ASHRAE 62-1999
(supersedes ANSI/ASHRAE 62-1989)
Includes ASHRAE Addenda Listed in Appendix I

ASHRAE® STANDARD

See Appendix I for approval dates by the ASHRAE Standards Committee and ASHRAE Board of Directors.

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Ventilation for Acceptable Indoor Air Quality

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CONTENTS

ASHRAE Standard 62-1999,
Ventilation for Acceptable Indoor Air Quality

(This foreword is not part of this standard but is included for information purposes only.)

FOREWORD

This release of ASHRAE Standard 62 incorporates the four addenda approved since the standard was converted to continuous maintenance in 1997. More specific information on the content of each addendum is included in an informative appendix at the end of this standard. Future addenda will be added to the standard as they are approved, in accordance with ASHRAE procedures for standards operating under continuous maintenance.

ASHRAE's first ventilation standard was ASHRAE Standard 62-73, Standards for Natural and Mechanical Ventilation *(see Reference i), which defined "…ventilation requirements for spaces intended for human occupancy and specifies minimum and recommended ventilation air quantities for the preservation of the occupant's health, safety, and well-being." The standard provided a prescriptive approach to ventilation by specifying both minimum and recommended outdoor airflow rates to obtain acceptable indoor air quality for a variety of indoor spaces. Under the normal review cycle, ASHRAE published the revised Standard 62-1981,* Ventilation for Acceptable Indoor Air Quality *(see Reference ii). The 1981 standard introduced the alternative air quality procedure to permit innovative, energy-conserving ventilation practices. This alternative procedure allowed the engineer to use whatever amount of outdoor air deemed necessary if he or she could show that the levels of indoor air contaminants were held below recommended limits.*

ANSI/ASHRAE Standard 62-1989 retained the two procedures for ventilation design, the Ventilation Rate Procedure and the Indoor Air Quality Procedure (see reference iii). The purpose of the standard was again to specify minimum ventilation rates and indoor air quality that will be acceptable to human occupants and are intended to minimize the potential for adverse health effects.

The four new addenda, while brief, nevertheless involve important changes to the standard that are consistent with the previous versions of ASHRAE Standard 62 in scope and philosophy. However, these four addenda do not impact the design procedures contained in the standard.

*Addendum 62*c *removes consideration of thermal comfort from the standard, since ASHRAE Standard 55 already covers this subject. The material deleted by this addendum required that the temperature and humidity conditions specified in Standard 55 be maintained when the ventilation system operates. This requirement implied that heating, cooling, humidifying, and dehumidifying systems may have to be installed in all ventilated spaces, even naturally ventilated spaces and unconditioned spaces (e.g., garages). While maintaining comfortable thermal and moisture conditions generally improves occupant perception of air quality, it is not always practical to do so and should not be required.*

*Addendum 62*d *adds caveats to the scope stating that compliance with the standard will not necessarily result in acceptable indoor air quality for a variety of reasons. The comfort and health effects of indoor environments are very complex and not fully understood. It is not possible at this time to create a standard that will provide acceptable indoor air for all occupants under all circumstances.*

*Addendum 62*e *removes the statement that the ventilation rates in Table 2 accommodate a moderate amount of smoking. The stated purpose of ASHRAE Standard 62-1999 is to "…specify minimum ventilation rates and indoor air quality that will be acceptable to human occupants…." The standard further defines acceptable indoor air quality as "air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities…." Since the last publication of this standard in 1989, numerous cognizant authorities have determined that environmental tobacco smoke is harmful to human health. These authorities include, among others, the United States Environmental Protection Agency, World Health Organization, American Medical Association, American Lung Association, National Institute of Occupational Safety and Health, National Academy of Sciences, Occupational Safety and Health Administration, and the Office of the U.S. Surgeon General. This addendum does not prohibit smoking or any other activity in buildings, but rather removes the statement that the recommended ventilation rates are intended to accommodate a moderate amount of smoking.*

*Addendum 62*f *addresses a lack of clarity in ANSI/ASHRAE Standard 62-1989 that has contributed to several misunderstandings regarding the significance of indoor carbon dioxide (CO_2) levels. The standard previously led many users to conclude that CO_2 was itself a comprehensive indicator of indoor air quality and a contaminant with its own health impacts, rather than simply a useful indicator of the concentration of human bioeffluents.*

The appendices (unless designated as normative) are not part of this standard but are included for information purposes only.

REFERENCES

i. *ASHRAE Standard 62-73 (ANSI B 194.1-1977), Standards for Natural and Mechanical Ventilation*. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta, GA. 1977.

ii. *ASHRAE Standard 62-1981, Ventilation for Acceptable Indoor Air Quality.* American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta, GA. 1981.

iii. *ANSI/ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality.* American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta, GA. 1989.

1. PURPOSE

The purpose of this standard is to specify minimum ventilation rates and indoor air quality that will be acceptable to human occupants and are intended to minimize the potential for adverse health effects.

2. SCOPE

2.1 This standard applies to all indoor or enclosed spaces that people may occupy, except where other applicable standards and requirements dictate larger amounts of ventilation than this standard. Release of moisture in residential kitchens and bathrooms, locker rooms, and swimming pools is included in the scope of this standard.

2.2 This standard considers chemical, physical, and biological contaminants that can affect air quality. Thermal comfort requirements are not included in this standard.

2.3 Acceptable indoor air quality may not be achieved in all buildings meeting the requirements of this standard for one or more of the following reasons:

(a) because of the diversity of sources and contaminants in indoor air;

(b) because of the many other factors that may affect occupant perception and acceptance of indoor air quality, such as air temperature, humidity, noise, lighting, and psychological stress; and

(c) because of the range of susceptibility in the population.

3. DEFINITIONS (see Figure 1)

absorption: the process of one substance entering into the inner structure of another.

acceptable indoor air quality: air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction.

adsorption: the adhesion of a thin film of liquid or gases to the surface of a solid substance.

air-cleaning system: a device or combination of devices applied to reduce the concentration of airborne contaminants, such as microorganisms, dusts, fumes, respirable particles, other particulate matter, gases, and/or vapors in air.

air conditioning: the process of treating air to meet the requirements of a conditioned space by controlling its temperature, humidity, cleanliness, and distribution.

air, ambient: the air surrounding an object.

air, exhaust: air removed from a space and not reused therein.

air, makeup: outdoor air supplied to replace exhaust air and exfiltration.

air, outdoor: air taken from the external atmosphere and, therefore, not previously circulated through the system.

air, recirculated: air removed from the conditioned space and intended for reuse as supply air.

air, return: air removed from a space to be then recirculated or exhausted.

air, supply: that air delivered to the conditioned space and used for ventilation, heating, cooling, humidification, or dehumidification.

air, transfer: the movement of indoor air from one space to another.

air, ventilation: that portion of supply air that is outdoor air plus any recirculated air that has been treated for the purpose of maintaining acceptable indoor air quality.

chemisorb: to take up and hold, usually irreversibly, by chemical forces.

concentration: the quantity of one constituent dispersed in a defined amount of another (see Appendix A).

conditioned space: that part of a building that is heated or cooled, or both, for the comfort of occupants.

contaminant: an unwanted airborne constituent that may reduce acceptability of the air.

dust: an air suspension of particles (aerosol) of any solid material, usually with particle size less than 100 micrometers (μm).

energy recovery ventilation system: a device or combination of devices applied to provide the outdoor air for ventilation in which energy is transferred between the intake and exhaust airstreams.

exfiltration: air leakage outward through cracks and interstices and through ceilings, floors, and walls of a space or building.

fumes: airborne particles, usually less than 1 micrometer in size, formed by condensation of vapors, sublimation, distillation, calcination, or chemical reaction.

gas: a state of matter in which substances exist in the form of nonaggregated molecules, and which, within acceptable limits of accuracy, satisfies the ideal gas laws; usually a highly superheated vapor.

infiltration: air leakage inward through cracks and interstices and through ceilings, floors, and walls of a space or building.

microorganism: a microscopic organism, especially a bacterium, fungus, or a protozoan.

natural ventilation: the movement of outdoor air into a space through intentionally provided openings, such as windows and doors, or through nonpowered ventilators or by infiltration.

occupied zone: the region within an occupied space between planes 3 and 72 in. (75 and 1800 mm) above the floor and more than 2 ft (600 mm) from the walls or fixed air-conditioning equipment (see ASHRAE Standard 55-1981, Reference 1).

odor: a quality of gases, liquids, or particles that stimulates the olfactory organ.

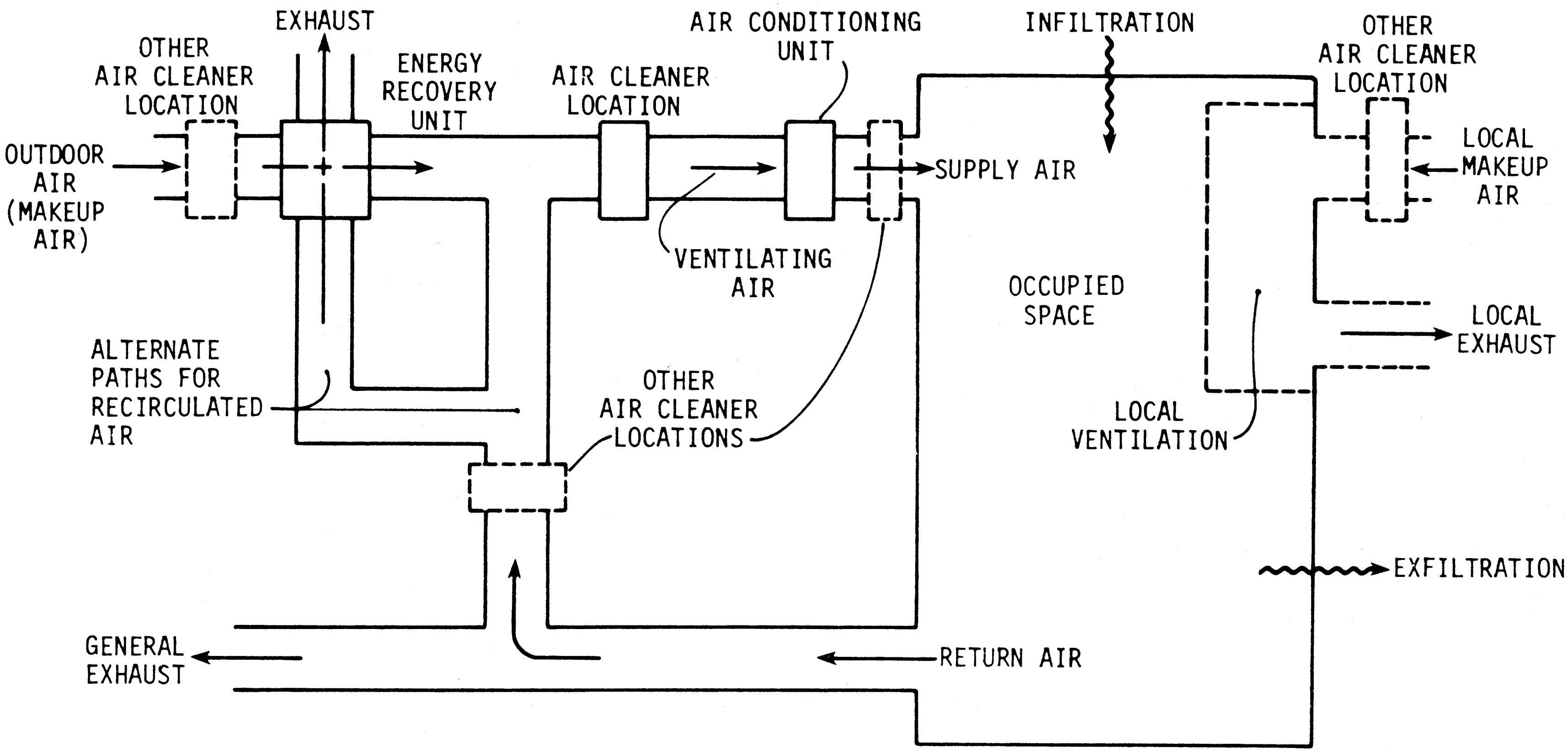

Figure 1 Ventilation system.

oxidation: a reaction in which oxygen combines with another substance.

particulate matter:a state of matter in which solid or liquid substances exist in the form of aggregated molecules or particles. Airborne particulate matter is typically in the size range of 0.01 to 100 micrometers.

plug flow: a flow regime where the flow is predominately in one direction and contaminants are swept along with the flow.

smoke: the airborne solid and liquid particles and gases that evolve when a material undergoes pyrolysis or combustion. Note: chemical smoke is excluded from this definition.

total suspended particulate matter: the mass of particles suspended in a unit of volume of air when collected by a high-volume air sampler.

respirable particles: respirable particles are those that penetrate into and are deposited in the nonciliated portion of the lung. Particles greater than 10 micrometers aerodynamic diameter are not respirable.

vapor: a substance in gas form, particularly one near equilibrium with its condensed phase, which does not obey the ideal gas laws; in general, any gas below its critical temperature.

ventilation: the process of supplying and removing air by natural or mechanical means to and from any space. Such air may or may not be conditioned.

4. CLASSIFICATION

This standard specifies alternative procedures to obtain acceptable air quality indoors:

4.1 Ventilation Rate Procedure: Acceptable air quality is achieved by providing ventilation air of the specified quality and quantity to the space (see 6.1). or

4.2 Indoor Air Quality Procedure: Acceptable air quality is achieved within the space by controlling known and specifiable contaminants (see 6.2).

Whenever the Ventilation Rate Procedure is used, the design documentation should clearly state that this method was used and that the design will need to be re-evaluated if, at a later time, space use changes occur or if unusual contaminants or unusually strong sources of specific contaminants are to be introduced into the space. If such conditions are known at the time of the original design, the use of the Indoor Air Quality Procedure may be indicated.

The Indoor Air Quality Procedure could result in a ventilation rate lower than would result from the first procedure, but the presence of a particular source of contamination in the space may result in increased ventilation requirements. Change in space use, contaminants, or operation may require a re-evaluation of the design and implementation of needed changes.

5. SYSTEMS AND EQUIPMENT

5.1 Ventilating systems may be mechanical or natural. When mechanical ventilation is used, provision for air flow measurement should be included. When natural ventilation and infiltration are relied upon, sufficient ventilation shall be demonstrable. When infiltration and natural ventilation are insufficient to meet ventilation air requirements, mechanical ventilation shall be provided. The use of energy recovery ventilation systems should be considered for energy conservation purposes in meeting ventilation requirements.

5.2 Ventilating systems shall be designed and installed so that the ventilation air is supplied throughout the occupied zone. The design documentation shall state assumptions that were made in the design with respect to ventilation rates and air distribution.

5.3 When the supply of air is reduced during times the space is occupied (e.g., in variable-air-volume systems), provision shall be made to maintain acceptable indoor air quality throughout the occupied zone.

5.4 Ventilating systems should be designed to prevent reentrainment of exhaust contaminants, condensation or freeze-ups (or both), and growth of microorganisms. Makeup air inlets and exhaust air outlets shall be located to avoid contamination of the makeup air. Contaminants from sources such as cooling towers, sanitary vents, vehicular exhaust from parking garages, loading docks, and street traffic should be avoided. This is a special problem in buildings where stack effect draws contaminants from these areas into the occupant space. Where soils contain high concentrations of radon, ventilation practices that place crawlspaces, basements, or underground ductwork below atmospheric pressure will tend to increase radon concentrations in buildings and should be avoided (see Appendix C).

5.5 Ventilating ducts and plenums shall be constructed and maintained to minimize the opportunity for growth and dissemination of microorganisms through the ventilation system. Construction also shall comply with applicable standards such as UL 181, NFPA 90A, NFPA 90B, and SMACNA (References 2-6).

5.6 Contaminants from stationary local sources within the space shall be controlled by collection and removal as close to the source as practicable. (See Reference 7, "Industrial Ventilation—Manual of Recommended Practice.")

5.7 Fuel-burning appliances, including fireplaces located indoors, shall be provided with sufficient air for combustion and adequate removal of combustion products. When infiltration supplies all or part of the combustion air, the supply rate of air shall be demonstrable (Appendix B shows one method of demonstrating adequate combustion air). The operation of clothes dryers and exhaust fans may require introduction of additional makeup air to avoid interference with fuel-burning appliances. Combustion system, kitchen, bathroom, and clothes dryer vents shall not be exhausted into attics, crawlspaces, or basements.

5.8 Airborne particulate contaminants vary in size, as shown in Figure 2. Microorganisms, dusts, fumes, smoke, and other particulate matter may be captured by air filters. Many bacteria (99% exceed 1 micrometer in size) are attached to larger particles such as human skin flakes. Viruses generally occur in clusters or in and on other particles. Lung-damaging particles that may be retained in the lungs are 0.2 to 5 micrometers in size (see Figure 2). When it is necessary to remove particulate contaminants, air filters or dust collectors should be used. Dust collectors, not air filters, should be used where the dust loading equals or exceeds 10 mg/m^3 (4 grains/ 1000 ft^3). Air filters and dust collectors shall be selected for the particle size and loading encountered. Filters shall be tested in accordance with ASHRAE Standard 52-76 (Reference 8) or MIL Std 282 (Reference 9). Dust collectors may be wet, dry, or electrostatic as required by particle size and loading (see Table 1, Chapter 11, *ASHRAE Handbook—1983 Equipment Volume* (Reference 10).

5.9 When compliance with this section does not provide adequate control of gaseous contaminants, methods based on sorption with or without oxidation or other scientifically proven technology shall be used. Such methods may be tailored to deal with a specific contaminant. A commonly used sorbent is activated carbon. The selection of gaseous contaminant control equipment for recirculation systems must consider the concentration, toxicity, annoyance, and odor properties of the contaminants present and the levels to which these must be reduced to be effective in maintaining air quality. The performance of gaseous contaminant removal devices often depends strongly on the physical and chemical properties of the individual contaminants present, on the temperature and humidity of the air, on the air velocity through the device, and its loading capacity.

5.10 High humidities can support the growth of pathogenic or allergenic organisms (see Reference 20). Examples include certain species of fungi, associated mycotoxins, and dust mites. This growth is enhanced by the presence of materials with high cellulose, even with low nitrogen content, such as fiberboard, dust, lint, skin particles, and dander. Areas of concern include bathrooms and bedrooms. Therefore, bathrooms shall conform to the ventilation rates in Table 2.3. Relative humidity in habitable spaces preferably should be maintained between 30% and 60% relative humidity (see Reference 11) to minimize growth of allergenic or pathogenic organisms.

5.11 Microbial contamination in buildings is often a function of moisture incursion from sources such as stagnant water in HVAC air distribution systems and cooling towers. Air-handling unit condensate pans shall be designed for self-drainage to preclude the buildup of microbial slime. Provision shall be made for periodic in-situ cleaning of cooling coils and condensate pans. Air-handling and fan coil units shall be easily accessible for inspection and preventive maintenance. Steam is preferred as a moisture source for humidifiers, but care should be exercised to avoid contamination from boiler water or steam supply additives. If cold water humidifiers are specified, the water shall originate from a potable source, and, if recirculated, the system will require frequent maintenance and blow-down. Care should be exercised to avoid particulate contamination due to evaporation of spray water. Standing water used in conjunction with water sprays in HVAC air distribution systems should be treated to avoid microbial buildup. If the relative humidity in occupied spaces and low velocity ducts and plenums exceeds 70%, fungal contamination (for example, mold, mildew, etc.) can occur. Special care

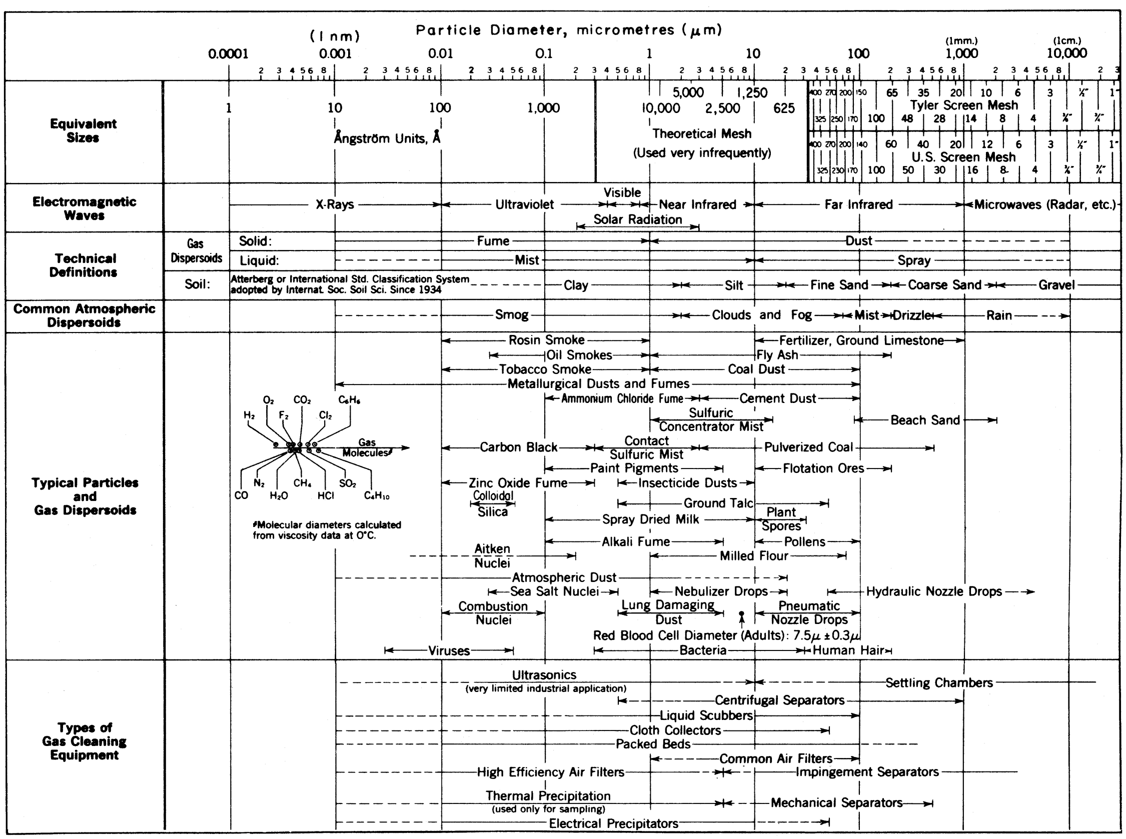

Figure 2 Characteristics of particles and particle dispersoids.

should be taken to avoid entrainment of moisture drift from cooling towers into the makeup air and building vents.

6. PROCEDURES

Indoor air quality is a function of many parameters including outdoor air quality, the design of enclosed spaces, the design of the ventilation system, the way this system is operated and maintained, and the presence of sources of contaminants and the strength of such sources. This Standard deals with the design of a ventilation system as it is affected by all these factors, so that an acceptable level of indoor air quality can be provided. Design documentation shall clearly state which assumptions were used in the design so that the limits of the system in removing contaminants can be evaluated by others before the system is operated in a different mode or before new sources are introduced into the space.

Indoor air should not contain contaminants that exceed concentrations known to impair health or cause discomfort to occupants. Such contaminants include various gases, vapors, microorganisms, smoke, and other particulate matter. These may be present in makeup air or be introduced from indoor activities, furnishings, building materials, surface coatings, and air-handling and air treatment components. Deleterious factors include toxicity, radioactivity, potential to induce infection or allergies, irritants, extreme thermal conditions, and objectionable odors.

The Ventilation Rate Procedure (6.1) provides one way to achieve acceptable air quality. This procedure prescribes the rate at which ventilation air must be delivered to a space and various means to condition that air. The ventilation rates in Table 2 are derived from physiological considerations, subjective evaluations, and professional judgments (see References 12-18).

The Indoor Air Quality Procedure (6.2) provides an alternative performance method for achieving acceptable air quality. This procedure uses one or more guidelines for the specification of acceptable concentrations of certain contaminants in indoor air but does not prescribe ventilation rates or air treatment methods.

TABLE 1
National Primary Ambient-Air Quality Standards for Outdoor Air as Set by the U.S. Environmental Protection Agency (Reference 19)

	Long Term			Short Term		
	Concentration		Averaging	Concentration		Averaging
Contaminant	μg/m³	ppm		μg/m³	ppm	
Sulfur dioxide	80	0.03	1 year	365[a]	0.14[a]	24 hours
Particles (PM 10)	50[b]	—	1 year	150[a]	—	24 hours
Carbon monoxide				40,000[a]	35[a]	1hour
Carbon monoxide				10,000[a]	9[a]	8 hours
Oxidants (ozone)				235[c]	0.12[c]	1 hour
Nitrogen dioxide	100	0.055	1 year			
Lead	1.5	—	3 months[d]			

[a] Not to be exceeded more than once per year.
[b] Arithmetic mean.
[c] Standard is attained when expected number of days per calendar year with maximal hourly average concentrations above 0.12 ppm (235 μg/m³) is equal to or less than 1, as determined by Appendix H to subchapter C, 40 CFR 50.
[d] Three-month period is a calendar quarter.

6.1 Ventilation Rate Procedure: This procedure prescribes:

- the outdoor air quality acceptable for ventilation
- outdoor air treatment when necessary
- ventilation rates for residential, commercial, institutional, vehicular, and industrial spaces
- criteria for reduction of outdoor air quantities when recirculated air is treated by contaminant-removal equipment
- criteria for variable ventilation when the air volume in the space can be used as a reservoir to dilute contaminants.

6.1.1 Acceptable Outdoor Air. This section describes a three-step procedure by which outdoor air shall be evaluated for acceptability:

Step 1: Contaminants in outdoor air do not exceed the concentrations listed in Table 1 as determined by one of the following conditions:

(d) Monitoring data of government pollution-control agencies, such as the U.S. Environmental Protection Agency (EPA) or equivalent state or local environmental protection authorities, show that the air quality of the area in which the ventilating system is located meets the requirements of Table 1. Conformity of local air to these standards may be determined by reference to the records of local authorities or of the National Aerometric Data Bank, Office of Air Quality Planning and Standards, EPA, Research Triangle Park, NC 27711, or

(e) The ventilating system is located in a community similar in population, geographic and meteorological settings, and industrial pattern to a community having acceptable air quality as determined by authorities having jurisdiction, or

(f) The ventilating system is located in a community with a population of less than 20,000 people, and the air is not influenced by one or more sources that cause substantial contamination, or

(g) Air monitoring for three consecutive months, as required for inclusion in the National Aerometric Data Bank, shows that the air quality meets or exceeds the requirements of Table 1 (as specified in Reference 19).

Step 2: If the outdoor air is thought to contain any contaminants not listed in Table 1, guidance on acceptable concentration levels may be obtained by reference to Appendix C.

Outdoor air requirements for ventilation of industrial building occupancies not listed in Table 2 may be determined by procedures presented in *1986 Industrial Ventilation—A Manual of Recommended Practice*, 1986 ed., published by the American Conference of Governmental Industrial Hygienists (ACGIH) (Reference 7).

Step 3: If after completing steps 1 and 2 there is still a reasonable expectation that the air is unacceptable, sampling shall be conducted in accordance with NIOSH procedures (see References 21 and 22). Local and national aerometric data banks may

TABLE 2
OUTDOOR AIR REQUIREMENTS FOR VENTILATION*
2.1 COMMERCIAL FACILITIES (offices, stores, shops, hotels, sports facilities)

Application	Estimated Maximum** Occupancy P/1000 ft^2 or 100 m^2	Outdoor Air Requirements cfm/person	L/s·person	cfm/ft^2	$L/s·m^2$	Comments
Dry Cleaners, Laundries						Dry-cleaning processes may require more air.
Commercial laundry	10	25	13			
Commercial dry cleaner	30	30	15			
Storage, pick up	30	35	18			
Coin-operated laundries	20	15	8			
Coin-operated dry cleaner	20	15	8			
Food and Beverage Service						
Dining rooms	70	20	10			
Cafeteria, fast food	100	20	10			
Bars, cocktail lounges	100	30	15			Supplementary smoke-removal equipment may be required.
Kitchens (cooking)	20	15	8			Makeup air for hood exhaust may require more ventilating air. The sum of the outdoor air and transfer air of acceptable quality from adjacent spaces shall be sufficient to provide an exhaust rate of not less than 1.5 cfm/ft^2 (7.5 $L/s·m^2$).
Garages, Repair, Service Stations						
Enclosed parking garage				1.50	7.5	Distribution among people must consider worker location and concentration of running engines; stands where engines are run must incorporate systems for positive engines exhaust withdrawal. Contaminant sensors may be used to control ventilation.
Auto repair rooms				1.50	7.5	
Hotels, Motels, Resorts, Dormitories				**cfm/room**	**L/s·room**	Independent of room size.
Bedrooms				30	15	
Living rooms				30	15	
Baths				35	18	Installed capacity for intermittent use.
Lobbies	30	15	8			
Conference rooms	50	20	10			
Assembly rooms	120	15	8			
Dormitory sleeping areas	20	15	8			See also food and beverage services, merchandising, barber and beauty shops, garages.
Gambling casinos	120	30	15			Supplementary smoke-removal equipment may be required.
Offices						
Office space	7	20	10			Some office equipment may require local exhaust.
Reception areas	60	15	8			
Telecommunication centers and data entry areas	60	20	10			
Conference rooms	50	20	10			
Public Spaces				**cfm/ft^2**	**$L/s·m^2$**	
Corridors and utilities				0.05	0.25	
Public restrooms, cfm/wc or cfm/urinal		50	25			Normally supplied by transfer air.
Locker and dressing rooms				0.5	2.5	Local mechanical exhaust with no recirculation recommended.
Smoking lounge	70	60	30			
Elevators				1.00	5.0	Normally supplied by transfer air.

* Table 2 prescribes supply rates of acceptable outdoor air required for acceptable indoor air quality. These values have been chosen to dilute human bioeffluents and other contaminants with an adequate margin of safety and to account for health variations among people and varied activity levels.

** Net occupiable space.

TABLE 2
OUTDOOR AIR REQUIREMENTS FOR VENTILATION* (*Continued*)
2.1 COMMERCIAL FACILITIES (offices, stores, shops, hotels, sports facilities)

Application	Estimated Maximum** Occupancy P/1000 ft^2 or 100 m^2	Outdoor Air Requirements				Comments
		cfm/ person	L/s· person	cfm/ft^2	L/s·m^2	
Retail Stores, Sales Floors, and Show Room Floors						
Basement and street	30			0.30	1.50	
Upper floors	20			0.20	1.00	
Storage rooms	15			0.15	0.75	
Dressing rooms				0.20	1.00	
Malls and arcades	20			0.20	1.00	
Shipping and receiving	10			0.15	0.75	
Warehouses	5			0.05	0.25	
Smoking lounge	70	60	30			Normally supplied by transfer air, local mechanical exhaust; exhaust with no recirculation recommended.
Specialty Shops						
Barber	25	15	8			
Beauty	25	25	13			
Reducing salons	20	15	8			
Florists	8	15	8			Ventilation to optimize plant growth may dictate requirements.
Clothiers, furniture				0.30	1.50	
Hardware, drugs, fabric	8	15	8			
Supermarkets	8	15	8			
Pet shops				1.00	5.00	
Sports and Amusement						
Spectator areas	150	15	8			When internal combustion engines are operated for maintenance of playing surfaces, increased ventilation rates may be required.
Game rooms	70	25	13			
Ice arenas (playing areas)				0.50	2.50	
Swimming pools (pool and deck area)				0.50	2.50	Higher values may be required for humidity control.
Playing floors (gymnasium)	30	20	10			
Ballrooms and discos	100	25	13			
Bowling alleys (seating areas)	70	25	13			
Theaters						Special ventilation will be needed to eliminate special stage effects (e.g., dry ice vapors, mists, etc.)
Ticket booths	60	20	10			
Lobbies	150	20	10			
Auditorium	150	15	8			
Stages, studios	70	15	8			
Transportation						Ventilation within vehicles may require special considerations.
Waiting rooms	100	15	8			
Platforms	100	15	8			
Vehicles	150	15	8			
Workrooms						
Meat processing	10	15	8			Spaces maintained at low temperatures (−10°F to + 50°F, or −23°C to + 10°C) are not covered by these requirements unless the occupancy is continuous. Ventilation from adjoining spaces is permissible. When the occupancy is intermittent, infiltration will normally exceed the ventilation requirement. (See Reference 18).

* Table 2 prescribes supply rates of acceptable outdoor air required for acceptable indoor air quality. These values have been chosen to dilute human bioeffluents and other contaminants with an adequate margin of safety and to account for health variations among people and varied activity levels.
** Net occupiable space.

TABLE 2
OUTDOOR AIR REQUIREMENTS FOR VENTILATION* (*Continued*)
2.1 COMMERCIAL FACILITIES (offices, stores, shops, hotels, sports facilities)

Application	Estimated Maximum** Occupancy P/1000 ft^2 or 100 m^2	Outdoor Air Requirements cfm/person	L/s·person	cfm/ft^2	L/s·m^2	Comments
Photo studios	10	15	8			
Darkrooms	10			0.50	2.50	
Pharmacy	20	15	8			
Bank vaults	5	15	8			
Duplicating, printing				0.50	2.50	Installed equipment must incorporate positive exhaust and control (as required) of undesirable contaminants (toxic or otherwise).
2.2 INSTITUTIONAL FACILITIES						
Education						
Classroom	50	15	8			
Laboratories	30	20	10			Special contaminant control systems may be required for processes or functions including laboratory animal occupancy.
Training shop	30	20	10			
Music rooms	50	15	8			
Libraries	20	15	8			
Locker rooms				0.50	2.50	
Corridors				0.10	0.50	
Auditoriums	150	15	8			
Smoking lounges	70	60	30			Normally supplied by transfer air. Local mechanical exhaust with no recirculation recommended.
Hospitals, Nursing and Convalescent Homes						
Patient rooms	10	25	13			Special requirements or codes and pressure relationships may determine minimum ventilation rates and filter efficiency. Procedures generating contaminants may require higher rates.
Medical procedure	20	15	8			
Operating rooms	20	30	15			
Recovery and ICU	20	15	8			
Autopsy rooms				0.50	2.50	Air shall not be recirculated into other spaces.
Physical therapy	20	15	8			
Correctional Facilities						
Cells	20	20	10			
Dining halls	100	15	8			
Guard stations	40	15	8			

* Table 2 prescribes supply rates of acceptable outdoor air required for acceptable indoor air quality. These values have been chosen to dilute human bioeffluents and other contaminants with an adequate margin of safety and to account for health variations among people and varied activity levels.
** Net occupiable space.

contain information on some unregulated pollutants. Finally, acceptable outdoor air quality should be evaluated using the definition for acceptable indoor air quality in Section 3.

6.1.2 Outdoor Air Treatment. If the outdoor air contaminant levels exceed the values given in 6.1.1 (Table 1), the air should be treated to control the offending contaminants. Air-cleaning systems suitable for the particle size encountered should be used. For removal of gases and vapors, appropriate air-cleaning systems should be used. Where the best available, demonstrated, and proven technology does not allow forthe removal of contaminants, the amount of outdoor air may be reduced during periods of high contaminant levels, such as those generated by rush-hour traffic. The need to control offending contaminants may depend on local regulations that require specific control measures.

6.1.3 Ventilation Requirements. Indoor air quality shall be considered acceptable if the required rates of acceptable outdoor air in Table 2 are provided for the occupied space.

Exceptions:

1. Where unusual indoor contaminants or sources are present or anticipated, they shall be controlled at the source or the procedure of 6.2 shall be followed.
2. For those areas within industrial facilities not covered by Table 2, refer to TLVs—*Threshold Limit Values and Biological Exposure Indices for 1986-87*, American Conference of Governmental Industrial Hygienists (Reference 7, 23).

Table 2 lists the required ventilation rates in cfm (L/s) per person or cfm/ft^2 (L/s·m^2) for a variety of indoor spaces. In most cases, the contamination produced is presumed to be in

TABLE 2
OUTDOOR AIR REQUIREMENTS FOR VENTILATION (*Continued*)
2.3[a] RESIDENTIAL FACILITIES (private dwellings, single, multiple)

Applications	Outdoor Requirements	Comments
Living areas	0.35 air changes per hour but not less than 15 cfm (7.5 L/s) per person	For calculating the air changes per hour, the volume of the living spaces shall include all areas within the conditioned space. The ventilation is normally satisfied by infiltration and natural ventilation. Dwellings with tight enclosures may require supplemental ventilation supply for fuel-burning appliances, including fireplaces and mechanically exhausted appliances. Occupant loading shall be based on the number of bedrooms as follows: first bedroom, two persons; each additional bedroom, one person. Where higher occupant loadings are known, they shall be used.
Kitchens[b]	100 cfm (50 L/s) intermittent or 25 cfm (12 L/s) continuous or openable windows	Installed mechanical exhaust capacity.[c] Climatic conditions may affect choice of the ventilation system.
Baths, Toilets[b]	50 cfm (25 L/s) intermittent or 20 cfm (10 L/s) continuous or openable windows	Installed mechanical exhaust capacity.[c]
Garages:		
Separate for each dwelling unit	100 cfm (50 L/s) per car	Normally satisfied by infiltration or natural ventilation
Common for several units	1.5 cfm/ft^2 (7.5 L/s·m^2)	See "Enclosed parking garages," Table 2.1

[a] In using this table, the outdoor air is assumed to be acceptable.
[b] Climatic conditions may affect choice of ventilation option chosen.
[c] The air exhausted from kitchens, bath, and toilet rooms may utilize air supplied through adjacent living areas to compensate for the air exhausted. The air supplied shall meet the requirements of exhaust systems as described in 5.8 and be of sufficient quantities to meet the requirements of this table.

proportion to the number of persons in the space. In other cases, the contamination is presumed to be chiefly due to other factors and the ventilating rates given are based on more appropriate parameters. Where appropriate, the table lists the estimated density of people for design purposes.

Where occupant density differs from that in Table 2, use the per occupant ventilation rate for the anticipated occupancy load. The ventilation rates for specified occupied spaces listed in Table 2 were selected to reflect the consensus that the provision of acceptable outdoor air at these rates would achieve an acceptable level of indoor air quality by reasonably diluting human bioeffluents, particulate matter, odors, and other contaminants common to those spaces.

Human occupants produce carbon dioxide, water vapor, and contaminants including particulate matter, biological aerosols, and volatile organic compounds. Comfort (odor) criteria with respect to human bioeffluents are likely to be satisfied if the ventilation results in indoor CO_2 concentrations less than 700 ppm above the outdoor air concentration. Appendix D discusses the relationship between ventilation rates and occupant generated CO_2.

6.1.3.1 Multiple Spaces. Where more than one space is served by a common supply system, the ratio of outdoor to supply air required to satisfy the ventilation and thermal control requirements may differ from space to space. The system outdoor air quantity shall then be determined using Equation 6-1 (see References 24 and 25).

$$Y = X/[1 + X - Z] \qquad (6\text{-}1)$$

where

$Y = V_{ot}/V_{st}$ = corrected fraction of outdoor air in system supply

$X = V_{on}/V_{st}$ = uncorrected fraction of outdoor air in system supply

$Z = V_{oc}/V_{sc}$ = fraction of outdoor air in critical space. The critical space is that space with the greatest required fraction of outdoor air in the supply to this space.

V_{ot} = corrected total outdoor air flow rate

V_{st} = total supply flow rate, i.e., the sum of all supply for all branches of the system

V_{on} = sum of outdoor air flow rates for all branches on system

V_{oc} = outdoor air flow rate required in critical spaces

V_{sc} = supply flow rate in critical space

Equation 6-1 is plotted in Figure 3. The procedure is as follows:

1. Calculate the uncorrected outdoor air fraction by dividing the sum of all the branch outdoor air requirements by the sum of all the branch supply flow rates.
2. Calculate the critical space outdoor air fraction by dividing the critical space outdoor air requirement by the critical space supply flow rate.
3. Evaluate Equation 6-1 or use Figure 3 to find the corrected fraction of outdoor air to be provided in the system supply.

Rooms provided with exhaust air systems, such as kitchens, baths, toilet rooms, and smoking lounges, may utilize air supplied through adjacent habitable or occupiable spaces to compensate for the air exhausted. The air supplied shall be of sufficient quantity to meet the requirements of Table 2. In some cases, the number of persons cannot be estimated accurately or varies considerably. In other cases, a space may require ventilation to remove contamination generated within the space but unrelated to human occupancy (e.g., outgassing from building materials or furnishings). For these cases, Table 2 lists quantities in cfm/ft^2 (L/s·m^2) or an equivalent term. If human carcinogens or other harmful contaminants are suspected to be present in the occupied space, other relevant standards or guidelines (e.g., OSHA, EPA) must supersede the ventilation rate procedure.

When spaces are unoccupied, ventilation is not generally required unless it is needed to prevent accumulation of contaminants injurious to people, contents, or structure. Design documentation shall specify all significant assumptions about occupants and contaminants.

6.1.3.2 Recirculation Criteria. The requirements for ventilation air quantities given in Table 2 are for 100% outdoor air when the outdoor air quality meets the specifications for acceptable outdoor air quality given in 6.1.1. While these quantities are for 100% outdoor air, they also set the amount of air required to dilute contaminants to acceptable levels. Therefore, it is necessary that at least this amount of air be delivered to the conditioned space at all times the building is in use except as modified in 6.1.3.4.

Properly cleaned air may be recirculated. Under the ventilation rate procedure, for other than intermittent variable occupancy as defined in 6.1.3.4, outdoor air flow rates may not be reduced below the requirements in Table 2. If cleaned, recirculated air is used to reduce the outdoor air flow rate below the values shown in Table 2, the Air Quality Procedure, 6.2, must be used. The air-cleaning system for the recirculated air may be located in the recirculated air or in the mixed outdoor and recirculated airstream (see Figure 1).

The recirculation rate for the system is determined by the air-cleaning system efficiency. The recirculation rate must be increased to achieve full benefit of the air-cleaning system. The air-cleaning used to clean recirculated air should be designed to reduce particulate and, where necessary and feasible, gaseous contaminants. The system shall be capable of providing indoor air quality equivalent to that obtained using outdoor air at a rate specified in Table 2. Appendix E may be referenced for assistance in calculating the air flow requirements for commonly used air distribution systems.

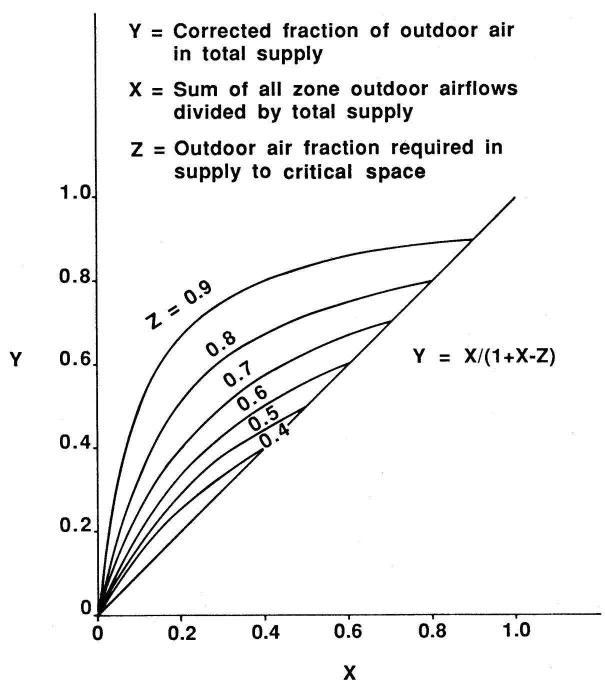

Figure 3 Ventilation reduction in multiple spaces supplied from a common source.

6.1.3.3 Ventilation Effectiveness, E_V: Outdoor air for controlling contaminant concentration can be used for dilution or for sweeping the contaminants from their source. The values in Table 2 define the outdoor air needed in the occupied zone for well-mixed conditions (ventilation effectiveness approaches 100%). The ventilation effectiveness is defined by the fraction of the outdoor air delivered to the space that reaches the occupied zone.

Ventilation effectiveness may be increased by creating a plug flow situation. If the flow pattern is such that the ventilation air flows past the contaminant source and sweeps the contaminant toward an exhaust, the contaminant concentration in the exhaust can be greater than that for the well-mixed condition. Ventilation effectiveness can then be greater than that which would be realized with perfect mixing. Local exhaust systems operate in this way. With perfect mixing between the ventilation air and the air in a space, ventilation effectiveness is 100%. With perfect mixing, $E_V = 1.0$. It is, however, not uncommon to find some of the ventilation air bypassing the occupants (moving from supply to exhaust without fully mixing in the occupied zone) and achieving E_V values as low as 0.5 (see Reference 26). Such flow conditions should be avoided. The ability of the ventilation air to mix in the occupied zone can be improved through recirculation or active mixing of the air in the space. Additional information about ventilation effectiveness can be found in Appendix F.

6.1.3.4 Intermittent or variable occupancy. Ventilating systems for spaces with intermittent or variable occupancy may have their outdoor air quantity adjusted by use of dampers or by stopping and starting the fan system to provide sufficient dilution to maintain contaminant concentrations within acceptable levels at all times. Such system adjustment may lag or should lead occupancy depending on the source of contaminants and the variation in occupancy. When contaminants are associated only with occupants or their activities, do not present a short-term health hazard, and are dissipated during unoccupied periods to provide air equivalent to acceptable outdoor air, the supply of outdoor air may lag occupancy. When contaminants are generated in the space or the conditioning system independent of occupants or their activities, supply of outdoor air should lead occupancy so that acceptable conditions will exist at the start of occupancy. Figures 4 and 5 show lag or lead times needed to achieve acceptable conditions for transient occupancy (see Appendix G for rationale). Where peak occupancies of less than three hours duration occur, the outdoor air flow rate may be determined on the basis of average occupancy for buildings for the duration of operation of the system, provided the average occupancy used is not less than one-half the maximum. Caution should be exercised for spaces that are allowed to lag and may be affected, due to pressure differences, by contaminants entering from adjacent spaces, such as parking garages, restaurants, etc.

6.2 Indoor Air Quality Procedure: This procedure provides an alternative performance method to the Ventilation Rate Procedure for achieving acceptable air quality. The Ventilation Rate Procedure described in 6.1 is deemed to provide acceptable indoor air quality, ipso facto. Nevertheless, that procedure, through prescription of required ventilation rates, provides only an indirect solution to the control of indoor contaminants. The Indoor Air Quality Procedure provides a direct solution by restricting the concentration of all known contaminants of concern to some specified acceptable levels. It incorporates both quantitative and subjective evaluation.

6.2.1 Quantitative Evaluation. Table 1 furnishes information on acceptable contaminant levels in outdoor air. This table also applies indoors for the same exposure times. For additional information on contaminants in the outdoor air, see 6.1.1. Table 3 contains limits for four other indoor contaminants. Three of these are limits set by other bodies as indicated in the table. The limit for CO_2 was selected based on the rationale outlined in Appendix D. Other potential contaminants for which definite limits have not been set are discussed in Appendix C. Tables C-1 and C-3 do not include all known contaminants that may be of concern, and these concentration limits may not, ipso facto, ensure acceptable indoor air quality with respect to other contaminants.

Human occupants produce carbon dioxide, water vapor, and contaminants including particulate matter, biological aerosols, and volatile organic compounds. Where only dilution ventilation is used to control indoor air quality, an indoor to outdoor differential concentration not greater than about 700 ppm of CO_2 indicates comfort (odor) criteria related to human bioeffluents are likely to be satisfied. Using CO_2 as an indicator of bioeffluents does not eliminate the need for consideration of other contaminants.

In recent years a number of indoor contaminants have received increased attention and emphasis. Some of these contaminants, such as formaldehyde or other vapor phase organic compounds, are generated by the building, its contents, and its site. Another important group of contaminants is produced by unvented indoor combustion. The pres-

PROCEDURE

a. Compute the air capacity per person in the space in ft^3 (m^3).
b. Find the required ventilation rate, in cfm (L/s) per person.
c. Enter Figure 4 with these values and read the maximum permissible ventilation lag time after occupancy from the intersection of a and b.

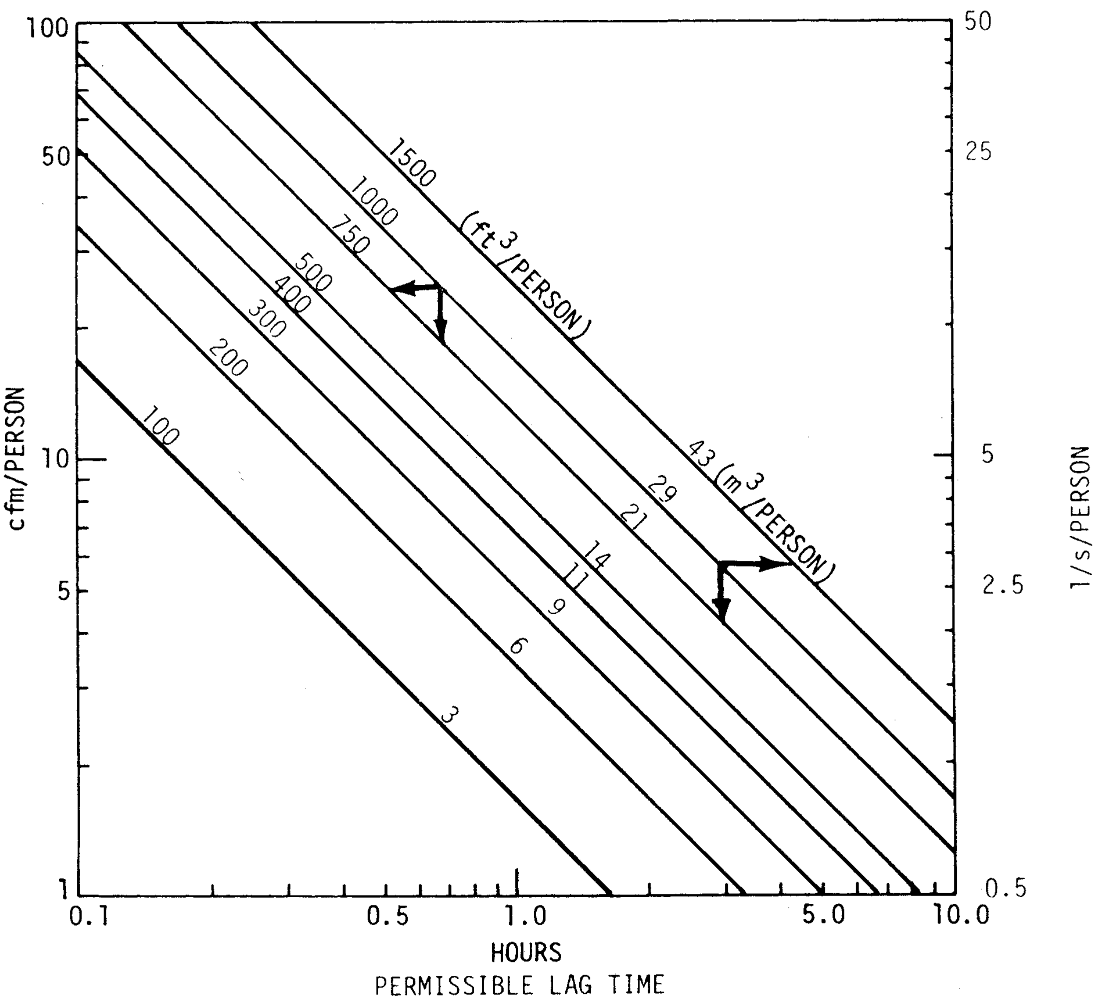

Figure 4 Maximum permissible ventilation lag time.

TABLE 3
GUIDELINES FOR SELECTED AIR CONTAMINANTS OF INDOOR ORIGIN

Contaminant	Concentration	ppm	Exposure Time	Comments
Human bioeffluents	See footnote a		Continuous	See Appendix D
Chlordane	5 μg/m^3	0.0003	Continuous	Reference 27
Ozone	100 μg/m^3	0.05	Continuous	Reference 28
Radon gas	4 pCi/L (29, 32)[b]		Annual Average	For existing houses that exceed 4 pCi/L see Reference 29

[a] SeeSubsection 6.2.1 and Appendix D for the use of CO_2 as an indicator of bioeffluents.
[b] This EPA recommendation applies specifically to residential and school occupancies. ASHRAE also recommends its use as a guideline for other building occupancies until specific recommendations for other occupancies are published by appropriate authority.

ence and use of consumer and hobby products, as well as cleaning and maintenance products, introduce a range of largely episodic releases of contaminants to the indoor environment (see Reference 30).

There are also complex mixtures, such as environmental tobacco smoke (see Reference 31), infectious and allergenic biologic aerosols, emanations from human bodies, and emanations from food preparation. Precise quantitative treatment of these contaminants can be difficult. To some degree, adequacy of control must rest upon subjective evaluation.

In the case of some odorless biologic aerosols, subjective evaluation is irrelevant. Application of generally acceptable technology, and vigilance regarding adverse influences of reduced ventilation, must therefore suffice. Appendix C contains information on standards and guidelines for selected air contaminants. Uniform governmental policies regarding

PROCEDURE

a. Compute the air capacity per person in the space in ft^3 (m^3).
b. Find the required ventilation rate, in cfm (L/s) per person.
c. Enter Figure 5 with these values and read the maximum required ventilation lead time before occupancy from the intersection of a and b.

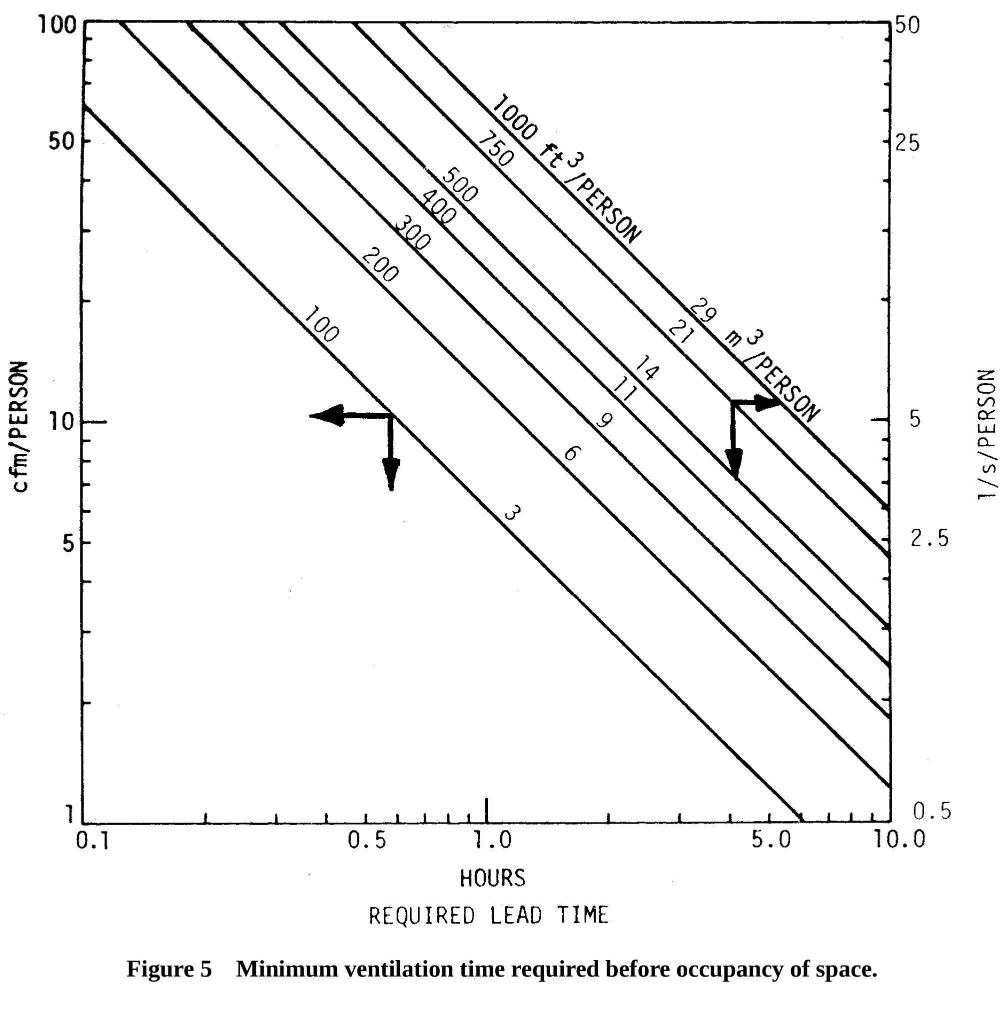

Figure 5 Minimum ventilation time required before occupancy of space.

limits on exposure to environmental carcinogens have not yet emerged.

6.2.2 Subjective Evaluation. Various indoor air contaminants may give rise to odor that is of unacceptable intensity or character or that irritates the eyes, nose, or throat. In the absence of objective means to assess the acceptability of such contaminants, the judgment of acceptability must necessarily derive from subjective evaluations of impartial observers. One method that may be used for measuring subjective response is described in Appendix C. Caution should be used in any subjective evaluation procedure to avoid unacceptable concentrations of other contaminants.

6.2.3 Air Cleaning. Recirculation criteria are defined in 6.1.3.2 for use with the Ventilation Rate Procedure. Recirculation with air-cleaning systems is also an effective means for controlling contaminants when using the Indoor Air Quality Procedure. The allowable contaminant concentration in the occupied zone can be used with the various system models in Appendix E to compute the required outdoor air flow rate. The air-cleaning system efficiency for the troublesome contaminants present, both gaseous and particulate, may be adequate to satisfy the Indoor Air Quality criteria of 6.2.1 and 6.2.2. However, contaminants that are not appreciably reduced by the air-cleaning system may be the controlling factor in design and prohibit the reduction of air below that set by the Ventilation Rate Procedure.

6.3 Design Documentation Procedures. Design criteria and assumptions shall be documented and should be made available for operation of the system within a reasonable time after installation. See Sections 4 and 6 as well as 5.2 and 6.1.3 regarding assumptions that should be detailed in the documentation.

7. REFERENCES

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This appendix is not part of this standard but is included for information purposes only.

APPENDIX A

CONVERSION FACTORS (A-1)

Parts Per Million and Mass Per Unit Volume

Measurement of airborne concentration of substances is generally converted to 77°F (25°C) and 29.92 in. Hg (760 mm Hg) pressure. Vapors or gases are often expressed as parts per million (ppm) by volume and are also frequently expressed in units of mass per unit volume, commonly in the following units:

milligram per cubic meter (mg/m^3);
microgram per cubic meter ($\mu g/m^3$);
milligram per cubic foot (mg/ft^3);
grains per cubic foot (gr/ft^3).

The ppm values may be converted to mass per unit volume values as follows:

ppm × molecular weight/24,450 = mg/L
ppm × molecular weight/0.02445 = $\mu g/m^3$
ppm × molecular weight/24.45 = mg/m^3
ppm × molecular weight × 28.3/24,450 = mg/ft^3
ppm × molecular weight × 28.3/64.8/24,450 = gr/ft^3

Airborne particle count concentrations measured in million particles per cubic foot (mppcf) or million particles per cubic meter (= particles per cubic centimeter, cc) can be converted approximately to mass per unit volume as follows when density and mass median diameter have not been determined:

mppcf × 6 (approximately) = mg/m^3
particles per cc × 210 (approximately) = mg/m^3

Units For Measuring Radon Progeny Concentrations And Exposures

Airborne concentrations of radon progeny, like radon itself, can be specified in picocuries per liter (pCi/L) or equivalent units. For radiation protection purposes, it has been useful to characterize radon progeny concentrations in terms of the total alpha energy emitted as a result of decay of the short-lived progeny (polonium 218 to polonium 214) to lead 210, a long-lived radionuclide. This "potential alpha energy concentration" (PAEC) is an indicator of potential dose to the lung, which, in turn, may be associated with increased lung cancer incidence on the basis of epidemiological studies (see Reference A-2) and other evidence.

The conventional unit for PAEC is the working level (WL), which has a value of 1.3×10^5 MeV/L, the potential alpha energy per unit volume that would be associated with air containing approximately 100 pCi/L of each of the short-lived progeny. For an arbitrary mixture with polonium 218 concentration (Ia), lead 214 concentration (Ib), and bismuth 214 concentration (Ic), the PAEC is approximately equal to (0.10 Ia + 0.51 Ib + 0.37 Ic) (WL/100, pCi/L). The associated exposure unit, working level month (WLM), is the exposure that an individual would experience remaining in 1 WL of progeny for 173 hours (an average working month).

If a volume were to have a constant source of radon and no mechanisms (other than radioactive decay) for removal of radon or its progeny from the enclosed air, the activity concentrations of each radionuclide (given in pCi/L) would eventually reach a state where all were numerically equal. Such a condition (referred to as "equilibrium") is never achieved in practice because of removal mechanisms such as ventilation and progeny "plateout." Ventilation both reduces the radon concentration and decreases the ratio of progeny to their parents below one. Plateout, the attachment of progeny to walls and other surfaces, also decreases this ratio.

The equilibrium condition of radon and its progeny is conventionally indicated by an "equilibrium factor" (F) that is the ratio of actual progeny PAEC to the PAEC were each offspring to have the same activity concentration as that of the radon actually present. Thus F = PAEC/(radon concentration/100), where the PAEC is given in WL and the radon concentration in pCi/L. In spaces with low progeny-removal rates, F is close to one. In houses, equilibrium factors have usually been found to lie in the range of 0.2 to 0.8, although factors above and below this range have sometimes been found. Taking 0.5 as a typical equilibrium factor, the annual exposure associated with a constant radon concentration of 1 pCi/L may be calculated as follows:

exposure rate for 1 pCi/L =

$$0.5(1\ \text{pCi/L})\left(\frac{1\ \text{WL}}{100\ \text{pCi/L}}\right)\left(\frac{1\ \text{WLM}}{1\ \text{WL}\times 173\ \text{h}}\right)\left(\frac{8760}{\text{year}}\right)$$

= 0.25 WLM/year

Also, 1 pCi/L = 37 Bq/m^3

REFERENCES FOR APPENDIX A

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This appendix is not part of this standard but is included for information purposes only.

APPENDIX B

POSITIVE COMBUSTION AIR SUPPLY

Fuel-fired appliances equipped with an open draft hood for control of combustion chamber draft must exhibit a positive flow of air into the draft hood whenever combustion is present. Measurements are made when building infiltration is low, i.e., the inside-outside temperature difference should be no more than 30°F (18°C) and wind velocity is no more than 5 mph (2.2 m/s). Commonly used exhaust fans, such as kitchen and bathroom exhaust fans, should be turned on, and fireplaces that have no dedicated combustion air supply should be operated simultaneously with all external doors and windows closed. Flow of room air into the draft hood under these conditions must indicate a 40% dilution of the products of combustion going up the stack (see Reference B-1). The dilution ratio for products of combustion can be determined by measuring the room air temperature entering the draft hood, the stack temperature downstream from the draft hood, and the flue temperature at the combustion chamber outlet just upstream of the draft hood before the draft hood dilution air cools the flue gas. Then

$$(T_f - T_s)/(T_s - T_r) = 0.40$$

T_f = flue temperature

T_s = stack temperature

T_r = room temperature

If the stack temperature exceeds

$$T_s = (T_f + 0.4T_r)/1.4$$

under the measurement conditions defined above, a positive supply of outside combustion air is needed for safe operation of the furnace. Reliable measurements of the stack temperature may be difficult because of nonuniformities across the stack due to incomplete mixing. (Methods based on pressure measurements can also be used.) Cold stack conditions may cause special problems (see Reference B-2).

Power burners have a blower to supply combustion air. There must be enough air supplied to this type of burner to ensure that the burner blower produces the pressure rise specified by the manufacturer. If a building is so tight that the blower cannot achieve its rated pressure rise, a positive supply of outdoor air must be provided. Care must be exercised with oil burners, however, if cold outdoor air is ducted directly to the burner. The low air temperature may degrade atomization and burner efficiency. The outdoor air provided should be tempered by heat loss from the stack and furnace jacket.

REFERENCES

B-1. *ASHRAE Handbook—1983 Equipment Volume,* Chapter 27, p. 27.24. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., Atlanta, GA 30329. 1983.

B-2. *Residential Combustion Venting Failure: A Systems Approach*. Research Div., Canada Mortgage and Housing Corp, 682 Montreal Rd., Ottawa, Canada, K1A OP7, July 30, 1987, 145 pp. 1987.

This appendix is not part of this standard but is included for information purposes only.

APPENDIX C

GUIDANCE FOR THE ESTABLISHMENT OF AIR QUALITY CRITERIA FOR THE INDOOR ENVIRONMENT

The ventilation rates recommended in Table 2 are based on existing practice in indoor environments that contain the specified occupant density and for activities that can normally be expected to take place in such environments. Whenever building materials, cleaning and maintenance materials, or specialized human activities introduce large quantities of specific contaminants into the building atmosphere there may be occupant complaints and special measures should be considered to alleviate them.

Threshold Limit Values for Chemical Substances in the Work Environment Adopted by ACGIH is obtainable from the Publications Office, American Conference of Governmental Industrial Hygienists, 6500 Glenway Avenue, Building D-7, Cincinnati, OH 45211-4438 (see Reference C-l; Reference C-2 is the West German counterpart). This publication provides 8-hour, 15-minute, and instantaneous case limits. It is a source of concentration limits for many chemical substances and physical agents for industrial hygiene use. In light of the constantly changing state of knowledge, the document is updated annually. It cautions the user, “The limits listed in this book are intended for use in the practice of industrial hygiene as guidelines or recommendations in the control of potential health hazards and for no other use.”

Industrial health practice attempts to limit worker exposure to injurious substances at levels that do not interfere with the work process and do not injure the workers' health. The elimination of all effects, e.g., unpleasant smells or mild irritation, is not attempted. Regulations are based on the results of accumulated experience with worker health and of animal experiments, carefully evaluated by groups of competent experts. Exposure and effects are related to dose of the injurious substance. Dose includes both the concentration of the substance and the time during which it is present. Since concentration commonly varies with time, dose is conveniently expressed as a time, weighted average concentration (TWA), short-term exposure limit (STEL), or threshold limit value (TLV). Regulations of the U.S. Occupational Safety and Health Administration are TWAs in most cases. Industrial exposures are regulated on the basis of a 40-hour work week with 8- to 10-hour days. The remainder of the time exposure is anticipated to be substantially lower for the pollutant of concern. For contaminants where standards or guidelines have not been established, it has been customary to assume as a first guide that a concentration of 1/10 TLV would not produce complaints in a nonindustrial population in residential, office, school, or other similar environments. The 1/10 TLV may not provide an environment satisfactory to individuals who are extremely sensitive to an irritant. In any event, where standards or guidelines do not exist, expert help should be sought in evaluating what level of such a chemical or combination of chemicals would be acceptable.

Guidelines have been established for a number of chemicals and metals that may be found in the outdoor air, as shown in References C-3 through C-9. Most would normally be found only in areas near certain industrial facilities, but some may be found in residential areas. These references are offered as sources of information when the quality of the outdoor air is suspect.

Tables C-1 and C-2 present lists of North American standards and guidelines for acceptable concentrations of substances in the indoor and outdoor environment. Table C-3 presents a summary of Canadian exposure guidelines for residential indoor air quality. Table C-4 presents a list of substances evaluated by a working group on indoor air quality research of the World Health Organization. These tables are presented as further background information when using the Indoor Air Quality Procedure.

Many contaminants have odors or are irritants that may be detected by human occupants or visitors to a space. The air can be considered acceptably free of annoying contaminants if 80% of a panel of at least 20 untrained observers deems the air to be not objectionable under representative conditions of use and occupancy. An observer should enter the space in the manner of a normal visitor and should render a judgment of acceptability within 15 seconds. Each observer should make the evaluation independently of other observers and without influence from a panel leader. Users of this method are cautioned that the method is only a test for odors. Many harmful contaminants will not be detected by this test. Carbon monoxide and radon are two examples of odorless contaminants.

References for Appendix C

C-1. *TLVs Threshold Limit Values and Biological Exposure Indices for 1987-88*. American Conference of Governmental Industrial Hygienists, 6500 Glenway, Building D-7, Cincinnati, OH 45211-4438. (Airborne concentrations of substances to which nearly all workers may be repeatedly exposed, day after day, without adverse effect; updated yearly.) 1986.

C-2. *Verein Deutscher Ingenieure, Handbuch Reinhaltung der Luft*. Maximale Imissions-Werte, VDI 2310, September 1974. (West German counterpart of TLVs at Reference C-l.)

C-3. Newill, V.A. *Air Quality Standards*, Table III, pp. 462-487, in Vol. V of Stern, A.C. (ed.), *Air Pollution*, 3rd ed. Academy Press, New York, NY (national, by county, ambient air quality standards). 1977.

C-4. Government of Ontario, Regulation 296 under the Environmental Protection Act, Revised Regulations of Ontario, Toronto (current update of Ontario, Canada, ambient air quality criteria) April 1987.

C-5. Martin, W., and A.C. Stern, *The World's Air Quality Standards*, Vol. II. *The Air Quality Management Standards of the United States*, Table 17, pp. 11-38, October 1974 (available from *NTIS PB-241-876*; National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161). 1974.

C-6. U.S. National Academy of Sciences, Committee on Toxicology, National Research Council, Guides for Short-Term Exposure of the Public to Air Pollutants. Microfiche or photocopies of these may be obtained from the National Technical Information Services, by order number. For example: *Ammonia PB-244-336, November 1972; Hydrochloric Acid PB-203-464, August 1971*.

C-7. U.S. Environmental Protection Agency, Code of Federal Regulations, Title 40, Part 61 (current national emission standards for hazardous air pollutants), July 1, 1986.

C-8. U.S. Environmental Protection Agency, National Air Toxics Information Clearinghouse Data Base, Report on State and Local Agency Air Toxics Activities, July 6, 1986 (tabulation of reporting states and communities published standards and guidelines for toxic air pollutants). 1986.

C-9. U.S. Environmental Protection Agency, Code of Federal Regulations, Title 40, Part 50 (current national ambient air quality standards) July 1, 1986.

C-10. U.S. Consumer Products Safety Commission, Code of Federal Regulations, Title 16, Parts 1303, 1304, 1305 and 1500 (ban of certain commercial practices and hazardous substances regulation), January 1987.

C-ll. U.S. Environmental Protection Agency, Code of Federal Regulation, Title 40, Part 763 (national asbestos regulations), February 25 and October 30, 1987.

C-12. U.S. Occupational Safety and Health Administration, Code of Federal Regulations, Title 29, Part 1910 (toxic and hazardous substances), July 1, 1986.

C-13. U.S. Mine Safety and Health Administration, Code of Federal Regulations, Title 30, Parts 56.5001, 57.5001, 57.5038 and 57.5039 (air quality), July 1, 1986.

TABLE C-1
STANDARDS APPLICABLE IN THE UNITED STATES FOR COMMON INDOOR AIR POLLUTANTS[a]

Pollutant	Indoor Standards	Outdoor Standards	Industrial Workplace Standards
Asbestos	Consumer Product Safety Commission has banned use of asbestos in artificial logs for fireplaces, in patching compounds, and in certain garments (16 CFR 1304, 1305, 1500.17(a)(7)); voluntary ban on use in hairdryers (C-10) EPA regulates use in schools (40 CFR 763.80) and removal projects (40 CFR 763.120); bans installation of friable asbestos for facility insulation (40 CFR 61.150) (C-11) (C-7)	National Emissions Standard: no visible emissions; may also comply by cleaning emissions as specified before particulate asbestos material escapes to air (EPA, 40 CFR 61.140 et seq.) (C-7) State air quality limits: CT 0.0010 μg/m^3 8 hr. MA 0.0001 fb/cm^3 24 hr. NC 0.0100 μg/m^3 24 hr. NY 5.0000 μg/m^3 1 yr. VA 2.0000 μg/m^3 24 hr. (all TLV based-fibers longer than 5 microns)* (NATICH Data Base, 1986) (C-8)	0.2 fiber/cm^3 8 hr. TWA (optically measured longer than 5 microns) (OSHA, 29 CFR 1910.1001(c) (C-12) 2.0 fiber/ml, 8 hr. TWA (Mine Safety and Health Admin., 30 CFR (56.5001(b), 57.5001(b)) (C-13)
Carbon Monoxide (See Table 1)		National Ambient Air Quality Primary Standard: 10 mg/m^3 (9 ppm) 8 hr. avg. 40 mg/m^3 (35 ppm) 1 hr. avg. (EPA, 40 CFR 50.8) (C9) State air quality limits: CT 10000. μg/m^3 8 hr. NV 1.3100 mg/m^3 8 hr. (NATICH Data Base, 1986) (C-8)	55 mg/m^3 (50 ppm) 8 hr. TWA (OSHA, 29 CFR 1910.1000, Table Z-1) (C-12) Mine Safety and Health Admin. uses ACGIH TLV* (30 CFR 57.5001(a)) (C-13)
Formaldehyde	Federal: 0.4 ppm target ambient level, HUD standard for manufactured homes, achieved through product emissions standards of .2 and .3 ppm (HUD, 24 CFR 3280.308, 1984) (C-14) State: 0.4 ppm standard for indoor exposure (MN statute 144.495, 1985) (C-15)	No federal standard. State air quality limits: CT 12.00 μg/m^3 8 hr. IL 0.0150 μg/m^3 1 yr. IN 18.00 μg/m^3 8 hr. MA 0.2000 μg/m^3 24 hr. NC 300.00 μg/m^3 15 min. NV 0.0710 mg/m^3 8 hr. NY 2.0000 μg/m^3 1 yr. VA 12.000 μg/m^3 24 hr. (NATICH Data Base, 1986) (C-8)	1 ppm 8 hr. TWA-PEL[b] 2 ppm 15-min. STEL[c] (OSHA, 29 CFR 1910.1000, Table Z-2; OSHA issued a final rule Dec. 4, 1987 (52 FR 46168) lowering a previous standard to the above levels, which was effective on Feb. 2, 1988). Mine Safety and Health Admin. uses ACGIH TLVs (30 CFR 57.5001(a)) (C-13)
Lead (See Table 1)	CPSC has banned in paint for consumer use or uses on consumer products (16 CFR 1303) (C-10)	National Ambient Air Quality Primary and Secondary Standard: 15 μg/m^3 max. arithmetic mean over calendar qtr. (EPA 40 CFR 50.12) (C-9) State air quality limits: CT 1.500 μg/m^3 8 hr. IL 0.500 μg/m^3 24 hr. MA 0.680 μg/m^3 24 hr. NV 0.004 mg/m^3 8 hr. VA 2.500 μg/m^3 24 hr. (NATICH Data Base for lead powder, 1986) (C-8)	50 μg/m^3 8 hr. TWA (OSHA, 29 CFR 1910. 1025(c)) (C-12) Mine Safety and Health Admin. uses ACGIH TLV (30 CFR 57.5001(a)) (C13)
Nitrogen Dioxide (See Table 1)		National Ambient Air Quality Primary and Secondary Standards: 100 μg/m^3 (0.053) ppm annual arithmetic mean (EPA, 40 CFR 50.11) (C-9) State air quality limits: CT 120.0 μg/m^3 8 hr. NV 0.143 mg/m^3 8 hr. (NATICH Data Base, 1986) (C-8)	(5 ppm) ceiling 9 mg/m^3 (OSHA, 29 CFR 1910.1000, Table Z-1) (C12) Mine Safety and Health Admin. uses ACGIH TLV (30 CFR 57.5001(a)) (C-12)

[a] Most ACGIH TLVs are referenced in western nations' standards, including Canada, Western Europe, and Australia.
[b] PEL—Permissible exposure limit.
[c] STEL—Short-term exposure limit.

TABLE C-1
STANDARDS APPLICABLE IN THE UNITED STATES FOR COMMON INDOOR AIR POLLUTANTS[a] (Continued)

Pollutant	Indoor Standards	Outdoor Standards	Industrial Workplace Standards
Ozone (See Table 1 and 3)	FDA prohibits devices (e.g., germicides, deodorizers) that result in more than 0.05 ppm in occupied enclosed spaces such as homes, offices, or hospitals, or that result in any releases in places occupied by the ill or infirm (21 CFR 801.415) (C-16)	National Ambient Air Quality Primary and Secondary Standards: 235 μg/m^3 (0.12 ppm) max. hourly avg. (EPA, 40 CFR 50.9) (C9) State air quality limits: CT 235.0 μg/m^3 1 hr. NV 0.005 mg/m^3 8 hr. (NATICH Data Base, 1986) (C-8)	0.2 mg/m^3 (0.1 ppm) 8 hr. TWA (OSHA, 29 CFR 1910.1000, Table Z-1) (C12) Mine and Safety and Health Admin. uses ACGIH TLV (30 CFR and 57.5001(a)) (C-13)
Particulates (See Table 1)		National Ambient Air Quality Primary Standard: 75 μg/m^3 annual geom. mean 260 μg/m^3 maximum 24 hr. Secondary Standard: 60 μg/m^3 annual geom. mean 150 μg/m^3 maximum 24 hr. (EPA, 40 CFR 50.6, 50.7) (C-9)	
Radon (See Table 3)		National Emission Standard for Radon-222 emissions from underground uranium mines—requires bulkhead construction (EPA, 40 CFR 61.22) (C-7) National Emissions Standard for Radionuclide Emissions (excluding Radon-220, 222) from DOE facilities, other federal facilities, and NRClicensed facilities: 25 mrem/y whole body 75 mrem/7 critical organ (EPA, 40 CFR 61.92, 61.102) (C-7)	1.0 WL radon progeny maximum 4 WLM radon progeny calendar year (Mine Safety and Health Admin., 30 CFR 57.5038, 57.5039) (C-13)
Sulfur Dioxide (See Table 1)		National Ambient Air Quality Primary Standard: 80 μg/m^3 (0.03 ppm) annual arithmetic mean 365 μg/m^3 (0.14 ppm) 24 hr. Secondary Standard: 1300 μg/m^3 (0.5 ppm) 3 hr. (EPA, 40 CFR 50.4, 50.5) (C-9) State air quality limits: CT 860.0 μg/m^3 8 hr. NV 0.119 mg/m^3 8 hr. TN 1.200 μg/m^3 1 yr. (NATICH Data Base, 1986) (C-8)	13 mg/m^3 (5 ppm) 8 hr. TWA (OSHA, 29 CFR 1910.1000, Table Z-1) (C12) Mine Safety and Health Admin. uses ACGIH TLV (30 CFR 57.5001(a)) (C-13)

[a] Most ACGIH TLVs are referenced in western nations' standards, including Canada, Western Europe, and Australia.

TABLE C-2
GUIDELINES USED IN THE UNITED STATES FOR COMMON INDOOR AIR POLLUTANTS

Pollutant	Indoor Guidelines	Outdoor Guidelines	Industrial Workplace Guidelines
Asbestos			0.2-2.0 fibers/cm^3 8 hr. TLV-TWA (depending on type of fiber) (fibers longer than 5 microns) (ACGIH, 1986-87) (C-1)

TABLE C-2
GUIDELINES USED IN THE UNITED STATES FOR COMMON INDOOR AIR POLLUTANTS (Continued)

Pollutant	Indoor Guidelines	Outdoor Guidelines	Industrial Workplace Guidelines
Carbon Monoxide			55 mg/m^3 (50 ppm) 8 hr. TLV-TWA 440 mg/m^3 (400 ppm) 15 min. STEL (ACGIH, 1986-87) (C-1)
Chlordane	NAS recommendation for military housing: (C-17) 5 μg/m^3 maximum		
Formaldehyde			1.5 mg/m^3 (1 ppm) 8 hr. TLV-TWA 3 mg/m^3 (2 ppm) 15 min. STEL (ACGIH, 1986-87) (C-1) 1.2 mg/m^3 (1 ppm) 8 hr. TWA 2.5 mg/m^3 (2 ppm) 15 min. STEL (American Industrial Hygiene Assn., 1986) (C20) NAS recommendations for manned spacecraft: (C-18) 1.0 mg/m^3 (1.0 ppm) 60 min. 0.1 mg/m^3 (0.1 ppm) 90 days 0.1 mg/m^3 (0.1 ppm) 6 mo. Navy Submarine Atmospheric Control Manual, levels set by Naval Research Laboratory: (C-19) 3.0 ppm 1 hour 1.0 ppm 24 hour 0.5 ppm 90 days
Lead Dust and Fumes			0.15 mg/m^3 8 hr. TLV-TWA (ACGIH, 1986-87) (C-1)
Nitrogen Dioxide			6 mg/m^3 (3 ppm) 8 hr. TLV-TWA 10 mg/m^3 (5 ppm) 15 min. STEL (ACGIH, 1986-87) (C-1) NAS recommendation for manned spacecraft: (C-18) 4 mg/m^3 (2.0 ppm) 60 min. 1.0 mg/m^3 (0.5 ppm) 90 days 1.0 mg/m^3 (0.5 ppm) 6 mo.
Ozone			0.2 mg/m^3 (0.1 ppm) 8 hr. TLV-TWA 0.6 mg/m^3 (0.3 ppm) 15 min. STEL (ACGIH, 1986-87) (C-1)
Radon (See Table 3)	EPA 1986 recommendation for homes: 4 pCi/l or less-can be reached in most homes At 4-20 pCi/l-take action to reduce within a few years At 20-200 pCi/l-reduce within several months At 200 pCi/l or above, reduce within several weeks or relocate until levels are reduced (EPA, “A Citizen’s Guide to Radon,” August 1986) (C-21) (EPA, “Radon Reduction Methods, A Homeowner’s Guide,” August 1986) (C22)		
Sulfur Dioxide			5 mg/m^3 (2 ppm) 8 hr. TLV-TWA 10 mg/m^3 (5 ppm) 15 min. STEL (ACGIH, 1986-87) (C-1) NAS recommendation for manned spacecraft (C-18) 13 mg/m^3 (5.0 ppm) 60 min. 3 mg/m^3 (1.0 ppm) 90 days 3 mg/m^3 (1.0 ppm) 6 mo.

TABLE C-3*
SUMMARY OF CANADIAN EXPOSURE GUIDELINES FOR RESIDENTIAL INDOOR AIR QUALITY

Contaminant	Acceptable Exposure Ranges ASTER[g]	ALTER[h]	Page
Aldehydes (total)	$\Sigma c_i/C_i<1$[a]	—	16
Carbon dioxide	—	× 6 300 mg/m^3 (<3 500 ppm)	17
Carbon monoxide	<11 ppm—8 h[b] <25 ppm—1 h[b]	—	18
Formaldehyde	c	[d]Action Level 120 µg/m^3 (0.10 ppm) Target Level 60 µg/m^3 (0.05 ppm)	26
Nitrogen dioxide	<480 µg/m^3 (<0.25 ppm)—1 h	<100 µg/m^3 (<0.05 ppm)	19
Ozone	<240 µg/m^3 (<0.12 ppm)—1 h	—	21
Particulate matter[e]	<100 µg/m^3—1 h	<40 µg/m^3	21
Sulphur dioxide	<1 000 µg/m^3 (<0.38 ppm)—5 m	<50 µg/m^3 (<0.019 ppm)	23
Water vapor	30-80% R.H.—summer 30-55% R.H.—winter[f]	—	24
Others See Below[i]	Minimize exposure	Minimize exposure	28-36

[a] C_i = 120 µg/m^3 (formaldehyde); 50 µg/m^3 (acrolein); 9000 µg/m^3 (acetaldehyde), and C_i are respective concentrations measured over a five-minute period.
[b] Units given only in parts per million so that guidelines are independent of ambient pressure.
[c] See Aldehydes (total).
[d] Although the epidemiological studies conducted to date provide little convincing evidence that formaldehyde is carcinogenic in human populations, because of this potential, indoor levels should be reduced as much as possible.
[e] <2.5 µm mass median aerodynamic diameter—MMMD.
[f] Unless constrained by window condensation.
[g] ASTER—Acceptable short-term exposure range.
[h] ALTER—Acceptable long-term exposure range.
[i] Other contaminants of concern; biological agents; chlorinated hydrocarbons; pest control products; product aerosols; fibrous materials; lead; polycyclic aromatic hydrocarbons (PAHs); and tobacco smoke.
* From Reference C-23, p.41.

TABLE C-4
WHO WORKING GROUP CONSENSUS OF CONCERN ABOUT INDOOR AIR POLLUTANTS AT 1984 LEVELS OF KNOWLEDGE*

Pollutant[a]	Concentrations[b] reported	Concentrations[b] of limited or no concern	Concentration[b] of concern	Remarks
Tobacco smoke (passive smoking)				
Respirable particulates	0.05-0.7	<0.1	>0.15	Japanese standard 0.15 mg/m^3
CO	1-1.5	<2	>5	indicator for eye irritation (only from passive smoking)
Nitros-dimethylamine	(1-50) × 10^{-6}	—	—	Mutagens under investigation fro carcinogenicity
NO_2	0.05-1	<0.19	>0.32	
CO		2% COHb	3% COHb	99.9%[c]
	1-100	<11	>30	Continuous exposure
Radon and Progenys	10-3000 Bq/m^3	–0	70 Bq/m^3	Swedish standard for new houses
Formaldehyde	0.05-2	<0.06	>0.12	Long- and short-term
SO_2	0.02-1	<0.5	>1.35	SO_2 alone short-term
CO_2	600-9000	<1800	>12000	Japanese standard 1800 mg/m^3
O_3	0.04-0.4	0.05	0.08	
Asbestos	<10 fibres/m^3	–0	10^5 fibre/m	For long-term exposure
Mineral fibers	<10 fibres/m^3	—	—	Skin irritation
Organics				
Methylene chloride	0.005-1	—	350	TLV[d]
			260	NIOSH[c] recommendations
Trichlormethene	0.0001-0.02	—	270	TLV
			135	NIOSH recommendations
Tetrachloroethene	0.002-0.05	—	335	TLV
1.4 Dichlorobenzene	0.005-0.1	—	450	TLV
Benzene	0.01-0.04	carcinogen	carcinogen	
Toluene	0.015-0.07	—	375	TLV
m.p.-Xylene	0.01-0.05	—	435	TLV
n-Nonane	0.001-0.03	—	1050	ILO (1980)
n-Decane	0.002-0.04	—	—	
Limonene	0.01-0.1	—	560	TLV turpentine

[a] All gases were considered on their own without other contaminants.
[b] Typical ranges of concentration given in mg/m^3 unless otherwise indicated and for short-term exposures.
[c] According to Environmental Health Criteria No. 4, Geneva World Health Organization, 1977.
[d] TLV (threshold limit values) established by the American Conference of Governmental Industrial Hygienists (1983-1984). These values are for occupation exposures and should be considered as extreme upper limits for nonoccupational populations for very short-term exposures.
[e] National Institute for Occupational Safety and Health (NIOSH), USA
[f] International Labor Organization (ILO)
— = no meaningful numbers can be given because of insufficient knowledge
* From Reference C-24, Table 3

C-14. U.S. Department of Housing and Urban Development, Code of Federal Regulations, Title 24, Part 3280.308 (formaldehyde emission controls for manufactured homes), April 1, 1988.
C-15. State of Minnesota, Minnesota Laws of 1985, Chapter 216, Section 144.495 (formaldehyde rules for new housing units). 1985.
C-16. U.S. Food and Drug Administration, Code of Federal Regulations, Title 21, Part 801 (maximum acceptable levels of ozone), April 1, 1986.
C-17. U.S. National Academy of Sciences, Committee on Toxicology, An Assessment of the Health Risks of Seven Pesticides Used in Termite Control (chlordane in military housing), August 1982.
C-18. U.S. National Academy of Sciences, National Research Council, Report of the Panel on Air Quality in Manned Spacecraft of the Committee on Toxicology, *Atmospheric Contaminants in Spacecraft*. June 1972.
C-19. U.S. Naval Research Laboratory, *Navy Submarine Atmospheric Control Manual* (current update of Table 3-7, unclassified defense information), 1987.
C-20. American Industrial Hygiene Association, Occupational Exposure and Work Practice Guidelines for Formaldehyde. July 24, 1986.
C-21. U.S. Environmental Protection Agency. *A Citizen's Guide to Radon.* August 1986.
C-22. U.S. Environmental Protection Agency. *Radon Reduction Methods, A Homeowner's Guide*. August 1986.
C-23. Canada Department of National Health and Welfare. *Exposure Guidelines for Residential Indoor Air Quality.* Ottawa. April 1987.
C-24. World Health Organization, Report on a WHO meeting, August 21-24, 1984, *Indoor Air Quality Research*. EURO Reports and Studies 103, Regional Office for Europe, Copenhagen, Denmark, 1986.

This appendix is not part of this standard but is included for information purposes only.

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 CO_2 and 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 carbon dioxide 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 (see Reference D-l). A value of RQ = 0.83 applies to a normal diet mix of fat, carbohydrate, and protein.

The rate at which oxygen is consumed and carbon dioxide is generated depends on physical activity. These relationships are shown in Figure D-2 (see Reference D-2). The breathing

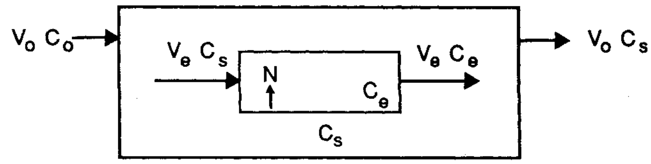

Figure D-1 Two chamber model.

rate is shown also. A simple mass balance equation gives the outdoor air flow 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 air flow 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 studies have shown that with sedentary persons about 7.5 L/s (15 cfm) 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 (Berg-Munch et al. 1986; Cain et al. 1983; Fanger and Berg-Munch 1983; Iwashita et al. 1989; Yaglou et al. 1936). If the ventilation rate is to be held to 7.5 L/s (15 cfm) per person, the result-

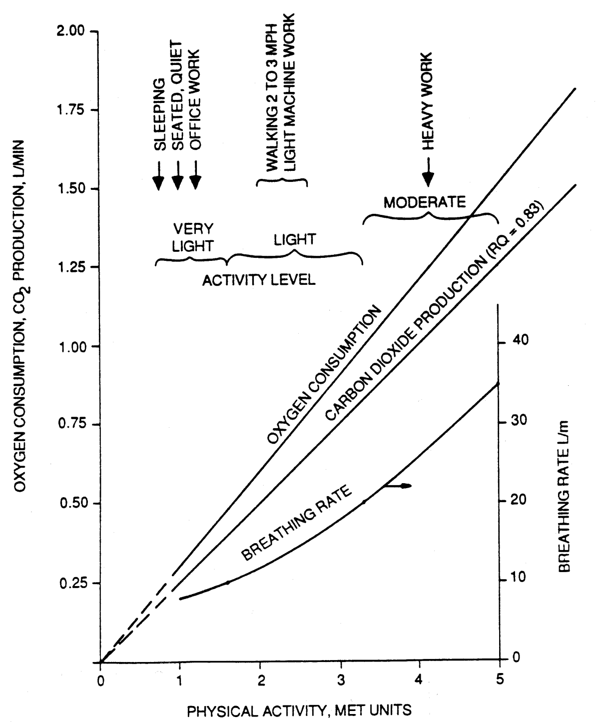

Figure D-2 Metabolic data.

ing steady-state CO_2 concentration relative to that in the outdoor air is,

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

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.

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 air flow 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 carbon dioxide 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.

$$C_o - C_s = N/V_o \quad \text{(D-2)}$$

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

$$C_s = C_o - N/V_o \quad \text{(D-3)}$$

The oxygen consumption rate is 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 to 20.9%. Thus the oxygen content of the room is reduced from 21% to 20.9%, a change of only 0.5%. The carbon dioxide is raised from the background of 0.03% to 0.1%, a change of 230%. Thus dilution of carbon dioxide is clearly more significant than replacing oxygen.

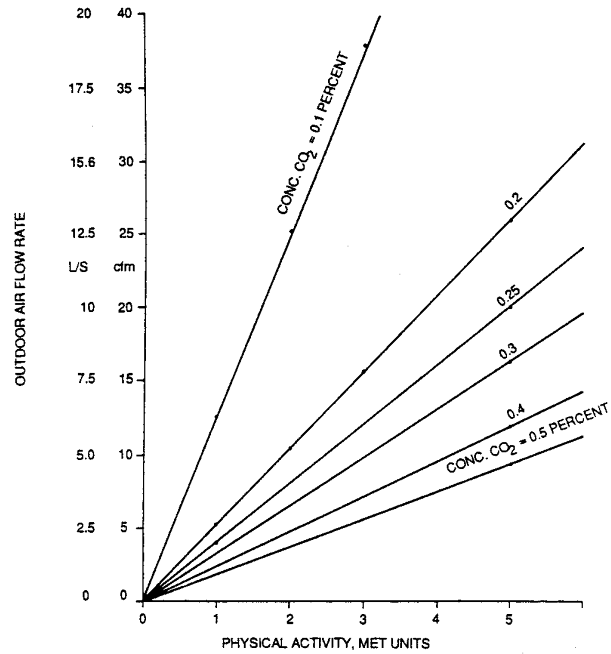

Figure D-3 Ventilation requirements.

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D-2. *ASHRAE Handbook—1985 Fundamentals Volume,* Chapter 8. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., Atlanta, GA 30329. 1985.

D-3. Berg-Munch, B., G.H. Clausen, and P.O. Fanger. 1986. Ventilation requirements for the control of body odor in spaces occupied by women. *Environ. Int.* 12: 195-200.

D-4. Cain, W.S., et al. 1983. Ventilation requirements in buildings - I. Control of occupancy odor and tobacco smoke odor. *Atmos. Environ.* 17(6): 1183-1197.

D-5. Fanger, P.O., and B. Berg-Munch. 1983. Ventilation and body odor. *Proceedings of an Engineering Foundation Conference on Management of Atmospheres in Tightly Enclosed Spaces, pp. 45-50.* Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

D-6. Iwashita, G., K. Kimura, et al. 1989. Pilot study on addition of old units for perceived air pollution sources. *Proceedings of SHASE Annual Meeting,* 3221-324. Tokyo: Society of Heating, Air-Conditioning and Sanitary Engineers of Japan.

D-7. Yaglou, C.P., E.C. Riley, and D.I. Coggins. 1936. Ventilation requirements. *ASHRAE Transactions* 42: 133-162.

D-8. ASTM. 1998. ATSM Standard D6245, American Society for Testing and Materials. *Standard Guide for Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation.* Philadelphia: American Society for Testing and Materials, D6245-98.

This appendix is not part of this standard but is included for information purposes only.

APPENDIX E

PROCEDURE FOR USE OF CLEANED RECIRCULATED AIR

The amount of outdoor air specified in Table 2 may be reduced by recirculating air from which offending contaminants have been removed or converted to less objectionable forms. Formaldehyde, for example, may be oxidized to water

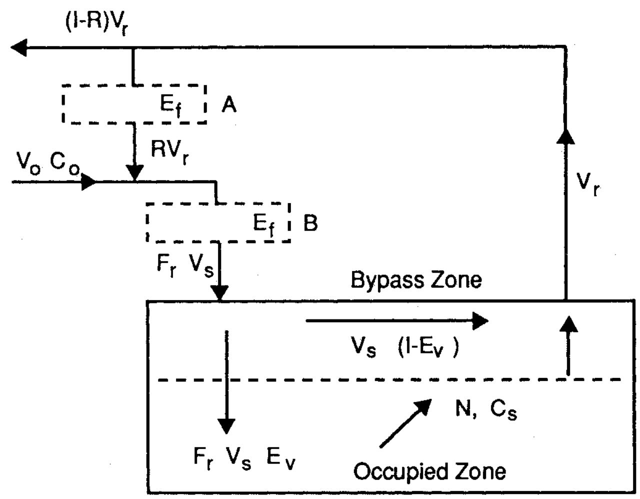

Figure E-1 Recirculation and filtration.

and carbon dioxide. The amount of outdoor air required depends on the contaminant generation in the space, the contaminant concentrations in the indoor and the outdoor air, the filter location, the filter efficiency for the contaminants in question, the ventilation effectiveness, the supply air circulation rate, and the fraction recirculated.

A, B = Filter Location
V = Volumetric Flow
C = Contaminate Concentration
E = Efficiency or Effectiveness
F_r = Flow Reduction Factor
N = Contaminate Generation Rate
R = Recirculation Flow Factor

Subscripts
f = filter
o = outdoor
r = return
s = supply
v = ventilation

Figure E-l shows a representative system. A filter may be located in the recirculated airstream (location A) or in the supply (mixed) airstream (location B). The ventilation effectiveness will depend on the location of the supply outlet, the return inlet, and the design and performance of the supply diffuser. Figure E-l is a schematic of a typical system with the supply outlet and the return inlet in the ceiling. It is possible for some supply air to flow directly from the supply to the return, bypassing the occupied zone of the room. This reduces the effectiveness of the ventilation supplied to the space (see Appendix F).

All of the exhaust is shown in Figure E-1 as being taken from the return airstream. Many systems will have part or all of the exhaust taken directly from the space. If the exhaust air is taken from the ceiling area, it will be subject to the same loss of ventilating efficiency as if it were taken from the return air flow. See Appendix F for its effect on ventilating efficiency, E_v. The exhaust air flow, V_e, is then equal to all of the exhaust air flow regardless of whether it is taken from the return air or from the room. Then:

$$V_e = V_o \quad \text{(E-1)}$$

let V_e' be the portion of air exhausted from the return duct, and V_e'' be the portion exhausted directly from the room. Then:

$$V_e = V_e' + V_e'' \quad \text{(E-2)}$$

and

$$V_r = V_s - V_e'' \quad \text{(E-3)}$$

The material balance at the supply outlet is:

$$V_s = V_o + RV_r = (V_e' + V_e'') + RV_r \quad \text{(E-4)}$$

$$RV_r = V_s - (V_e' + V_e'') \quad \text{(E-5)}$$

RV_r is the recirculated air and V_r is the return air. Therefore:

$$R = [V_s - (V_e' + V_e'')]/V_r \quad \text{(E-6)}$$

Variable-air-volume (VAV) systems reduce the circulation rate when the thermal load is satisfied. This is accounted for by

TABLE E-1
Required Outdoor Air or Space Contaminant Concentration with Recirculation and Filtration

Class	Required Recirculation Rate				Required Outdoor Air	Space Contaminant Concentration	Required Recirculation Rate
	Filter Location	Flow	Temperature	Outdoor Air			
I	None	VAV	Constant	100%	$V_o = \frac{N}{E_v F_r (C_s - C_o)}$	$C_s = C_o + \frac{N}{E_v F_r V_o}$	Not applicable
II	A	Constant	Variable	Constant	$V_o = \frac{N - E_v R V_r E_f C_s}{E_v (C_s - C_o)}$	$C_s = \frac{N + E_v V_o C_o}{E_v (V_o + R V_r E_f)}$	$RV_r = \frac{N + E_v V_o (C_o - C_s)}{E_v E_f C_s}$
III	A	VAV	Constant	Constant	$V_o = \frac{N - E_v F_r R V_r E_f C_s}{E_v (C_s - C_o)}$	$C_s = \frac{N + E_v V_o C_o}{E_v (V_o + F_r R V_r E_f)}$	$RV_r = \frac{N + E_v V_o (C_o - C_s)}{E_v F_r E_f C_s}$
IV	A	VAV	Constant	Proportional	$V_o = \frac{N - E_v F_r R V_r E_f C_s}{E_v F_r (C_s - C_o)}$	$C_s = \frac{N + E_v F_r V_o C_o}{F_r E_v (V_o + R V_r E_f)}$	$RV_r = \frac{N + E_v F_r V_o (C_o - C_s)}{E_v F_r E_f C_s}$
V	B	Constant	Variable	Constant	$V_o = \frac{N - E_v R V_r E_f C_s}{E_v [C_s - (1 - E_f) C_o]}$	$C_s = \frac{N + E_v V_o (1 - E_f) C_o}{E_v (V_o + R V_r E_f)}$	$RV_r = \frac{N + E_v V_o [(1 - E_f) C_o - C_s]}{E_v E_f C_s}$
VI	B	VAV	Constant	Constant	$V_o = \frac{N - E_v F_r R V_r E_f C_s}{E_v [C_s - (1 - E_f) C_o]}$	$C_s = \frac{N + E_v V_o (1 - E_f) C_o}{E_v (V_o + F_r R V_r E_f)}$	$RV_r = \frac{N + E_v V_o [(1 - E_f) C_o - C_s]}{E_v F_r E_f C_s}$
VII	B	VAV	Constant	Proportional	$V_o = \frac{N - E_v F_r R V_r E_f C_s}{E_v F_r [C_s - (1 - E_f)(C_o)]}$	$C_s = \frac{N + E_v F_r V_o (1 - E_f) C_o}{E_v F_r (V_o + R V_r E_f)}$	$RV_r = \frac{N + E_v F_r V_o [(1 - E_f) C_o - C_s]}{E_v F_r E_f C_s}$

a flow reduction factor *Fr.* The supply air temperature is normally held constant in a VAV system. Constant-volume systems require a variable supply air temperature. VAV systems also may have a constant or proportional outdoor air flow rate.

A mass balance for the contaminant may be written to determine the space contaminant concentration for each of the system arrangements. The various permutations for the air-handling and distribution systems are described in Table E-l. There are seven variations. The mass balance equations for computing the space contaminant concentration for each system are presented in Table E-l.

If the allowable space contamination is specified, the equations in Table E-l may be solved for the outdoor flow rate V_o. When the outdoor air flow rate is specified, the equations may be solved for the resulting contaminant concentration as shown in Table E-l.

Filters are effective for removing particles. They are less effective or ineffective in removing gases and vapors. Therefore, when designing a filtration system, consideration must be given to contaminants that are poorly filtered or not filtered at all. The ventilating rate may only be reduced until some contaminant reaches its maximum acceptable limit.

This appendix is not part of this standard but is included for information purposes only.

APPENDIX F

VENTILATION EFFECTIVENESS

Stratification Model. A model for ventilation effectiveness can be derived by considering a typical HVAC air-handling system as shown schematically in Figure F-1. It is possible that a fraction, *S*, of the supply air may bypass directly to the return inlet without mixing at the occupied level, i.e., below the dotted line in Figure F-l.

The total outdoor air in the supply air is V_{os}.

The fraction of the supply air that stratifies and bypasses directly to the return is designated by *S*. This model applies to the forced ventilation system and excludes the effects of passive infiltration. The amount of outdoor air supplied to the space is:

$$V_{os} = V_o + R \times S \times V_{os} \qquad \text{(F-1)}$$

The amount of unvitiated (unused) air that is exhausted is:

$$V_{oe} = (1-R)S\,V_{os} \qquad \text{(F-2)}$$

The ventilation efficiency then can be defined as:

$$E_v = [V_o - V_{oe}]/V_o \qquad \text{(F-3)}$$

Combining Equations F-l, F-2, and F-3,

$$E_v = [1-S]/[1-RS] \qquad \text{(F-4)}$$

Equation F-4 defines the effectiveness with which the outdoor air is circulated to the occupied space in terms of a stratification or mixing factor *S* and the recirculation factor *R*. If there is no exhaust flow, *R* = 1 and the effectiveness = 100%. If, however, there is both stratified flow and recirculation, outdoor air can pass through the system without ever being

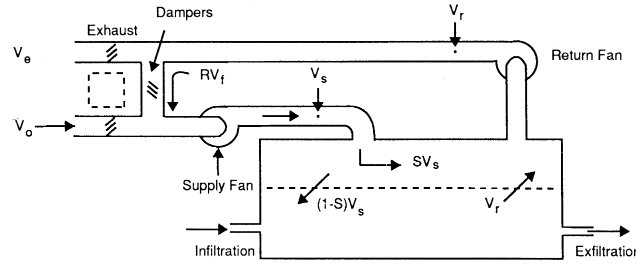

Figure F-1 Typical air distribution system.

used to dilute contaminants at the occupied level. This ventilation loss also represents an energy loss.

REFERENCE

F-1. Janssen, J.E. *Ventilation Stratification and Air Mixing, Indoor Air*, Vol. 5. Proc. of the 3rd Intern. Conference on Indoor Air Quality and Climate, Stockholm, Sweden, 1984. Sponsored by USEPA, ASHRAE, GRI, EPRI and European organizations. 1984.

This appendix is not part of this standard but is included for information purposes only.

APPENDIX G

RATIONALE FOR LAG OR LEAD TIME FOR TRANSIENT OCCUPANCY

When spaces such as classrooms, auditoriums, or offices are unoccupied for several hours and then occupied, operation of the ventilation system may be delayed to use the capacity of the air in the space to dilute contaminants. This applies to cases where the inside contaminants are associated only with human occupancy and where contaminants are dissipated by natural means during long vacant periods. The operation of the ventilation system can then be delayed until the concentration of contaminants reaches the acceptable limit associated with the minimum ventilation requirements at steady state.

The concentration of any contaminant *C* in the absence of ventilation in a given space of volume *v* is expressed as follows:

$$C_t = \frac{N \cdot t}{v} \qquad \text{(G-1)}$$

where *N* is the contaminant generation rate and *t* is time. The contaminant concentration C_s under a steady-state condition with ventilation rate *V* is:

$$C_s = \frac{N}{V} \qquad \text{(G-2)}$$

The maximum permissible ventilation delay time after the space is occupied is when C_t equals C_s, or:

$$t = \frac{v}{V} \qquad \text{(G-3)}$$

This equation is plotted in Figure 4 for various ventilation rates in cfm/person (L/s per person) and space volume in ft^3/person (L/person). When contaminants are generated independent of people or their activities, and the contaminants do not present a short-term health hazard, ventilation may be shut off during unoccupied periods. In these cases, however, ventilation must be provided in advance of the time of occupancy, so that acceptable conditions will exist for people at the start of occupancy. It is impractical to operate the ventilation system at the minimum requirement until steady state is reached, because this is approached asymptotically with time and may take several hours to reach practical equilibrium. An engineering estimate of a permissible contaminant level of 1.25 times the steady-state value has, therefore, been selected as the maximum level at the time of occupancy. The occupants would, for a time, be subjected to somewhat higher contaminant concentrations than the steady-state value. It is postulated that the factor of safety implicit in the concentrations in 6.1.3 are adequate so that, for practical purposes, the required air quality is provided over the entire occupancy period.

When an initially contaminated room with a level of concentration C_i is diluted by a given rate of ventilation V, the time required to lower the concentration to a fraction X above the final steady-state concentration level can be expressed as follows:

$$t = (v/V)\ln\left[\frac{(C_i)V/N - 1}{X}\right] \quad \text{(G-4)}$$

where:

t = time
v = room volume
V = ventilation rate
N = contaminant generation rate
C_i = initial concentration

Figure 5 is a plot of this relationship, where C_i is assumed to be approximately 10 times the steady-state value end X = 0.25 or 25%.

This appendix is not part of this standard but is included for information purposes only.

APPENDIX H

RATIONALE FOR REDUCING OUTDOOR AIR WHEN LOADS ON A MULTI-ZONE SYSTEM ARE UNEQUAL

Building HVAC systems often serve more than one room or zone. When the ventilating requirements for different rooms or zones are unequal, some of the return air is recirculated, and exhaust is taken from the return air, it is possible to reduce the fraction of outdoor air in the total supply below that required for the critical space, i.e., the space with the greatest ventilation requirement. Derivation of the formula that specifies the fraction of the outdoor air required in the total supply is as follows:

A two-chamber model may be used as shown in Figure H-l. One chamber, represented by subscript c, represents the critical zone or zone with the highest ventilation load. The other chamber represents the sum of the other zones or rooms that require a smaller fraction of outdoor air in their supplies than the critical zone.

V_e = exhaust from the system
V_{ot} = outdoor air supply corrected to account for recirculation
V_{st} = total supply air flow
V_r = return air flow
V_{oi} = outdoor air flow supplied to zone i
V_{on} = sum of the outdoor air supplied to all zones

$$V_{on} = \sum_{i=1}^{n} V_{oi}$$

V_{si} = supply air flow to zone i
V_{sn} = sum of supply flows to all zones

$$V_{sn} = \sum_{i=1}^{n} V_{si}$$

V_{oc} = outdoor air supplied to critical zone
V_{sc} = supply air flow to critical zone
F = fraction of outdoor air in supply to critical zone

$$F = V_{oc}/V_{sc} \quad \text{(H-1)}$$

R = fraction of return air that is recirculated, i.e.,

$$R = [(V_r - V_e)/V_r] = [(V_{st} - V_{ot})/V_{st}] \quad \text{(H-2)}$$

Note that

$$V_{on} = \sum_{i=1}^{n} V_{oi} \quad \text{(H-3)}$$

and

$$V_{sn} = \sum_{i=1}^{n} V_{si} \quad \text{(H-4)}$$

Then, by definition for the critical zone,

$$V_{oc}/V_{sc} \geq V_{on}/V_{st} \quad \text{(H-5)}$$

Thus, if the supply contains a fraction of outdoor air needed to satisfy the critical zone, the other zones will be overventilated and their return will contain unvitiated or “unused” outdoor air. A fraction, R, of the return air then can be recirculated to supply some of the outdoor air needed by the critical zone. This will reduce the amount of outdoor air needed by the system.

If F is the fraction of outdoor air in the supply to the critical zone, the flow rate of unvitiated (unused) outdoor air in the return from the overventilated zones is,

$$FV_{st} - V_{on} \quad \text{(H-6)}$$

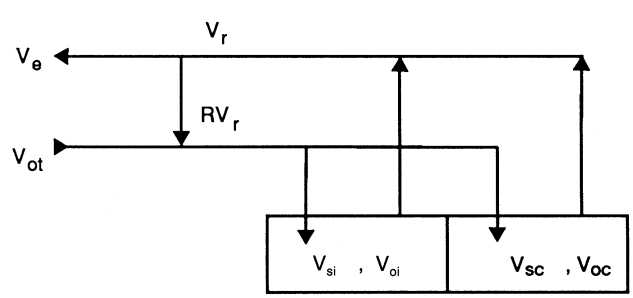

Figure H-1 Multi-zone model.

The fraction of this unvitiated return air that is recirculated is

$$R[FV_{st} - V_{on}] \quad \text{(H-7)}$$

The total amount of usable outdoor air, V_{st}, in the supply then is,

$$V_{ot} + R\,[FV_{st} - V_{on}] \quad \text{(H-8)}$$

The ventilation requirement of the critical space is met when the supply air, V_{st}, contains a fraction of outdoor air equal to,

$$FV_{st} = V_{ot} + R[FV_{st} - V_{on}] \quad \text{(H-9)}$$

From the definitions of the recirculation fraction, R, given by Equation H-2,

$$FV_{st} = V_{ot} + [(V_{st} - V_{ot})/\, V_{st}]\,[FV_{st} - V_{on}] \quad \text{(H-10)}$$

Equation H-10 can now be solved for the total outdoor air, or fresh air needed to satisfy all zones.

$$FV_{st} = V_{ot} + FV_{st} - FV_{ot} - V_{on} + V_{ot}\, V_{on}/V_{st} \quad \text{(H-11)}$$

$$O = V_{ot}[1 - F + V_{on}/V_{st}] - V_{on} \quad \text{(H-12)}$$

Therefore,

$$V_{ot} = V_{on}/[1 + V_{on}/V_{st} - F] \quad \text{(H-13)}$$

or substituting the value for F and dividing both sides of the equation by the total supply V_{st}:

$$V_{ot}/V_{st} = [V_{on}/V_{st}]/[1 + ([V_{on}/V_{st}) - (V_{oc}/V_{sc})] \quad \text{(H-14)}$$

Equation H-14 can be written

$$Y = X/(1 + X - Z) \quad \text{(H-15)}$$

where

Y = V_{ot}/V_{st}, the corrected fraction of outdoor air in the total supply

X = $V_{on}/\, V_{st}$, the uncorrected fraction of outdoor air in the total supply

Z = F, the fraction of outdoor air in the supply of the critical zone.

This appendix is not part of this standard but is included for information purposes only.

APPENDIX I

ADDENDA DESCRIPTION INFORMATION

ASHRAE Standard 62-1999 incorporates ANSI/ASHRAE Standard 62-1989 and addenda 62*a*, 62*c*, 62*d*, 62*e*, and 62*f* to ANSI/ASHRAE Standard 62-1989. The following table, Table I-1, lists each addendum and describes the way in which the text is affected by the change. Table I-2 states the ASHRAE and ANSI approval dates.

TABLE I-1
Addenda to ANSI/ASHRAE Standard 62-1989, Changes Identified

Addenda to 62-1989	Sections Affected	Description of Changes
62*a*	7 and Appendix C	Addendum *a* revises section 7 by deleting a footnote and by updating references 3-5, 9, 23, 27, 28, 29, and 32. This addendum updates references in Appendix C and also modifies Tables 1 and 3.
62*c*	2.1, 2.2, and 5.3	Addendum *c* removes consideration of thermal comfort from the standard. This addendum renumbers Section 2 and adds a new subsection 2.2. This addendum also deletes section 5.3 in its entirety.
62*d*	2.3	Addendum *d* adds caveats to the scope stating that compliance with the standard will not necessarily result in acceptable indoor air quality for a variety of reasons. This addendum adds new subsection 2.3.
62*e*	6.1.3 – Table 2	Addendum *e* removes the statement that the ventilation rates in Table 2 of subsection 6.1.3 accommodate a moderate amount of smoking.
62*f*	6.1.3, 6.2.1, Table 3, and Appendix D	Addendum *f* is intended to address a lack of clarity in the standard that has contributed to several misunderstandings regarding CO_2. The text of 6.1.3 and 6.2.1 has been changed, and Table 3 has been modified. Text of Appendix D has also been changed as a result of this addendum.

TABLE I-2
Addenda to ANSI/ASHRAE Standard 62-1989, Approval Dates

Addenda to 62-1989	ASHRAE Board of Directors Approval Date	ANSI Approval Date
62*a*	November 9, 1990	May 17, 1991
62*c*	January 27, 1999	August 5, 1999
62*d*	January 27, 1999	August 5, 1999
62*e*	January 27, 1999	pending
62*f*	January 27, 1999	August 5, 1999

NOTICE

INSTRUCTIONS FOR SUBMITTING A PROPOSED CHANGE TO THIS STANDARD UNDER CONTINUOUS MAINTENANCE

This standard is maintained under continuous maintenance procedures 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. SSPC consideration will be given to proposed changes according to the following schedule:

Deadline for receipt of proposed changes	SSPC will consider proposed changes at next
February 20	ASHRAE Annual Meeting (normally June)

Proposed changes must be submitted to the Manager of Standards (MOS) in the latest published format available from the MOS. However, the MOS may accept proposed changes in an earlier published format, if the MOS concludes that the differences are immaterial to the proposed changes. If the MOS concludes that the current form must be utilized, the proposer may be given up to 20 additional days to resubmit the proposed changes in the current format.

Specific changes in text or values are required and must be substantiated. The Manager of Standards will return to the submitter any change proposals that do not meet these requirements. Supplemental background documents to support changes submitted may be included.

FORM FOR SUBMITTAL OF PROPOSED CHANGE TO ASHRAE STANDARD UNDER CONTINUOUS MAINTENANCE

(Please type)

1. Submitter: ____
(name—type)

Affiliation: ____

Address: ______________________ City: ______________ State: _______ Zip: ________

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I hereby grant the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) the non-exclusive royalty rights, including non-exclusive royalty rights in copyright, in my proposals and I understand that I acquire no rights in publication of this standard in which my proposal in this or other similar analogous form is used. I hereby attest that I have the authority and am empowered to grant this copyright release.

Author's Signature: ______________________________________ Date: ______________

NOTE: Use a separate form for each comment, completing each section (including Sections 1 and 2) to facilitate processing.

2. Number and Year of Standard:

3. Clause (i.e., Section), Subclause or Paragraph Number, and Page Number:

4. I Propose To: [ ] Change to read as shown [ ] Delete and substitute as shown
(check one) [ ] Add new text as shown [ ] Delete without substitution

---

(Indicate the proposed change by showing a strikeout line through material to be deleted and underlining material to be added. After showing the text to be changed, insert a horizontal line and state the purpose, reason, and substantiation for the proposed change. Use additional pages if necessary.)

5. Proposed Change:

6. Purpose, Reason, and Substantiation Statements:
(Be brief; provide abstracts of lengthy substantiation; full text should be enclosed for reference on request by project committee members.)

[ ] Check if additional pages are attached. Number of additional pages: ______

NOTE: Use separate form for each comment. Submittals (MS Word 7 preferred) may be attached to e-mail (preferable), submitted on diskettes, uploaded to ASHRAE's ftp site, or submitted in paper form by mail or fax to ASHRAE, Manager of Standards, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305.
E-mail: change.proposal@ashrae.org. Ftp server address: ftp.ashrae.org, directory: *change.proposal*. Fax: 404-321-5478

ELECTRONIC PREPARATION/SUBMISSION OF FORM FOR PROPOSING CHANGES

An electronic version of each change, which must comply with the instructions in the Notice and the Form, is the preferred form of submittal to ASHRAE Headquarters at the address shown below. The electronic format facilitates both paper-based and computer-based processing. Submittal in paper form is acceptable. The following instructions apply to change proposals submitted in electronic form.

Use the appropriate file format for your word processor and save the file in either Microsoft Word 7 (preferred) or higher or WordPerfect 5.1 for DOS format. Please save each change proposal file with a different name (example, prop001.doc, prop002.doc, etc., for Word files—prop001.wpm, prop002.wpm, etc., for WordPerfect files). If supplemental background documents to support changes submitted are included, it is preferred that they also be in electronic form as wordprocessed or scanned documents.

Electronic change proposals may be submitted either as files (MS Word 6 preferred) attached to an e-mail (uuencode preferred), files uploaded to an ftp site, or on 3.5" floppy disk. ASHRAE will accept the following as equivalent tot he signature required on the change submittal form to convey non-exclusive copyright:

Files attached to e-mail:	Electronic signature on change submittal form (as a picture; *.tif, or *.wpg), or e-mail address.
Files on disk or uploaded to ftp site:	Electronic signature on change submittal form (as a picture; *.tif, or *.wpg), listing of the submitter's e-mail address on the change submittal form, or a letter with submitter's signature accompanying the disk or sent by facsimile (single letter may cover all of proponent's proposed changes).

Submit e-mail, ftp file, or disks containing change proposal files to:
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(Alternatively, mail paper versions to ASHRAE address or Fax: 404-321-5478.)

The form and instructions for electronic submittal to ASHRAE's ftp site or as attachments to e-mail may be obtained from the Standards section of ASHRAE's Home Page, *http://www.ashrae.org*, or by contacting a Standards Secretary, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. Phone: 404-636-8400. Fax: 404-321-5478.
Email: *standards.section@ashrae.org*.

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.

INTERPRETATION IC 62-1989-1 OF
ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

June 22, 1991

Request from: Eugene M. Moreau, P.E., Manager, Indoor Air Program, Division of Health Engineering, State of Maine, Department of Human Services, Augusta, ME 04333.

References. This request refers to the requirements for ventilation of public restrooms given in ASHRAE Standard 62-1989, Table 2.1, and in paragraphs 6.1.3.1, 6.1.3.2 and 6.1.3.4.

Question 1. Is intermittent exhaust permissible in restrooms?

Answer. Yes. Restroom ventilation may be interrupted under the procedure of subsection 6.1.3.4, "Intermittent or Variabale Occupancy."

Question 2. Are the remarks in Table 2.1 mandatory or advisory?

Answer. Advisory (should, or recommended), unless stated as mandatory (shall).

INTERPRETATION IC 62-1989-2a OF
ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

Original: July 24, 1991
Rev.: December 13, 1993

Request from: This reissued interpretation incorporates changes to the caveat accompanying the answer to Question 1 and deletes the comment. It also incorporates editorial changes for clarification of the Background Section, the headings, and Comment (b) to Answer 3. This revised interpretation is intended to resolve comments received as a result of publication of the original interpretation in the October 1991 issue of the ASHRAE Journal. The comments were received from Mr. Kenneth D. Mentzer, North American Insulation Manufacturers Association, 44 Canal Center Plaza, Suite 310, Alexandria, VA 22314. The original request for interpretation was received from William S. Ostrander, P.E., Newcomb & Boyd, Consulting Engineers, One Northside 75, Atlanta, GA 30318-7761.

References. This request refers to the requirements given in ASHRAE Standard 62-1989, paragraphs 5.6, 5.11 and 5.12.

Background. The questions in Mr. Ostrander's April 2, 1991 letter relate to the control of microorganisms in ventilation systems. His letter is quoted below. The Interpretation Committee responses to specific questions follow.

"We (Newcomb & Boyd) are told that their growth accelerates in the presence of increased moisture, nutrients and rough textured surfaces to shelter the colony; and that the denial of one or more of these essentials is an effective control means.

1. Section 5.6 requires ducts and plenums to be 'constructed and maintained to minimize the opportunity for growth and dissemination of microorganisms.' This is being interpreted by some individuals as prohibiting the use of glass fiber or any other type duct liner with a rough surface where particles would be likely to adhere. Duct linings can be coated or encapsulated to provide a smoother surface, but these surfaces are still subject to damage.

Our interpretation of this section is that it is not intended to prevent the use of conventional duct linings for acoustical control purposes. It is intended to minimize the growths by appropriate means, including:

(a) avoiding unnecessary use of duct liner,

(b) emphasis on proper air filtration upstream of duct liner, especially during the construction period when large quantities of nutrients and contaminants are present,

(c) encapsulation of duct liner,

(d) protection of duct liner with perforated metal, or similar protected package sound attenuators, and

(e) provision of access to duct liner for future cleaning.

2. Sections 5.11 and 5.12 reference the risk of mold, mildew, fungus, and other growths in high humidity environments. Section 5.12 cautions about 'humidity above 70 percent RH in low velocity ducts and plenums.' The humidity downstream of a dehumidifying coil will generally be between 90 and 95 percent RH. The velocity in the supply air ducts of a 'low velocity' air distribution system will generally vary between 2000 fpm at the fan to as low as 700 fpm at the extremities.

This statement could be interpreted as requiring or recommending a maximum of 70 percent RH in the supply system downstream of the cooling coils. Such interpretation would require the use of reheat or cooling coil bypass, resulting in either a large increase in supply air quantity or a significant lowering of chilled water or refrigerant temperature. A substantial initial system cost and annual energy penalty is involved.

We (Newcomb & Boyd) interpret this statement as a caution: since the high relative humidity will promote the growths of microorganisms, it is essential to minimize the accumulation of dirt that would provide nutrients. The same preventative measures listed above would accomplish this objective."

Question 1. "Is our (Newcomb & Boyd) interpretation of 5.6 correct as given in Item No. 1 above?"

Interpretation Committee (IC) Answer 1. Yes, with the following caveat:

It is not the intent of 5.6 to restrict the use of any duct lining material provided adequate precautions have been used to prevent the accumulation of liquid water, condensation, and moisture at levels conducive to microbial growth.

Question 2. "Is our (Newcomb & Boyd) interpretation of 5.11 and 5.12 correct as given in Item No. 2 above?"

IC Answer 2. Yes.

Question 3. "(Newcomb & Boyd) Is it the intent of 5.12 to limit the relative humidity to 70 percent or less in low velocity ducts and plenums?"

IC Answer 3. No.

IC Comments

(a) Paragraph 5.6 is mandatory for users who wish to claim compliance with the standard, while 5.11 and 5.12 are advisory in nature.

(b) It is the intent of 5.11 and 5.12 to advise the user of the standard of conditions that, especially in combination, are conducive to the growth of microorganisms. The currently available means of using desiccants for dehumidification are expensive, and the practice commonly used in the past of reheating subcooled air for humidity control purposes has been discarded, except in special applications, by the need to conserve energy and economic resources. Practical measures available today include those listed by Mr. Ostrander in 1(a - e) above, plus assuring that drain pans remain free of standing water. Also, it is recommended that 50 to 70 percent efficient or better filters be specified in 1(b). Paragraph 5.12 gives additional recommendations. In general, microbiological growth can be controlled by limiting moisture or by limiting nutrients (e.g., dirt and debris). Innovative design concepts for reducing moisture as well as dirt and debris in air supply systems are encouraged.

(c) The requirements and recommendations given in ASHRAE 62-1989 are based on investigation by microbiologists of buildings experiencing complaints of poor indoor air quality. Yet most buildings operate with duct humidities in excess of 70 percent without complaints. Standards Project Committee 62-1981R believes there is urgent need for research to provide more data on why not all susceptible buildings experience poor indoor air quality.

INTERPRETATION IC 62-1989-3 OF
ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

April 4, 1993

Request from: Preston E. McNall, Phoenix Engineers, 10041 El Monte, Overland Park, KA 66207

Reference: This request refers to the requirements given in ASHRAE Standard 62-1989, Table 2.1, Outdoor Air Ventilation Requirements - Commercial Facilities.

Background: Dr. McNall's letter points out that Table 2.1 lacks a recommended ventilation rate for court rooms. By referring to hotel and office conference rooms and theater auditoriums, his letter opines that the appropriate figure would be between 15 and 20 cfm/person. Dr. McNall characterizes the space as a civil court room, smoking not permitted, with occasional presence of apprehension or excitement.

Question: What are ASHRAE's recommended values for Estimated Maximum Occupancy and Outdoor Air Requirements for civil court rooms?

Answer: Estimated Maximum Occupancy: 70 persons/1000 ft^2
Outdoor Air Requirement: 15 cfm/person

Comments:

1. The values listed in Table 2.1 for conference room spaces are based on moderate smoking, which does not apply to court rooms.

2. ASHRAE Standard 62-1973 listed the estimated persons/1000 ft^2 as 70 for legislative chambers, a close kin to court rooms.

INTERPRETATION IC 62-1989-4 OF
ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

April 20, 1993

Request from: Mr. Hy Sandler, Sumner Schein Architects and Engineers Limited Partnership, The Maple Leaf Building, 23 East Street, Cambridge, MA 02141-1215

References: Mr. Sandler's request refers to Standard 62-1989, Table 2 (reprint marked STD 62 Rev 10/91 G on outside back cover)

Background: In Table 2 under the "Estimated Maximum Occupancy" column heading, there is a double asterisk footnote designating "Net Occupiable Space." However, under the "Outdoor Air Requirement" column heading, the double asterisk does not appear with the cfm/ft^2 and $L/s \times m^2$ subheadings.

Question: Are the cfm/ft^2 and $L/s \times m^2$ values based on net occupiable space?

Answer: Yes.

Comment: The required rates of acceptable outdoor air calculated from area-based criteria are intended to be based on net occupiable space in the same manner as the person-based criteria. The estimated maximum occupancy column is not relevant where area-based ventilation rates are listed, since occupants are not expected to be the primary source of contaminants in these spaces.

The project committee will consider eliminating occupancy values for all spaces having area-based ventilation rates in the next addendum or revision.

INTERPRETATION IC 62-1989-5 OF
ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

April 30, 1993

Request from: Mr. Frederick Satink, Industrial Hygiene Engineer, State of Vermont, Vermont Department of Health, Division of Occupational and Radiological Health, Administration Building, 10 Baldwin Street, Montpelier, Vermont 05602

References: Mr. Satink's request refers to Standard 62-1989, Table 2.

Background: In ANSI/ASHRAE 62-1989, Table 2 Outdoor Air Requirements for Ventilation indicates that "Ice Arenas (playing areas)" should be ventilated at the rate of 0.50 cfm/ft^2. Mr. Satink's letter opines, that the parenthetical clause means that this value should apply to the playing area only (i.e. the ice area) and not the total square footage of building. He surmises that spectator area ventilation requirements are calculated separately and would use the value 15 listed under the cfm/person heading. This volume of acceptable outdoor air would then be added to the volume calculated for the ice arena (and any other occupiable space) to arrive at the total figure for the building.

Question: Is Mr. Satink's interpretation correct?

Answer: Yes

Comment: The first item under Sports and Amusement in Table 2 addresses spectator areas in general with the remainder of the topic items noted as areas having different types of activity levels requiring different ventilation rates. A rate per square foot is more appropriate to use than a rate per person when occupant loads vary significantly, e.g., recreational skating versus hockey. Although there may be fewer hockey players on the rink, their activity level is much greater than recreational skaters.

INTERPRETATION IC 62-1989-6 OF
ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

June 27, 1993

Request from: Janet Kremzar, Mechanical Engineer, SAI Engineers, Inc., 3030 Patrick Henry Drive, PO Box 54979, Santa Clara, CA 95054-0979

Reference. This request refers to the requirements given in ASHRAE Standard 62-1989, paragraph 6.1.3.4.

Background. Paragraph 6.1.3.4 reads as follows:

"Where peak occupancies of less than three hours duration occur, the outdoor air flow rate may be determined on the basis of average occupancy for buildings for the duration of operation of the system, provided the average occupancy used is not less than one-half the maximum."

SAI has established the following two possible interpretations for complying with 6.1.3.4 with respect to an airport terminal building with 24 hour daily operation. Peak occupancy occurs for less than three hours, with an average occupancy of less than half the peak occupancy.

SAI Interpretation No. 1. Outdoor air flow rate is determined on the basis of 1/2 peak occupancy for the full 24 hour operation period.

SAI Interpretation No. 2. Outdoor air flow rate is determined on the basis of peak occupancy for a three hour period and 1/2 peak occupancy for the remaining 21 hours of operation.

SAI believes that Interpretation No. 1 above expresses the intent of Standard 62-1989.

Question. Is SAI's interpretation No. 1 correct?

Answer. Yes

INTERPRETATION IC 62-1989-7 OF
ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

June 27, 1993

Request from: This is a joint request, originated by Ms. Carol C. Brumfield, Industrial Hygienist, Law Engineering, P.O. Box 5726, 3901 Carmichael Avenue, Jacksonville, FL 32207; and supplemented by John D. Cowan, Cowan Quality Buildings, 74 Willowbank Blvd, Toronto, ON Canada M5N 1G6.

References: This request refers to Standard 62-1989, 6.1.2 Ventilation Requirements, including the footnote to Table 2; and to 6.2.1 Quantitative Evaluation, second paragraph.

Background: Table 2 footnote states: "Table 2 prescribes supply rates of acceptable outdoor air required for acceptable indoor air quality. These values have been chosen to control CO_2 and other contaminants with an adequate margin of safety and to account for health variations among people, varied activity levels, and a moderate amount of smoking. Rationale of CO_2 control is presented in Appendix D."

The last three sentences of 6.1.3 state: "Carbon dioxide concentration has been widely used as an indicator of indoor air quality. Comfort (odor) criteria are likely to be satisfied if the ventilation rate is set so that 1000 ppm CO_2 is not exceeded. In the event CO_2 is controlled by any method other than dilution, the effects of possible elevation of other contaminants must be considered (see Refs 12-18)."

For the Indoor Air Quality Procedure a similar caution is given in the second paragraph of 6.2.1.

Ms. Brumfield's letter states that some are using this "dilution" provision as justification to install CO_2 filtration systems in buildings, in lieu of designing according to the ventilation rate method, in order to cut first costs and operating costs associated with the additional outdoor air requirement within the building.

Mr. Cowan's letter states that CO_2 sensors are being used by some to control the volume intake of outdoor air and by others to control of CO_2 filters. In either case, the referenced sections are cited as justification for claiming compliance with the standard if CO_2 is maintained under 1000 ppm.

Both requesters interpret that:

1. The Ventilation Rate Procedure is intended to control many more factors than the level of CO_2. That very fact disallows the use of CO_2 control to reduce outdoor air intake below Table 2 values, if compliance with the Ventilation Rate Procedure is claimed.

2. The Air Quality Procedure requires consideration of many more factors than the level of CO_2. Therefore, CO_2 control of outdoor air intake or the filtration of CO_2 can not be used as sole proof of compliance under the Air Quality Procedure.

3. The standard allows for a filtration system to be installed in order to reduce the outdoor air requirement if there are known potential contaminants that will be generated in the facility, such as Environmental Tobacco Smoke (ETS) from smokers or formaldehyde from indoor processes.

Question: Are the above interpretations by Ms. Brumfield and Mr. Cowan correct?

Answer 1: Yes

Answer 2: Yes

Comment: Filtration of CO_2 is not an appropriate way to comply with Standard 62, since CO_2 is a surrogate for other contaminants. Removal of CO_2 may not have any effect on the contaminants for which it is a surrogate (e.g., occupant odors).

Answer 3: Yes

Comment: Standard 62-1989 allows air filtration (air cleaning) to be used to reduce outdoor air requirements below rates specified in Table 2, but only if the Indoor Air Quality Procedure is used (see 6.1.3.2). It is possible that air cleaning provided in accordance with this procedure to handle "known potential contaminants generated in the facility" will not allow outdoor air requirements to be reduced below the minimum values in Table 2.

INTERPRETATION IC 62-1989-8 OF
ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

September 22, 1993

Request from: Eileen P. Senn, Shop Steward, CWA Local 1034, 321 West State Street, Trenton, NJ 08618

References. This request refers to the requirements given in ASHRAE Standard 62-1989, paragraphs 5.1 and 5.11.

Background

1. Paragraph 5.1 of the standard states in part:

> "When natural ventilation and infiltration are relied upon, sufficient ventilation shall be demonstrable."

Ms. Senn's letter interprets "sufficient ventilation" to mean ventilation rates specified in Table 2, or alternatively, ventilation sufficient to meet the indoor air quality guidelines in Table 3.

2. Paragraph 5.11 of the standard states in part:

> "Relative humidity in habitable spaces preferably should be maintained between 30% and 60% relative humidity ...."

Ms. Senn's letter interprets that this range should be maintained by using mechanical humidification and/or dehumidification equipment, if necessary.

Question 1. Is Ms. Senn's interpretation of 5.1 correct as given in Item No. 1 above?

Answer 1. No with respect to ventilation rates. Yes with respect to IAQ Guidelines in Table 3 "Guidelines for Selected Air Contaminants of Indoor Origin."

Comment. Demonstration of ventilation rates specified in Table 2 is only one of the acceptable methods. Acceptable means of demonstrating natural ventilation include the infiltration methods described in Chapter 23 "Infiltration and Ventilation" of the 1993 ASHRAE Handbook - Fundamentals. Acceptable means of demonstrating openable areas to the outdoors for natural ventilation are given in the model building codes. Documentation of a background of successful natural ventilation experience in similar buildings and building uses could also be considered suitable demonstration.

Question 2. Is Ms. Senn's interpretation of 5.11 correct as given in Item No. 2 above?

Answer 2. Yes

Comments.

a) It is important to note that the word "should" in 5.11 is a recommendation and not a mandatory requirement.

b) Since ASHRAE 62-1989 does not define "habitable space," the provisions of 5.11 would not apply to bathrooms, toilet compartments, halls, or storage or utility spaces, as currently defined in model building codes. ASHRAE SSPC 62 will consider adding a definition for "habitable space" in the next revision of the standard.

INTERPRETATION IC 62-1989-9 OF
ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

October 6, 1993

Request from: Donald C. Herrmann, Creighton & Associates, Inc., 611 East Broward Boulevard, Suite 207, Fort Lauderdale, Florida 33301

Reference. This request pertains to the requirements given in ASHRAE Standard ANSI/ASHRAE 62-1989 including Addendum 62a-1990, paragraph 6.1.3

Background. Paragraph 6.1.3 reads as follows:

> "Where occupant density differs from that in table 2, use the per occupant ventilation rate for the anticipated occupancy load."

Creighton & Associates has established the following two possible interpretations for complying with 6.1.3.

Interpretation No. 1. If an anticipated occupancy rate is provided by an owner or architect and it is less than or greater than that listed in Table 2, the system designer is to use the anticipated occupancy in lieu of the estimated maximum occupancy P/1000 square feet listed in Table 2.

Interpretation No. 2. If a local occupancy code or fire occupancy code indicates a greater occupancy than that listed in table 2, the system designer is to use the greater of the occupancies regardless of the known or anticipated occupancy provided by the building owner or architect.

Creighton & Associates believes that Interpretation No. 1 above expresses the intent of Standard 62-1989.

Question. Is Interpretation No. 1 correct?

Answer. Yes

Comment. Interpretation No. 1 is consistent with the directions on occupant density given in 6.1.3. Provisions of ASHRAE 62-1989 do not have legal precedence over prevailing codes that may contain conflicting provisions. Occupancy loads as codified for fire safety are based upon considerations that may differ from those on which ventilation are based. In jurisdictions where ASHRAE 62-1989 is adopted into the building or mechanical code by reference, it is our opinion that 6.1.3 is applicable and appropriate; however, this opinion should be confirmed by the authority having jurisdiction.

INTERPRETATION IC 62-1989-10 OF
ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

October 18, 1993

Request from: David R. Aldridge, U.S. Army Engineer Division - Huntsville, CEHND-ED-ME, Huntsville, AL 35807-4301

Reference. This request refers to the requirements given in ASHRAE Standard 62-1989, Subsection 6.1 Ventilation Rate Procedure, and paragraph 6.1.3.4 Intermittent or Variable Occupancy.

Background. Paragraph 6.1.3.4 reads in part:

"Where peak occupancies of less than three hours duration occur, the outdoor air flow rate may be determined on the basis of average occupancy for buildings for the duration of operation of the system, provided the average occupancy used is not less than one-half the maximum."

Mr. Aldridge's letter presupposes a case where the peak occupancy of a classroom is 300 students and the occupancy period is less than three hours. His letter opines that the "less than three hours duration" stipulated in 6.1.3.4 is to be used as a fixed elapsed time period over which to average the occupancy loading; i.e., paragraph 6.1.3.4 allows averaging the occupant loading over the period of occupancy which is to be less than three hours. Thus, 300 persons for 1.5 hours and zero persons for 1.5 hours is an average of 150 persons over 3 hours. This results in an outdoor air requirement of 150 persons x 15 cfm/person = 2250 cfm.

Question. Is Mr. Aldridge's interpretation correct?

Answer. No

Comment. It is coincidence that the numerical result happens to be correct for the example presented. The occupancy is to be averaged over "the duration of operation of the system," not "over the period of occupancy which is to be less than 3 hours."

The intermittent occupancy provision contained in 6.1.3.4 of the Standard also can be applied to multiple daily episodes of peak occupancy as long as each is for less than three hours. It is intended to apply to occupancy profiles that permit pollutant reduction through over-ventilation (on a per person basis) during intervening periods of reduced occupancy between peaks.

More precise guidelines will be studied for possible incorporation into the next revision of the standard.

INTERPRETATION IC 62-1989-11 OF
ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

December 9, 1993

Request from: Douglas Wall, P.E., The Trane Company, 4811 S. Zero Street, Fort Smith, AR 72903

References. This request refers to Standard 62-1989, Subsection 5.4 and Section 6.

Background. Subsection 5.4 states in part:

> "**5.4** When the supply air is reduced during times the space is occupied... provision shall be made to maintain acceptable indoor air quality throughout the occupied zone."

Mr. Wall's letter interprets this to mean that thermostatically controlled supply air fans violate the standard if no provision is made to restart the fan when the indoor air quality no longer meets the requirements given in Section 6. His letter explains, "for example, a unit may supply the proper outside air flow rate while the space thermostat calls for heating or cooling, but the unit will stop supplying air when the thermostat is satisfied. His letter opines that since the thermostat may be satisfied indefinitely, control of indoor air quality through ventilation is lost.

Question. Is the interpretation in Mr. Wall's letter correct?

Answer. Yes

INTERPRETATION IC 62-1989-12 OF
ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

December 9, 1993

Request from: Donald C. Herrmann, Creighton & Associates, Inc., 611 East Broward Boulevard, Suite 207, Fort Lauderdale, Florida 33301

Reference. This request pertains to the requirements given in ASHRAE Standard ANSI/ASHRAE 62-1989 including Addendum 62a-1990, paragraph 6.1.3.4.

Background. Paragraph 6.1.3.4 reads as follows:

> "Where peak occupancies of less than three hours duration occur, the outdoor air flow rate may be determined on the basis of average occupancy for buildings for the duration of operation of the system, provided the average occupancy used is not less than one-half the maximum."

Case 1. Creighton & Associates has established the following two possible interpretations for complying with 6.1.3.4

1-A (Creighton & Associates interpretation). The system designer may use an average occupancy value when determining the required outdoor air flow for variable occupancies to prevent over ventilating, providing it is not less than one-half the maximum listed in table 2 or one-half the anticipated peak occupancy load as referenced in 6.1.3.4.

1-B (Alternative interpretation). The system designer may use an average occupancy value when determining the required outdoor air flow for variable occupancies to prevent over ventilating, providing it is not less than one-half the maximum listed in table 2.

Creighton & Associates believes that Interpretation No. 1a above expresses the intent of Standard 62-1989.

Question 1. Is interpretation No. 1-A correct?

Answer 1. Yes

Case 2. Creighton & Associates has established the following two possible interpretations to define "peak occupancies of less than three hours duration."

2-A (Creighton & Associates interpretation). The term "peak occupancies" allows more than one peak period of less than three hours duration over the operation time of the system. Examples; auditoriums, conference rooms, special use classrooms, concert halls, etc.

2-B (Alternative interpretation). Only one peak occupancy may be used within a twenty four hour period.

Creighton & Associates believes that Interpretation No. 2a above expresses the intent of Standard 62-1989.

Question 2. Is interpretation No. 2-A correct?

Answer 2. Yes

INTERPRETATION IC 62-1989-13 OF
ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

January 20, 1994

Request from: Dennis Stefani, Executive Officer, Environmental Services, Calgary Health Services, PO Box 4016, Station "C", 320 17th Avenue S.W., Calgary, Alberta T2T 5T1 CANADA

References. This request refers to the requirements given in ASHRAE Standard 62-1989, Appendix C, Guidance for the Establishment of Air Quality Criteria for the Indoor Environment.

Background. Appendix C, third paragraph, states in part that it has been customary to use 1/10 the TLV in indoor environments occupied by the public.

Question. Is this recommendation inclusive of the TLV averaging times and ceiling limits? In other words, if the TLV for compound "x" is 20 ppm, 8 hour time weighted average (TWA), is the public exposure guideline an 8 hour TWA as well?

Answer. No

Comments. The "divide by ten" guide is an attempt to give a sense of the concentration of concern for various chemicals where indoor air standards do not exist. This guide is not provided in professional hygiene documents and there is no consensus within the industrial hygiene community as to its appropriateness. (Note ASHRAE conference proceedings *IAQ92 Environments for People*, including the discussion at the end of the Peter Breysse paper, pp. 13-21.) Any attempt to use this rule in a precise way, as implied by this question, is contrary to its intended use as a scale factor.

The appropriate use of TLVs, and any set "criteria values" in consideration of indoor environments has been proposed as a topic to be covered in the next revision of ASHRAE 62.

INTERPRETATION IC 62-1989-14 OF
ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

May 1, 1994

Request from: Max H. Sherman, Lawrence Berkeley Laboratory, Building 90, Room 3074, Berkeley, CA 94720

References. This request refers to ANSI/ASHRAE 62-1989, Subsection 6.1.3, Table 2.3, Outdoor Air Requirements for Ventilation of Residential Facilities (Private Dwellings, Single, Multiple), and specifically to the comments in Table 2.3 associated with the entry, "Living areas." Also referenced is ANSI/ASHRAE 136-1993, A Method of Determining Air Change Rates in Detached Dwellings.

Background. The comment in Table 2.3 states in part: "The ventilation is normally satisfied by infiltration and natural ventilation."

Dr. Sherman's letter opines that the referenced comment does not specify how this is to be determined, over what time frame, what kind of averaging is allowed, etc. The purpose of ANSI/ASHRAE Standard 136-1993 is essentially ". . . to provide a procedure for determining effective air change rates in detached dwellings . . . for use in evaluating the impact . . . on indoor air quality." Dr. Sherman interprets the referenced statements in ASHRAE 62 and ASHRAE 136 to mean that the rates calculated by ASHRAE 136 are one acceptable form of compliance to Table 2.3 of ASHRAE 62-1989 for single-family, detached dwellings.

Question. Is Dr. Sherman's interpretation correct?

Answer. Yes

INTERPRETATION IC 62-1989-15 OF
ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

June 3, 1994

Request from: Barry L. Spurlock, P.E., Member, Georgia Building and Mechanical Task Force, Georgia Department of Community Affairs, 1200 Equitable Building, 100 Peachtree Street, Atlanta, GA 30303.

References. This request refers to the intermittent and variable occupancy criteria in Standard 62-1989, 6.1.3.4.

Background. Mr. Spurlock's letter cites Table 2.2 requirement that outside air be provided in school classrooms at the rate of 15 cfm per person.

Subsection 6.1.3.4 deals with intermittent or variable occupancy and states in part: "Where peak occupancies of less than three hours duration occur, the outdoor air flow rate may be determined on the basis of average occupancy for buildings for the duration of the operation of the system, provided the average occupancy is not less than one half the maximum."

Mr. Spurlock's letter also enclosed typical schedules for elementary, middle and high schools in the Gwinnett County Georgia Public Schools. These schedules indicate that on a typical day the HVAC systems run 510 minutes and during this time the classroom is occupied 250 minutes or 49 percent of the time. Also enclosed is an actual schedule for a typical elementary school classroom indicating that the classroom is occupied 44 percent of the time.

Mr. Spurlock's letter interprets that, using this occupancy rate and the variable occupancy rule, the outside air to a typical classroom can be reduced to a level required by the average occupancy of the space, which in this example is half the peak occupancy. The outdoor air required for this average occupancy is 15 cfm per person.

Question. Is Mr. Spurlock's interpretation correct?

Answer. Yes.

INTERPRETATION IC 62-1989-16 OF

ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

June 26, 1994

Request from: Bruce F. Kimball, Marshall Erdman and Associates, Inc., 5117 University Avenue, Madison, WI 53705

Reference. This request refers to the requirements given in ASHRAE Standard 62-1989, paragraph 6.1.3 and 6.1.3.1.

Background. Paragraph 6.1.3 Ventilation Rate Requirements states in part:

> "Indoor air quality shall be considered acceptable if the required rates of acceptable outdoor air in Table 2 are provided for the occupied space."

Paragraph 6.1.3.1 Multiple Spaces states in part:

> "Where more than one space is served by a common supply system, the ratio of outdoor to supply air required to satisfy the ventilation and thermal control requirements may differ from space to space. The system outdoor air quantity shall then be determined using Equation 6.1."

Mr. Kimball's letter opines that it is not necessary to apply equation 6.1 if the required rates of acceptable outdoor air in Table 2 are provided to each space.

Question. Is Mr. Kimball's interpretation correct?

Answer. Yes

Comment. The project committee has found the issue of how and when to apply Table 2 and Equation 6.1 difficult to resolve and will consider proposals for clarifying/modifying the requirements in the next revision of Standard 62.

Case 3. Creighton & Associates has established the following two possible interpretations for complying with 6.1.3.4.

3-A (Creighton & Associates interpretation) The system designer may, at his or her option, lead or lag the ventilation supply to the space. This is not a mandatory requirement.

3-B (Alternative interpretation) Lead/Lag ventilation is a mandatory part of the standard and shall be used in the design of ventilating systems for all occupied spaces of intermittent or variable occupancies.

Question 3. Is interpretation No. 3-A correct?

Answer 3. Yes

Comment: The concept of lag ventilation assumes no appreciable buildup of contaminants during the unoccupied hours However, such a buildup may occur from materials or machines in the building, microbially contaminated areas, or activities of maintenance personnel. The designer should therefore not routinely presume that lag ventilation will result in acceptable indoor air quality.

INTERPRETATION IC 62-1989-17 OF

ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

Orig. September 11, 1994
SI equiv. added September 27, 1994

Request from: Paul B. Miskowicz, P.E., Integrated Planning & Engineering, Inc., 3333 S. Wadsworth Blvd., Suite D231, Lakewood, CO, 80227

References. This request refers to the requirements given in ANSI/ASHRAE Standard 62-1989, Subsections 5.4, 6.1.3.4 and 6.1.3.1.

Background No. 1. Mr. Miskowicz's letter of June 28, 1994 states:

Subsection 5.4 reads:
"5.4 When the supply of air is reduced during times when the space is occupied, provision shall be made to maintain acceptable indoor air quality throughout the occupied zone."

Subsection 6.1.3.4 states in part:
"6.1.3.4 Intermittent or Variable Occupancy. Ventilating systems for spaces with intermittent or variable occupancy may have their outdoor air quantity adjusted by use of dampers or by stopping and starting the fan system to provide sufficient dilution to maintain contaminant concentrations within acceptable levels at all times."

Table 2 lists "Outdoor Air Requirements for Ventilation" based on the type of space.

IP&E's Interpretation No. 1. IP&E interprets that supply fans can be duty cycled on and off during occupied times for energy conservation, provided that the supply of outdoor air to the occupied space provides sufficient dilution to maintain contaminant concentrations within acceptable levels at all times, even if this produces a time-averaged rate of outside air introduction that is less than the rate set forth in Table 2.

Background No. 2. Subsection 6.1.3.1 Multiple Spaces gives a procedure for determining the system outdoor air quantity, and Table 2 lists "outdoor air requirements for ventilation" based on the type of space.

IP&E's Interpretation No. 2. IP&E interprets that it is acceptable to provide less than the quantity of outside air called for in Table 2 to the critical space in an application where one supply system serves multiple spaces with differing outside air requirements, example:

Consider a system that serves two spaces with Table 2 outdoor air requirements (e.g., cfm/person x persons) of 100 and 500 cfm (47 and 236 l/s) respectively, and supply airflow rates (dictated by temperature control requirements) of 1000 cfm (472 l/s) each. Equation 6-1 yields a corrected outdoor-air-in-system fraction (OAF) of 0.375. But at this OAF, the rate of outdoor air delivered to the critical space with 1000 cfm (472 l/s) of total supply is 375 cfm (177 l/s) versus the 500 cfm (236 l/s) requirement calculated from Table 2.

IP&E interprets Subsection 6.1.3.1 to allow the corrected (reduced) amount of outside air to be used to avoid designing a system that consumes an excess amount of energy while maintaining a minimum level of acceptable ventilation.

Question 1. Is IP&E's Interpretation No. 1 correct?

Answer 1. No.

Comment: When the user of the standard chooses the ventilation rate procedure involving Table 2, the time-averaged rate of outdoor air is required to be at least that specified in Table 2. The indoor air quality procedure of clause 6.2 must be used if methods other than outdoor ventilation rate are used to control contaminants so that the time-averaged ventilation rates drop below that of Table 2.

Question 2. Is IP&E's Interpretation No. 2 correct?

Answer 2. Yes.

Comment: This is a direct application of Equation 6-1.

Using the symbols of that equation, the uncorrected fraction of outdoor air in the system supply, X, is 600/2000 = 0.3. The fraction of outdoor air in the critical space, Z, is 500/1000 = 0.5. Therefore, the corrected fraction of outdoor air in the system supply is 0.3/(1 + 0.3 - 0.5) = 0.375.

The outdoor air supplied to the system must be 0.375(2000) = 750 cfm (354 l/s). The total outdoor air, 750 cfm (354 l/s), is greater than the 600 cfm (283 l/s) required by Table 2 if two separate outdoor air supplies were available, yet less than the 1000 cfm (472 l/s) required if the outdoor air supply were set by the critical space requiring 500 cfm (236 l/s).

INTERPRETATION IC 62-1989-18 OF
ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

January 29, 1995

Request from: David Elovitz, PE, Energy Economics, Inc., Registered Professional Engineers, 26 Robinhood Road, Natick, MA 01760

References: This request seeks a clarification of Table 2, under Public Spaces: Corridors and Utilities.

Background: Table 2 requires 0.05 CFM per sq ft minimum outside air ventilation for public corridors.

Question: Does Standard 62-1989 intend to require outside air ventilation for exit corridors and service corridors which are not normally occupied, but only used for egress and for delivery of merchandise, such as the service corridors in a shopping mall which are not part of the normal public circulation system?

Answer: Yes. The value of 0.05 cfm/sq ft should be supplied to these spaces assuming there is transient occupancy.

INTERPRETATION IC 62-1989-19 OF
ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

January 29, 1995

Request from: W. Hugh Bache, P.E., 4739 Brownstone Drive, Duluth, GA 30136

References. This request concerns subsection 6.1.3.4 of ANSI/ASHRAE Standard 62-1989.

Background. Subsection 6.1.3.4 states in part: "Where peak occupancies of less than three hours duration occur, the outdoor air flow rate may be determined on the basis of average occupancy for buildings for the duration of the operation of the system, provided the average occupancy is not less than one half the maximum."

Mr. Bache's letter cites a general application of classroom HVAC. An isolated classroom is served by a dedicated classroom HVAC unit (water source heat pump, fan-coil unit or unitary equipment) with ventilation (outside) air introduced into the classroom unit's return (recirculated) air duct. The classroom is fully occupied during each class period and partially occupied during the 6 minutes transition between the bell marking the end of a period and the tardy bell for the next period.

Case 1. The classroom is in use for Periods 1, 2, and 3, consuming a total time of 3 hrs. and 2 min. Of this total time, the classroom is fully occupied for 2 hrs and 50 min., and partially occupied during the transition between class periods for a total of 12 min. After Period 3, it is unoccupied during Period 4 and the succeeding lunch period for a total time of 1 hr. and 42 min. before the start of Period 5. During Period 5, it is again occupied for 55 min.

Hugh Bache's Interpretation of Case 1. Mr. Bache's interpretation for Case 1 is that the flow rate of outdoor air may be reduced below the value shown in Table 2 to the extent allowed for intermittent variable occupancy as defined in 6.1.3.4, since the effective time of peak occupancy meets the "less than three hours duration" criterion.

Question 1. Is Mr. Bache's interpretation of Case 1 correct?

Answer 1. No. In the situation you described the committee believes that the rooms should be considered occupied during the six minute class change interval between classes. Students are on their feet exiting and entering the rooms. If anything, their metabolic rate is higher suggesting a need for increased ventilation.

Case 2. The classroom is in use for Periods 1, 2, 3, and 4, consuming a total time of 4 hrs. and 3 min. Of this total time, it is fully occupied for 3 hrs and 45 min., and partially occupied between periods for a total of 18 min. After Period 4, the classroom is unoccupied for 41 min. before the start of Period 5. During Period 5, it is again occupied for 55 min.

Hugh Bache's Interpretation of Case 2: Mr. Bache's interpretation for Case 2 is that the flow rate of outdoor air cannot be reduced below the value shown in Table 2 because the effective time of peak occupancy exceeds the "less than three hours duration" criterion.

Question 2. Is Mr. Bache's interpretation of Case 2 correct?

Answer 2. Yes.

INTERPRETATION IC 62-1989-20 OF ASHRAE STANDARD 62-1989 VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

January 29, 1995

Request from: Debbie Paolini, Manager of Health and Safety, The Dufferin-Peel Roman Catholic Separate School Board, 40 Matheson Blvd. West, Mississauga, Ontario L5R 1C5, CANADA

References: This request refers to the CO_2 requirements in ASHRAE Standard 62-1989, 6.1.3 Ventilation Requirements.

Background:

Ms. Paolini's letter includes the following comments:

Exception #2 under 6.1.3 Ventilation Requirements, reads in part: "Carbon dioxide concentration has been widely used as an indicator of indoor air quality. Comfort (odor) criteria are likely to be satisfied if the ventilation rate is set so that 1000 ppm CO_2 is not exceeded."

CO_2 is also referenced in 6.2.1, Quantitative Evaluation, in Table 3, Guidelines for Selected Air Contaminants of Indoor Origin and in Appendix D, Rationale for Minimum Physiological Requirements For Respiration Air Based on CO_2 Concentrations.

It is unclear what is meant by the clause, "ventilation rate is set so that 1000 ppm CO_2 is not exceeded."

Ms. Paolini's letter continues, "as a result of continuous monitoring of indoor air quality using CO_2 levels in several classrooms, we have noted that CO_2 levels peak when students enter the classroom in the morning, after morning recess, after lunch and after afternoon recess. In some instances these peaks are above 1000 ppm CO_2. Recently the provincial Ministry of Labour issued a Compliance Order at one of the schools to 'reduce the levels of CO_2 below the guideline of 1000 ppm, whenever the classrooms are occupied.'"

Question 1: Is the 1000 ppm CO_2 a ceiling value or a time weighted average value?

Answer 1: The reference to 1000 ppm CO_2 in Section 6.1.3 is only as a point of information. This is not a requirement of ASHRAE 62-1989. Since it is not a requirement it is neither a ceiling value nor a time weighted average value. Rather, it can be considered a target concentration level. Since the comfort (odor) criteria are likely to be satisfied when the CO_2 does not exceed 1000 ppm the converse is also likely to be true, i.e., when the CO_2 level exceeds 1000 ppm, the comfort (odor) criteria may not be satisfied.

Question 2: If it is a time weighted average value, how are CO_2 test results to be calculated and weighted?

Answer 2: Moot because of Answer 1.

Question 3: Would CO_2 levels measured only during room occupancy be used or CO_2 levels measured throughout the time period of ventilation system operation?

Answer 3: CO_2 levels should be measured during the time of occupancy. This is defined for the classroom as the time between initial occupancy in the morning and dismissal time for students.

INTERPRETATION IC 62-1989-21 OF ANSI/ASHRAE STANDARD 62-1989

VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

June 26, 1995

Request from: Gren Yuill, Ph.D, Professor, Department of Architectural Engineering, College of Engineering, The Pennsylvania State University, 104 Engineering "A" Bldg., University Park, PA 16802-1416

References. This request refers to Ventilation Rate Procedure in Standard 62-1989, particularly 6.1.3.1 Multiple Spaces Method.

Background. Mr. Yuill's letter indicates that he considers the requirements in 6.1.3.1 to be unambiguous, but is requesting this interpretation because others are interpreting it differently in referencing 62-1989 in proposed building energy design codes. Mr. Yuill's letter gives the following 1-A and 2-A as his interpretations and 1-B and 2-B as the interpretations of others:

1-A (Yuill interpretation): The outdoor air required by each space and specified in Table 2 must be delivered to that space, applying the Multiple Spaces Equation (6-1) to account for the effect of other rooms served by the same air supply system that may be receiving more than their specified amounts of outdoor air.

1-B (Alternative interpretation): The outdoor air required to be delivered to a building by an air supply system may be calculated by adding up the amount of outdoor air required to meet the requirements of Table 2 in each space served by that system, even if the percentage of outdoor air required may differ from space to space.

2-A (Yuill interpretation): If a variable air volume system is used, the system must be designed so that it will deliver the required amount of outdoor air to each space it serves not only under the conditions that prevail on the cooling design day, but under the full range of weather and load conditions that can be expected, and under the range of space ventilation rates and system airflows that the system will deliver to meet those loads.

2-B (Alternative interpretation): If the variable volume system delivers the required amount of outdoor air under the cooling design conditions, it need not be designed to do so under other operating conditions that may be expected to occur in the building.

Assuming that the answers to 1-A and 2-A are YES, Dr. Yuill's letter postulates the following two example variable air volume (VAV) system design approaches:

VAV System Design Approach No. 1: Assume that each VAV box will close to its minimum position at some time when the room is fully occupied. Find the critical space with the highest required outdoor air fraction, Z, when its VAV box is fully turned down. Find the building's uncorrected outdoor air fraction, X, with all the other VAV boxes at their minimum settings. Use the Multiple Spaces Equation to find the fraction, and thus the absolute amount, of outdoor air required. Repeat this calculation with all the other VAV boxes at their maximum settings. Choose the result that gives the higher outdoor air flow and design the air supply system to always deliver at least this amount.

VAV System Design Approach No. 2: Use a building energy analysis computer program to simulate the hour-by-hour operation of the building with a year of realistic weather data. Determine the flow rate through each VAV box in each hour, and use this data with assumed occupant densities and the Multiple Spaces Equation to find the amount of outdoor air required in each hour. Design an air supply system that never delivers less outdoor air than the highest of these air requirements.

Question 1. Is Dr. Yuill's interpretation 1-A correct?

Answer 1. Yes.

Comment. The intent of 62-89 is to have the outside air requirements listed in Table 2 designed to be delivered to these spaces based upon the best estimate of occupancy at the time of design. However, the impact of Eq. 6-1 on overall system outside air rates will be minimized if (a) supply air to critical spaces is increased using fan-powered boxes transferring air from a common return air plenum for example, or (b) for rooms that are particularly densely occupied such as conference rooms, when exhaust or transfer fans are used to allow air transferred from adjacent spaces to meet part of the supply air requirement, as allowed by subclause 6.1.3.1.

Question 2. Is Dr. Yuill's interpretation 2-A correct?

Answer 2. Yes.

Comment. The corrected outdoor air flow rate must be calculated for the most critical case. This outdoor air flow rate may be supplied at all times. Less air may be supplied when conditions are less critical provided the flow is recalculated based on those conditions (e.g., lower occupancy).

Question 3. Does VAV System Design Approach No. 1 satisfy Standard 62-1989?

Answer 3. Yes.

Comment. This is not the only acceptable system design approach.

Question 4. Does VAV System Design Approach No. 2 satisfy Standard 62-1989?

Answer 4. Yes.

Comment. This is not the only acceptable system design approach.

INTERPRETATION IC 62-1989-22 OF
ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

June 26, 1995

Request from: David M. Elovitz, PE, Energy Economics Inc., 26 Robinhood Road, Natick, MA 01760

References. This request seeks clarification of Table 2 in ANSI/ASHRAE Standard 62-1989.

Background. A footnote to Table 2 heading, "Estimated Maximum Occupancy, P/1000ft^2" reads as follows: "** Net occupiable space."

Energy Economics Interpretation. Energy Economics interprets that Standard 62 intends that the "net occupiable space" area is the floor area less permanent fixed furniture and fixtures, such as the display gondolas in a retail store.

Question 1. Is the Energy Economics interpretation correct?

Answer 1. No.

Question 2. If the answer to Question 1 is No, what is the definition for "net occupiable space?"

Answer 2. The floor area of an occupiable space is defined by the inside surfaces of its bounding walls.

INTERPRETATION IC 62-1989-23 OF
ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

June 26, 1995

Request from: Robert L. Towell, P.E. and Steven G. Liescheidt, P.E., Hellmuth, Obata & Kassabaum, Inc. (HOK), One Metropolitan Square, 211 North Broadway, Suite 600, Saint Louis, MO 63102-2733

Note: Text in the Background sections has been edited for sake of brevity, including deletion of two exhibits and four spreadsheets attached to the HOK letter.

References. This request refers to ANSI/ASHRAE Standard 62-1989, Clause 3 Definitions, 6.1.3 Ventilation Requirements, 6.1.3.1 Multiple Spaces, 6.1.3.3 Ventilation Effectiveness, 6.1.3.4 Intermittent or Variable Occupancy, and 6.2 Indoor Air Quality Procedure, Table 3.

HOK Background 1. Clause 3 includes definitions for *air, return; air, supply; air, transfer;* and *air, ventilation*. The definition of *air, supply* is not clear.

Question 1. Is it consistent with the Standard that air referred to as *supply air* (i.e., *air, supply*) (V_{st} and V_{sc} per 6.1.3.1) may be composed of both *ventilation air* and *transfer air*?

ASHRAE Answer 1. Yes.

HOK Background 2. The carbon dioxide (CO_2) level of 1000 ppm noted in 6.1.3 and 6.2 including Table 3 appears to be provided as a recommended guideline rather than a mandatory requirement.

Question 2. Can the carbon dioxide level in a space ever exceed the referenced value of 1000 ppm, and still remain in compliance with the Standard?

ASHRAE Answer 2. Yes.

Comment. The CO_2 level of 1000 ppm is a guideline for comfort acceptability, not a ceiling value for air quality.

HOK Background 3. When applying 6.1.3.1 for multiple spaces, if the critical space requires 100% outdoor air, the entire HVAC unit which serves the multiple spaces must be designed to provide 100% outdoor air.

Question 3a. Is it the intent of the Standard for systems which serve multiple spaces, that if any one space supplied by the system has an outdoor air fraction of 100% per Equation 6-1, the system must operate on 100% outdoor air, as shown in Spreadsheet No. 1?

ASHRAE Answer 3a. Yes.

Question 3b. Can toilet rooms with 100% exhaust, at 50 cfm/fixture in compliance with the Standard, be omitted from the critical space analysis ($Z = V_{oc}/V_{sc}$) required by 6.1.3.1?

ASHRAE Answer 3b. Yes.

Comment. See Comments column in Table 2 of 62-1989, Public Spaces, Public Restrooms.

HOK Background 4. When applying 6.1.3.1 for multiple spaces, it may be helpful to increase the quantity of supply air for a particular space to reduce the critical space outdoor air fraction (Z) for the entire system.

Question 4a. Which of the following methods would be considered consistent with the Standard for increasing the supply air (V_{sc}) to a critical space such as a conference room (shown in spreadsheet not included in this response)?

Concept 1. Increase the primary supply air (ventilation air) from the HVAC system and provide a constant volume terminal unit with reheat coil to compensate for the over cooling that may result from the excess primary air.

Concept 2. Provide an exhaust fan with ducted discharge to the ceiling plenum of an adjacent space, to mix primary supply air from the HVAC system (ventilation air) with transfer air drawn from an adjacent space to produce increased total airflow (supply air).

Concept 3. Provide a VAV air mixing device, such as a fan terminal unit, to mix primary supply air from the HVAC system (ventilation air) with plenum air to produce increased total airflow (supply air).

ASHRAE Answer. Concepts 1, 2, and 3 are all consistent with the Standard for the example described.

Question 4b. If Concept 3 is acceptable, is either of the following arrangements (options) for this system consistent with the Standard?

Option 1. Plenum air is added to the primary air and is drawn from the plenum space directly above the room served.

Option 2. Plenum air is added to the primary air and is filtered.

ASHRAE Answer 4b. No.

Comment. The portion of air recirculated directly from the room as described in Option 1 does not provide dilution of contaminants produced within the room and therefore should not be included as supply air any more than would air recirculated by a fan within the room. Concerning Option 2, the primary contaminants are not particles.

HOK Background 5a-c. Subclause 6.1.3.1 defines an uncorrected outdoor air flow rate, V_{on}, as the "sum of outdoor air flow rates for all branches of the system." A similar definition is provided for the total supply air flow rate, V_{st}, as the "sum of all supply for all branches of the system." Finally, the last paragraph in

6.1.3.1 states in part, "When spaces are unoccupied, ventilation is not generally required unless it is needed to prevent accumulation of contaminants injurious to people, contents, or structure."

Question 5a. In 6.1.3.1 is it intended that the total supply air flow rate, V_{st}, be the combination of *ventilation air* and *transfer air*?

ASHRAE Answer 5a. No.

Comment. V_{st} refers to air supplied by the system. Adding transfer air would count the same air twice. The article by David Warden in the June 1995 issue of the *ASHRAE Journal* provides an elaboration of this issue.

Question 5b. In 6.1.3.1 does supply air flow rate, V_{st}, refer to the HVAC system primary supply air, i.e., *ventilation air*?

ASHRAE Answer 5b. Yes.

Question 5c. During periods when a space is not occupied and "contaminants injurious to people" are not present, is it consistent with the Standard to not supply any ventilation air, supply air, etc., to the respective space.

ASHRAE Answer 5c. Yes.

HOK Background 5d-h. Typically, HVAC design procedures would incorporate a diversity factor for both the number of people and primary supply air flow rate to account for the reality that not all spaces would have maximum occupancy at the same time.

Question 5d. Is it consistent with the requirements of 6.1.3.1 to calculate outdoor air requirements based on the peak system occupancy and supply air values, in lieu of the sum of the peak branch values, with proper adjustment for the critical zone outdoor air fraction (Z)?

ASHRAE Answer 5d. No.

Question 5g. Is it consistent with the requirements of 6.1.3.4 to allow the system outdoor air (O.A.) flow rate to be calculated based on the average occupancy, but not less than one-half the outdoor air flow rate required by the peak occupancy level, if the peak occupancy period is less than three hours in duration? For example, based on peak total supply air, maximum outdoor air cfm/person (20.0 cfm/person from Table 2), and the critical zone outdoor air fraction (Z) of 40% (6.1.3.1):

System operation from	7 AM to 6 PM (11 hours)	
Occupancy schedule:	7 AM to 8 AM	10 people
	8 AM to 9 AM	50 people
	9 AM to 11 AM	100 people
	11 AM to 12 AM	80 people
	12 AM to 1 PM	10 people
	1 PM to 2 PM	50 people
	2 PM to 4 PM	60 people
	4 PM to 5 PM	40 people
	5 PM to 6 PM	10 people
	Average	52 people

Required outdoor air (V_{on})	=	52 people x 20.0 cfm/person = 1,040 cfm
Total HVAC system S.A.	=	9,370 cfm
Uncorrected O.A. fraction (X)	=	1,040 cfm / 9,370 cfm = 11.1%
Corrected O.A. fraction (Y)	=	11.1% / (1 + 11.1% - 40%) = 15.6%
Corrected total O.A. flow rate	=	15.6% x 9,370 cfm = 1,463 cfm O.A.
Average O.A. per person	=	14.6 cfm/person at peak occupancy

ASHRAE Answer 5g. Yes.

Comment. This answer is predicated on the assumption that the space that is eligible for application of the provision of 6.1.3.4 is the critical space.

Question 5h. Is it consistent with the Ventilation Rate Procedure that the Corrected Total Outdoor Air Flow Rate may be reduced to reflect lower actual occupancy levels during periods of lower total occupancy? This question addresses, for example, an HVAC system that serves multiple classrooms. If it can be determined that a classroom is not occupied, is it consistent with the Standard to reduce the system outdoor air flow rate during the period of lower occupancy, even though the peak occupancy period my exceed the three hours noted in 6.1.3.4?

ASHRAE Answer 5h. Yes.

Comment. If the total outdoor air supply based on the occupied space is reduced during periods of less occupancy by demand control, it is improper to also apply the variable provision of 6.1.3.4. Concentration of occupant generated contaminants would not then be adequately decreased with reduced occupancy to render the space suitable for future occupancy.

Question 5i. Is it consistent with the Ventilation Rate Procedure that, for a variable air volume (VAV) HVAC system, the Corrected Total Outdoor Air Flow Rate must be provided as a minimum outdoor air intake value under all occupied operating conditions of the system?

ASHRAE Answer 5i. Yes.

Comment. The corrected outdoor air flow rate must be calculated for the most critical case. This outdoor air flow rate may be supplied at all times. Less air may be supplied when conditions are less critical provided the flow is recalculated based on those conditions (e.g., lower occupancy).

HOK Background 6. The term *occupied space* as used in the first sentence of 6.1.3, and in the definition of *occupied zone*, is not defined.

Question 6a. Is it the intent of the Standard that an *occupied space* means the volume of space defined by the inside surfaces of the walls, floors, and ceilings of each room?

ASHRAE Answer 6a. Yes.

Question 6b. Is it the intent of the Standard that *occupied space* means the volume of space defined by the inside surfaces of the walls, floors, and ceilings of the entire building?

ASHRAE Answer 6b. No.

Comment. The occupied space of the building is the sum of the volumes of the occupied spaces as defined by the inside dimensions of each space.

HOK Background 7. Subclause 6.1.3.3 states in part, "The values in Table 2 define the outdoor air needed in the occupied zone for well mixed conditions (ventilation effectiveness approaches 100%)....", and refers to Appendix F for additional information.

Question 7a. If an air distribution design is provided to maximize air mixing, and minimize "ventilation air bypassing the occupants," is it consistent with the Standard to assume an effectiveness of 100%?

ASHRAE Answer 7a. Yes.

Question 7b. If an air distribution design is provided which may result in a portion of the "ventilation air bypassing the occupants," is it required by the Standard to adjust the Table 2 values to correct for the reduced effectiveness?

ASHRAE Answer 7b. Not necessarily.

Comment. The answer is dependent on ventilation effectiveness, not bypass alone. The answer is YES if, having gone through the analysis, the ventilation effectiveness is less than 90%.

Question 7c. If the answer to 7b is YES, is the following calculation procedure consistent with the Standard for an effectiveness of 60%?

Room Type: Two person office space
Table 2 Requirements: 20 cfm/person outdoor air
Standard ventilation rate: 2 people x 20 cfm/person = 40 cfm outdoor air
Ventilation effectiveness: 60%
Adjusted ventilation rate: 40 cfm / 60% = 66.7 cfm min. outdoor air

ASHRAE Answer 7c. Yes.

Question 7d. If supply air devices are provided that achieve an Air Diffusion Performance Index (ADPI) of 75 or greater, as defined in Chapter 31 Space Air Diffusion of the 1993 ASHRAE Handbook of Fundamentals, is it consistent with the Standard to assume an effectiveness of 100%?

ASHRAE Answer 7d. Yes.

Comment. We note the statement in Fundamentals Chapter 31 (p. 31.15):

"For an office environment in cooling mode, the design goal should be an ADPI greater than 80. The ADPI should not be used as a measure of performance for heating conditions."

The ADPI does not account for the Recirculation Flow Factor, described in Appendices E and F of Standard 62-1989. Therefore, the assurance of a ventilation effectiveness being close to the value of unity (1) with an ADPI of 75 or 80 is less with a 100% outdoor air supply than with a supply containing a significant proportion of recirculated air.

**INTERPRETATION IC 62-1989-24 OF
ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY**

July 12, 1995

Request from: David O. Vick, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, TN 37831

References. This request refers to Table 2 and subclause 6.1.3.3 of ANSI/ASHRAE 62-1989.

Background. Table 2 prescribes supply rates of acceptable outdoor air required for acceptable indoor air quality. The standard states (6.1.3.3), "The values in Table 2 define the outdoor air needed in the occupied zone for well-mixed conditions (ventilation effectiveness approaches 100%)." The standard recognized that ventilation effectiveness is often much lower than 100%, i.e., $E_v < 1$, because there is less than perfect mixing in the occupied space.

Mr. Vick's Interpretation. Mr. Vick's letter opines, ". . . that the required ventilation rate must account for imperfect mixing, and that the values in Table 2 refer to an effective volumetric flow (V_{eff}) rather than what might be called the mechanical ventilation rate (V_{act}). Therefore, in practice, the engineered ventilation rate must be greater than the values in Table 2 in order to compensate for imperfect mixing of the ventilation air in the occupied space."

Question. Is Mr. Vick's interpretation of Table 2 and 6.1.3.3 correct as given above?

Answer. Yes.

Comment. If the ventilation effectiveness is E_v the values in Table 2 must be multiplied by $1/E_v$. For example, if the ventilation effectiveness is 0.8, typical of ceiling supply and return system in a heating (warm supply air) mode, the values in Table 2 must be multiplied by 1/0.8 = 1.25. For a ceiling supply and return system in the cooling mode, the ventilation effectiveness is around 1.0 so no adjustment is required. For a displacement ventilation system, ventilation effectiveness may be greater than one, allowing values in Table 2 to be reduced for a displacement system.

INTERPRETATION IC 62-1989-25 OF
ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

January 26, 1997

Request from: Kevin F. Wade, P.E., Advanced Power Control, Inc., 126 Sandy Drive, P.O. Box 7019, Newark, DE 19714

References. This request refers to subclause 6.2 Indoor Air Quality Procedure of ANSI/ASHRAE Standard 62-1989.

Background. The last two sentences of 6.2 read as follows:

> "The Indoor Air Quality Procedure provides a direct solution by restricting the concentration of all known contaminants of concern to some specified levels. It incorporates both quantitative and subjective evaluation."

The last paragraph of 6.2.1 includes the following sentence:

> "Application of generally acceptable technology, and vigilance regarding adverse influences of reduced ventilation, must therefore suffice."

Mr. Wade's Interpretation No. 1. Mr. Wade's letter states,"I interpret the phrase 'all known contaminants of concern' to be contaminants specific to an occupation or task being performed in the space in question (e.g. - monitoring for ammonia in a blue print room) and not to mean all contaminants that may be present (e.g.- individual monitors for all the pollutants listed in applicable tables of informative Appendix C Guidance for the Establishment of Air Quality Criteria for the Indoor Environment)."

Mr. Wade's Interpretation No. 2. Mr. Wade's letter further states, "I interpret `Application of generally accepted technology ....' to be the use of Volatile Organic Compound (VOC) sensors for the monitoring of contaminants that may be generated by a building and its contents."

Question 1. Is Mr. Wade's Interpretation No. 1 correct?

Answer. No.

Comment. Depending upon the rationale for using the Indoor Air Quality Procedure for design, there may be different interpretations of what are the "contaminants of concern" in the given application. While this interpretation rests solely with the user of this Procedure, it may be helpful to consider two distinct categories of use, in keeping with the philosophy of the Standard. The contaminants of concern may be very different for these two categories.

In the first case, the designer knows of unusual sources of a particular contaminant or contaminants that will be present in an otherwise typical space due to its use, construction, etc. As a first step, these particular contaminants may be the only ones considered as contaminants of concern. Provided these contaminants are satisfactorily controlled at outdoor air rates equal to or higher than the rates required by the Ventilation Rate Procedure, the "usual" contaminants in the space need not be considered "contaminants of concern."

In the second case, the designer is attempting to utilize new materials, new technology and/or innovative design, etc. to reduce outdoor air rates below those required by the Ventilation Rate Procedure. In this case, all known contaminants maybe considered contaminants of concern. The designer should evaluate the "usual" contaminants as contaminants of concern in this scenario because anyone may otherwise be present in greater concentration than would be the case when using the Ventilation Rate Systems or Prescriptive Procedure.

Question No. 2. Is Mr. Wade's interpretation of No. 2 correct?

Answer. No.

Comment: The technology strategy to apply the IAQ Procedure is much broader than ventilation control using VOC sensors. It may include source control, appropriate ventilation and ventilation control strategies, as well as contaminant sensors to control ventilation.

INTERPRETATION IC 62-1989-26 OF
ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

January 26, 1997

Request from: Robert S. Swinney and Larry D. Riggs, Engineers Consortium, 8016 State Line, Suite 200, Leawood, Kansas 66208.

Reference. This request pertains to the requirements given in subclause 6.1.3.4 of ANSI/ASHRAE Standard 62-1989.

Background. An excerpt of Subclause 6.1.3.4 reads as follows:

> “Where peak occupancies of less than three hours duration occur, the outdoor air flow rate may be determined on the basis of average occupancy for buildings for the duration of operation of the system, provided the average occupancy used is not less than one-half the maximum."

Engineers Consortium has established the following two possible interpretations to define "peak occupancies of less than three hours duration:"

Engineers Consortium Interpretation. The term "peak occupancies" allows multiple peak periods over the daily operation time of the system and that each space served by a common HVAC system may have its own unique peak time thereby allowing for diversity in the building. Example: theater (motion picture) auditoriums where movie durations are less than three hours, where 15-30 minutes are provided between occupancies, where occupancy times are staggered for each space served by common HVAC systems, and for the associated lobbies where occupancies are transient and of a very short duration. The entire facilities are non-smoking.

Alternative Interpretation. Only one peak occupancy may be used within a 24 hour period.

Question. Is Engineers Consortium's interpretation correct?

Answer. Yes.

Comment. This interpretation is consistent with Interpretation IC 62-1989-12 (question 2) relating to multiple peaks of less than three hours duration.

INTERPRETATION IC 62-1989-27 OF
ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

January 26, 1997

Request from: Mike Schell, Englehard Sensor Technology, 6489 Calle Real, Goleta, CA 93117.

References. This request refers to ANSI/ASHRAE 62-1989 subclauses 6.1.3 Ventilation Requirements, 6.1.3.4 Intermittent or Variable Occupancies, and Figure 4 Maximum Permissible Ventilation Lag Time.

Mr. Schell's letter provides the following background in two parts:

Englehard Background No.1. In Interpretation IC 62-1989-23 of ANSI/ASHRAE Standard 62-1989, the comment in support of Answer 5h states that the use of demand control with the Ventilation Rate Procedure where the variable provision of 6.1.3.4 is applied is improper. "Comment. If the total outdoor air supply based on the occupied space is reduced during periods of less occupancy by demand control, it is improper to also apply the variable provision of 6.1.3.4."

Answer 5h supports the use of demand control with the Ventilation Rate Procedure as long as demand control is properly applied, the variable provision of 6.1.3.4 is not applied, and other requirements are met. This request seeks to clarify the requirements for proper use and implementation of demand control with the Ventilation Rate Procedure.

Englehard Interpretation No. 1. It is consistent with the Ventilation Rate Procedure that demand control be permitted for use to reduce the total outdoor air supply during periods of less occupancy, providing the following conditions are met:

a) The variable provision of 6.1.3.4 is not applied to lower the estimated maximum occupancy for the purpose of reducing the design ventilation rate.

b) CO_2 is not being removed by methods other than dilution ventilation, such as gas phase sorption filtration (interpretation IC 62-1989-7).

c) The designer has not routinely presumed that lag ventilation will result in acceptable indoor air quality, but has considered the potential for "appreciable buildup of contaminants during the unoccupied hours," for instance "from materials of machines in building, microbially contaminated areas, or activities of maintenance personnel" (Interpretation IC 62-1989-7).

d) Where required, the multiple spaces requirements of 6.1.3.1 are used to determine the system outdoor air quantity using the corrected fraction of outdoor air.

e) Sensor location and setpoints are selected on the basis of achieving the rates in Table 2.

f) Method of demand control of outdoor air intake is properly implemented (See Englehard Interpretations No. 2 and 3 below).

Question 1. Is Englehard Interpretation No. 1 correct?

Answer. Yes.

Comment. However, good practice and the rationale on which the ventilation rates in Table 2 are based, indicates the need for a non-zero base ventilation rate to handle non-occupant sources whenever the space is occupied.

Englehard Background No. 2. The considerations presented in the first sentences of Section 6.1.3.4, Intermittent or Variable Occupancy, must always be taken into account when considering the use of demand control based on CO_2 levels. Designs must take into account the need to ensure increased outdoor air intake within the maximum permissible ventilation lag time as shown in Figure 4 of ANSI/ASHRAE Standard 62-1989.

Englehard Interpretation No. 2. It is consistent with the Ventilation Rate Procedure that demand control be permitted for use to reduce the total outdoor air supply during periods of less occupancy if it is properly implemented using a make or break CO_2 controller to call for the design ventilation rate in accordance with the requirements of the Ventilation Rate Procedure and Table 2.

Question 2. Is Englehard Interpretation No. 2 correct?

Answer. Yes.

Englehard Interpretation No. 3. It is consistent with the Ventilation Rate Procedure that demand control be permitted for use to reduce the total outdoor air supply during periods of less occupancy, if it is properly implemented using a Proportional, Proportional-Integral, or Proportional-Integral-Derivative controller to control outdoor air intake, using the difference between indoor and outdoor CO_2 levels to meet the requirements of the Ventilation Rate Procedure and Table 2.

Question 3. Is Englehard Interpretation No. 3 correct?

Answer. Yes.

INTERPRETATION IC 62-1989-28 OF
ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

April 26, 1998

Request from: Mr. Mike Pella, Steven Feller P.E. Inc.

References: This request refers to Table 2 of Standard 62-1989

Background: Under "Hotels, Motels, Resorts, Dormitories," the outdoor air requirements for "bedrooms" and "living rooms" are listed as 30 cfm while the requirement for "baths" are listed as 35 cfm. Unlike "public restrooms," there is no comment across from hotel/motel bathroom stating that the outdoor air requirement is "Normally supplied by transfer air." However, section 6.1.3 states in part, "Rooms provided with exhaust air systems, such as kitchens, baths, toilet rooms, and smoking lounges, may utilize air supplied through adjacent habitable or occupiable spaces to compensate for the air exhausted."

Question 1: Can the outdoor air requirement for a hotel/motel bathroom be met by exhausting the bathroom at a rate of at least 35 cfm with make-up air by transfer from the adjacent guestroom rather than direct supply of outdoor air to the bathroom?

Answer: Yes.

Question 2: Does a design wherein 35 cfm of outdoor air is supplied to the hotel/motel bedroom then exhausted through the bathroom at the same rate meet the standard for both the bedroom and the bathroom?

Answer: Yes.

Comment: The principle behind ventilation is to dilute pollutants generated in the space being ventilated. Outdoor air is primarily used as ventilation supply air since it usually has very low or negligible concentrations of the pollutants we are trying to dilute. Since the primary pollutants in bathrooms and toilet rooms are odors and moisture that are not present in adjacent spaces, air transferred from those spaces may be used as effectively for ventilation and dilution as outdoor air.

For clarity, the SSPC will consider adding a note in Table 2 for "Baths" in "Hotels, Motels, Resorts, Dormitories" stating that the rate specified is "exhaust air normally made-up by transfer air," similar to the notes for bathrooms and restrooms in other occupancy categories.

INTERPRETATION IC 62-1989-29 OF
ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

April 26, 1998

Request from: H.E. Burroughs, IAQ/Building Wellness Consultancy
225 Mt. Ranier Way Alpharetta, GA 30022-5438

References. This request refers to **Section 6.2 of Standard 62-1989**

Background. **A high school in Pasco County, Florida was renovated to correct air quality; thermal; humidity; pressurization; and equipment operating, control, and capacity deficiencies. The corrective renovation was performed as a performance contract, which balanced the corrective design tactics with energy optimization constraints.**

Concurrently, the county school board administration required the renovation to conform to Standard 62-1989. The design was based upon the IAQ method of Standard 62 and included the following features:

- **Ventilation rates @ 10 cfm per student design occupancy**
- **Positive pressurization control**
- **Rigorous humidity control**
- **Controlled at less than 60% RH 24 hours per day**
- **Dedicated outdoor air pre-treatment**
- **Continuous RH monitoring**
- **Continuous system operation based on humidity sensing**
- **Upgrade and replacement of all air handlers**
- **Ducted return air system**
- **Individual classroom temperature control**
- **High efficiency mini pleat particulate filtration (95% ASHRAE Atmospheric Dust Spot) pre-filtered with 2" pleats**
- **High capacity gas phase air cleaners (deep pleated active particle type)**
- **CO_2 monitoring**
- **New supply air diffusers to optimize ventilation effectiveness**

The facility was extensively evaluated prior to renovation to establish baseline IAQ data and to determine areas and contaminants of concern. The facility was re-evaluated subsequent to construction to verify air quality levels and compliance to Standard 62. The environmental quality factors evaluated included temperature, relative humidity, carbon monoxide, carbon dioxide, nitrogen dioxide, volatile organic compounds, respirable particulates, pressurization, and sound.

The values on the iterated factors documented compliance and attainment of a high level of indoor air quality. In this evaluation, carbon dioxide was monitored over an extended period to assure the response and behavior patterns of the HVAC system-not as a quality assurance target.

The origin of this interpretation request emerges from a concern on the part of the owner that regulatory representatives use 1000 ppm of CO_2 as a measure of ventilation where corrective action is recommended. These recommendations are interpreted by staff and parents to be requirements with which the school district must comply. To not comply triggers negative repercussions with the staff and parents and invites additional visits by the regulatory agency representatives resulting in possible mandates or penalties.

Question. **When the IAQ Procedure of Section 6.2 is employed and gas phase air cleaners are installed to control bioeffluents and odors, is the 1000 ppm CO_2 guideline value in Table 3 still applicable?**

Answer. No.

Comment. While **the 1000 ppm guideline may still be useful, it is not strictly relevant to situations where air cleaning is employed to control odors from human bioeffluents. The 1000 ppm guideline in Table 3 is based on the use of indoor carbon dioxide concentration as an indicator of human bioeffluent concentrations and on the need to control the level of bioeffluents in order to provide indoor air quality that is acceptable in terms of olfactory perception (odor). Furthermore, indoor carbon dioxide concentrations in the range of 1000 ppm or less are not related to any health impact from the carbon dioxide itself, only to odor perception. 1000 ppm is the steady-state carbon dioxide concentration corresponding to a constant ventilation rate of 15 cfm/person of outdoor air at a concentration of about 350 ppm in a space occupied by sedentary adults. Chamber studies have shown that 15 cfm/person and indoor carbon dioxide concentrations that are about 650 ppm above outdoors correspond to 80% satisfaction of visitors to such a space with respect to body odor. If the bioeffluents that result in perceptions of human body odor are controlled by means other than dilution ventilation, for example, by gas phase air cleaning, then the indoor carbon dioxide concentration is no longer a useful indicator of perception of these objectionable bioeffluents. Therefore, if the IAQ Procedure is employed and gas phase air cleaning is used to control bioeffluents, then the 1000 ppm carbon dioxide guideline in Table 3 is not strictly applicable.**

However, when using the IAQ Procedure, one must still consider the concentrations of all relevant pollutants and the ability of the design approach to control these pollutants. Even when gas phase air cleaning is used, ventilation may still be a significant means of pollutant control. Since indoor carbon dioxide concentrations can be a useful indicator of outdoor air ventilation rates per person, carbon dioxide concentrations may still be meaningful in relation to overall ventilation rates and the concentrations of other pollutants. However, no generalizable relationship exists between indoor carbon dioxide concentrations and the concentrations of other pollutants, as it

does between carbon dioxide and human bioeffluents.

INTERPRETATION IC 62-1989-30 OF
ANSI/ ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

January 1999

Request from: Suzanne K. Condon, Department of Public Health, The Commonwealth of Massachusetts, 250 Washington Street, Boston, MA 01206-4619, (Contact Michael Feeney, 617 624-5757).

Reference: This request for interpretation refers to the requirements presented in ANSI/ASHRAE Standard 62-1989, Section 6.1.3 Ventilation Requirements, Exception 1.

Background: Section 6.1.3 Exception 1 requires that when "unusual indoor contaminants or sources are present or anticipated, they shall be controlled at the source or the procedure of section 6.2 (i.e., the Indoor Air Quality (IAQ) Procedure) shall be followed." The renovation of a building can involve a number of activities that release volatile organic compounds, and other indoor air pollutants. The question has arisen of how to apply ASHRAE Standard 62-1989 to situations of high contaminant emission rates shortly after renovation.

Condon's Interpretation No. 1: Volatile organic compounds and other contaminants that off-gas at high rates shortly after renovation are "unusual indoor contaminants or sources" in the context of Exception 1 to section 6.1.3 of ASHRAE Standard 62-1989.

Question No. 1: Is Condon's Interpretation No. 1 correct?

Answer: Yes, but only if the contaminants and their emission rates lead to unacceptable indoor air quality.

Comment: ASHRAE Standard 62-1989 does not specifically address the contaminants associated with renovation. Such contaminants, including VOCs, and the emission rates that exist after renovation may or may not lead to unacceptable indoor air quality in a building ventilated at the rates in Table 2 of ASHRAE Standard 62-1989, and therefore, may nor may not constitute unusual contaminants or sources. In order to determine whether the contaminants and emission rates are unusual within the context of Standard 62-1989 requires an analysis of the contaminants, their emission rates and the ventilation rates that exist in a given situation.

Condon's Interpretation No. 2: The Indoor Air Quality Procedure of Section 6.2 is the required procedure for achieving acceptable indoor air quality in a building after renovations.

Question No. 2: Is Condon's Interpretation No. 2 correct?

Answer: No

Comment: As noted in the response to Question No. 1 above, the emissions associated with renovation do not necessarily constitute an unusual source. If they do, then Exception 1 in Section 6.1.3 requires the use of either source control or the IAQ Procedure. Even if the post-renovation emissions do not constitute an unusual contaminant or source, it may be prudent to operate the ventilation system for extended periods of time or at elevated outdoor air intake rates until these emissions abate, or to delay occupancy for a period of time.

INTERPRETATION IC 62-1989-31 OF
ANSI/ ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

April 1, 1999

Request from: Richard Fox, Allied Signal, Chair TC 9.3

Reference: This request for interpretation refers to the requirements presen ted in ANSI/ASHRAE Standard 62-1989, Table 2 relating to vehicles.

Background: The scope of standard 62 does not explicitly address transportation ventilation. Table 2 has a single listing for vehicles under the heading of "Transportation" and contains a comment that "ventilation within vehicles may require special considerations." No specific listing of the types or conditions on these vehicles is mentioned. There are many kinds of vehicles, many of which have special needs. Other standards are written or are being written to deal with specific vehicles, such as aircraft.

Interpretation No. 1: Standard 62 cannot be applied to transportation HVAC applications.

Question No. 1: Is Interpretation No. 1 correct?

Answer: No. The scope of 62-89 specifically applies to all enclosed spaces. The entry for vehicles may be used for transportation applications.

Comment: ASHRAE Standard 62-1989 does not specifically address many kinds of occupancies covered in its broad scope. Nonetheless, when it was written, the Society chose to try to cover all ventilation applications, even if only broadly. The standard is under continuous maintenance now and efforts are underway to limit the scope of the standard to occupancies that can be dealt with explicitly and in code language. Whether the requirements of Standard 62 *should* be applied to specific vehicles would be a decision for the authority having enforcement jurisdiction.

Interpretation No. 2: The entry in Table 2 was not developed with the specific needs of aircraft in mind.

Question No. 2: Is Interpretation No. 2 correct?

Answer: Yes.

Comment: As noted in the response to Question No. 1 above, 62-89 covers vehicles only broadly. The note in the table indicates ventilation within vehicles requires special consideration, but the standard does not state what that is. ASHRAE is currently developing a standard specifically on aircraft ventilation and such a standard would contain the details of such "special considerations."

INTERPRETATION IC 62-1989-32 OF
ANSI/ASHRAE STANDARD 62-1989
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

June 19, 1999

Request from: Brian Hall, Naval Facilities Engineering

Reference: This request for interpretation refers to the requirements present ed in ANSI/ASHRAE Standard 62-1989, Tables 2.

Background: Tables 2 specifies minimum ventilation rates for a variety of occupancy types. With respect to residential-type sleeping spaces, there are three entries: In Table 2.1 under "Hotels, Motels, Resorts, Dormitories" there is an entry for "Bedrooms" (30 cfm/room) and another for "Dormitory sleeping areas" (15 cfm/person). In Table 2.3 under "Ventilation of Residential Facilities (Private Dwellings, Single, Multiple)," there is an entry for "living areas" which includes bedrooms. This interpretation relates to a Bachelors Enlisted Quarters, a three-story building consisting of several private bedrooms, every two of which share a bathroom and a "service area," which is essentially a small kitchenette and storage area.

Interpretation No. 1: The Bachelors Enlisted Quarters (BEQ) is considered an apartment building and thus ventilation rates for the building must be determined from Table 2.3 "Ventilation of Residential Facilities (Private Dwellings, Single, Multiple)."

Question No. 1: Is Interpretation No. 1 correct?

Answer: No.

Comment: Depending on the circumstances, either Table 2.1 or Table 2.3 may be appropriate. One of the primary distinctions between the residential buildings covered by Table 2.3 and the commercial occupancies covered by Table 2.1 is the amount of individual control occupants have in residential buildings over furnishings, decorations, and operation of ventilation systems. If the BEQ is characterized by these limitations in occupant control, it and similar spaces would not be covered by Table 2.3. Under circumstances where the occupants have control over sources, systems and indeed their occupancy, then the use of Table 2.3 may be more appropriate.

Interpretation No. 2: Assuming Table 2.1 rates apply, the correct ventilation rate for the BEQ bedrooms is that listed for "dormitory sleeping area" (15 cfm per person), as opposed to that listed for "bedrooms" (30 cfm per room).

Question No. 2: Is Interpretation No. 2 correct?

Answer: No.

Comment: "Dormitory sleeping areas" in this context refer to large open areas of beds, like those found in barracks. This can be seen by the estimated occupancy density for this space type in Table 2.1 which is 20 people per 1000 ft^2, two or three times more dense than would be expected in a BEQ room. "Bedrooms" in Table 2.1 refer to single or double occupancy rooms such as hotel rooms or school dormitory rooms. The BEQ rooms fall into this category. Hence, the proper ventilation rate for these rooms is 30 cfm per room.

INTERPRETATION IC 62-1999-09 OF
ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-1) on June 22, 1991, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Eugene M. Moreau, P.E., Manager, Indoor Air Program, Division of Health Engineering, State of Maine, Department of Human Services, Augusta, ME 04333.

References. This request refers to the requirements for ventilation of public restrooms given in ASHRAE Standard 62-1989, Table 2.1, and in paragraphs 6.1.3.1, 6.1.3.2 and 6.1.3.4.

Question 1. Is intermittent exhaust permissible in restrooms?

Answer. Yes. Restroom ventilation may be interrupted under the procedure of subsection 6.1.3.4, "Intermittent or Variabale Occupancy."

Question 2. Are the remarks in Table 2.1 mandatory or advisory?

Answer. Advisory (should, or recommended), unless stated as mandatory (shall).

INTERPRETATION IC 62-1999-10 OF
ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-2a) on December 13, 1993, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: This reissued interpretation incorporates changes to the caveat accompanying the answer to Question 1 and deletes the comment. It also incorporates editorial changes for clarification of the Background Section, the headings, and Comment (b) to Answer 3. This revised interpretation is intended to resolve comments received as a result of publication of the original interpretation in the October 1991 issue of the ASHRAE Journal. The comments were received from Mr. Kenneth D. Mentzer, North American Insulation Manufacturers Association, 44 Canal Center Plaza, Suite 310, Alexandria, VA 22314. The original request for interpretation was received from William S. Ostrander, P.E., Newcomb & Boyd, Consulting Engineers, One Northside 75, Atlanta, GA 30318-7761.

References. This request refers to the requirements given in ASHRAE Standard 62-1989, paragraphs 5.6, 5.11 and 5.12.

Background. The questions in Mr. Ostrander's April 2, 1991 letter relate to the control of microorganisms in ventilation systems. His letter is quoted below. The Interpretation Committee responses to specific questions follow.

"We (Newcomb & Boyd) are told that their growth accelerates in the presence of increased moisture, nutrients and rough textured surfaces to shelter the colony; and that the denial of one or more of these essentials is an effective control means.

1. Section 5.6 requires ducts and plenums to be 'constructed and maintained to minimize the opportunity for growth and dissemination of microorganisms.' This is being interpreted by some individuals as prohibiting the use of glass fiber or any other type duct liner with a rough surface where particles would be likely to adhere. Duct linings can be coated or encapsulated to provide a smoother surface, but these surfaces are still subject to damage.

Our interpretation of this section is that it is not intended to prevent the use of conventional duct linings for acoustical control purposes. It is intended to minimize the growths by appropriate means, including:

(a) avoiding unnecessary use of duct liner,

(b) emphasis on proper air filtration upstream of duct liner, especially during the construction period when large quantities of nutrients and contaminants are present,

(c) encapsulation of duct liner,

(d) protection of duct liner with perforated metal, or similar protected package sound attenuators, and

(e) provision of access to duct liner for future cleaning.

2. Sections 5.11 and 5.12 reference the risk of mold, mildew, fungus, and other growths in high humidity environments. Section 5.12 cautions about 'humidity above 70 percent RH in low velocity ducts and plenums.' The humidity

downstream of a dehumidifying coil will generally be between 90 and 95 percent RH. The velocity in the supply air ducts of a 'low velocity' air distribution system will generally vary between 2000 fpm at the fan to as low as 700 fpm at the extremities.

This statement could be interpreted as requiring or recommending a maximum of 70 percent RH in the supply system downstream of the cooling coils. Such interpretation would require the use of reheat or cooling coil bypass, resulting in either a large increase in supply air quantity or a significant lowering of chilled water or refrigerant temperature. A substantial initial system cost and annual energy penalty is involved.

We (Newcomb & Boyd) interpret this statement as a caution: since the high relative humidity will promote the growths of microorganisms, it is essential to minimize the accumulation of dirt that would provide nutrients. The same preventative measures listed above would accomplish this objective."

Question 1. "Is our (Newcomb & Boyd) interpretation of 5.6 correct as given in Item No. 1 above?"

Interpretation Committee (IC) Answer 1. Yes, with the following caveat:

It is not the intent of 5.6 to restrict the use of any duct lining material provided adequate precautions have been used to prevent the accumulation of liquid water, condensation, and moisture at levels conducive to microbial growth.

Question 2. "Is our (Newcomb & Boyd) interpretation of 5.11 and 5.12 correct as given in Item No. 2 above?"

IC Answer 2. Yes.

Question 3. "(Newcomb & Boyd) Is it the intent of 5.12 to limit the relative humidity to 70 percent or less in low velocity ducts and plenums?"

IC Answer 3. No.

IC Comments

(a) Paragraph 5.6 is mandatory for users who wish to claim compliance with the standard, while 5.11 and 5.12 are advisory in nature.

(b) It is the intent of 5.11 and 5.12 to advise the user of the standard of conditions that, especially in combination, are conducive to the growth of microorganisms. The currently available means of using desiccants for dehumidification are expensive, and the practice commonly used in the past of reheating subcooled air for humidity control purposes has been discarded, except in special applications, by the need to conserve energy and economic resources. Practical measures available today include those listed by Mr. Ostrander in 1(a - e) above, plus assuring that drain pans remain free of standing water. Also, it is recommended that 50 to 70 percent efficient or better filters be specified in 1(b). Paragraph 5.12 gives additional recommendations. In general, microbiological growth can be controlled by limiting moisture or by limiting nutrients (e.g., dirt and debris). Innovative design concepts for reducing moisture as well as dirt and debris in air supply systems are encouraged.

(c) The requirements and recommendations given in ASHRAE 62-1989 are based on investigation by microbiologists of buildings experiencing complaints of poor indoor air quality. Yet most buildings operate with duct humidities in excess of 70 percent without complaints. Standards Project Committee 62-1981R believes there is urgent need for research to provide more data on why not all susceptible buildings experience poor indoor air quality.

INTERPRETATION IC 62-1999-11 OF
ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-3) on April 4, 1993, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Preston E. McNall, Phoenix Engineers, 10041 El Monte, Overland Park, KA 66207

Reference: This request refers to the requirements given in ASHRAE Standard 62-1989, Table 2.1, Outdoor Air Ventilation Requirements - Commercial Facilities.

Background: Dr. McNall's letter points out that Table 2.1 lacks a recommended ventilation rate for court rooms. By referring to hotel and office conference rooms and theater auditoriums, his letter opines that the appropriate figure would be between 15 and 20 cfm/person. Dr. McNall characterizes the space as a civil court room, smoking not permitted, with occasional presence of apprehension or excitement.

Question: What are ASHRAE's recommended values for Estimated Maximum Occupancy and Outdoor Air Requirements for civil court rooms?

Answer: Estimated Maximum Occupancy: 70 persons/1000 ft^2
Outdoor Air Requirement: 15 cfm/person

Comments:

1. The values listed in Table 2.1 for conference room spaces are based on moderate smoking, which does not apply to court rooms.

2. ASHRAE Standard 62-1973 listed the estimated persons/1000 ft^2 as 70 for legislative chambers, a close kin to court rooms.

INTERPRETATION IC 62-1999-12 OF
ANSI/ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-4) on April 20, 1993, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Mr. Hy Sandler, Sumner Schein Architects and Engineers Limited Partnership, The Maple Leaf Building, 23 East Street, Cambridge, MA 02141-1215

References: Mr. Sandler's request refers to Standard 62-1989, Table 2 (reprint marked STD 62 Rev 10/91 G on outside back cover)

Background: In Table 2 under the "Estimated Maximum Occupancy" column heading, there is a double asterisk footnote designating "Net Occupiable Space." However, under the "Outdoor Air Requirement" column heading, the double asterisk does not appear with the cfm/ft^2 and $L/s \times m^2$ subheadings.

Question: Are the cfm/ft^2 and $L/s \times m^2$ values based on net occupiable space?

Answer: Yes.

Comment: The required rates of acceptable outdoor air calculated from area-based criteria are intended to be based on net occupiable space in the same manner as the person-based criteria. The estimated maximum occupancy column is not relevant where area-based ventilation rates are listed, since occupants are not expected to be the primary source of contaminants in these spaces.

The project committee will consider eliminating occupancy values for all spaces having area-based ventilation rates in the next addendum or revision.

INTERPRETATION IC 62-1999-13 OF
ANSI/ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-5) on April 30, 1993, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Mr. Frederick Satink, Industrial Hygiene Engineer, State of Vermont, Vermont Department of Health, Division of Occupational and Radiological Health, Administration Building, 10 Baldwin Street, Montpelier, Vermont 05602

References: Mr. Satink's request refers to Standard 62-1989, Table 2.

Background: In ANSI/ASHRAE 62-1989, Table 2 Outdoor Air Requirements for Ventilation indicates that "Ice Arenas (playing areas)" should be ventilated at the rate of 0.50 cfm/ft^2. Mr. Satink's letter opines, that the parenthetical clause means that this value should apply to the playing area only (i.e. the ice area) and not the total square footage of building. He surmises that spectator area ventilation requirements are calculated separately and would use the value 15 listed under the cfm/person heading. This volume of acceptable outdoor air would then be added to the volume calculated for the ice arena (and any other occupiable space) to arrive at the total figure for the building.

Question: Is Mr. Satink's interpretation correct?

Answer: Yes

Comment: The first item under Sports and Amusement in Table 2 addresses spectator areas in general with the remainder of the topic items noted as areas having different types of activity levels requiring different ventilation rates. A rate per square foot is more appropriate to use than a rate per person when occupant loads vary significantly, e.g., recreational skating versus hockey. Although there may be fewer hockey players on the rink, their activity level is much greater than recreational skaters.

INTERPRETATION IC 62-1999-14 OF
ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-6) on June 27, 1993, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Janet Kremzar, Mechanical Engineer, SAI Engineers, Inc., 3030 Patrick Henry Drive, PO Box 54979, Santa Clara, CA 95054-0979

Reference. This request refers to the requirements given in ASHRAE Standard 62-1989, paragraph 6.1.3.4.

Background. Paragraph 6.1.3.4 reads as follows:

"Where peak occupancies of less than three hours duration occur, the outdoor air flow rate may be determined on the basis of average occupancy for buildings for the duration of operation of the system, provided the average occupancy used is not less than one-half the maximum."

SAI has established the following two possible interpretations for complying with 6.1.3.4 with respect to an airport terminal building with 24 hour daily operation. Peak occupancy occurs for less than three hours, with an average occupancy of less than half the peak occupancy.

SAI Interpretation No. 1. Outdoor air flow rate is determined on the basis of 1/2 peak occupancy for the full 24 hour operation period.

SAI Interpretation No. 2. Outdoor air flow rate is determined on the basis of peak occupancy for a three hour period and 1/2 peak occupancy for the remaining 21 hours of operation.

SAI believes that Interpretation No. 1 above expresses the intent of Standard 62-1989.

Question. Is SAI's interpretation No. 1 correct?

Answer. Yes

INTERPRETATION IC 62-1999-15 OF
ANSI/ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-7) on June 27, 1993, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: This is a joint request, originated by Ms. Carol C. Brumfield, Industrial Hygienist, Law Engineering, P.O. Box 5726, 3901 Carmichael Avenue, Jacksonville, FL 32207; and supplemented by John D. Cowan, Cowan Quality Buildings, 74 Willowbank Blvd, Toronto, ON Canada M5N 1G6.

References: This request refers to Standard 62-1989, 6.1.2 Ventilation Requirements, including the footnote to Table 2; and to 6.2.1 Quantitative Evaluation, second paragraph.

Background: Table 2 footnote states: "Table 2 prescribes supply rates of acceptable outdoor air required for acceptable indoor air quality. These values have been chosen to control CO_2 and other contaminants with an adequate margin of safety and to account for health variations among people, varied activity levels, and a moderate amount of smoking. Rationale of CO_2 control is presented in Appendix D."

The last three sentences of 6.1.3 state: "Carbon dioxide concentration has been widely used as an indicator of indoor air quality. Comfort (odor) criteria are likely to be satisfied if the ventilation rate is set so that 1000 ppm CO_2 is not exceeded. In the event CO_2 is controlled by any method other than dilution, the effects of possible elevation of other contaminants must be considered (see Refs 12-18)."

For the Indoor Air Quality Procedure a similar caution is given in the second paragraph of 6.2.1.

Ms. Brumfield's letter states that some are using this "dilution" provision as justification to install CO_2 filtration systems in buildings, in lieu of designing according to the ventilation rate method, in order to cut first costs and operating costs associated with the additional outdoor air requirement within the building.

Mr. Cowan's letter states that CO_2 sensors are being used by some to control the volume intake of outdoor air and by others to control of CO_2 filters. In either case, the referenced sections are cited as justification for claiming compliance with the standard if CO_2 is maintained under 1000 ppm.

Both requesters interpret that:

1. The Ventilation Rate Procedure is intended to control many more factors than the level of CO_2. That very fact disallows the use of CO_2 control to reduce outdoor air intake below Table 2 values, if compliance with the Ventilation Rate Procedure is claimed.

2. The Air Quality Procedure requires consideration of many more factors than the level of CO_2. Therefore, CO_2 control of outdoor air intake or the filtration of CO_2 can not be used as sole proof of compliance under the Air Quality Procedure.

3. The standard allows for a filtration system to be installed in order to reduce the outdoor air requirement if there are known potential contaminants that will be generated in the facility, such as Environmental Tobacco Smoke (ETS) from smokers or formaldehyde from indoor processes.

Question: Are the above interpretations by Ms. Brumfield and Mr. Cowan correct?

Answer 1: Yes

Answer 2: Yes

Comment: Filtration of CO_2 is not an appropriate way to comply with Standard 62, since CO_2 is a surrogate for other contaminants. Removal of CO_2 may not have any effect on the contaminants for which it is a surrogate (e.g., occupant odors).

Answer 3: Yes

Comment: Standard 62-1989 allows air filtration (air cleaning) to be used to reduce outdoor air requirements below rates specified in Table 2, but only if the Indoor Air Quality Procedure is used (see 6.1.3.2). It is possible that air cleaning provided in accordance with this procedure to handle "known potential contaminants generated in the facility" will not allow outdoor air requirements to be reduced below the minimum values in Table 2.

INTERPRETATION IC 62-1999-16 OF
ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-8) on September 22, 1993, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Eileen P. Senn, Shop Steward, CWA Local 1034, 321 West State Street, Trenton, NJ 08618

References. This request refers to the requirements given in ASHRAE Standard 62-1989, paragraphs 5.1 and 5.11.

Background

1. Paragraph 5.1 of the standard states in part:

> "When natural ventilation and infiltration are relied upon, sufficient ventilation shall be demonstrable."

Ms. Senn's letter interprets "sufficient ventilation" to mean ventilation rates specified in Table 2, or alternatively, ventilation sufficient to meet the indoor air quality guidelines in Table 3.

2. Paragraph 5.11 of the standard states in part:

> "Relative humidity in habitable spaces preferably should be maintained between 30% and 60% relative humidity ...."

Ms. Senn's letter interprets that this range should be maintained by using mechanical humidification and/or dehumidification equipment, if necessary.

Question 1. Is Ms. Senn's interpretation of 5.1 correct as given in Item No. 1 above?

Answer 1. No with respect to ventilation rates. Yes with respect to IAQ Guidelines in Table 3 "Guidelines for Selected Air Contaminants of Indoor Origin."

Comment. Demonstration of ventilation rates specified in Table 2 is only one of the acceptable methods. Acceptable means of demonstrating natural ventilation include the infiltration methods described in Chapter 23 "Infiltration and Ventilation" of the 1993 ASHRAE Handbook - Fundamentals. Acceptable means of demonstrating openable areas to the outdoors for natural ventilation are given in the model building codes. Documentation of a background of successful natural ventilation experience in similar buildings and building uses could also be considered suitable demonstration.

Question 2. Is Ms. Senn's interpretation of 5.11 correct as given in Item No. 2 above?

Answer 2. Yes

Comments.

a) It is important to note that the word "should" in 5.11 is a recommendation and not a mandatory requirement.

b) Since ASHRAE 62-1989 does not define "habitable space," the provisions of 5.11 would not apply to bathrooms, toilet compartments, halls, or storage or utility spaces, as currently defined in model building codes. ASHRAE SSPC 62 will consider adding a definition for "habitable space" in the next revision of the standard.

INTERPRETATION IC 62-1999-17 OF
ANSI/ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-9) on October 6, 1993, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Donald C. Herrmann, Creighton & Associates, Inc., 611 East Broward Boulevard, Suite 207, Fort Lauderdale, Florida 33301

Reference. This request pertains to the requirements given in ASHRAE Standard ANSI/ASHRAE 62-1989 including Addendum 62a-1990, paragraph 6.1.3

Background. Paragraph 6.1.3 reads as follows:

> "Where occupant density differs from that in table 2, use the per occupant ventilation rate for the anticipated occupancy load."

Creighton & Associates has established the following two possible interpretations for complying with 6.1.3.

Interpretation No. 1. If an anticipated occupancy rate is provided by an owner or architect and it is less than or greater than that listed in Table 2, the system designer is to use the anticipated occupancy in lieu of the estimated maximum occupancy P/1000 square feet listed in Table 2.

Interpretation No. 2. If a local occupancy code or fire occupancy code indicates a greater occupancy than that listed in table 2, the system designer is to use the greater of the occupancies regardless of the known or anticipated occupancy provided by the building owner or architect.

Creighton & Associates believes that Interpretation No. 1 above expresses the intent of Standard 62-1989.

Question. Is Interpretation No. 1 correct?

Answer. Yes

Comment. Interpretation No. 1 is consistent with the directions on occupant density given in 6.1.3. Provisions of ASHRAE 62-1989 do not have legal precedence over prevailing codes that may contain conflicting provisions. Occupancy loads as codified for fire safety are based upon considerations that may differ from those on which ventilation are based. In jurisdictions where ASHRAE 62-1989 is adopted into the building or mechanical code by reference, it is our opinion that 6.1.3 is applicable and appropriate; however, this opinion should be confirmed by the authority having jurisdiction.

INTERPRETATION IC 62-1999-18 OF
ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-10) on October 18, 1993, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: David R. Aldridge, U.S. Army Engineer Division - Huntsville, CEHND-ED-ME, Huntsville, AL 35807-4301

Reference. This request refers to the requirements given in ASHRAE Standard 62-1989, Subsection 6.1 Ventilation Rate Procedure, and paragraph 6.1.3.4 Intermittent or Variable Occupancy.

Background. Paragraph 6.1.3.4 reads in part:

"Where peak occupancies of less than three hours duration occur, the outdoor air flow rate may be determined on the basis of average occupancy for buildings for the duration of operation of the system, provided the average occupancy used is not less than one-half the maximum."

Mr. Aldridge's letter presupposes a case where the peak occupancy of a classroom is 300 students and the occupancy period is less than three hours. His letter opines that the "less than three hours duration" stipulated in 6.1.3.4 is to be used as a fixed elapsed time period over which to average the occupancy loading; i.e., paragraph 6.1.3.4 allows averaging the occupant loading over the period of occupancy which is to be less than three hours. Thus, 300 persons for 1.5 hours and zero persons for 1.5 hours is an average of 150 persons over 3 hours. This results in an outdoor air requirement of 150 persons x 15 cfm/person = 2250 cfm.

Question. Is Mr. Aldridge's interpretation correct?

Answer. No

Comment. It is coincidence that the numerical result happens to be correct for the example presented. The occupancy is to be averaged over "the duration of operation of the system," not "over the period of occupancy which is to be less than 3 hours."

The intermittent occupancy provision contained in 6.1.3.4 of the Standard also can be applied to multiple daily episodes of peak occupancy as long as each is for less than three hours. It is intended to apply to occupancy profiles that permit pollutant reduction through over-ventilation (on a per person basis) during intervening periods of reduced occupancy between peaks.

More precise guidelines will be studied for possible incorporation into the next revision of the standard.

INTERPRETATION IC 62-1999-19 OF
ANSI/ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-11) on December 9, 1993, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Douglas Wall, P.E., The Trane Company, 4811 S. Zero Street, Fort Smith, AR 72903

References. This request refers to Standard 62-1989, Subsection 5.4 and Section 6.

Background. Subsection 5.4 states in part:

> "**5.4** When the supply air is reduced during times the space is occupied... provision shall be made to maintain acceptable indoor air quality throughout the occupied zone."

Mr. Wall's letter interprets this to mean that thermostatically controlled supply air fans violate the standard if no provision is made to restart the fan when the indoor air quality no longer meets the requirements given in Section 6. His letter explains, "for example, a unit may supply the proper outside air flow rate while the space thermostat calls for heating or cooling, but the unit will stop supplying air when the thermostat is satisfied. His letter opines that since the thermostat may be satisfied indefinitely, control of indoor air quality through ventilation is lost.

Question. Is the interpretation in Mr. Wall's letter correct?

Answer. Yes

INTERPRETATION IC 62-1999-20 OF
ANSI/ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-12) on December 9, 1993, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Donald C. Herrmann, Creighton & Associates, Inc., 611 East Broward Boulevard, Suite 207, Fort Lauderdale, Florida 33301

Reference. This request pertains to the requirements given in ASHRAE Standard ANSI/ASHRAE 62-1989 including Addendum 62a-1990, paragraph 6.1.3.4.

Background. Paragraph 6.1.3.4 reads as follows:

> "Where peak occupancies of less than three hours duration occur, the outdoor air flow rate may be determined on the basis of average occupancy for buildings for the duration of operation of the system, provided the average occupancy used is not less than one-half the maximum."

Case 1. Creighton & Associates has established the following two possible interpretations for complying with 6.1.3.4

1-A (Creighton & Associates interpretation). The system designer may use an average occupancy value when determining the required outdoor air flow for variable occupancies to prevent over ventilating, providing it is not less than one-half the maximum listed in table 2 or one-half the anticipated peak occupancy load as referenced in 6.1.3.4.

1-B (Alternative interpretation). The system designer may use an average occupancy value when determining the required outdoor air flow for variable occupancies to prevent over ventilating, providing it is not less than one-half the maximum listed in table 2.

Creighton & Associates believes that Interpretation No. 1a above expresses the intent of Standard 62-1989.

Question 1. Is interpretation No. 1-A correct?

Answer 1. Yes

Case 2. Creighton & Associates has established the following two possible interpretations to define "peak occupancies of less than three hours duration."

2-A (Creighton & Associates interpretation). The term "peak occupancies" allows more than one peak period of less than three hours duration over the operation time of the system. Examples; auditoriums, conference rooms, special use classrooms, concert halls, etc.

2-B (Alternative interpretation). Only one peak occupancy may be used within a twenty four hour period.

Creighton & Associates believes that Interpretation No. 2a above expresses the intent of Standard 62-1989.

Question 2. Is interpretation No. 2-A correct?

Answer 2. Yes

INTERPRETATION IC 62-1999-21 OF
ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-13) on January 20, 1994, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Dennis Stefani, Executive Officer, Environmental Services, Calgary Health Services, PO Box 4016, Station "C", 320 17th Avenue S.W., Calgary, Alberta T2T 5T1 CANADA

References. This request refers to the requirements given in ASHRAE Standard 62-1989, Appendix C, Guidance for the Establishment of Air Quality Criteria for the Indoor Environment.

Background. Appendix C, third paragraph, states in part that it has been customary to use 1/10 the TLV in indoor environments occupied by the public.

Question. Is this recommendation inclusive of the TLV averaging times and ceiling limits? In other words, if the TLV for compound "x" is 20 ppm, 8 hour time weighted average (TWA), is the public exposure guideline an 8 hour TWA as well?

Answer. No

Comments. The "divide by ten" guide is an attempt to give a sense of the concentration of concern for various chemicals where indoor air standards do not exist. This guide is not provided in professional hygiene documents and there is no consensus within the industrial hygiene community as to its appropriateness. (Note ASHRAE conference proceedings *IAQ92 Environments for People*, including the discussion at the end of the Peter Breysse paper, pp. 13-21.) Any attempt to use this rule in a precise way, as implied by this question, is contrary to its intended use as a scale factor.

The appropriate use of TLVs, and any set "criteria values" in consideration of indoor environments has been proposed as a topic to be covered in the next revision of ASHRAE 62.

INTERPRETATION IC 62-1999-22 OF
ANSI/ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-14) on May 1, 1994, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Max H. Sherman, Lawrence Berkeley Laboratory, Building 90, Room 3074, Berkeley, CA 94720

References. This request refers to ANSI/ASHRAE 62-1989, Subsection 6.1.3, Table 2.3, Outdoor Air Requirements for Ventilation of Residential Facilities (Private Dwellings, Single, Multiple), and specifically to the comments in Table 2.3 associated with the entry, "Living areas." Also referenced is ANSI/ASHRAE 136-1993, A Method of Determining Air Change Rates in Detached Dwellings.

Background. The comment in Table 2.3 states in part: "The ventilation is normally satisfied by infiltration and natural ventilation."

Dr. Sherman's letter opines that the referenced comment does not specify how this is to be determined, over what time frame, what kind of averaging is allowed, etc. The purpose of ANSI/ASHRAE Standard 136-1993 is essentially ". . . to provide a procedure for determining effective air change rates in detached dwellings . . . for use in evaluating the impact . . . on indoor air quality." Dr. Sherman interprets the referenced statements in ASHRAE 62 and ASHRAE 136 to mean that the rates calculated by ASHRAE 136 are one acceptable form of compliance to Table 2.3 of ASHRAE 62-1989 for single-family, detached dwellings.

Question. Is Dr. Sherman's interpretation correct?

Answer. Yes

INTERPRETATION IC 62-1999-23 OF
ANSI/ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-15) on June 3, 1994, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Barry L. Spurlock, P.E., Member, Georgia Building and Mechanical Task Force, Georgia Department of Community Affairs, 1200 Equitable Building, 100 Peachtree Street, Atlanta, GA 30303.

References. This request refers to the intermittent and variable occupancy criteria in Standard 62-1989, 6.1.3.4.

Background. Mr. Spurlock's letter cites Table 2.2 requirement that outside air be provided in school classrooms at the rate of 15 cfm per person.

Subsection 6.1.3.4 deals with intermittent or variable occupancy and states in part: "Where peak occupancies of less than three hours duration occur, the outdoor air flow rate may be determined on the basis of average occupancy for buildings for the duration of the operation of the system, provided the average occupancy is not less than one half the maximum."

Mr. Spurlock's letter also enclosed typical schedules for elementary, middle and high schools in the Gwinnett County Georgia Public Schools. These schedules indicate that on a typical day the HVAC systems run 510 minutes and during this time the classroom is occupied 250 minutes or 49 percent of the time. Also enclosed is an actual schedule for a typical elementary school classroom indicating that the classroom is occupied 44 percent of the time.

Mr. Spurlock's letter interprets that, using this occupancy rate and the variable occupancy rule, the outside air to a typical classroom can be reduced to a level required by the average occupancy of the space, which in this example is half the peak occupancy. The outdoor air required for this average occupancy is 15 cfm per person.

Question. Is Mr. Spurlock's interpretation correct?

Answer. Yes.

INTERPRETATION IC 62-1999-24 OF

ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-16) on June 26, 1994, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Bruce F. Kimball, Marshall Erdman and Associates, Inc., 5117 University Avenue, Madison, WI 53705

Reference. This request refers to the requirements given in ASHRAE Standard 62-1989, paragraph 6.1.3 and 6.1.3.1.

Background. Paragraph 6.1.3 Ventilation Rate Requirements states in part:

> "Indoor air quality shall be considered acceptable if the required rates of acceptable outdoor air in Table 2 are provided for the occupied space."

Paragraph 6.1.3.1 Multiple Spaces states in part:

> "Where more than one space is served by a common supply system, the ratio of outdoor to supply air required to satisfy the ventilation and thermal control requirements may differ from space to space. The system outdoor air quantity shall then be determined using Equation 6.1."

Mr. Kimball's letter opines that it is not necessary to apply equation 6.1 if the required rates of acceptable outdoor air in Table 2 are provided to each space.

Question. Is Mr. Kimball's interpretation correct?

Answer. Yes

Comment. The project committee has found the issue of how and when to apply Table 2 and Equation 6.1 difficult to resolve and will consider proposals for clarifying/modifying the requirements in the next revision of Standard 62.

Case 3. Creighton & Associates has established the following two possible interpretations for complying with 6.1.3.4.

3-A (Creighton & Associates interpretation) The system designer may, at his or her option, lead or lag the ventilation supply to the space. This is not a mandatory requirement.

3-B (Alternative interpretation) Lead/Lag ventilation is a mandatory part of the standard and shall be used in the design of ventilating systems for all occupied spaces of intermittent or variable occupancies.

Question 3. Is interpretation No. 3-A correct?

Answer 3. Yes

Comment: The concept of lag ventilation assumes no appreciable buildup of contaminants during the unoccupied hours However, such a buildup may occur from materials or machines in the building, microbially contaminated areas, or activities of maintenance personnel. The designer should therefore not routinely presume that lag ventilation will result in acceptable indoor air quality.

INTERPRETATION IC 62-1999-25 OF
ANSI/ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-17) on September 11 and 27, 1994, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Paul B. Miskowicz, P.E., Integrated Planning & Engineering, Inc., 3333 S. Wadsworth Blvd., Suite D231, Lakewood, CO, 80227

References. This request refers to the requirements given in ANSI/ASHRAE Standard 62-1989, Subsections 5.4, 6.1.3.4 and 6.1.3.1.

Background No. 1. Mr. Miskowicz's letter of June 28, 1994 states:

Subsection 5.4 reads:
"5.4 When the supply of air is reduced during times when the space is occupied, provision shall be made to maintain acceptable indoor air quality throughout the occupied zone."

Subsection 6.1.3.4 states in part:
"6.1.3.4 Intermittent or Variable Occupancy. Ventilating systems for spaces with intermittent or variable occupancy may have their outdoor air quantity adjusted by use of dampers or by stopping and starting the fan system to provide sufficient dilution to maintain contaminant concentrations within acceptable levels at all times."

Table 2 lists "Outdoor Air Requirements for Ventilation" based on the type of space.

IP&E's Interpretation No. 1. IP&E interprets that supply fans can be duty cycled on and off during occupied times for energy conservation, provided that the supply of outdoor air to the occupied space provides sufficient dilution to maintain contaminant concentrations within acceptable levels at all times, even if this produces a time-averaged rate of outside air introduction that is less than the rate set forth in Table 2.

Background No. 2. Subsection 6.1.3.1 Multiple Spaces gives a procedure for determining the system outdoor air quantity, and Table 2 lists "outdoor air requirements for ventilation" based on the type of space.

IP&E's Interpretation No. 2. IP&E interprets that it is acceptable to provide less than the quantity of outside air called for in Table 2 to the critical space in an application where one supply system serves multiple spaces with differing outside air requirements, example:

Consider a system that serves two spaces with Table 2 outdoor air requirements (e.g., cfm/person x persons) of 100 and 500 cfm (47 and 236 l/s) respectively, and supply airflow rates (dictated by temperature control requirements) of 1000 cfm (472 l/s) each. Equation 6-1 yields a corrected outdoor-air-in-system fraction (OAF) of 0.375. But at this OAF, the rate of outdoor air delivered to the critical space with 1000 cfm (472 l/s) of total supply is 375 cfm (177 l/s) versus the 500 cfm (236 l/s) requirement calculated from Table 2.

IP&E interprets Subsection 6.1.3.1 to allow the corrected (reduced) amount of outside air to be used to avoid designing a system that consumes an excess amount of energy while maintaining a minimum level of acceptable ventilation.

Question 1. Is IP&E's Interpretation No. 1 correct?

Answer 1. No.

Comment: When the user of the standard chooses the ventilation rate procedure involving Table 2, the time-averaged rate of outdoor air is required to be at least that specified in Table 2. The indoor air quality procedure of clause 6.2 must be used if methods other than outdoor ventilation rate are used to control contaminants so that the time-averaged ventilation rates drop below that of Table 2.

Question 2. Is IP&E's Interpretation No. 2 correct?

Answer 2. Yes.

Comment: This is a direct application of Equation 6-1.

Using the symbols of that equation, the uncorrected fraction of outdoor air in the system supply, X, is 600/2000 = 0.3. The fraction of outdoor air in the critical space, Z, is 500/1000 = 0.5. Therefore, the corrected fraction of outdoor air in the system supply is 0.3/(1 + 0.3 - 0.5) = 0.375.

The outdoor air supplied to the system must be 0.375(2000) = 750 cfm (354 l/s). The total outdoor air, 750 cfm (354 l/s), is greater than the 600 cfm (283 l/s) required by Table 2 if two separate outdoor air supplies were available, yet less than the 1000 cfm (472 l/s) required if the outdoor air supply were set by the critical space requiring 500 cfm (236 l/s).

INTERPRETATION IC 62-1999-26 OF
ANSI/ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-18) on January 29, 1995, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: David Elovitz, PE, Energy Economics, Inc., Registered Professional Engineers, 26 Robinhood Road, Natick, MA 01760

References: This request seeks a clarification of Table 2, under Public Spaces: Corridors and Utilities.

Background: Table 2 requires 0.05 CFM per sq ft minimum outside air ventilation for public corridors.

Question: Does Standard 62-1989 intend to require outside air ventilation for exit corridors and service corridors which are not normally occupied, but only used for egress and for delivery of merchandise, such as the service corridors in a shopping mall which are not part of the normal public circulation system?

Answer: Yes. The value of 0.05 cfm/sq ft should be supplied to these spaces assuming there is transient occupancy.

INTERPRETATION IC 62-1999-27 OF
ANSI/ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-19) on January 29, 1995, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: W. Hugh Bache, P.E., 4739 Brownstone Drive, Duluth, GA 30136

References. This request concerns subsection 6.1.3.4 of ANSI/ASHRAE Standard 62-1989.

Background. Subsection 6.1.3.4 states in part: "Where peak occupancies of less than three hours duration occur, the outdoor air flow rate may be determined on the basis of average occupancy for buildings for the duration of the operation of the system, provided the average occupancy is not less than one half the maximum."

Mr. Bache's letter cites a general application of classroom HVAC. An isolated classroom is served by a dedicated classroom HVAC unit (water source heat pump, fan-coil unit or unitary equipment) with ventilation (outside) air introduced into the classroom unit's return (recirculated) air duct. The classroom is fully occupied during each class period and partially occupied during the 6 minutes transition between the bell marking the end of a period and the tardy bell for the next period.

Case 1. The classroom is in use for Periods 1, 2, and 3, consuming a total time of 3 hrs. and 2 min. Of this total time, the classroom is fully occupied for 2 hrs and 50 min., and partially occupied during the transition between class periods for a total of 12 min. After Period 3, it is unoccupied during Period 4 and the succeeding lunch period for a total time of 1 hr. and 42 min. before the start of Period 5. During Period 5, it is again occupied for 55 min.

Hugh Bache's Interpretation of Case 1. Mr. Bache's interpretation for Case 1 is that the flow rate of outdoor air may be reduced below the value shown in Table 2 to the extent allowed for intermittent variable occupancy as defined in 6.1.3.4, since the effective time of peak occupancy meets the "less than three hours duration" criterion.

Question 1. Is Mr. Bache's interpretation of Case 1 correct?

Answer 1. No. In the situation you described the committee believes that the rooms should be considered occupied during the six minute class change interval between classes. Students are on their feet exiting and entering the rooms. If anything, their metabolic rate is higher suggesting a need for increased ventilation.

Case 2. The classroom is in use for Periods 1, 2, 3, and 4, consuming a total time of 4 hrs. and 3 min. Of this total time, it is fully occupied for 3 hrs and 45 min., and partially occupied between periods for a total of 18 min. After Period 4, the classroom is unoccupied for 41 min. before the start of Period 5. During Period 5, it is again occupied for 55 min.

Hugh Bache's Interpretation of Case 2: Mr. Bache's interpretation for Case 2 is that the flow rate of outdoor air cannot be reduced below the value shown in Table 2 because the effective time of peak occupancy exceeds the "less than three hours duration" criterion.

Question 2. Is Mr. Bache's interpretation of Case 2 correct?

Answer 2. Yes.

INTERPRETATION IC 62-1999-28 OF
ANSI/ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-21) on June 26, 1995, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Gren Yuill, Ph.D, Professor, Department of Architectural Engineering, College of Engineering, The Pennsylvania State University, 104 Engineering "A" Bldg., University Park, PA 16802-1416

References. This request refers to Ventilation Rate Procedure in Standard 62-1989, particularly 6.1.3.1 Multiple Spaces Method.

Background. Mr. Yuill's letter indicates that he considers the requirements in 6.1.3.1 to be unambiguous, but is requesting this interpretation because others are interpreting it differently in referencing 62-1989 in proposed building energy design codes. Mr. Yuill's letter gives the following 1-A and 2-A as his interpretations and 1-B and 2-B as the interpretations of others:

1-A (Yuill interpretation): The outdoor air required by each space and specified in Table 2 must be delivered to that space, applying the Multiple Spaces Equation (6-1) to account for the effect of other rooms served by the same air supply system that may be receiving more than their specified amounts of outdoor air.

1-B (Alternative interpretation): The outdoor air required to be delivered to a building by an air supply system may be calculated by adding up the amount of outdoor air required to meet the requirements of Table 2 in each space served by that system, even if the percentage of outdoor air required may differ from space to space.

2-A (Yuill interpretation): If a variable air volume system is used, the system must be designed so that it will deliver the required amount of outdoor air to each space it serves not only under the conditions that prevail on the cooling design day, but under the full range of weather and load conditions that can be expected, and under the range of space ventilation rates and system airflows that the system will deliver to meet those loads.

2-B (Alternative interpretation): If the variable volume system delivers the required amount of outdoor air under the cooling design conditions, it need not be designed to do so under other operating conditions that may be expected to occur in the building.

Assuming that the answers to 1-A and 2-A are YES, Dr. Yuill's letter postulates the following two example variable air volume (VAV) system design approaches:

VAV System Design Approach No. 1: Assume that each VAV box will close to its minimum position at some time when the room is fully occupied. Find the critical space with the highest required outdoor air fraction, Z, when its VAV box is fully turned down. Find the building's uncorrected outdoor air fraction, X, with all the other VAV boxes at their minimum settings. Use the Multiple Spaces Equation to find the fraction, and thus the absolute amount, of outdoor air required.

Repeat this calculation with all the other VAV boxes at their maximum settings. Choose the result that gives the higher outdoor air flow and design the air supply system to always deliver at least this amount.

VAV System Design Approach No. 2: Use a building energy analysis computer program to simulate the hour-by-hour operation of the building with a year of realistic weather data. Determine the flow rate through each VAV box in each hour, and use this data with assumed occupant densities and the Multiple Spaces Equation to find the amount of outdoor air required in each hour. Design an air supply system that never delivers less outdoor air than the highest of these air requirements.

Question 1. Is Dr. Yuill's interpretation 1-A correct?

Answer 1. Yes.

Comment. The intent of 62-89 is to have the outside air requirements listed in Table 2 designed to be delivered to these spaces based upon the best estimate of occupancy at the time of design. However, the impact of Eq. 6-1 on overall system outside air rates will be minimized if (a) supply air to critical spaces is increased using fan-powered boxes transferring air from a common return air plenum for example, or (b) for rooms that are particularly densely occupied such as conference rooms, when exhaust or transfer fans are used to allow air transferred from adjacent spaces to meet part of the supply air requirement, as allowed by subclause 6.1.3.1.

Question 2. Is Dr. Yuill's interpretation 2-A correct?

Answer 2. Yes.

Comment. The corrected outdoor air flow rate must be calculated for the most critical case. This outdoor air flow rate may be supplied at all times. Less air may be supplied when conditions are less critical provided the flow is recalculated based on those conditions (e.g., lower occupancy).

Question 3. Does VAV System Design Approach No. 1 satisfy Standard 62-1989?

Answer 3. Yes.

Comment. This is not the only acceptable system design approach.

Question 4. Does VAV System Design Approach No. 2 satisfy Standard 62-1989?

Answer 4. Yes.

Comment. This is not the only acceptable system design approach.

INTERPRETATION IC 62-1999-29 OF
ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

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Originally issued as interpretation of Standard 62-1989 (IC 62-1989-22) on June 26, 1995, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: David M. Elovitz, PE, Energy Economics Inc., 26 Robinhood Road, Natick, MA 01760

References. This request seeks clarification of Table 2 in ANSI/ASHRAE Standard 62-1989.

Background. A footnote to Table 2 heading, "Estimated Maximum Occupancy, P/1000ft^2" reads as follows: "** Net occupiable space."

Energy Economics Interpretation. Energy Economics interprets that Standard 62 intends that the "net occupiable space" area is the floor area less permanent fixed furniture and fixtures, such as the display gondolas in a retail store.

Question 1. Is the Energy Economics interpretation correct?

Answer 1. No.

Question 2. If the answer to Question 1 is No, what is the definition for "net occupiable space?"

Answer 2. The floor area of an occupiable space is defined by the inside surfaces of its bounding walls.

INTERPRETATION IC 62-1999-30 OF
ANSI/ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

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Originally issued as interpretation of Standard 62-1989 (IC 62-1989-24) on July 12, 1995, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: David O. Vick, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, TN 37831

References. This request refers to Table 2 and subclause 6.1.3.3 of ANSI/ASHRAE 62-1989.

Background. Table 2 prescribes supply rates of acceptable outdoor air required for acceptable indoor air quality. The standard states (6.1.3.3), "The values in Table 2 define the outdoor air needed in the occupied zone for well-mixed conditions (ventilation effectiveness approaches 100%)." The standard recognized that ventilation effectiveness is often much lower than 100%, i.e., $E_v < 1$, because there is less than perfect mixing in the occupied space.

Mr. Vick's Interpretation. Mr. Vick's letter opines, ". . . that the required ventilation rate must account for imperfect mixing, and that the values in Table 2 refer to an effective volumetric flow (V_{eff}) rather than what might be called the mechanical ventilation rate (V_{act}). Therefore, in practice, the engineered ventilation rate must be greater than the values in Table 2 in order to compensate for imperfect mixing of the ventilation air in the occupied space."

Question. Is Mr. Vick's interpretation of Table 2 and 6.1.3.3 correct as given above?

Answer. Yes.

Comment. If the ventilation effectiveness is E_v the values in Table 2 must be multiplied by $1/E_v$. For example, if the ventilation effectiveness is 0.8, typical of ceiling supply and return system in a heating (warm supply air) mode, the values in Table 2 must be multiplied by 1/0.8 = 1.25. For a ceiling supply and return system in the cooling mode, the ventilation effectiveness is around 1.0 so no adjustment is required. For a displacement ventilation system, ventilation effectiveness may be greater than one, allowing values in Table 2 to be reduced for a displacement system.

INTERPRETATION IC 62-1999-31 OF
ANSI/ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-25) on January 26, 1997, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Kevin F. Wade, P.E., Advanced Power Control, Inc., 126 Sandy Drive, P.O. Box 7019, Newark, DE 19714

References. This request refers to subclause 6.2 Indoor Air Quality Procedure of ANSI/ASHRAE Standard 62-1989.

Background. The last two sentences of 6.2 read as follows:

> "The Indoor Air Quality Procedure provides a direct solution by restricting the concentration of all known contaminants of concern to some specified levels. It incorporates both quantitative and subjective evaluation."

The last paragraph of 6.2.1 includes the following sentence:

> "Application of generally acceptable technology, and vigilance regarding adverse influences of reduced ventilation, must therefore suffice."

Mr. Wade's Interpretation No. 1. Mr. Wade's letter states,"I interpret the phrase ‘all known contaminants of concern’ to be contaminants specific to an occupation or task being performed in the space in question (e.g. - monitoring for ammonia in a blue print room) and not to mean all contaminants that may be present (e.g.- individual monitors for all the pollutants listed in applicable tables of informative Appendix C Guidance for the Establishment of Air Quality Criteria for the Indoor Environment)."

Mr. Wade's Interpretation No. 2. Mr. Wade's letter further states, "I interpret `Application of generally accepted technology ....' to be the use of Volatile Organic Compound (VOC) sensors for the monitoring of contaminants that may be generated by a building and its contents."

Question 1. Is Mr. Wade's Interpretation No. 1 correct?

Answer. No.

Comment. Depending upon the rationale for using the Indoor Air Quality Procedure for design, there may be different interpretations of what are the "contaminants of concern" in the given application. While this interpretation rests solely with the user of this Procedure, it may be helpful to consider two distinct categories of use, in keeping with the philosophy of the Standard. The contaminants of concern may be very different for these two categories.

In the first case, the designer knows of unusual sources of a particular contaminant or contaminants that will be present in an otherwise typical space due to its use, construction, etc. As a first step, these particular contaminants may be the only ones considered as contaminants of concern. Provided these contaminants are satisfactorily controlled at outdoor air rates equal to or higher than the rates required by the Ventilation Rate Procedure, the "usual" contaminants in the space need not be considered "contaminants of concern."

In the second case, the designer is attempting to utilize new materials, new technology and/or innovative design, etc. to reduce outdoor air rates below those required by the Ventilation Rate Procedure. In this case, all known contaminants maybe considered contaminants of concern. The designer should evaluate the "usual" contaminants as contaminants of concern in this scenario because anyone may otherwise be present in greater concentration than would be the case when using the Ventilation Rate Systems or Prescriptive Procedure.
Question No. 2. Is Mr. Wade's interpretation of No. 2 correct?

Answer. No.

Comment: The technology strategy to apply the IAQ Procedure is much broader than ventilation control using VOC sensors. It may include source control, appropriate ventilation and ventilation control strategies, as well as contaminant sensors to control ventilation.

INTERPRETATION IC 62-1999-32 OF
ANSI/ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

TRANSFER TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-26) on January 26, 1997, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Robert S. Swinney and Larry D. Riggs, Engineers Consortium, 8016 State Line, Suite 200, Leawood, Kansas 66208.

Reference. This request pertains to the requirements given in subclause 6.1.3.4 of ANSI/ASHRAE Standard 62-1989.

Background. An excerpt of Subclause 6.1.3.4 reads as follows:

> "Where peak occupancies of less than three hours duration occur, the outdoor air flow rate may be determined on the basis of average occupancy for buildings for the duration of operation of the system, provided the average occupancy used is not less than one-half the maximum."

Engineers Consortium has established the following two possible interpretations to define "peak occupancies of less than three hours duration:"

Engineers Consortium Interpretation. The term "peak occupancies" allows multiple peak periods over the daily operation time of the system and that each space served by a common HVAC system may have its own unique peak time thereby allowing for diversity in the building. Example: theater (motion picture) auditoriums where movie durations are less than three hours, where 15-30 minutes are provided between occupancies, where occupancy times are staggered for each space served by common HVAC systems, and for the associated lobbies where occupancies are transient and of a very short duration. The entire facilities are non-smoking.

Alternative Interpretation. Only one peak occupancy may be used within a 24 hour period.

Question. Is Engineers Consortium's interpretation correct?

Answer. Yes.

Comment. This interpretation is consistent with Interpretation IC 62-1989-12 (question 2) relating to multiple peaks of less than three hours duration.

INTERPRETATION IC 62-1999-33 OF
ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

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Originally issued as interpretation of Standard 62-1989 (IC 62-1989-27) on January 26, 1997, but transferred to Standard 62-1999. Since no changes were made to the relevant sections of Standard 62-1999, no revisions were made to the interpretation as part of this transfer.

Request from: Mike Schell, Englehard Sensor Technology, 6489 Calle Real, Goleta, CA 93117.

References. This request refers to ANSI/ASHRAE 62-1989 subclauses 6.1.3 Ventilation Requirements, 6.1.3.4 Intermittent or Variable Occupancies, and Figure 4 Maximum Permissible Ventilation Lag Time.

Mr. Schell's letter provides the following background in two parts:

Englehard Background No.1. In Interpretation IC 62-1989-23 of ANSI/ASHRAE Standard 62-1989, the comment in support of Answer 5h states that the use of demand control with the Ventilation Rate Procedure where the variable provision of 6.1.3.4 is applied is improper. "Comment. If the total outdoor air supply based on the occupied space is reduced during periods of less occupancy by demand control, it is improper to also apply the variable provision of 6.1.3.4."

Answer 5h supports the use of demand control with the Ventilation Rate Procedure as long as demand control is properly applied, the variable provision of 6.1.3.4 is not applied, and other requirements are met. This request seeks to clarify the requirements for proper use and implementation of demand control with the Ventilation Rate Procedure.

Englehard Interpretation No. 1. It is consistent with the Ventilation Rate Procedure that demand control be permitted for use to reduce the total outdoor air supply during periods of less occupancy, providing the following conditions are met:

a) The variable provision of 6.1.3.4 is not applied to lower the estimated maximum occupancy for the purpose of reducing the design ventilation rate.

b) CO_2 is not being removed by methods other than dilution ventilation, such as gas phase sorption filtration (interpretation IC 62-1989-7).

c) The designer has not routinely presumed that lag ventilation will result in acceptable indoor air quality, but has considered the potential for "appreciable buildup of contaminants during the unoccupied hours," for instance "from materials of machines in building, microbially contaminated areas, or activities of maintenance personnel" (Interpretation IC 62-1989-7).

d) Where required, the multiple spaces requirements of 6.1.3.1 are used to determine the system outdoor air quantity using the corrected fraction of outdoor air.

e) Sensor location and setpoints are selected on the basis of achieving the rates in Table 2.

f) Method of demand control of outdoor air intake is properly implemented (See Englehard Interpretations No. 2 and 3 below).

Question 1. Is Englehard Interpretation No. 1 correct?

Answer. Yes.

Comment. However, good practice and the rationale on which the ventilation rates in Table 2 are based, indicates the need for a non-zero base ventilation rate to handle non-occupant sources whenever the space is occupied.

Englehard Background No. 2. The considerations presented in the first sentences of Section 6.1.3.4, Intermittent or Variable Occupancy, must always be taken into account when considering the use of demand control based on CO_2 levels. Designs must take into account the need to ensure increased outdoor air intake within the maximum permissible ventilation lag time as shown in Figure 4 of ANSI/ASHRAE Standard 62-1989.

Englehard Interpretation No. 2. It is consistent with the Ventilation Rate Procedure that demand control be permitted for use to reduce the total outdoor air supply during periods of less occupancy if it is properly implemented using a make or break CO_2 controller to call for the design ventilation rate in accordance with the requirements of the Ventilation Rate Procedure and Table 2.

Question 2. Is Englehard Interpretation No. 2 correct?

Answer. Yes.

Englehard Interpretation No. 3. It is consistent with the Ventilation Rate Procedure that demand control be permitted for use to reduce the total outdoor air supply during periods of less occupancy, if it is properly implemented using a Proportional, Proportional-Integral, or Proportional-Integral-Derivative controller to control outdoor air intake, using the difference between indoor and outdoor CO_2 levels to meet the requirements of the Ventilation Rate Procedure and Table 2.

Question 3. Is Englehard Interpretation No. 3 correct?

Answer. Yes.

INTERPRETATION IC 62-1999-34 OF
ANSI/ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

REVISION TO 62-1999 APPROVED: August 14, 2000

Originally issued as interpretation of Standard 62-1989 (IC 62-1989-28) on April 26, 1998, but revised based on the publication of Standard 62-1999. Revisions made to all Background, Question and Answer statements to reflect Standard 62-1999 language.

Request from: Mr. Mike Pella, Steven Feller P.E. Inc.

References: This request refers to Table 2 of Standard 62-1989

Background: Under "Hotels, Motels, Resorts, Dormitories," the outdoor air requirements for "bedrooms" and "living rooms" are listed as 30 cfm while the requirement for "baths" are listed as 35 cfm. Unlike "public restrooms," there is no comment across from hotel/motel bathroom stating that the outdoor air requirement is "Normally supplied by transfer air." However, section 6.1.3 states in part, "Rooms provided with exhaust air systems, such as kitchens, baths, toilet rooms, and smoking lounges, may utilize air supplied through adjacent habitable or occupiable spaces to compensate for the air exhausted."

Question 1: Can the outdoor air requirement for a hotel/motel bathroom be met by exhausting the bathroom at a rate of at least 35 cfm with make-up air by transfer from the adjacent guestroom rather than direct supply of outdoor air to the bathroom?

Answer: Yes.

Question 2: Does a design wherein 35 cfm of outdoor air is supplied to the hotel/motel bedroom then exhausted through the bathroom at the same rate meet the standard for both the bedroom and the bathroom?

Answer: Yes.

Comment: The principle behind ventilation is to dilute pollutants generated in the space being ventilated. Outdoor air is primarily used as ventilation supply air since it usually has very low or negligible concentrations of the pollutants we are trying to dilute. Since the primary pollutants in bathrooms and toilet rooms are odors and moisture that are not present in adjacent spaces, air transferred from those spaces may be used as effectively for ventilation and dilution as outdoor air.

For clarity, the SSPC will consider adding a note in Table 2 for "Baths" in "Hotels, Motels, Resorts, Dormitories" stating that the rate specified is "exhaust air normally made-up by transfer air," similar to the notes for bathrooms and restrooms in other occupancy categories.

INTERPRETATION IC 62-1999-35 OF ANSI/ ASHRAE STANDARD 62-1999 VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

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Originally issued as interpretation of Standard 62-1989 (IC 62-1989-30) on January 1999, but revised based on the publication of Standard 62-1999. Revisions made to all Background, Question and Answer statements to reflect Standard 62-1999 language.

Request from: Suzanne K. Condon, Department of Public Health, The Commonwealth of Massachusetts, 250 Washington Street, Boston, MA 01206-4619, (Contact Michael Feeney, 617 624-5757).

Reference: This request for interpretation refers to the requirements presented in ANSI/ASHRAE Standard 62-1989, Section 6.1.3 Ventilation Requirements, Exception 1.

Background: Section 6.1.3 Exception 1 requires that when "unusual indoor contaminants or sources are present or anticipated, they shall be controlled at the source or the procedure of section 6.2 (i.e., the Indoor Air Quality (IAQ) Procedure) shall be followed." The renovation of a building can involve a number of activities that release volatile organic compounds, and other indoor air pollutants. The question has arisen of how to apply ASHRAE Standard 62-1989 to situations of high contaminant emission rates shortly after renovation.

Condon's Interpretation No. 1: Volatile organic compounds and other contaminants that off-gas at high rates shortly after renovation are "unusual indoor contaminants or sources" in the context of Exception 1 to section 6.1.3 of ASHRAE Standard 62-1989.

Question No. 1: Is Condon's Interpretation No. 1 correct?

Answer: Yes, but only if the contaminants and their emission rates lead to unacceptable indoor air quality.

Comment: ASHRAE Standard 62-1989 does not specifically address the contaminants associated with renovation. Such contaminants, including VOCs, and the emission rates that exist after renovation may or may not lead to unacceptable indoor air quality in a building ventilated at the rates in Table 2 of ASHRAE Standard 62-1989, and therefore, may nor may not constitute unusual contaminants or sources. In order to determine whether the contaminants and emission rates are unusual within the context of

Standard 62-1989 requires an analysis of the contaminants, their emission rates and the ventilation rates that exist in a given situation.

Condon's Interpretation No. 2: The Indoor Air Quality Procedure of Section 6.2 is the required procedure for achieving acceptable indoor air quality in a building after renovations.

Question No. 2: Is Condon’s Interpretation No. 2 correct?

Answer: No

Comment: As noted in the response to Question No. 1 above, the emissions associated with renovation do not necessarily constitute an unusual source. If they do, then Exception 1 in Section 6.1.3 requires the use of either source control or the IAQ Procedure. Even if the post-renovation emissions do not constitute an unusual contaminant or source, it may be prudent to operate the ventilation system for extended periods of time or at elevated outdoor air intake rates until these emissions abate, or to delay occupancy for a period of time.

INTERPRETATION IC 62-1999-36 OF
ANSI/ ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

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Request from: Richard Fox, Allied Signal, Chair TC 9.3

Reference: This request for interpretation refers to the requirements presented in ANSI/ASHRAE Standard 62-1989, Table 2 relating to vehicles.

Background: The scope of standard 62 does not explicitly address transportation ventilation. Table 2 has a single listing for vehicles under the heading of "Transportation" and contains a comment that "ventilation within vehicles may require special considerations." No specific listing of the types or conditions on these vehicles is mentioned. There are many kinds of vehicles, many of which have special needs. Other standards are written or are being written to deal with specific vehicles, such as aircraft.

Interpretation No. 1: Standard 62 cannot be applied to transportation HVAC applications.

Question No. 1: Is Interpretation No. 1 correct?

Answer: No. The scope of 62-89 specifically applies to all enclosed spaces. The entry for vehicles may be used for transportation applications.

Comment: ASHRAE Standard 62-1989 does not specifically address many kinds of occupancies covered in its broad scope. Nonetheless, when it was written, the Society chose to try to cover all ventilation applications, even if only broadly. The standard is under continuous maintenance now and efforts are underway to limit the scope of the standard to occupancies that can be dealt with explicitly and in code language. Whether the requirements of Standard 62 *should* be applied to specific vehicles would be a decision for the authority having enforcement jurisdiction.

Interpretation No. 2: The entry in Table 2 was not developed with the specific needs of aircraft in mind.

Question No. 2: Is Interpretation No. 2 correct?

Answer: Yes.

Comment: As noted in the response to Question No. 1 above, 62-89 covers vehicles only broadly. The note in the table indicates ventilation within vehicles requires special consideration, but the standard does not state what that is. ASHRAE is currently developing a standard specifically on aircraft ventilation and such a standard would contain the details of such "special considerations."

INTERPRETATION IC 62-1999-37 OF
ANSI/ASHRAE STANDARD 62-1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

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Request from: Brian Hall, Naval Facilities Engineering

Reference: This request for interpretation refers to the requirements presented in ANSI/ASHRAE Standard 62-1989, Tables 2.

Background: Tables 2 specifies minimum ventilation rates for a variety of occupancy types. With respect to residential-type sleeping spaces, there are three entries: In Table 2.1 under "Hotels, Motels, Resorts, Dormitories" there is an entry for "Bedrooms" (30 cfm/room) and another for "Dormitory sleeping areas" (15 cfm/person). In Table 2.3 under "Ventilation of Residential Facilities (Private Dwellings, Single, Multiple)," there is an entry for "living areas" which includes bedrooms. This interpretation relates to a Bachelors Enlisted Quarters, a three-story building consisting of several private bedrooms, every two of which share a bathroom and a "service area," which is essentially a small kitchenette and storage area.

Interpretation No. 1: The Bachelors Enlisted Quarters (BEQ) is considered an apartment building and thus ventilation rates for the building must be determined from Table 2.3 "Ventilation of Residential Facilities (Private Dwellings, Single, Multiple)."

Question No. 1: Is Interpretation No. 1 correct?

Answer: No.

Comment: Depending on the circumstances, either Table 2.1 or Table 2.3 may be appropriate. One of the primary distinctions between the residential buildings covered by Table 2.3 and the commercial occupancies covered by Table 2.1 is the amount of individual control occupants have in residential buildings over furnishings, decorations, and operation of ventilation systems. If the BEQ is characterized by these limitations in occupant control, it and similar spaces would not be covered by Table 2.3. Under circumstances where the occupants have control over sources, systems and indeed their occupancy, then the use of Table 2.3 may be more appropriate.

Interpretation No. 2: Assuming Table 2.1 rates apply, the correct ventilation rate for the BEQ bedrooms is that listed for "dormitory sleeping area" (15 cfm per person), as opposed to that listed for "bedrooms" (30 cfm per room).

Question No. 2: Is Interpretation No. 2 correct?

Answer: No.

Comment: "Dormitory sleeping areas" in this context refer to large open areas of beds, like those found in barracks. This can be seen by the estimated occupancy density for this space type in Table 2.1 which is 20 people per 1000 ft^2, two or three times more dense than would be expected in a BEQ room. "Bedrooms" in Table 2.1 refer to single or double occupancy rooms such as hotel rooms or school dormitory rooms. The BEQ rooms fall into this category. Hence, the proper ventilation rate for these rooms is 30 cfm per room.