Explaining Science Behind Standard 62.1-2004

Many research studies indicate that increasing ventilation increases beneficial outcomes in terms of health, odor/irritant comfort and productivity, while decreasing ventilation decreases beneficial outcomes. However, since Standard 62.1 prescribes minimum—not "best-practice" rates—reducing ventilation for some previously "overventilated" occupancy categories was deemed appropriate.

By Dennis A. Stanke, Member ASHRAE

As chair of Standing Standards Project Committee (SSPC) 62.1, I am often asked to respond either directly or indirectly to inquiries regarding ANSI/ASHRAE Standard 62.1-2004. We refer to these queries as unofficial interpretation requests.

Niraj Chandra, P.E., Member ASHRAE, recently submitted a detailed review of Standard 62.1-2004, which included several comments and questions. Hopefully, sharing some of the key elements of this exchange with *IAQ Application* readers will be beneficial and help justify the considerable time spent in reviewing the standard and responding to comments and questions.

Comment: Standard 62.1-2004 replaces the "simple ventilation rate" prescribed by earlier versions of the standard with a "…more complex procedure requiring greater design effort. However, the science on which the new procedures are based is not indicated in the standard."

Response: At the zone level, the 2004 version replaces the historic single ventilation rate—airflow rate per-person *or* per-unit-area—with two ventilation rates, airflow rate per-person *and* per-unit-area. Historically, the standard assumed that contaminant emissions from all sources in the zone were proportional to *either* zone population or zone area. The new version assumes that some contaminant emissions in each zone are proportional to population while others are proportional to zone area.

Historically, per-person rates were inflated to ensure adequate ventilation for area-related contaminants, which placed an undue penalty on high occupant-density zones. The new version uses less conservative per-person rates in addition to per-unit-area rates to reduce the high-density penalty and increase flexibility for designers.

While it may be somewhat more complex to determine zone outdoor airflow as the sum of two flow rates (new) rather than as a single flow rate (historical), the increase in complexity is not substantial and it is supported by several scientific studies.[1–4]

Although references to these studies are not incorporated in the Standard directly, the *Standard 62.1-2004 User's Manual*[5] includes a detailed discussion on the concept of ventilation "additivity" and it refers to many scientific studies that help to justify the concept.

Comment: In many cases, this approach (the Ventilation Rate Procedure of Standard 62.1-2004) results in a reduction in the minimum ventilation rate. What effect would this reduction have on indoor air quality?

Response: Compared to Standard 62-2001, the new rates and procedures in Standard 62.1-2004 reduce the required minimum outdoor airflow significantly (by 30% to 70%) for 47% of the listed occupancy categories. They maintain about the same minimum airflow (within ±30%) for 49% of the listed categories, and they increase the minimum significantly (by 30% to 80%) for the remaining 4% of listed categories. In the judgment of the committee as well as that of others in the design community—consensus was achieved after several public review periods during development of the standard—the historical rates caused overventilation in many high-density occupancy categories and the new lower rates reduce this overventilation.

Will lower ventilation rates alter indoor air quality? Yes. Many research studies[6] indicate that increasing ventilation increases beneficial outcomes in terms of health, odor/irritant comfort and productivity, while decreasing ventilation decreases beneficial outcomes. However, since Standard 62.1 prescribes minimum—not "best-

Category	R_p	Discussion
Occupant Component		
0	0 cfm/person	Applies to spaces with ventilation requirements dominated by building related sources, typically due to very low and transient occupancy, such that the occupant component may be ignored. Examples include storage rooms and warehouses.
1	5 cfm/person	Applies to spaces with adults (primarily) involved in low levels of activity, similar to sedentary office work.
2	7.5 cfm/person	Applies to spaces with occupants involved in higher levels of activity (though not strenuous) and producing higher levels of bioeffluents, or involved in activities associated with increased contaminant generation. Examples include lobbies and retail stores.
3	10 cfm/person	Applies to spaces with occupants involved in more strenuous levels of activity (though not at exercise-like levels), or involved in activities associated with even higher contaminant generation. Examples include most classrooms and other school occupancies.
4	20 cfm/person	Applies to spaces with occupants involved in very high levels of activity, or involved in activities associated with very high contaminant generation. Examples include beauty salons, dance floors, and exercise rooms. (Hair sprays, shampoos, etc., are considered occupant-related rather than building-related.)
Building Component		
Category	**R_a**	**Discussion**
1	0.06 cfm/ft^2	Applies to spaces where building-related contaminant-generation rates are expected to be similar to those in office spaces. Examples include conference rooms and lobbies.
2	0.12 cfm/ft^2	Applies to spaces where building-related contaminant-generation rates are expected to be significantly higher than those in offices. Examples include typical classrooms and museums.
3	0.18 cfm/ft^2	Applies to spaces where building-related contaminant-generation rates are assumed to be even higher than the previous category. Examples include laboratories and art classrooms.
4	0.30 cfm/ft^2	Applies to unusual spaces in the sports and entertainment category where occupancy is highly variable and, therefore, a people-based ventilation requirement is not used. Accordingly, the building ventilation requirement is elevated.
5	0.48 cfm/ft^2	Applies to indoor swimming areas, where chemical sources dominate all other contaminant sources.

Table 1: R_a *and* R_p *values.*

practice" rates—reducing ventilation for some previously "overventilated" occupancy categories was deemed appropriate. And remember, designers can always provide ventilation in excess of the minimum rates prescribed. In fact, since Standard 62.1-2004 now includes only minimum rates, LEED® v2.2 offers a credit for designs that exceed these minimums by 30%.

Comment: "Table 6 -1 prescribes values for People Outdoor Rate (R_p) and Area Outdoor Rate (R_a) for various occupant categories. An explanation should be provided as to how these factors were developed and what research they are based upon."

Response: The reasoning used to establish the prescribed People Outdoor Rate (R_p) and Area Outdoor Rate (R_a) is detailed in the *Standard 62.1-2004 User's Manual*. In a nutshell, laboratory and field studies[7–13] have consistently shown that for bioeffluents, 15 cfm/person satisfies 80% of unadapted visitors and 5 cfm/person satisfies 80% of adapted occupants. Other studies[14–18] have shown that for building sources, ventilation ranging from a low of 0.03 cfm/ft^2 to a mean of 0.40 cfm/ft^2 satisfies 80% of adapted occupants. Based on these studies, as well as the experience and judgment of the committee (and public review participants), and with the goal of satisfying occupants rather than visitors, minimum values of 5 cfm/person and 0.06 cfm/ft^2 were selected for offices. Minimum rates for other occupancy categories were assigned using the logic summarized in *Table 1* and presented in more detail in Table 6-A of the *User's Manual*.

The committee was directed by ASHRAE governing bodies to write the standard in mandatory language. To a large extent, this direction precludes explanations and rationales within the standard. That's one of the reasons why the *User's Manual* was created.

Comment: "Historically, the minimum ventilation rates prescribed by ASHRAE [for offices] … have changed substantially over time. …An explanation of the science behind this shift should be provided, so that users can have more confidence in the validity of the latest recommendations."

Response: Although, as you observe, the minimum ventilation rate prescribed for offices has changed over time, it has been consistently based on studies that established the outdoor airflow rate necessary to dilute people-related odors to reasonably acceptable levels. The rate in 1973, 15 cfm/person, was deemed sufficient to satisfy 80% of unadapted visitors to a zone. The rate in 1981, 5 cfm/person, was deemed sufficient to satisfy 80% of adapted zone occupants, using the same research data as the 1973 version. Ventilating to satisfy adapted occupants rather than unadapted visitors helped to save operating energy—an ASHRAE response to the energy crisis of 1973.

But the lower ventilation rate, along with tighter building envelopes and increased use of building materials with high chemical emissions, led to an increase in IAQ complaints. As a result, the rate for offices was increased in 1989 to once again satisfy visitors (15 cfm/person) with respect to people-related odors, and increased even more (by an additional 5 cfm/person) to dilute contaminants from non-people-related sources.

The 1989 rates, used for more than 14 years and adopted by many code jurisdictions, seemed to result in reasonably acceptable indoor air quality, but penalized zones with a high proportion of occupant-related contaminants (high occupant-density zones, like conference rooms and theaters). Also, contaminant emissions from building and cleaning materials decreased steadily and considerably in this timeframe, largely due to the extensive emissions testing and product certification programs that have emerged in response to increased demand for lower emitting building and cleaning materials under the larger umbrella of building sustainability.

New rates were introduced in 2004 since the previous rates were artificially high for some occupancy categories, and since building-related source levels were dropping. These minimum rates dilute bioeffluents to satisfy adapted occupants (5 cfm/person) while separately accounting for the dilution of contaminants from non-people-related sources (0.06 cfm/ft^2). The committee made a conscious effort to keep the effective office rate near 20 cfm/person, since many studies and much field experience in offices[19] indicate that approximately 20 cfm/person is an effective minimum rate.

Whether this logic results in the "correct" minimum rates can be debated, but nevertheless, it shows that the committee used a mixture of scientific evidence and practical experience to establish the rates. And these rates were subjected to, and improved as a result of, significant public review and comment during the development of the standard.

I hope that these responses help to clear up some of the "science" behind the new (2004) rates. The ASHRAE continuous maintenance process allows anyone to question the standard and/or suggest improvements at any time, through interpretation requests and specific change proposals. I urge concerned and conscientious individuals to help SSPC 62.1 keep Standard 62.1 current and useful by participating in the process.

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Standard 62.1-2004 Addenda Status

ANSI/ASHRAE Standard 62.1 is on continuous maintenance. This list recaps the status of addenda in process.

62*g*—Creates requirements for classification, signage and separation of areas where smoking is permitted. After five public reviews, Board of Directors (BOD) publication approval, and two ASHRAE appeals, this addendum was published in the Standard 62.1-2004, 2006 Supplement.

62*ag*—Expected to address scope issues related to a BOD directive that Standard 62 apply only to no-smoking spaces, this addendum was combined with Draft Addendum 62.1 DA-8 (formerly 62*ak*), which includes other scope changes.

62.1*a*—Clarifies several issues from Addendum 62*x* including exceptions to 65% RH requirement and other exceptions in labs and industrial spaces. This was published in the Standard 62.1-2004, 2006 Supplement.

62.1*b*—(Formerly DA-3) Deals with inconsistencies and missing information in Tables 5-2, 6-1 and 6-4, which developed due to phased drafting and approval of Addenda 62*y* and 62*n*. This addendum was published in the Standard 62.1-2004, 2006 Supplement.

62.1*c*—(Formerly DA-6) Updates information in tables in Appendix B. This addendum was published in the Standard 62.1-2004, 2006 Supplement.

62.1*d*—(Formerly DA-7) Updates Table 4-1 to be more consistent with current U.S. Environmental Protection Agency National Ambient Air Quality Standards listings. This addendum was published in the Standard 62.1-2004, 2006 Supplement.

DA-1—Expected to consolidate interpretations of Standard 62 related to demand control ventilation (DCV), and provisions of Standard 62.1-2004. Expected to provide language that clarifies DCV is an acceptable method to comply with ventilation requirements. Moved to DA-4, then to DA-11.

DA-2—Expected to add documentation requirements, incorporating existing requirements with new requirements to provide single point reference for users. Public review closed in May 2006 with no comments. Final publication approval expected in July 2006.

DA-4—General cleanup of Standard 62.1-2004, adding clarity and removing errors and inconsistencies, with no significant new requirements. Subsequently altered to cover only Section 5 changes. Expected to be approved for Publication Public Review in January 2007.

DA-5—Reconciles differences in ventilation for residential occupancies between Table E-2 and Standard 62.2. Expected to add some high-rise residential ventilation requirements to Table 6-1, while eliminating Table E-2. Cancelled and combined with DA-9.

DA-8—(Formerly 62*ag* and 62*ak*) Expected to remove information from the title, purpose and scope that is covered by Standard 62.2, which was approved by the BOD in July 2003. Changes made in response to April 2004 public review comments. Subsequent public review closed May 2005 without substantive comment. Final publication approval expected in July 2006.

DA-9—Reconciles differences in ventilation for residential occupancies between Table E-2 and Standard 62.2. Public review closed May 2006, and the committee approved responses to public review comments in June.

DA-10—Minor changes to correct errors in Appendix C, D and F. Expected to be approved for Publication Public Review in January 2007.

DA-11—Expected to "clean up" Section 6 with minor changes to correct errors and improve clarity and consistency. Expected to be approved for Publication Public Review in January 2007.

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