ADDENDA

ANSI/ASHRAE Addendum f to
ANSI/ASHRAE Standard 62.1-2016

Ventilation for Acceptable Indoor Air Quality

Approved by the ASHRAE Standards Committee on June 23, 2018; by the ASHRAE Technology Council on June 27, 2018; and by the American National Standards Institute on June 28, 2018.

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FOREWORD

The so-called "Multiple-Spaces Equation" (Normative Appendix A, Equations A1.2.1 for single-supply systems and A1.2.2-1 for systems with multiple recirculation paths) is very difficult to use, especially for variable-volume systems, for which there are an infinite number of scenarios with varying airflow, occupancy, supply air temperature, etc., all of which affect system ventilation efficiency. Accordingly, Standard 62.1 includes two options for calculating system ventilation efficiency, a prescriptive approach using Table 6.2.5.2 and a more fundamental (and complex) approach described in Normative Appendix A. The Table 6.2.5.2 approach is intended to apply to single-supply systems in a fairly conservative manner. The procedure has several disadvantages:

- *It is seldom used because the Z_{pz} values are so high. Few VAV systems fall under this table, in part because of caps in Standard 90.1 on minimum airflow limits. So designers are forced to use the very complex Normative Appendix A approach.*
- *It implies that it addresses VAV systems under all conditions, but it does not directly address how low VAV box minimums can be.*

To address these issues, addendum g replaces the Table 6.2.5.2 approach with two formulas, one to determine system ventilation efficiency (E_v) and one to determine the minimum primary airflow set point intended for use in VAV systems. These equations were developed from actual projects that had single-duct VAV systems with ventilation rates calculated using the Normative Appendix A approach with guidance in accordance with the Standard 62.1 User's Manual. The projects, summarized below, addressed various occupancy types, including densely occupied spaces. The equations for system ventilation efficiency and minimum primary airflow set point were developed to try to meet or exceed the Normative Appendix A rates.

Building	*Appendix A OA Rate*	*Addendum F OA Rate*	*Ratio*
Office/assembly	*2283*	*2598*	*114%*
Residential	*2066*	*2662*	*129%*
Classroom/office	*24922*	*25703*	*103%*
Classroom/office	*5213*	*5320*	*102%*
User's Manual Office	*1938*	*1955*	*101%*

There is always the possibility with some occupancy types and ventilation system designs that the equations will result in under-ventilation as compared to Normative Appendix A, but this possibility also exists with the Table 6.2.5.2 approach.

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 f to Standard 62.1-2016

Modify the definition of "ventilation zone" in Section 3.

ventilation zone: any indoor area that requires ventilation and comprises one or more spaces with the same occupancy category (see Table 6.2.2.1), occupant density, zone air distribution effectiveness (see Section 6.2.2.2), and design zone primary airflow (see Section ~~6.2.5.1~~ 6.2.5.3.2 and Normative Appendix A) per unit area.

Modify Section 6.2.5 as shown.

6.2.5 Multiple-Zone Recirculating Systems. For ventilation systems wherein one or more air handlers supply a mixture of outdoor air and recirculated air to more than one ventilation zone, the outdoor air intake flow (V_{ot}) shall be determined in accordance with Sections 6.2.5.1 through 6.2.5.4.

~~6.2.5.1 Primary Outdoor Air Fraction.~~ ~~Primary outdoor air fraction (Z_{pz}) shall be determined for ventilation zones in accordance with Equation 6.2.5.1.~~

$$Z_{pz} = V_{oz}/V_{pz} \qquad (6.2.5.1)$$

~~where V_{pz} is the zone primary airflow to the ventilation zone, including outdoor air and recirculated air.~~

~~a. For VAV system design purposes, V_{pz} is the lowest zone primary airflow value expected at the design condition analyzed.~~

~~b. In some cases, it is permitted to determine these parameters for only selected zones as outlined in Normative Appendix A.~~

~~TABLE 6.2.5.2 System Ventilation Efficiency~~

~~Max (Z_{pz})~~	~~E_v~~
~~≤0.15~~	~~1.0~~
~~≤0.25~~	~~0.9~~
~~≤0.35~~	~~0.8~~
~~≤0.45~~	~~0.7~~
~~≤0.55~~	~~0.6~~
~~>0.55~~	~~Use Normative Appendix A~~

~~**NOTES:**~~

~~1. "Max (Z_{pz})" refers to the largest value of Z_{pz}, calculated using Equation 6.2.5.1, among all the ventilation zones served by the system.~~

~~2. For values of Max (Z_{pz}) between 0.15 and 0.55, the corresponding value of E_v may be determined by interpolating the values in the table.~~

~~3. The values of E_v in this table are based on a 0.15 average outdoor air fraction for the system. For systems with higher values of the average outdoor air fraction, this table may result in unrealistically low values of E_v and the use of Normative Appendix A may yield more practical results.~~

~~6.2.5.2 System Ventilation Efficiency.~~ ~~The system ventilation efficiency (E_v) shall be determined in accordance with Table 6.2.5.2 or Normative Appendix A.~~

6.2.5.~~3~~1 Uncorrected Outdoor Air Intake. The uncorrected outdoor air intake (V_{ou}) flow shall be determined in accordance with Equation 6.2.5.~~3~~1.

$$V_{ou} = D\Sigma_{all\ zones}(R_p \times P_z) + \Sigma_{all\ zones}(R_a \times A_z) \quad (6.2.5.\text{~~3~~}1)$$

6.2.5.~~3~~1.1 Occupant Diversity. The occupant diversity ratio (D) shall be determined in accordance with Equation 6.2.5.~~3~~1.1 to account for variations in population within the ventilation zones served by the system.

$$D = P_s / \Sigma_{all\ zones}\ P_z \quad (6.2.5.\text{~~3~~}1.1)$$

where the system population (P_s) is the total population in the area served by the system.

Exception: Alternative methods to account for occupant diversity shall be permitted, provided the resulting V_{ou} value is no less than that determined using Equation 6.2.5.~~3~~1.

~~***Informative Note:*** The uncorrected outdoor air intake (V_{ou}) is adjusted for occupant diversity, but it is not corrected for system ventilation efficiency.~~

6.2.5.~~3~~1.2 Design System Population. Design system population (P_s) shall equal the largest (peak) number of people expected to occupy all ventilation zones served by the ventilation system during use.

Informative Note: Design system population is always equal to or less than the sum of design zone population for all zones in the area served by the system because all zones may or may not be simultaneously occupied at design population.

6.2.5.2 System Ventilation Efficiency. The system ventilation efficiency (E_v) shall be determined in accordance with Section 6.2.5.3 for the Simplified Procedure or Normative Appendix A for the Alternative Procedure.

Informative Note: These procedures also establish zone minimum primary airflow rates for VAV systems.

6.2.5.3 Simplified Procedure

6.2.5.3.1 System Ventilation Efficiency. System ventilation efficiency (E_v) shall be determined in accordance with Equation 6.2.5.3.1a or 6.2.5.3.1b.

$$E_v = 0.88 \times D + 0.22 \quad \text{for } D < 0.60 \quad (6.2.5.3.1a)$$

$$E_v = 0.75 \quad \text{for } D \geq 0.60 \quad (6.2.5.3.1b)$$

6.2.5.3.2 Zone Minimum Primary Airflow. For each zone, the minimum primary airflow ($V_{pz\text{-}min}$) shall be determined in accordance with Equation 6.2.5.3.2.

$$V_{pz\text{-}min} = V_{oz} \times 1.5 \quad (6.2.5.3.2)$$

6.2.5.4 Outdoor Air Intake. The design outdoor air intake flow (V_{ot}) shall be determined in accordance with Equation 6.2.5.4.

$$V_{ot} = V_{ou}/E_v \quad (6.2.5.4)$$

Modify Normative Appendix A introduction as shown.

NORMATIVE APPENDIX A MULTIPLE-ZONE SYSTEMS~~ VENTILATION EFFICIENCY~~— ALTERNATIVE PROCEDURE

This appendix presents an alternative procedure for calculating the system ventilation efficiency (E_v) for multiple zone recirculating systems that must be used when ~~Table 6.2.5.2 values are~~ Section 6.2.5.3 is not used. In this alternative procedure, E_v is equal to the lowest calculated value of the zone ventilation efficiency (E_{vz}) (see Equation A1.2.1-1 below).

Informative Note: Figure A-1 contains a ventilation system schematic depicting most of the quantities used in this appendix.

Modify Section A1.1 as shown.

A1.1 Average Outdoor Air Fraction. The average outdoor air fraction (X_s) for the ventilation system shall be determined in accordance with Equation A1.1.

$$X_s = V_{ou}/V_{ps} \quad (A1.1)$$

where the uncorrected outdoor air intake (V_{ou}) is found in accordance with Section 6.2.5.~~3~~1, and the system primary airflow (V_{ps}) is found at the condition analyzed.

Informative Note: For VAV-system design purposes, Vps is the highest expected system primary airflow at the design condition analyzed. System primary airflow at design is usually less than the sum of design zone primary airflow values because primary airflow seldom peaks simultaneously in all VAV zones.

Modify Section A1.2.1 as shown.

A1.2.1 Single Supply Systems. For single supply systems, wherein all of the air supplied to each ventilation zone is a mixture of outdoor air and system-level recirculated air, zone ventilation efficiency (E_{vz}) shall be determined in accordance with Equation A1.2.1-1. Examples of single supply systems include constant-volume reheat, single-duct VAV, single-fan dual-duct, and multizone systems.

$$E_{vz} = 1 + X_s - Z_{pz} \quad (A1.2.1\text{-}1)$$

where the average outdoor air fraction for the system (X_s) is determined in accordance with Equation A1.1, and the primary outdoor air fraction for the zone (Z_{pz}) is determined in accordance with ~~Section 6.2.5.1~~ Equation A1.2.1-2.

$$Z_{pz} = V_{oz}/V_{pz} \quad (A1.2.1\text{-}2)$$

For VAV systems, V_{pz} is the lowest zone primary airflow value expected at the design condition analyzed.

Modify Section A3 as shown. The remainder of Section A3 is unchanged.

A3. SYMBOLS

[. . .]

E_v ***system ventilation efficiency:*** the efficiency with

which the system distributes air from the outdoor air intake to the breathing zone in the ventilation-critical zone, which requires the largest fraction of outdoor air in the primary airstream. ~~E_v shall be determined in accordance with Section 6.2.5.2 or Section A1.~~

[. . .]

V_{ou} ***uncorrected outdoor air intake:*** see Section 6.2.5.~~3~~1.

[. . .]

V_{pz} ***zone primary airflow:*** ~~see Section 6.2.5.1~~ the zone primary airflow to the ventilation zone, including outdoor air and recirculated air.

[. . .]

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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.

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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.

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