ADDENDA

ANSI/ASHRAE Addendum v to
ANSI/ASHRAE Standard 62.2-2013

Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings

Approved by the ASHRAE Standards Committee on January 23, 2016; by the ASHRAE Board of Directors on January 27, 2016; and by the American National Standards Institute on February 24, 2016.

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 ISSN 1041-2336

Approved American National Standard
ANSI
www.ansi.org

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FOREWORD

This addendum addresses inconsistencies in the determination of intermittent ventilation flow rates. It also puts forth explicit mechanisms to meet the equivalence intent of noncontinuous ventilation, which allows for a broader range of potential control algorithms than had previously existed in the standard. It also establishes a short-term exposure limit of 5 times the long-term exposure limit, which must be considered when using noncontinuous ventilation.

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum v to Standard 62.2-2013

Revise Sections 4 and 4.1 as shown.

4. ~~WHOLE-BUILDING~~DWELLING-UNIT VENTILATION

A ~~whole-building~~ dwelling-unit ventilation system shall be installed in compliance~~, complying~~ with ~~either~~ Sections 4.1 through 4.4, Section 4.5, or Section 4.6 ~~4.5 or Section 4.6, shall be installed~~.

4.1 Ventilation Rate. A mechanical exhaust system, supply system, or combination thereof shall be installed to operate for each dwelling unit to provide continuous ~~whole-building~~ dwelling-unit ventilation with outdoor air at a rate not less than specified in Section 4.1.1.

~~**Exception:** An intermittently operating whole-building mechanical ventilation system shall be permitted if the ventilation rate complies with Section 4.5. The system shall be designed for automatic operation.~~

Delete Section 4.5 and Table 4.2 and replace with the following.

~~**4.5 Intermittent Mechanical Ventilation.** Whole-building mechanical systems designed to provide intermittent ventilation shall comply with this section.~~

~~**4.5.1 Intermittent Ventilation.** When mechanical ventilation is provided at least once every three hours by a system of one or more fans, the intermittent mechanical ventilation rate shall be calculated as the larger of the time average supply or exhaust airflow rate and shall be no less than specified in Section 4.1.~~

~~**4.5.2 Extended-Cycle Intermittent Ventilation.** When mechanical ventilation is not provided at least once every three hours by a single fan system, the intermittent fan airflow rate (Q_{on}) shall be calculated from Equation 4.7. Fan cycle time (T_{cyc}) shall not exceed 24 hours. Where the fan airflow rate during the on-cycle varies with time, the time average airflow rate during each hour shall meet or exceed the intermittent mechanical ventilation requirement of Equation 4.7.~~

$$Q_{on} = Q_{fan}/(\varepsilon f) \qquad (4.7)$$

~~where~~

~~Q_{on} = intermittent fan airflow rate during the on-cycle~~

~~Q_{fan} = continuous mechanical ventilation air requirement (from Section 4.1)~~

~~ε = mechanical ventilation effectiveness (from Table 4.2)~~

~~f = fractional on-time, defined as the on-time for one cycle divided by the cycle time~~

~~Table 4.2 also requires the calculation of the required turnover, N, as follows:~~

$$N = 12.8 \cdot Q_{fan} \cdot T_{cyc}/A_{floor} \qquad \text{(I-P)} \qquad (4.8a)$$

~~where~~

~~Q_{fan} = mechanical ventilation air requirement (from Section 4.1), cfm~~

~~T_{cyc} = fan cycle time, defined as the total time for one off-cycle and one on-cycle, h~~

~~A_{floor} = floor area of residence, ft^2~~

$$N = 2.51 \cdot Q_{fan} \cdot T_{cyc}/A_{floor} \qquad \text{(SI)} \qquad (4.8b)$$

~~where~~

~~Q_{fan} = mechanical ventilation air requirement (from Section 4.1), L/s~~

~~T_{cyc} = fan cycle time, defined as the total time for one off-cycle and one on-cycle, h~~

~~A_{floor} = floor area of residence, m^2~~

~~For values not listed in Table 4-2, use the next higher value for N or the next lower value for f. Linear interpolation shall be permitted.~~

4.5 Variable Mechanical Ventilation. Dwelling-unit mechanical ventilation systems designed to provide variable ventilation shall comply with Section 4.5.1, 4.5.2 or 4.5.3. Sections 4.5.2 and 4.5.3 also require compliance with Normative Appendix C and require verification with supporting documentation from the manufacturer, designer, or specifier of the ventilation control system that the system meets the requirements of these sections. Where the dwelling-unit ventilation rate varies based on occupancy, occupancy shall be determined by occupancy sensors or by an occupant-programmable schedule.

4.5.1 Short-Term Average Ventilation. To comply with this section, a variable ventilation system shall be installed to provide an average dwelling-unit ventilation rate over any three-hour period that is greater than or equal to Q_{fan} as calculated using Section 4.

4.5.2 Scheduled Ventilation. This section may only be used when one or more fixed patterns of designed ventilation are known at the time compliance to this standard is being determined. Such patterns include those both clock-driven

~~TABLE 4.2 Mechanical Ventilation Effectiveness (ε) for Intermittent Fans~~

Fractional On-Time, *f*	Turnover, *N*														
	0.0	1.0	1.5	2.0	2.5	3.0	3.5	4.0	5.0	6.0	8.0	12	20	40	100+
0.00	1.00	0.95	0.88	0.78	0.60	0.00	-	-	-	-	-	-	-	-	-
0.05	1.00	0.96	0.90	0.81	0.67	0.41	0.00	-	-	-	-	-	-	-	-
0.10	1.00	0.96	0.91	0.83	0.72	0.55	0.21	0.00	-	-	-	-	-	-	-
0.15	1.00	0.96	0.92	0.85	0.76	0.63	0.44	0.18	0.00	-	-	-	-	-	-
0.20	1.00	0.97	0.93	0.87	0.79	0.69	0.56	0.40	0.03	0.00	-	-	-	-	-
0.25	1.00	0.97	0.94	0.89	0.82	0.74	0.64	0.53	0.26	0.02	0.00	-	-	-	-
0.30	1.00	0.98	0.95	0.90	0.85	0.78	0.71	0.62	0.42	0.24	0.00	-	-	-	-
0.35	1.00	0.98	0.95	0.92	0.87	0.82	0.76	0.69	0.54	0.39	0.14	0.00	-	-	-
0.40	1.00	0.98	0.96	0.93	0.89	0.85	0.80	0.75	0.63	0.52	0.32	0.02	0.00	-	-
0.45	1.00	0.99	0.97	0.94	0.91	0.88	0.84	0.79	0.70	0.61	0.45	0.21	0.00	-	-
0.50	1.00	0.99	0.97	0.95	0.93	0.90	0.87	0.83	0.76	0.69	0.57	0.37	0.13	0.00	0.00
0.60	1.00	0.99	0.98	0.97	0.96	0.94	0.92	0.90	0.86	0.81	0.74	0.61	0.45	0.27	0.14
0.70	1.00	1.00	0.99	0.98	0.98	0.97	0.96	0.94	0.92	0.90	0.85	0.78	0.68	0.55	0.46
0.80	1.00	1.00	1.00	0.99	0.99	0.99	0.98	0.98	0.97	0.96	0.94	0.90	0.85	0.77	0.70
0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.98	0.97	0.96	0.93	0.88
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

and driven by typical meteorological data. Compliance with this section can be demonstrated with either Section 4.5.2.1 or 4.5.2.2.

4.5.2.1 Annual Average Schedule. An annual schedule of ventilation complies with this section when the annual average relative exposure during occupied periods is no more than unity as calculated in Normative Appendix C.

4.5.2.2 Block Scheduling. The schedule of ventilation complies with this section if it is broken into blocks of time and each block individually has an average relative exposure during occupied periods that is no more than unity as calculated in Normative Appendix C.

4.5.2.2.1 Short Blocks. For each block that is less than 2 days in duration but does not meet the requirements of Section 4.5.1, the procedure in Normative Appendix C shall be run multiple times. For any runs after the first run, the relative exposure at the end of the prior run shall be used as the initial condition in the current run. The block complies if the average relative exposure during occupied periods in the final run is no more than unity. Blocks that are less than 18 hours in duration must be run at least 3 times. Other blocks must be run at least twice.

4.5.3 Real-Time Control. A real-time ventilation controller complies with this section when it is designed to adjust the ventilation system based on real-time input to the ventilation calculations so that the average relative exposure during occupied periods is no more than unity as calculated in Normative Appendix C. The averaging period shall be at least one day but no more than one year and shall be based on simple, recursive or running average, but not extrapolation.

Add a new Normative Appendix C, "Relative Exposure," as shown. Reletter the current Informative Appendix C as "Informative Appendix D."

(This is a normative appendix and is part of the standard.)

NORMATIVE APPENDIX C— RELATIVE EXPOSURE

C1. SUMMARY

The purpose of this appendix is to calculate the time-varying relative exposure (from Section C3) provided by a user-specified, time-varying ventilation pattern. This calculation is only required if directed by the main body of the standard.

C1.1 Target Ventilation. The target ventilation, Q_{tot}, for the relative exposure calculation is the determined by Section 4.1 without taking any infiltration credit from Section 4.1.2 but allowing for other modifications of Section 4.1.

C1.2 Time Step. The time step length in minutes (seconds) for use in this calculation, Δt, shall be no more than one hour. Scheduled or real-time quantities that are known to vary faster than the time step shall be averaged for each time step.

C1.3 Peak Exposure Limitation. To maintain compliance with this appendix, a ventilation system and controls shall be

TABLE C.1 Wind Speed Multiplier, *G*

House Height, Stories		
One	**Two**	**Three**
0.48	0.59	0.67

TABLE C.2 Shelter Factor, *s*

No Flue	One Story with Flue	Two Story with Flue	Three Story with Flue
0.50	0.70	0.64	0.61

TABLE C.3 Wind Coefficient, C_w (SI)

	One-Story		Two-Story		Three-Story	
Foundation	**No Flue**	**With Flue**	**No Flue**	**With Flue**	**No Flue**	**With Flue**
Basement or slab on grade	0.156	0.142	0.170	0.156	0.170	0.167
Crawlspace	0.128	0.128	0.142	0.142	0.151	0.154

TABLE C.3 Wind Coefficient, C_w (I-P)

	One-Story		Two-Story		Three-Story	
Foundation	**No Flue**	**With Flue**	**No Flue**	**With Flue**	**No Flue**	**With Flue**
Basement or slab on grade	0.001313	0.001194	0.001432	0.001313	0.001432	0.001402
Crawlspace	0.001074	0.001074	0.001194	0.001194	0.001271	0.001295

provided such that the relative exposure, R_i, as calculated in accordance with Section C3, shall not exceed 5 for any given time step.

C1.4 Space Volume. If the authority having jurisdiction has defined the volume of the space, V_{space}, it shall be used. Otherwise, the volume of the space shall be set to the product of the floor area, A_{floor}, and the reference height, H_r, for the purposes of this appendix (see Section 4.1.)

C2. TIME-VARYING TOTAL VENTILATION

This section determines the total ventilation at each time step by combining infiltration and mechanical ventilation.

C2.1 Mechanical Ventilation. The mechanical ventilation rate, $Q_{fan,i}$, shall be the larger of either the average exhaust rate from any operating device or the average supply rate from any operating device.

C2.2 Infiltration. Either Section C2.2.1 or C2.2.2 shall be used to determine the infiltration, $Q_{inf,i}$, for detached dwelling units less than four stories in height if a blower door test has been performed (see Section 4.1.2). For other dwelling units, the infiltration shall be set to zero.

C2.2.1 Annual Average Method. To calculate $Q_{inf,i}$, divide the result from Equation 4.5, Section 4.1.2, Q_{inf}, by the number of time steps in a year.

C2.2.2 Smaller Time Step Method. The wind speed (U_{met} [m/s or mph]) and outdoor temperature (T_{out} [°C or °F]) shall be taken from typical meteorological year data or from the nearest available meteorological site. For each time step, the total infiltration shall be calculated as a function of wind and stack effects as provided in this section.

The envelope leakage coefficient, *C*, and pressure exponent, *n*, shall be taken from blower door measurements using ASTM E779[1] or CGSB 149.10[2]. Alternatively, if ELA (m^2 or ft^2) is known, then *n* is assumed to be 0.65, and *C* is calculated using Equation C.1 or C.2:

$$C = 1.05 \times ELA \quad \text{(SI)} \qquad (C.1)$$

$$C = 0.36 \times ELA \quad \text{(I-P)} \qquad (C.2)$$

C2.2.2.1 Wind-Driven Flow. The wind speed shall be converted to site wind speed using the wind speed multiplier, *G*, from Table C.1 and Equation C.3.

$$U = GU_{met} \qquad (C.3)$$

The wind-driven flow shall be calculated using Equation C.4:

$$Q_w = CG_w(sU)^{2n} \qquad (C.4)$$

Where shelter factor, *s*, is taken from Table C.2 and the wind coefficient, C_w, from Table C.3. The values for a flue shall be used whenever there is an open fireplace or combustion device that takes its combustion air from conditioned space (e.g., furnace, water heater or woodstove).

TABLE C.4 Stack Coefficient, C_s (SI)

One Story		Two Story		Three Story	
No Flue	**With Flue**	**No Flue**	**With Flue**	**No Flue**	**With Flue**
0.054	0.069	0.078	0.089	0.098	0.107

TABLE C.4 Stack Coefficient, C_s (I-P)

One Story		Two Story		Three Story	
No Flue	**With Flue**	**No Flue**	**With Flue**	**No Flue**	**With Flue**
0.000893	0.01144	0.00138	0.001478	0.001641	0.001791

C2.2.2.2 Stack-Driven Flow. The stack-driven flow shall be calculated using Equation C.5:

$$Q_s = CC_s(|T_{in} - T_{out}|)^n \quad \text{(C.5)}$$

Where the stack coefficient, C_s, is taken from Table C.4 and T_{in} is assumed to be 68°F (20°C).

C2.2.2.3 Total Infiltration Flow. The total infiltration flow shall be calculated using Equation C.6.

$$Q_{inf,i} = \sqrt{Q_w^2 + Q_s^2} \quad \text{(C.6)}$$

C2.3 Combination of Infiltration and Mechanical Ventilation. The total ventilation is the sum of the mechanical ventilation and infiltration at each time step:

$$Q_i = Q_{fan,i} + \phi Q_{inf,i} \quad \text{(C.7)}$$

Where ϕ is the additivity coefficient, which is unity for balanced systems, and otherwise

$$\phi = \frac{Q_{inf,i}}{Q_{inf,i} + Q_{inf,i}} \quad \text{(C.8)}$$

C3. RELATIVE EXPOSURE CALCULATION

This section uses the time series of actual ventilation (from Section C2) to calculate the time series of relative exposure.

C3.1 Nonzero Ventilation. The relative exposure for a given time step shall be calculated from the relative exposure from the prior step and the current ventilation using the following equation, unless the real-time or scheduled ventilation is zero:

$$R_i = \frac{Q_{tot}}{Q_i} + \left(R_{i-1} - \frac{Q_{tot}}{Q_i}\right)e^{-Q_i\Delta t/V_{space}} \quad \text{(C.9)}$$

where R_i is the relative exposure for time step *i*.

C3.2 Zero Ventilation. If the real-time or scheduled ventilation at a given time step is zero then the following equation shall be used:

$$R_i = R_{i-1} + \frac{Q_{tot}\Delta t}{V_{space}} \quad \text{(C.10)}$$

C3.3 Initial Conditions. Unless otherwise specified in this standard, the prior (i.e. "*i* – 1") step's relative exposure to be used in the first step's calculation of the relative exposure shall be unity.

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the standards and guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive technical committee structure, continue to generate up-to-date standards and guidelines where appropriate and adopt, recommend, and promote those new and revised standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating standards and guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

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