210 cfm	230 cfm	255 cfm	285 cfm	not allowed
100 cfm	100 cfm	105 cfm	110 cfm	115 cfm	120 cfm	130 cfm	135 cfm	145 cfm	150 cfm	160 cfm	175 cfm	185 cfm	200 cfm	220 cfm	240 cfm	270 cfm	300 cfm	not allowed
105 cfm	105 cfm	110 cfm	115 cfm	120 cfm	130 cfm	135 cfm	140 cfm	150 cfm	160 cfm	170 cfm	180 cfm	195 cfm	210 cfm	230 cfm	255 cfm	280 cfm	315 cfm	not allowed
110 cfm	110 cfm	115 cfm	120 cfm	130 cfm	135 cfm	140 cfm	150 cfm	160 cfm	165 cfm	180 cfm	190 cfm	205 cfm	220 cfm	240 cfm	265 cfm	295 cfm	330 cfm	not allowed
115 cfm	115 cfm	120 cfm	130 cfm	135 cfm	140 cfm	150 cfm	155 cfm	165 cfm	175 cfm	185 cfm	200 cfm	215 cfm	230 cfm	255 cfm	280 cfm	310 cfm	345 cfm	not allowed
120 cfm	120 cfm	130 cfm	135 cfm	140 cfm	150 cfm	155 cfm	160 cfm	170 cfm	180 cfm	195 cfm	210 cfm	225 cfm	240 cfm	265 cfm	290 cfm	320 cfm	360 cfm	not allowed
125 cfm	130 cfm	135 cfm	140 cfm	145 cfm	155 cfm	160 cfm	170 cfm	180 cfm	190 cfm	200 cfm	215 cfm	235 cfm	250 cfm	275 cfm	300 cfm	335 cfm	375 cfm	not allowed
130 cfm	140 cfm	145 cfm	150 cfm	160 cfm	165 cfm	175 cfm	185 cfm	195 cfm	210 cfm	225 cfm	240 cfm	260 cfm	285 cfm	315 cfm	350 cfm	390 cfm	not allowed	
135 cfm	145 cfm	150 cfm	155 cfm	165 cfm	175 cfm	180 cfm	195 cfm	205 cfm	220 cfm	235 cfm	250 cfm	270 cfm	295 cfm	325 cfm	360 cfm	405 cfm	not allowed	

(The Intermittent H-P-D table has been abbreviated for this document.)

D. MV Calculator - Step 3B: Intermittent MV - Minutes-Per-Hour (M-P-H) Runtime

This step is used to calculate the Minimum Intermittent Mechanical Ventilation Airflow Requirement based on the customer's desired number of Minutes-Per-Hour (M-P-H) of operation. Do not use this step if MV scheduling has been based on Intermittent MV - Hours-Per-Day (Step 3A).

1. Whole-House Intermittent M-P-H Mechanical Ventilation Requirements:
   a. Intermittent M-P-H whole-house mechanical ventilation requires increased fan airflow (greater cfm) depending on the number of minutes per hour of fan operation. Fewer minutes per hour means a higher airfow is required.
   b. The fan controller must be programmed to operate every hour of the day for the desired number of minutes per hour.
2. Calculator inputs for step 3A:
   a. The Minimum Continuous Airflow Requirement will transfer from Step 2.
   b. Enter desired number of minutes per hour in the calculator.
   c. The intermittent Minutes-Per-Hour airflow requirement is auto-calculated from the table below.

(Sample data has been entered in the example below. Blue values indicate auto-calculated results.)

Step 3B: Use this form to calculate the Minimum Intermittent Mechanical Ventilation Airflow Requirement based on the desired number of **Minutes-Per-Hour (M-P-H)** of operation. Enter desired number of minutes per hour of operation in row 9.

Whole-House INTERMITTENT M-P-H Mechanical Ventilation Airflow Requirements:
1. Intermittent M-P-H whole-house mechanical ventilation requires increased fan airflow (greater cfm) depending on the number of minutes per hour of fan operation.
2. The fan controller must be programmed to operate every hour of the day for the desired number of minutes per hour.

Whole-House Mechanical Ventilation Continuous Airflow Requirement (from the MV calculator):	100 cfm
Desired number of minutes of whole-house mechanical ventilation per hour:	30 minutes per hour
Whole-House Mechanical Ventilation Intermittent Minutes-Per-Hour Airflow Requirement:	200 cfm

	Whole-House Mechanical Ventilation Intermittent Minutes-Per-Hour Airflow Requirement										
MV Continuous Airflow Requirement	60 minutes per hour	55 minutes per hour	50 minutes per hour	45 minutes per hour	40 minutes per hour	35 minutes per hour	30 minutes per hour	25 minutes per hour	20 minutes per hour	15 minutes per hour	10 minutes per hour	5 minutes per hour
30 cfm	30 cfm	35 cfm	40 cfm	40 cfm	45 cfm	55 cfm	60 cfm	75 cfm	90 cfm	120 cfm	180 cfm	360 cfm
35 cfm	35 cfm	40 cfm	45 cfm	50 cfm	55 cfm	60 cfm	70 cfm	85 cfm	105 cfm	140 cfm	210 cfm	420 cfm
40 cfm	40 cfm	45 cfm	50 cfm	55 cfm	60 cfm	70 cfm	80 cfm	100 cfm	120 cfm	160 cfm	240 cfm	480 cfm
45 cfm	45 cfm	50 cfm	55 cfm	60 cfm	70 cfm	80 cfm	90 cfm	110 cfm	135 cfm	180 cfm	270 cfm	540 cfm
50 cfm	50 cfm	55 cfm	60 cfm	70 cfm	75 cfm	90 cfm	100 cfm	120 cfm	150 cfm	200 cfm	300 cfm	600 cfm
55 cfm	55 cfm	60 cfm	70 cfm	75 cfm	85 cfm	95 cfm	110 cfm	135 cfm	165 cfm	220 cfm	330 cfm	660 cfm
60 cfm	60 cfm	70 cfm	75 cfm	80 cfm	90 cfm	105 cfm	120 cfm	145 cfm	180 cfm	240 cfm	360 cfm	720 cfm
65 cfm	65 cfm	75 cfm	80 cfm	90 cfm	100 cfm	115 cfm	130 cfm	160 cfm	195 cfm	260 cfm	390 cfm	780 cfm
70 cfm	70 cfm	80 cfm	85 cfm	95 cfm	105 cfm	120 cfm	140 cfm	170 cfm	210 cfm	280 cfm	420 cfm	840 cfm
75 cfm	75 cfm	85 cfm	90 cfm	100 cfm	115 cfm	130 cfm	150 cfm	180 cfm	225 cfm	300 cfm	450 cfm	900 cfm
80 cfm	80 cfm	90 cfm	100 cfm	110 cfm	120 cfm	140 cfm	160 cfm	195 cfm	240 cfm	320 cfm	480 cfm	960 cfm
85 cfm	85 cfm	95 cfm	105 cfm	115 cfm	130 cfm	150 cfm	170 cfm	205 cfm	255 cfm	340 cfm	510 cfm	1020 cfm
90 cfm	90 cfm	100 cfm	110 cfm	120 cfm	135 cfm	155 cfm	180 cfm	220 cfm	270 cfm	360 cfm	540 cfm	1080 cfm
95 cfm	95 cfm	105 cfm	115 cfm	130 cfm	145 cfm	165 cfm	190 cfm	230 cfm	285 cfm	380 cfm	570 cfm	1140 cfm
100 cfm	100 cfm	110 cfm	120 cfm	135 cfm	150 cfm	175 cfm	200 cfm	240 cfm	300 cfm	400 cfm	600 cfm	1200 cfm

(The M-P-H table has been abbreviated for this document.)

(END)