Understanding CO_2 And Standard 62

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IAQ assessment reports for buildings often include a statement like, "CO_2 measurements found in this building are in excess of the maximum concentration of 1,000 ppm recommended in ASHRAE Standard 62." This is an example of one of the most misunderstood and misused statements found in such reports.

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Then something happened. I read the standard. Not just skimming through it or reading so I could say I had "read the standard." I mean reading it to understand its intent. During this process, I realized that almost everyone, myself included, were citing the CO_2 portion of the standard incorrectly.

Although ANSI/ASHRAE Standard 62-1999 is available, ANSI/ASHRAE Standard 62-1989, *Ventilation for Acceptable Indoor Air Quality* is the most referenced source.

CO_2 and Standard 62

1. The American National Standards Institute (ANSI) approved Standard 62 on May 16, 1991. Addendum 62a-1990 was approved on May 17, 1990. By developing into an ANSI standard, Standard 62 has become a recognized standard of care.

2. Table 3, "Guidelines for Selected Air Contaminants of Indoor Origin" lists the concentration of CO_2 at 1.8 g/cm³ (1,000 ppm) and notes *"This level is not considered a health risk but is a surrogate for human comfort (odor). See Section 6.1.3 and Appendix D."*

3. Table C-1, "Standards Applicable in the United States for Common Indoor Air Pollutants," Table C-2, "Guidelines Used in the United States for Common Indoor Air Pollutants," and Table 1, "National Primary Ambient-Air Quality Standards for Outdoor Air," as set by the U.S. Environmental Protection Agency (EPA), do not list CO_2 as a pollutant.

4. Table C-3, "Summary of Canadian Guidelines for Residential Indoor Air Quality" does not list a short-term exposure range for CO_2. The long-term "acceptable" exposure range for CO_2 is <3,500 ppm.

5. Table C-4, "WHO (World Health Organization) Working Group Consensus of Concern About Indoor Air Pollutants at 1984 Levels of Knowledge" lists CO_2 concentrations of limited or no concern at <1,800 mg/m³ (approximately 1,000 ppm) and concentrations of concern at >12,000 mg/m³ (approximately 6,667 ppm).

How to Figure CO_2 Rate

So, what's the problem? The standard uses a maximum of 1,000 ppm CO_2 in Table 3, Section 6.1.3 and Appendix D, right? The answer is "sort of." The footnote in Table 3 says the 1,000 ppm level is not considered a health risk but a comfort concern (odor). Section 6.1.3 states: "(Appendix D shows the outdoor air needed to control occupant-generated CO_2 under various conditions.)" It later says, "Comfort (odor) criteria are likely to be satisfied if the ventilation rate is set so that 1,000 ppm CO_2 is not exceeded."

The real explanation of CO_2 and its relationship to the ventilation requirements of the standard is found in Appendix D. It is appropriately titled, "Rationale for Minimum Physiological Requirements for Respiration Air Based on CO_2 Concentration." Understanding this appendix will help to comprehend the rationale used to determine the ventilation rates in Table 2.

The example uses a CO_2 generation rate of 0.30 L/min. for a person with an activity level of 1.2-met units. (Note: This activity level would be characteristic of an office, lab, school or residential environment.)

To find the outdoor flow rate per person, we need to divide the CO_2 generation rate per person, at the appropriate activity level, by the *difference* between the steady-state CO_2 concentration in the space and the CO_2 concentration in the outdoor air. Continuing with their example, using the generation rate of 0.30 L/min., an indoor concentration of 1,000 ppm (0.001) and an outdoor concentration of 300 ppm (0.0003), we conclude the following: 0.30 / [0.0007 x 60] = 7.143 L/s. To convert L/s to cfm, we divide 7.143 L/s by 0.472 for 15.134 cfm per person. From this, we can see that a

differential of 700 ppm between the steady-state indoor and outdoor concentration of CO_2 is equal to an outdoor ventilation rate of approximately 15 cfm per person.

Now that we understand the method, we can see 1,000 ppm has no real bearing on the ventilation rate; it was just used in the example. We also know the differential between the steady-state indoor and outdoor concentrations can be related to the per person outdoor ventilation rate. The following chart summarizes the outcome:

Approximate cfm/person	Steady State CO_2 Differential
15	707
20	530
25	424
30	353

If you used or are using the 1,000-ppm as the limit to establish ventilation rates, you are not complying with the standard. In fact, you may be under- or over-ventilating the building. The range of outdoor CO_2 concentration levels typically experienced in South Florida is between 350 and 450 ppm. Using an average of 400 ppm, occupied spaces with a 15-cfm/person requirement may be over-ventilated by approximately 17%, while those with a 20 cfm/person requirement may be under-ventilated by approximately 12%, when compared to a 1,000 ppm level.

ASHRAE Responds

Realizing the lack of clarity and misunderstanding regarding CO_2 levels in Standard 62-1989, Addendum 62f was drafted, approved and incorporated in Standard 62-1999. As a result, CO_2 has been removed from Table 3; Section 6.1.3 has been changed to "Comfort (odor) criteria with respect to human bioeffluents are likely to be satisfied if the ventilation results in indoor CO_2 less than 700 ppm above the outdoor concentration;" and Appendix D has been revised to show 15 cfm per person resulting in a steady-state CO_2 concentration relative to the outdoor air of approximately 700 ppm.

Continuous Maintenance

Standard 62 is one of six ASHRAE standards under continuous maintenance. Continuous maintenance procedures allow anyone, including project committee members, to propose changes at any time. Each change will be considered by the project committee, according to a definite schedule (deadline is February 20) to be considered at the Annual meeting.

It is imperative to stay current about standards activity and be ready to adapt to change.

For additional information, please see ASTM Standard D6245, Addendum 62f, Interpretations IC 62-1989-27, IC 62-1989-29, and Standard 62-1999.

Conclusion

Occupied spaces with concentrations >1,000 ppm are not necessarily bad. Conversely, occupied spaces with concentrations <1,000 ppm are not automatically good.

When using CO_2 to determine the ventilation rate, use the differential between indoor and outdoor concentrations. In addition, the inside concentration level used in the differential calculation should be taken at equilibrium.

Bibliography

ANSI/ASHRAE 62-1989, *Ventilation for Acceptable Indoor Air Quality* including ANSI/ASHRAE Addendum 62a-1990.

Interpretations for ANSI/ASHRAE Standard 62-1999, *Ventilation for Acceptable Indoor Air Quality*.

ASTM Standard D6245.

ANSI/ASHRAE 62-1999, *Ventilation for Acceptable Indoor Air Quality* including ASHRAE addenda listed in Appendix I.

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Book Describes IAQ Standards Of Performance

ATLANTA—A new publication from ASHRAE places the control of indoor air quality into the hands of building operators.

Poor operations and maintenance procedures often lead to indoor air quality problems, according to Chad Dorgan, co-author of *Application Guide: Indoor Air Quality Standards of Performance.*

Outlined in the book are methods to ensure that HVAC&R equipment, plumbing systems and building envelope systems are working properly to obtain good IAQ.

The book helps operators evaluate their system's operation and building IAQ levels. Through the evaluation outlined in the guide, operators can identify problem areas and find solutions, he said.

Also included are examples of several performance standards for various equipment, such as a central air handling unit. The book suggests measuring the supply air temperature, visually inspecting the filtration system to make sure it is working properly, inspecting for mold and measuring system supply static pressure and outside airflow. Each of these tests should be performed regularly, and the results compared to the design values.

The publication is designed to help engineers, owners and operators and maintenance personnel understand how operation and maintenance procedures affect IAQ, evaluate systems in a specific building and apply operation and maintenance procedures to maintain acceptable IAQ.

The price of *Application Guide: Indoor Air Quality Standards of Performance* is $43/$34 member. To order, contact ASHRAE Customer Service at 1-800-5-ASHRAE (U.S. and Canada) or 404-636-8400 (worldwide), fax: 404-321-5478; e-mail: orders@ashrae.org; ASHRAE Online: www.ashrae.org; or by mail: 1791 Tullie Circle, N.E., Atlanta, GA 30329.