ADDENDA

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

Ventilation for Acceptable Indoor Air Quality

Approved by the ASHRAE Standards Committee on June 22, 2019; by the ASHRAE Technology Council on June 26, 2019; and by the American National Standards Institute on June 27, 2019.

This addendum was approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. Instructions for how to submit a change can be found on the ASHRAE® website (https://www.ashrae.org/continuous-maintenance).

The latest edition of an ASHRAE Standard may be purchased on the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

 ISSN 1041-2336

SPECIAL NOTE

This American National Standard (ANS) is a national voluntary consensus Standard developed under the auspices of ASHRAE. *Consensus* is defined by the American National Standards Institute (ANSI), of which ASHRAE is a member and which has approved this Standard as an ANS, as “substantial agreement reached by directly and materially affected interest categories. This signifies the concurrence of more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that an effort be made toward their resolution.” Compliance with this Standard is voluntary until and unless a legal jurisdiction makes compliance mandatory through legislation.

ASHRAE obtains consensus through participation of its national and international members, associated societies, and public review.

ASHRAE Standards are prepared by a Project Committee appointed specifically for the purpose of writing the Standard. The Project Committee Chair and Vice-Chair must be members of ASHRAE; while other committee members may or may not be ASHRAE members, all must be technically qualified in the subject area of the Standard. Every effort is made to balance the concerned interests on all Project Committees.

The Senior Manager of Standards of ASHRAE should be contacted for

a. interpretation of the contents of this Standard,
b. participation in the next review of the Standard,
c. offering constructive criticism for improving the Standard, or
d. permission to reprint portions of the Standard.

DISCLAIMER

ASHRAE uses its best efforts to promulgate Standards and Guidelines for the benefit of the public in light of available information and accepted industry practices. However, ASHRAE does not guarantee, certify, or assure the safety or performance of any products, components, or systems tested, installed, or operated in accordance with ASHRAE’s Standards or Guidelines or that any tests conducted under its Standards or Guidelines will be nonhazardous or free from risk.

ASHRAE INDUSTRIAL ADVERTISING POLICY ON STANDARDS

ASHRAE Standards and Guidelines are established to assist industry and the public by offering a uniform method of testing for rating purposes, by suggesting safe practices in designing and installing equipment, by providing proper definitions of this equipment, and by providing other information that may serve to guide the industry. The creation of ASHRAE Standards and Guidelines is determined by the need for them, and conformance to them is completely voluntary.

In referring to this Standard or Guideline and in marking of equipment and in advertising, no claim shall be made, either stated or implied, that the product has been approved by ASHRAE.

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

Addendum ah clarifies and expands the values of zone air distribution effectiveness (E_z) in Table 6.2.2.1 and adds Normative Appendix X, "Zone Air Distribution Effectiveness—Alternate Procedures," to provide a procedure for calculating zone air distribution effectiveness. Notes on Table 6.2.2.1 have also been removed and replaced with definitions or specific requirements within the language of the standard.

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 ah to Standard 62.1-2016

Add New Definitions to Section 3 as shown. The remainder of Section 3 is unchanged.

3. DEFINITIONS (SEE FIGURE 3.1)

air, cool: air whose temperature is less than the average space temperature.

air, warm: air whose temperature is greater than the average space temperature.

ceiling return: air removed from the space more than 4.5 ft (1.4 m) above the floor.

ceiling supply: air supplied to the space more than 4.5 ft (1.4 m) above the floor.

floor return: air removed from the space less than 4.5 ft (1.4 m) above the floor.

floor supply: air supplied to the space less than 4.5 ft (1.4m) above the floor.

stratified air distribution system: a device or combination of devices applied to provide a stratified thermal and pollutant distribution within a zone.

zone air distribution effectiveness: the ratio of the change of contaminant concentration between the air supply and air exhaust to the change of contaminant concentration between the air supply and the breathing zone.

Modify Section 6.2.2.2.2 as shown.

6.2.2.2 Zone Air Distribution Effectiveness. The zone air distribution effectiveness (*Ez*) shall be ~~not less than the default value~~ determined ~~using~~ in accordance with Table 6.2.2.2~~.~~ or Normative Appendix X.

Informative Notes:

1. For some configurations, the default value depends upon average space temperature and supply air temperature.
2. Calculation of E_z using the procedures in Normative Appendix X may result in values greater than those listed in Table 6.2.2.2 for systems with the same description.

6.2.2.2.1 Stratified Air Distribution Systems. A stratified air distribution system shall be designed in accordance with the following subsections, or the zone air distribution effectiveness (E_z) shall be determined in accordance with Normative Appendix X.

6.2.2.2.1.1 Supply Air. Cool air shall be at least 4°F (2°C) less than the average room air temperature.

6.2.2.2.1.2 Return Air. The return air openings or pathways shall be located more than 9 ft (2.8 m) above the floor.

6.2.2.2.1.3 Stratification. The zone shall not contain any devices that mechanically mix the air, and shall be protected from impinging airstreams from adjacent ventilation zones.

Informative Note: Ceiling fans, blowers, air curtains, aspirating diffusers without adequate draft separation, or other devices that disrupt the stratification cause the zone air distribution effectiveness to be similar to a well-mixed system.

6.2.2.2.2 Personalized Ventilation Systems. A personalized ventilation system shall be designed in accordance with the following subsections, or the zone air distribution effectiveness (*Ez*) shall be determined in accordance with Normative Appendix X.

Informative Note: A personalized ventilation system is primarily for exposure control and dilution of contaminants in the breathing zone and may provide some spot cooling. Personalized ventilation is used when the occupant spends most of their time in one occupied space. The ventilation outlet is usually incorporated into or mounted on the furniture. It is used in conjunction with another air distribution system that handles the area ventilation requirements and thermal loads in the space.

6.2.2.2.2.1 Personalized Air. The personalized air shall be distributed in the breathing zone and designed such that the velocity is equal to or less than 50 fpm (0.25 m/s) at the head/facial region of the occupant.

6.2.2.2.2.2 Return Air. The return air openings or pathways shall be located more than 9 ft (2.8 m) above the floor.

Modify Normative Appendix A as shown. The remainder of Appendix A is unchanged.

A3. SYMBOLS

[. . .]

Ez — ***zone air distribution effectiveness:*** a measure of the effectiveness of supply air distribution to the breathing zone. *Ez* is determined in accordance with Section 6.2.2.2 or Normative Appendix X.

Table 6.2.2.2 Zone Air Distribution Effectiveness

Air Distribution Configuration	E_z
Well-Mixed Air Distribution Systems	
Ceiling supply of cool air	1.0
Ceiling supply of warm air and floor return	1.0
Ceiling supply of warm air 15°F (8°C) or more above space temperature and ceiling return	0.8
Ceiling supply of warm air less than 15°F (8°C) above average space temperature where the supply air-jet velocity is less than 150 fpm (0.8 m/s) within 4.5 ft (1.4 m) of the floor and ceiling return	0.8
Ceiling supply of warm air less than 15°F (8°C) above average space temperature where the supply air-jet velocity is equal to or greater than 150 fpm (0.8 m/s) within 4.5 ft (1.4 m) of the floor and ceiling return ~~provided that the 150 fpm (0.8 m/s) supply air jet reaches to within 4.5 ft (1.4 m) of floor level (See Note 6)~~	1.0
~~Floor supply of cool air and ceiling return, provided that the vertical throw is greater than 50 fpm (0.25 m/s) at a height of 4.5 ft (1.4 m) or more above the floor~~	~~1.0~~
~~Floor supply of cool air and ceiling return, provided low-velocity displacement ventilation achieves unidirectional flow and thermal stratification, or underfloor air distribution systems where the vertical throw is less than or equal to 50 fpm (0.25 m/s) at a height of 4.5 ft (1.4 m) above the floor~~	~~1.2~~
Floor supply of warm air and floor return	1.0
Floor supply of warm air and ceiling return	0.7
Makeup supply outlet located more than half the length of the space from ~~drawn in on the opposite side of the room from~~ the exhaust, return, or both.	0.8
Makeup supply outlet located less than half the length of the space from ~~drawn in near to~~ the exhaust, return, or both.	0.5
Stratified Air Distribution Systems (6.2.2.2.1)	
Floor supply of cool air where the vertical throw is greater than or equal to 60 fpm (0.25 m/s) at a height of 4.5 ft (1.4 m) above the floor and ceiling return at a height less than or equal to 18 ft (5.5 m) above the floor	1.05
Floor supply of cool air where the vertical throw is less than or equal to 60 fpm (0.25 m/s) at a height of 4.5 ft (1.4 m) above the floor and ceiling return at a height less than or equal to 18 ft (5.5 m) above the floor	1.2
Floor supply of cool air where the vertical throw is less than or equal to 60 fpm (0.25 m/s) at a height of 4.5 ft (1.4 m) above the floor and ceiling return at a height greater than 18 ft (5.5 m) above the floor	1.5
Personalized Ventilation Systems (6.2.2.2.2)	
Personalized air at a height of 4.5 ft (1.4 m) above the floor combined with ceiling supply of cool air and ceiling return	1.40
Personalized air at a height of 4.5 ft (1.4 m) above the floor combined with ceiling supply of warm air and ceiling return	1.40
Personalized air at a height of 4.5 ft (1.4 m) above the floor combined with a stratified air distribution system with nonaspirating floor supply devices and ceiling return	1.20
Personalized air at a height of 4.5 ft (1.4 m) above the floor combined with a stratified air distribution system with aspirating floor supply devices and ceiling return	1.50

~~**NOTES:**~~

1. ~~"Cool air" is air cooler than space temperature.~~
2. ~~"Warm air" is air warmer than space temperature.~~
3. ~~"Ceiling supply" includes any point above the breathing zone.~~
4. ~~"Floor supply" includes any point below the breathing zone.~~
5. ~~As an alternative to using the above values, E_z may be regarded as equal to air-change effectiveness determined in accordance with ASHRAE Standard 129[16] for air distribution configurations except unidirectional flow.~~
6. ~~For lower velocity supply air, E_z = 0.8.~~

Add New Normative Appendix X as shown below.

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

NORMATIVE APPENDIX X
ZONE AIR DISTRIBUTION EFFECTIVENESS—ALTERNATE PROCEDURES

This appendix provides a procedure for determining zone air distribution effectiveness (E_z) for all system types.

Informative Note: Table 6.2.2.2 provides default values of E_z that are be permitted to be used for the air distribution configurations described in the table. The reference E_z value of 1 is typical of ideal mixing in the zone. The strategy of removing contaminants or displacing contaminants from the breathing zone may result in an effective E_z value greater than unity, which is typical of stratified systems.

X1. ZONE AIR DISTRIBUTION EFFECTIVENESS

Zone air distribution effectiveness shall be calculated in accordance with Equation X-1:

$$E_z = (C_e - C_s)/(C - C_s) \quad \text{(X-1)}$$

where

E_z = zone air distribution effectiveness

C = average contaminant concentration at the breathing zone

C_e = average contaminant concentration at the exhaust

C_s = average contaminant concentration at the supply

X1.1 Personalized Ventilation Systems. For the purpose of calculating zone air distribution effectiveness for personalized ventilation systems, the breathing zone shall be 9 ft^2 (0.8 m^2) centered on each occupant with a height of 4.5 ft (1.4 m) from the floor.

X2. MODELED AIR DISTRIBUTION SYSTEM

X2.1 Computational Model. The computational fluid dynamics (CFD) model for calculating zone air distribution effectiveness shall be in accordance with the following subsections.

X2.1.1 Computational Domain. The computational domain shall comprise of all sensible heat sources, all major obstructions to airflow, and all air distribution devices. The calculation domain shall include all boundary walls.

X2.1.2 Solution Variables. Analysis shall include the solutions for fluid flow, heat transfer, and chemical species transport. The buoyancy (gravitational) effects shall be included in the calculation procedure.

X2.1.3 Boundary Conditions. Sensible heat sources shall be permitted to be modeled as volumetric heat sources to allow the air to pass through the source or as hollow blocks (no mesh inside) specified with either heat flux or constant temperature on the surfaces of the blocks. Boundary walls shall be modeled as adiabatic (zero heat flux), specified heat flux, or specified temperature boundary.

X2.1.4 Species Transport. The sources shall be modeled as volumetric source or a boundary flux with known generation rate with zero release velocity. The analysis shall be performed with a uniformly distributed source at the breathing zone level of the occupants. All the boundary walls shall be modeled as impermeable to the chemical species.

Informative Note: The species modeled should be a tracer gas, such as CO_2. Discretion is left to the modeler to determine the appropriate model depending on the design compounds in the zone.

X2.1.5 Turbulence Model. Reynolds (ensemble) averaging turbulence models shall be utilized.

Informative Note: RNG and realizable k-ε models meet the requirements of this section.

X2.1.6 Computational Mesh. A fine mesh shall be generated near the sensible heat sources, such as occupants and computers, to resolve the thermal plume surrounding these sources. The fine mesh shall be generated on all supply air and return air locations.

X2.1.7 Solution Convergence. The solution convergence levels shall include the monitoring of relevant physical quantities such as temperature or species concentration at strategic locations. The globally scaled residuals shall be decreased to10^{-3} for all equations except the energy and species equations, for which the residuals shall be decreased to 10^{-7}. The mass and energy balance shall be calculated up to at least four (4) decimal places.

Informative Note: Review of the thermal comfort of occupants in the computational model may be desirable.

X2.2 Zone Air Distribution Effectiveness. Zone air distribution effectiveness (E_z) shall be computed in accordance with Equation X-1 for each computational cell in the breathing zone. The zone air distribution effectiveness (E_z) of the system shall be the average value of the zone air distribution effectiveness of each computational cell within the breathing zone. The analysis shall be performed for both summer cooling conditions and winter heating conditions.

Informative Note: Validation of the computational model with physical measurements during design can improve the accuracy of the computational model and the zone air distribution effectiveness of the system. Field measurements could also be performed post building occupancy to verify zone air distribution effectiveness.

X3. INFORMATIVE REFERENCES

ASHRAE. 2001. *Simplified Diffuser Boundary Conditions for Numerical Room Airflow Models*. ASHRAE Research Project (RP-1009). Atlanta: ASHRAE.

ASHRAE. 2009. *Air Distribution Effectiveness with Stratified Air Distribution Systems*. ASHRAE Research Project (RP-1373). Atlanta: ASHRAE.

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.

ASHRAE · 1791 Tullie Circle NE · Atlanta, GA 30329 · www.ashrae.org

About ASHRAE

ASHRAE, founded in 1894, is a global society advancing human well-being through sustainable technology for the built environment. The Society and its members focus on building systems, energy efficiency, indoor air quality, refrigeration, and sustainability. Through research, Standards writing, publishing, certification and continuing education, ASHRAE shapes tomorrow's built environment today.

For more information or to become a member of ASHRAE, visit www.ashrae.org.

To stay current with this and other ASHRAE Standards and Guidelines, visit www.ashrae.org/standards.

Visit the ASHRAE Bookstore

ASHRAE offers its Standards and Guidelines in print, as immediately downloadable PDFs, and via ASHRAE Digital Collections, which provides online access with automatic updates as well as historical versions of publications. Selected Standards and Guidelines are also offered in redline versions that indicate the changes made between the active Standard or Guideline and its previous version. For more information, visit the Standards and Guidelines section of the ASHRAE Bookstore at www.ashrae.org/bookstore.

IMPORTANT NOTICES ABOUT THIS STANDARD

To ensure that you have all of the approved addenda, errata, and interpretations for this Standard, visit www.ashrae.org/standards to download them free of charge.

Addenda, errata, and interpretations for ASHRAE Standards and Guidelines are no longer distributed with copies of the Standards and Guidelines. ASHRAE provides these addenda, errata, and interpretations only in electronic form to promote more sustainable use of resources.

7/19