



providing insights for today's hvac system designer

Engineers Newsletter

volume 49-3

ASHRAE® Standard 62.1-2019 Update



The latest version of ASHRAE Standard 62.1 was published in late 2019. This *Engineers Newsletter* highlights several addenda that were incorporated into the 2019 version, as well as some that were incorporated into the previous 2016 version.

Since it was first published in 1973, ANSI/ASHRAE Standard 62.1 *Ventilation for Acceptable Indoor Air Quality* has been the basis of most mechanical codes.¹ This standard is under continuous maintenance by an ASHRAE committee, whereby changes are made via a rigorous process of issuing proposed addenda for public review and comment. ASHRAE currently publishes a new version of this standard every three years, incorporating all addenda approved since its last publication.

The 2019 version incorporates 35 addenda which, according to the committee chair, are intended to “achieve clarity, address misinterpretations, and improve equipment and building requirements.”² Several of these addenda are discussed in this EN. For the complete list, refer to Appendix O in the standard, which includes a brief description of each and identifies the section(s) impacted.

Section 5: Systems and Equipment

Section 5 of the standard includes general requirements related to the design of the ventilation system and its components.

Maximum indoor dew point. Addendum AE deleted the existing Section 5.9 (“Dehumidification Systems”) and replaced it with a new section that

requires that the indoor dew point temperature be no higher than 60°F in any space served by mechanical cooling equipment. The committee’s stated intent for this requirement is to “reduce the risk of microbial growth in buildings and their interstitial spaces because it limits the mass of indoor water vapor that can condense or be absorbed into mechanically cooled surfaces.”

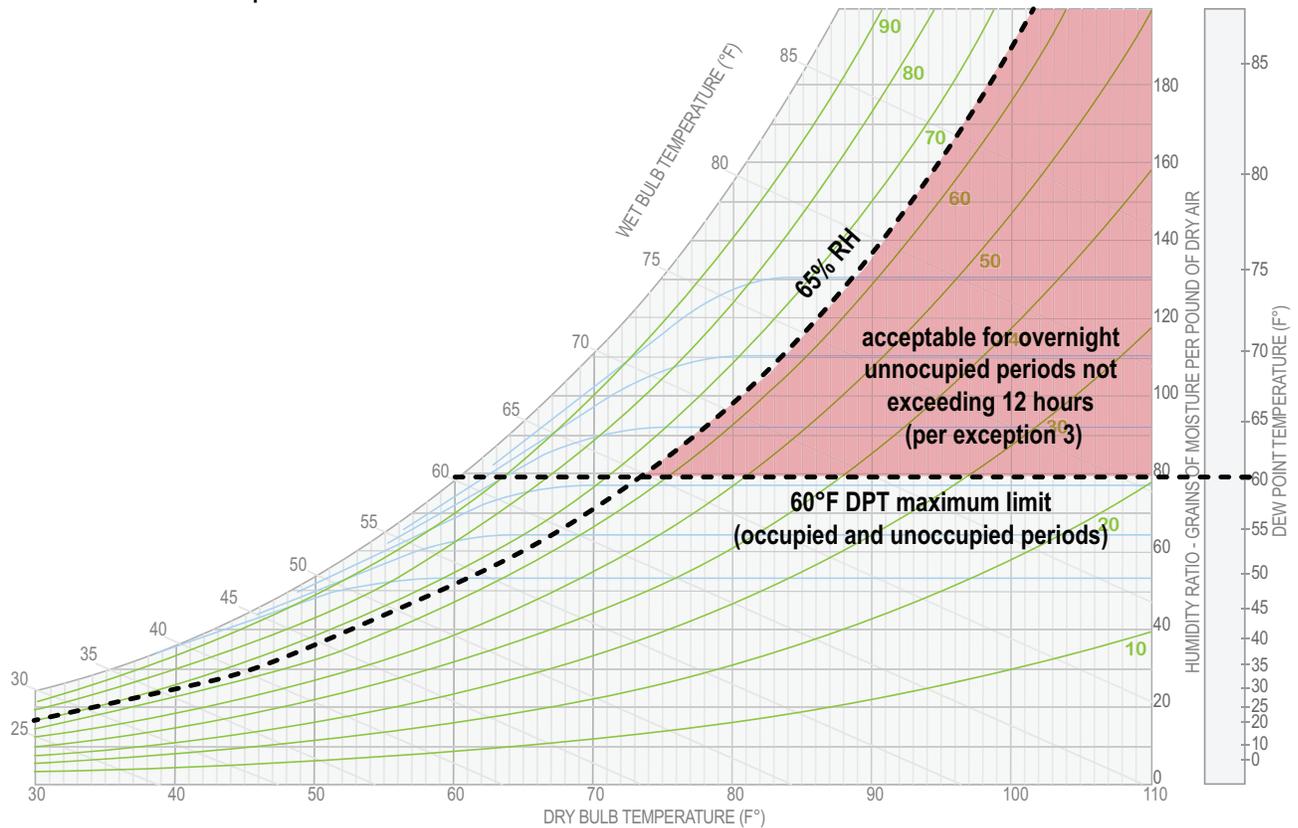
5.10 Maximum Indoor-Air Dew Point in Mechanically Cooled Buildings.

Buildings or spaces equipped with or served by mechanical cooling equipment shall be provided with dehumidification components and controls that limit the indoor humidity to a maximum dew point of 60°F (15°C) during both occupied and unoccupied hours whenever the outdoor-air dew point is above 60°F (15°C).

Exceptions to 5.10:

- 1 Buildings or spaces that are neither equipped with nor served by mechanical cooling equipment.*
- 2 Buildings or spaces equipped with materials, assemblies, coatings, and furnishings that resist microbial growth and that are not damaged by continuously high indoor-air dew points.*
- 3 During overnight unoccupied periods not exceeding 12 hours, the 60°F (15°C) dew-point limit shall not apply, provided that indoor relative humidity does not exceed 65 percent at any time during those hours.*

Figure 1. Maximum indoor dew point limit



Note that this indoor dew point limit only applies when the outdoor dew point is above 60°F. Whenever it is hot and dry outside, or cool outside, the outdoor dew point will be below this threshold.

Also note that this limit applies during both occupied and unoccupied hours. However, exception 3 exempts overnight periods not exceeding 12 hours, as long as the indoor relative humidity does not exceed 65 percent during that time-frame. In other words, the indoor dew point is allowed to rise above 60°F overnight as long as the indoor relative humidity remains below 65 percent (Figure 1).

Finally, exception 2 exempts spaces constructed with materials that resist microbial growth or damage. Examples listed in the standard include shower rooms, swimming pool enclosures, kitchens, spa rooms, and semi-cooled warehouses.

Air-cleaning devices that generate ozone are prohibited. Addendum AJ added a new section related to the use of devices that generate ozone:

5.7 Ozone Generating Devices. *The use of ozone generating devices shall comply with the following sections.*

Exception to 5.7: *Electronic devices used exclusively for the operation of HVAC equipment and controls.*

5.7.1 Air Cleaning Devices. *Air cleaning devices shall be listed and labeled in accordance with UL 2998.*

5.7.2 Ultraviolet Devices. *Ultraviolet generating devices in supply air or spaces shall not transmit 185 nm wavelengths.*

Filters not required for sensible-only cooling coils. Section 5.9 (“Particulate Matter Removal”) requires a filter (or air cleaner) with a MERV not less than 8 to be “provided upstream of all cooling coils or other devices with wetted surfaces through which air is supplied to an occupiable space.”

Addendum D to the 2013 version added the following exception to clarify that this filter is NOT required upstream of cooling coils that provide only sensible cooling and no dehumidification:

Exception to 5.9: *Cooling coils that are designed, controlled, and operated to provide sensible cooling only.*

Section 6.2: Ventilation Rate Procedure

The Ventilation Rate Procedure (VRP) is one of three procedures—each outlined in Section 6 of the standard—that can be used to determine the minimum outdoor airflow required for each zone, and then to calculate how much outdoor air must be brought in through the intake of the ventilation system.

The latter calculation differs based on the type of ventilation system being designed—a single-zone system, a 100-percent outdoor air system, or a multiple-zone recirculating system. A multiple-zone recirculating system is comprised of an air handler that supplies a mixture of outdoor air and recirculated air to more than one ventilation zone; a common example is a multiple-zone VAV system.

New simplified procedure for calculating E_v . For a multiple-zone recirculating system, the VRP determines the system ventilation efficiency (E_v) in order to calculate the design outdoor air intake flow (V_{ot}). Previous versions of the standard included a table that could be used to lookup a default value for E_v , as well as an appendix with an alternate procedure for calculating E_v .

Addendum F deleted the existing Table 6.2.5.2 (“System Ventilation Efficiency”) and replaced it with a new “simplified procedure” for determining E_v (see inset on page 5). The alternative calculation procedure is also still available and included in Appendix A of the standard.

To compliment this new simplified procedure, Addendum B added a new appendix with a table and simple calculation that is intended for use in assessing the ventilation performance of a multiple-zone recirculating system in an existing building, where some of the data needed to perform the full VRP calculations might be difficult to obtain.

For this simplified procedure, calculation of E_v is simply a function of the occupant diversity ratio (D), which the standard defines as the total population (P_s) in the area served by the system divided by the sum of design zone populations (P_z) for all zones served by the system:

$$D = P_s / \sum_{\text{all zones}} P_z$$

Figure 2 depicts a floor of an example, multiple-story office building. This 23,000-ft² floor plate consists of open-plan office areas (cubicles), private offices along the East and West exposures, and four conference rooms.

The core area includes restrooms, elevators, mechanical space, a janitor closet, and stairwells. This entire floor is served by one multiple-zone recirculating ventilation system.

Table 1 lists the design population (P_z) for each zone, which are used for the breathing-zone ventilation calculations ($V_{bz} = P_z \times R_p + A_z \times R_a$). The sum of these design zone populations is 152. However, in this case, a person is expected to be either in their office (or cubicle) or attending a meeting in one of the conference rooms; not in both zones at the same time. Therefore, the design team estimates that the largest (peak) number of people expected to occupy this floor is 102; this is the design system population (P_s), as defined by the standard.

The occupant diversity ratio is calculated to be 0.67 for the ventilation system serving this example floor plate:

$$D = 102 / 152 = 0.67$$

Figure 2. Occupancy diversity ratio (D) example

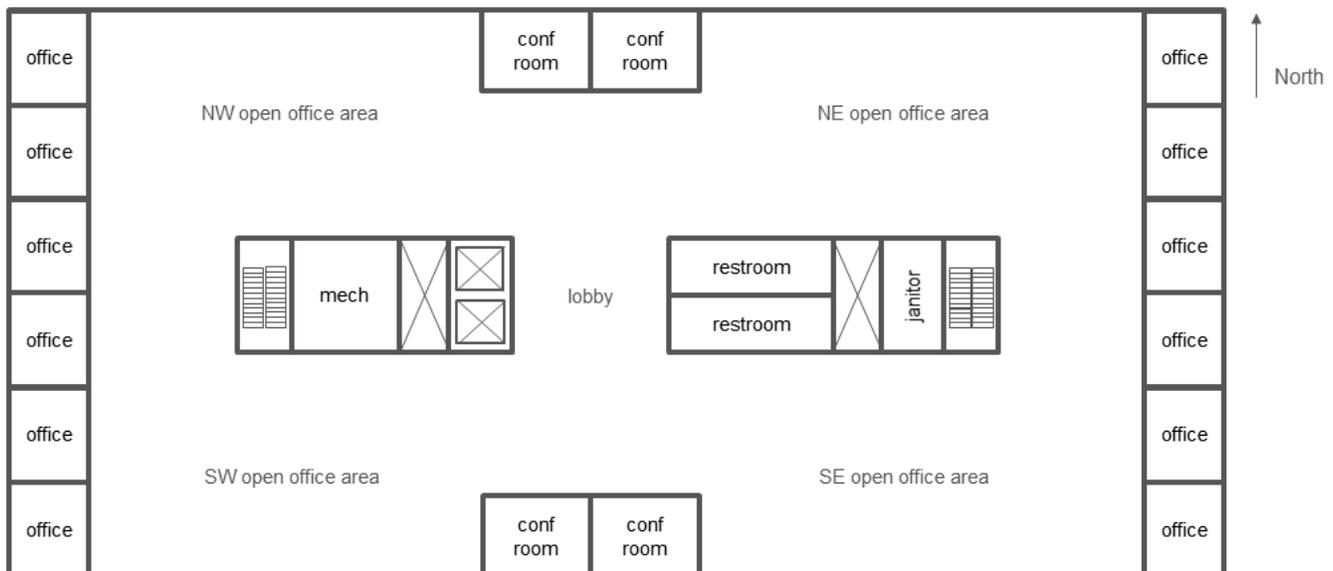


Table 1. Occupancy diversity ratio (D) example

zone	P _z	R _p cfm/p	P _z × R _p cfm	A _z ft ²	R _a cfm/ft ²	A _z × R _a cfm	V _{bz} cfm
West private offices	6	5	30	1575	0.06	95	125
East private offices	6	5	30	1575	0.06	95	125
NW open offices	19	5	95	3800	0.06	228	323
SW open offices	19	5	95	3800	0.06	228	323
NE open offices	21	5	105	4200	0.06	252	357
SE open offices	21	5	105	4200	0.06	252	357
North conference rooms	30	5	150	600	0.06	36	186
South conference rooms	30	5	150	600	0.06	36	186
Elevator lobby	0	5	0	600	0.06	36	36
Σ P_z =	152	Σ P_z × R_p =	760		Σ A_z × R_a =	1258	
P_s =	102						
D = P_s / Σ_{all zones} P_z =	102/152	V_{ou} =	D × Σ_{all zones} (P_z × R_p) + Σ_{all zones} (A_z × R_a)				
=	0.67	=	0.67 × 760 cfm + 1258 cfm = 1767 cfm				

As mentioned, when using this simplified procedure, the calculation of E_v is a function of only this occupant diversity ratio. If D is greater than or equal to 0.60—which is the case in our example—then E_v is equal to 0.75; but if D is less than 0.60, then E_v is calculated using the equation in the standard (Figure 3).

Finally, this value of system ventilation efficiency (E_v) is used to calculate the design outdoor air intake flow (V_{ot}) for the system (per Section 6.2.4.4), which is 2356 cfm for this example:

$$V_{ot} = V_{ou} / E_v = 1767 \text{ cfm} / 0.75$$

$$= 2356 \text{ cfm}$$

Per Section 6.2.4.3.2, in order to use this simplified procedure, the minimum primary airflow setpoint for each zone (V_{pz-min}) must be no lower than 1.5 times the design zone outdoor airflow (V_{oz} = V_{bz} / E_z). To demonstrate, the minimum primary airflow setpoint for the “West private offices” zone in our example must be no lower than 187 cfm in the cooling mode—assuming an E_{z-cooling} of 1.0—and no lower than 233 cfm in the heating mode—assuming an E_{z-heating} of 0.8 (Table 2).

If minimum primary airflow setpoints are below this threshold, then the alternative calculation procedure in Appendix A of the standard should be used.

Figure 3. Calculation of system ventilation efficiency (E_v) using the simplified procedure

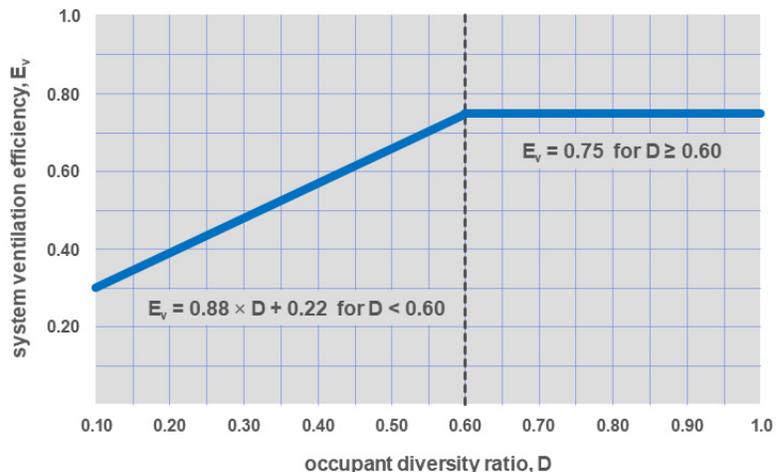


Table 2. Minimum primary airflow setpoints (V_{pz-min})

zone	V _{bz} cfm	E _{z-cooling}	V _{oz-cooling} cfm	V _{pz-min-cooling} cfm	E _{z-heating}	V _{oz-heating} cfm	V _{pz-min-heating} cfm
West private offices	125	1.0	125	187	0.8	156	233
East private offices	125	1.0	125	187	0.8	156	233
NW open offices	323	1.0	323	485	0.8	404	606
SW open offices	323	1.0	323	485	0.8	404	606
NE open offices	357	1.0	357	536	0.8	446	669
SE open offices	357	1.0	357	536	0.8	446	669
North conference rooms	186	1.0	186	279	0.8	233	349
South conference rooms	186	1.0	186	279	0.8	233	349
Elevator lobby	36	1.0	36	54	0.8	45	68

In the 2019 version of ASHRAE Standard 90.1, Section 6.5.2.1 was revised to correspond with this new minimum primary airflow setpoint requirement.³ This section prevents reheating air that has been previously cooled, unless the zone controls first reduce airflow to prescribed minimum thresholds. Exception 2 used to require airflow be reduced to 20 percent of the zone’s design supply airflow (see strike-through text). But this has now been changed to require airflow be reduced to the minimum primary airflow rate required by the simplified procedure in Standard 62.1 (see underlined text)—which, as explained previously, is 1.5 times the design zone outdoor airflow (V_{oz}).

6.5.2.1 Zone Controls. Zone thermostatic control shall prevent reheating ...

Exceptions to 6.5.2.1:

2. Zones with DDC that comply with all of the following:

(a) The airflow rate in dead band between heating and cooling does not exceed the larger of the following:

~~(1) 20 percent of the zone design peak supply airflow~~

(1) The minimum primary airflow rate required to meet the Simplified Procedure ventilation requirements of ASHRAE Standard 62.1 for the zone...

(b) The airflow rate that is reheated, recooled, or mixed shall be less than 50% of the zone design peak supply rate.

(c) The first stage of heating consists of modulating the zone supply air temperature set point up to a maximum set point while the airflow is maintained at the dead band flow rate.

(d) The second stage of heating consists of modulating the airflow rate from the dead band flow rate up to the heating maximum flow rate

Simplified procedure

6.2.4.2 System Ventilation Efficiency. The system ventilation efficiency (E_v) shall be determined in accordance with Section 6.2.4.3 for the Simplified Procedure or Normative Appendix A for the Alternative Procedure.

6.2.4.3 Simplified Procedure

6.2.4.3.1 System Ventilation Efficiency. System ventilation efficiency (E_v) shall be determined in accordance with Equation 6-7 or 6-8.

$$E_v = 0.88 \times D + 0.22 \text{ for } D < 0.60 \text{ (Equation 6-7)}$$

$$E_v = 0.75 \text{ for } D \geq 0.60 \text{ (Equation 6-8)}$$

6.2.4.3.2 Zone Minimum Primary Airflow. For each zone, the minimum primary airflow (V_{pz-min}) shall be determined in accordance with Equation 6-9.

$$V_{pz-min} = V_{oz} \times 1.5 \text{ (Equation 6-9)}$$

6.2.4.4 Outdoor Air Intake. The design outdoor air intake flow (V_{ot}) shall be determined in accordance with Equation 6-10.

$$V_{ot} = V_{ou} / E_v \text{ (Equation 6-10)}$$

Demand-controlled ventilation and occupied standby mode. Section 6.2.6 (“Dynamic Reset”) explicitly permits resetting the outdoor air intake flow (V_{ot}), or zone ventilation airflow (V_{oz}), in response to the current population. This energy-saving control strategy is often referred to as demand-controlled ventilation (DCV), and is typically implemented using a carbon dioxide (CO_2) sensor, an occupancy sensor (motion detector), or some other means of counting or estimating the number of people in a zone.

Addenda P and R to the 2013 version clarified requirements for when DCV is implemented, and introduced the term “occupied standby mode” to the standard. According to the definitions in Section 3 of the standard:

- **Occupied mode** refers to when a zone is scheduled to be occupied. This is typically defined by the scheduling function in a building automation system (BAS) or programmable thermostat.
- **Occupied standby mode** refers to when a zone is scheduled to be occupied, but an occupancy sensor located in that zone indicates that no occupants are currently present.

Whenever a zone is in occupied mode, Section 6.2.6.1.2 requires that the outdoor airflow delivered to the breathing zone be no less than the building component of the ventilation rate ($R_a \times A_z$). However, for certain occupancy categories, if an occupancy sensor is installed in the zone, Section 6.2.6.1.4 allows outdoor airflow to be reduced to zero whenever the zone is in occupied standby mode (no occupants present). Table 6-1 in the standard includes a column to indicate which occupancy categories are permitted to implement this “occupied standby mode.”

6.2.6.1 Demand Control Ventilation (DCV). DCV shall be permitted as an optional means of dynamic reset.

Exception to 6.2.6.1: CO_2 -based DCV shall not be applied in zones with indoor

sources of CO_2 other than occupants, or with CO_2 removal mechanisms, such as gaseous air cleaners.

6.2.6.1.1 For DCV zones in the occupied mode, breathing zone outdoor airflow (V_{bz}) shall be reset in response to current population. Current population estimates used in DCV control calculations shall not result in ventilation rates that are less than those required by the actual population during any one-hour time period.

6.2.6.1.2 For DCV zones in the occupied mode, breathing zone outdoor airflow (V_{bz}) shall be not less than the building component ($R_a \times A_z$) for the zone.

6.2.6.1.3 Where CO_2 sensors are used for DCV, the CO_2 sensors shall be certified by the manufacturer to be accurate within ± 75 ppm at concentrations of both 600 and 1000 ppm when measured at sea level at 77°F (25°C). Sensors shall be factory calibrated and certified by the manufacturer to require calibration not more frequently than once every five years. Upon detection of sensor failure, the system shall provide a signal that resets the ventilation system to supply the required minimum quantity of outdoor air (V_{bz}) to the breathing zone for the design zone population (P_z).

6.2.6.1.4 For DCV zones in the occupied standby mode, breathing zone outdoor airflow shall be permitted to be reduced to zero for the occupancy categories indicated “OS” in Table 6-1, provided that airflow is restored to V_{bz} whenever occupancy is detected.

In addition, addendum AL to the 2016 version added new requirements (in Section 6.2.6.1.3) for the **accuracy of carbon dioxide (CO_2) sensors**, when they are used for DCV.

Zone air distribution effectiveness (E_z). Addendum AH expanded Table 6-4 in the standard, which includes default values for zone air

distribution effectiveness (E_z). In addition to changes that improve clarity, this table now includes default values for stratified air systems (such as displacement ventilation or underfloor air distribution systems) and personalized ventilation systems (such as where the ventilation outlet is incorporated into furniture).

This addendum also added a new appendix that includes an alternate procedure for calculating E_z .

Alignment with Standard 170 and FGI guidelines. Most health care facilities are designed and constructed according to guidelines published by the Facility Guidelines Institute (FGI). For outpatient facilities, the FGI guidelines require some types of spaces to comply with ASHRAE/ASHE Standard 170, *Ventilation of Health Care Facilities*.^{4,5} But for other types of outpatient spaces—notably psychiatric, urgent care, physical therapy, imaging, and dental—the FGI guidelines require compliance with local codes, which are typically based on Standard 62.1.

To fill this gap, and to better align with Standard 170 and the FGI guidelines, addendum AF added minimum ventilation rates for these types of outpatient spaces to Table 6-1 in Standard 62.1.

In addition, addendum AS added language to clarify that the ventilation rates from Standard 170 are to be used for any occupancy categories that are included in that standard.

Air cleaning for ozone. Section 6.1.4.3 requires the installation, operation, and maintenance of an air-cleaning device that removes ozone for locations where the outdoor ozone concentration is expected to exceed 0.100 ppm.

Addendum K changed this threshold to align with current classifications defined by the U.S. Environmental Protection Agency (EPA).⁶ As such, air cleaning for ozone is only required in locations classified as “serious” or higher.

Section 6.3: Indoor Air Quality Procedure

The Indoor Air Quality Procedure (IAQP) is another allowable procedure outlined in Section 6 of the standard.

While the ASHRAE committee has been working on a major revision to this procedure for some time, the proposed addendum is still being discussed and did not make it into the 2019 version. A previous EN described the steps required for compliance with the IAQP.⁷

Consideration for contaminant mixtures. The first step in the IAQP is to identify each “contaminant of concern” for the space, both indoor and outdoor sources. Addendum J to the 2013 version added a new requirement to also consider the combined effects that multiple contaminants of concern (called a “contaminant mixture”) have on an individual organ system.

For each contaminant mixture, the design team must calculate the ratio of the concentration of each individual contaminant divided by its concentration limit, and the sum of these ratios shall be no greater than one.⁸

6.3.1 Contaminant Sources. *Each contaminant of concern, for purposes of the design, shall be identified. For each contaminant of concern, indoor sources and outdoor sources shall be identified, and the emission rate for each contaminant of concern from each source shall be determined. Where two or more contaminants of concern target the same organ system, these contaminants shall be considered to be a contaminant mixture.*

6.3.2 Contaminant Concentration. *For each contaminant of concern, a concentration limit and its corresponding exposure period and an appropriate reference to a cognizant authority shall be specified. For each contaminant mixture of concern, the ratio of the concentration of each contaminant to its concentration limit shall be determined, and the sum of these ratios shall be no greater than one.*

Section 6.4: Natural Ventilation Procedure

Addenda L and T resulted in a significant revision to the Natural Ventilation Procedure (NVP), which is the final allowable procedure outlined in Section 6 of the standard.

Users of the NVP can choose between a prescriptive compliance path or an “engineered system” compliance path.

The **prescriptive compliance path** dictates the location and minimum required size of natural ventilation openings, based on the floor area to be ventilated and ceiling height. But any zone designed for natural ventilation must also include a mechanical ventilation system—designed using either the VRP or IAQP—unless the openings are permanently open or are equipped with controls that prevent them from being closed during periods of expected occupancy.

The **engineered system compliance path** offers greater flexibility to design the natural ventilation system, as long as sufficient outdoor airflow—calculated using either the VRP or IAQP—reaches the breathing zone.

Summary

This EN discussed some of the 35 addenda which were incorporated into the 2019 version of ASHRAE Standard 62.1. The complete list can be found in Appendix O of the standard.

To receive e-mail notification of proposed addenda being issued for public review, you can subscribe to the ASHRAE Listserve at www.ashrae.org/technical-resources/free-resources/listserves.

By John Murphy, Trane. To subscribe or view previous issues of the Engineers Newsletter visit trane.com and select the Training & Support from the drop down menu. Send comments to ENL@trane.com.

References

- [1] ANSI/ASHRAE, Standard 62.1-2019, *Ventilation for Acceptable Indoor Air Quality*. Atlanta: ASHRAE. 2019.
- [2] “Updated Standard 62.1 Simplifies, Improves Calculations and Procedures.” *HVAC&R Industry Newsletter*. ASHRAE. 31 October 2019.
- [3] ANSI/ASHRAE/IES, Standard 90.1-2019, *Energy Standard for Buildings Except Low-Rise Residential Buildings*. Atlanta: ASHRAE. 2019.
- [4] *Guidelines for Design and Construction of Outpatient Facilities*. Facility Guidelines Institute (FGI). 2018.
- [5] ANSI/ASHRAE/ASHE, Standard 170-2017, *Ventilation of Health Care Facilities*. Atlanta: ASHRAE. 2017.
- [6] “Nonattainment Areas for Criteria Pollutants.” U.S. Environmental Protection Agency. www.epa.gov/green-book
- [7] Stanke, D. “Minimum Outdoor Airflow Using the IAQ Procedure” *Engineers Newsletter*. ADM-APN042-EN. Trane. 2011.
- [8] Trane. *Compliance with the IAQ Procedure of ASHRAE Standard 62.1-2016* white paper. EDU-SLB038-EN. 2019.

Download the New Version of TRACE®3D Plus

New features provide improved capabilities and performance that reduces the time you spend creating and analyzing models

New features and enhancements:

- Adjustable solar positioning for shading visualization and analysis
- New options for partition modeling that can significantly speed-up simulations
- New tools for drawing angled buildings even faster
- Ability to model adiabatic surfaces that make it easy for retrofit or partial building analyses
- Residential and indoor agriculture themes have been added to the library
- Various quality, performance, and scaling improvements

Visit Trane.com—*Products—Design & Analysis Software*, for more information and to download the latest version.

Check out the latest *Engineers Newsletter LIVE* programs now available online!

Impact of DOAS Dew Point on Space Humidity. Dedicated outdoor-air systems (DOAS) are used in a variety of building types to provide ventilation; and when the outdoor air is dehumidified, a DOAS can help prevent high space humidity levels. But many of the systems designed and installed today are not dehumidifying adequately. This ENL will demonstrate how space humidity levels are affected by the DOAS discharge-air conditions, at both full load and part load.

Indoor Agriculture: HVAC System Design Considerations. Conditioning spaces for plants instead of humans introduces new challenges. This ENL will discuss plants, the dehumidification challenges they pose, and how precision cooling for indoor agriculture is different compared to comfort cooling. We'll also discuss common air- and waterside system configurations used to maintain space conditions to ensure a healthy crop.

You will find these and more under *Training & Support—Self-Paced Learning* on the NEW Trane.com website!

Coming Soon...

Decarbonize HVAC Systems (October). Many municipalities are taking action to reduce their carbon emissions which includes the reduction, or removal, of natural gas for heating. The HVAC industry will face the challenge of heating buildings with electric heat. This ENL will cover the motivation to electrify, areas currently effected by this trend, and potential systems to meet electrification needs.

Applying VRF for a Complete Building Solution (November) This ENL builds upon the 2014 VRF program "Applying Variable Refrigerant Flow" with detailed discussions on several considerations. Topics will include: when to use heat recovery instead of heat pump configurations, how to scale VRF systems to include other building systems, ventilation delivery, humidity management and more.



For additional information on **Variable Refrigerant Flow (VRF)** technology, visit Trane.com/VRF to view and download the latest VRF System Catalog.



For more information, contact your local Trane office or e-mail us at comfort@trane.com

This newsletter is for informational purposes only and does not constitute legal advice. Trane believes the facts and suggestions presented here to be accurate. However, final design and application decisions are your responsibility. Trane disclaims any responsibility for actions taken on the material presented.

All trademarks referenced are the trademarks of their respective owners.