ADDENDA

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

Ventilation for Acceptable Indoor Air Quality

Approved by the ASHRAE Standards Committee on January 20, 2018; by the ASHRAE Board of Directors on January 24, 2018; and by the American National Standards Institute on February 21, 2018.

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. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE website (www.ashrae.org) or in paper form from the Senior Manager of Standards.

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FOREWORD

This addendum deletes Informative Appendix D, "Rationale for Minimum Physiological Requirements for Respiration Air Based on CO_2 Concentration." Appendix D first appeared in ASHRAE Standard 62-1989. Since that time there have been additions and modifications. Its purpose was to explain the relationship between oxygen and carbon dioxide in spaces. It is based on data from the 1950s. Newer information is available. The committee is aware of misuse and confusion caused by the information in its present form and prefers to delete this misused appendix now. The committee may readd relevant informative guidance that assists with implementation of the standard in the next edition.

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 d to Standard 62.1-2016

Delete Informative Appendix D. For legibility, the text is not shown in strikethrough. All text and tables below will be deleted by this addendum.

(This appendix 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.)

INFORMATIVE APPENDIX D RATIONALE FOR MINIMUM PHYSIOLOGICAL REQUIREMENTS FOR RESPIRATION AIR BASED ON CO_2 CONCENTRATION

Oxygen is necessary for metabolism of food to sustain life. Carbon and hydrogen in foods are oxidized to carbon dioxide (CO_2) and water (H_2O), which are eliminated by the body as waste products. Foods can be classified as carbohydrates, fats, and proteins, and the ratio of carbon to hydrogen in each is somewhat different. The respiratory quotient (RQ) is the volumetric ratio of CO_2 produced to oxygen consumed. It varies from 0.71 for a diet of 100% fat to 0.8 for a diet of 100% protein and 1.00 for a diet of 100% carbohydrates [D-1]. A value of RQ = 0.83 applies to a normal diet mix of fat, carbohydrate, and protein.

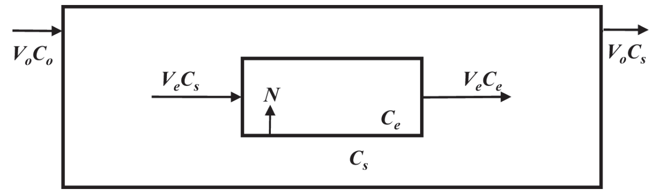

FIGURE D-1 Two-chamber model.

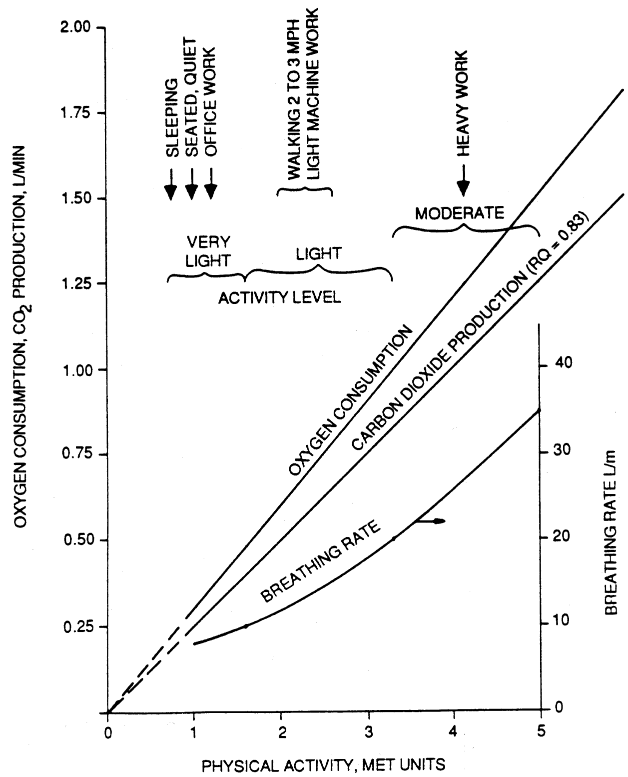

FIGURE D-2 Metabolic data.

The rate at which oxygen is consumed and CO_2 is generated depends on physical activity. These relationships are shown in Figure D-2 (see Reference D-2). The breathing rate is shown also. A simple mass balance equation gives the outdoor airflow rate needed to maintain the steady-state CO_2 concentration below a given limit.

$$V_o = N/(C_s - C_o) \qquad \text{(D-1)}$$

where

V_o = outdoor airflow rate per person

V_e = breathing rate

N = CO_2 generation rate per person

C_e = CO_2 concentration in exhaled breath

C_s = CO_2 concentration in the space

C_o = CO_2 concentration in outdoor air

For example, at an activity level of 1.2 met units (1.0 met = 18.4 Btu/h· ft^2), corresponding to sedentary persons, the CO_2 generation rate is 0.31 L/min. Laboratory and field stud-

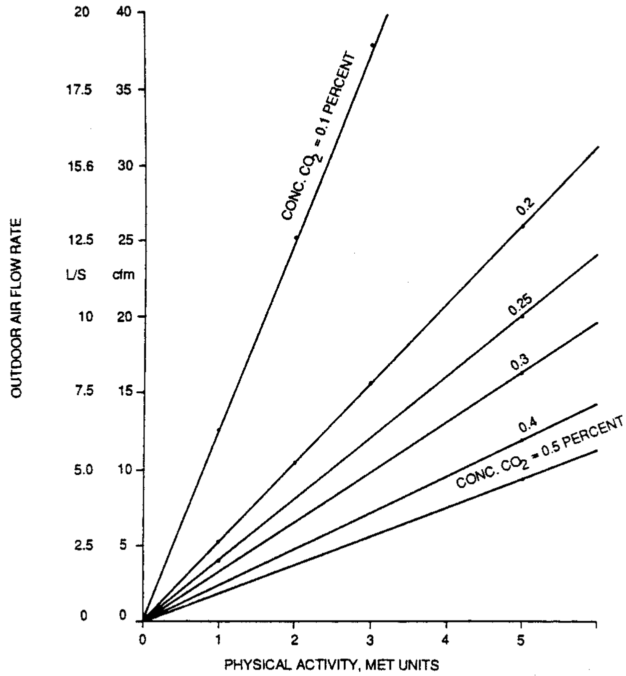

FIGURE D-3 Ventilation requirements.

ies have shown that with sedentary persons about15 cfm (7.5 L/s) per person of outdoor air will dilute odors from human bioeffluents to levels that will satisfy a substantial majority (about 80%) of unadapted persons (visitors) to a space [D-3,D-4,D-5,D-6,D-7]. If the ventilation rate is to be held to 15 cfm (7.5 L/s) per person, the resulting steady-state CO_2 concentration relative to that in the outdoor air is

$$C_s - C_o = N/V_o$$
$$= 0.31/(7.5 \times 60 \text{ s/min})$$
$$= 0.000689 \text{ L of } CO_2 \text{ per L of air}$$
$$\approx 700 \text{ ppm}$$

Thus, maintaining a steady-state CO_2 concentration in a space no greater than about 700 ppm above outdoor air levels will indicate that a substantial majority of visitors entering a space will be satisfied with respect to human bioeffluents (body odor). A more detailed discussion of this relationship between CO_2 concentrations and the perception of bioeffluents, as well as the use of indoor CO_2 to estimate building ventilation rates, is contained in ASTM Standard D6245 [D-8].

CO_2 concentrations in acceptable outdoor air typically range from 300 to 500 ppm. High CO_2 concentrations in the outdoor air can be an indicator of combustion and/or other contaminant sources.

Figure D-3 shows the outdoor airflow rate required as a function of physical activity and steady-state room concentration. If the activity level is greater than 1.2 met, the required ventilation must be increased to maintain the same CO_2 level.

Also the decrease in oxygen content of the room air can be found from Equation D-l when oxygen concentration is substituted for carbon dioxide concentration.

$$C_o - C_s = N/V_o \tag{D-2}$$

The term N now has a negative value with respect to its use in Equation D-1 because oxygen is consumed rather than generated.

$$C_s = C_o - N/V_o \tag{D-3}$$

The oxygen consumption rate is 0.0127 cfm (0.36 L/min) when the activity level is 1.2 met. For ventilation at a rate of 15 cfm (429 L/m) and an activity level of 1.2 met units, the room oxygen level will be reduced from an outdoor concentration of 20.95% to 20.85%, a percent change of 0.48% ([20.95 – 20.85]/20.95). Unlike oxygen, CO_2 is generated as a result of activity. At 1.2 met, the CO_2 indoors is raised from the outdoor background of 0.03% to 0.1%, a percent change of 230%. Thus, measuring the increase of CO_2 is clearly more significant than measuring the decrease of oxygen.

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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.

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.

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