ANSI/ASHRAE Standard 62.1 What's new in ventilation?

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ANSI/ASHRAE Standard 62.1-2007 Ventilation for Acceptable Indoor Air Quality

ANSI/ASHRAE Standard 62.1-2007
(Supersedes ANSI/ASHRAE Standard 62.1-2004)
Includes ANSI/ASHRAE Addenda listed in Appendix I

ASHRAE STANDARD

Ventilation for Acceptable Indoor Air Quality

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

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site, http://www.ashrae.org, or in paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 404-321-5478. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada).

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Purpose: To specify minimum ventilation rates and other measures intended to provide indoor air quality that is acceptable to human occupants and that minimizes adverse health effects.

Introduction to Standard 62.1

- Consensus standard
- First published in 1973
- Initially prescribed ventilation rates only
- Introduced “IAQ” Procedure in 1981- Rates lowered in 1981 – Energy Crisis
- 1989 version increased rates due to emerging IAQ problems

Introduction to Standard 62.1

- Backed by years of research
- Specifies “Breathing Zone Ventilation Rates”
- 2007 Edition incorporates all 2004 addenda
- Now on continuous maintenance

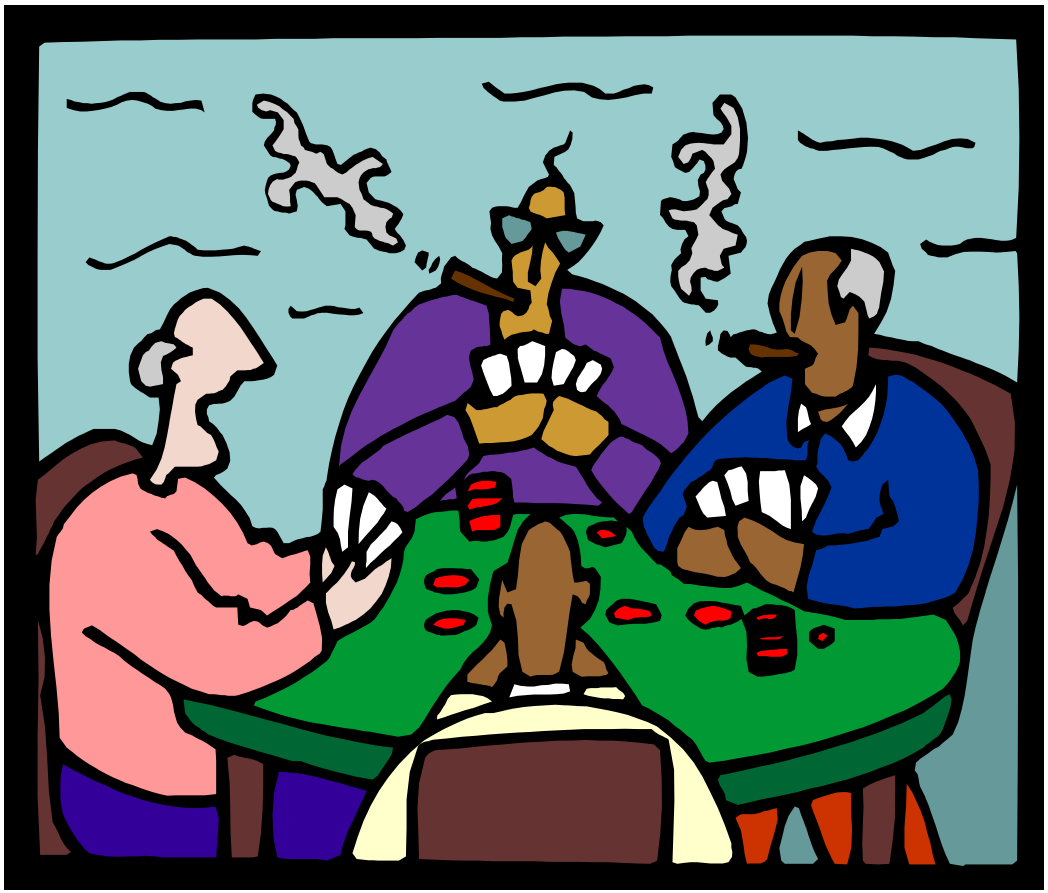
Introduction to Standard 62.1

- Applicable to new buildings and changes to existing buildings
- Applies to all indoor or enclosed spaces intended for human occupancy
- Also covers release of moisture in bathrooms, locker rooms, etc.

Introduction to Standard 62.1

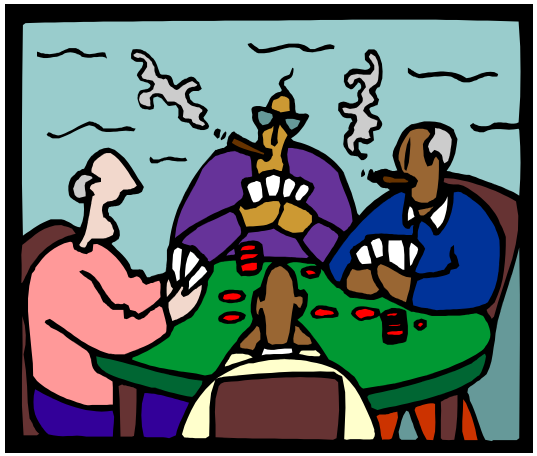
- Does not apply to single family houses
- Does not apply to multi family structures 3 stories or fewer above grade
- Does not apply to vehicles or aircraft

Does not address ventilation rates for smoking areas



ETS Requirements

- ETS free spaces must be positive relative to adjacent ETS areas
- Separated by solid walls, floors, ceilings, etc.
- Can transfer air from ETS free to ETS areas
- Don’t cross contaminate ETS free areas with air from ETS areas
- ETS areas must have signage



Includes Code Intended Language

- The standard has been incorporated in one form or another in the model codes

2003 International Mechanical Code

402.3 Adjoining spaces. Where rooms and spaces without openings to the outdoors are ventilated through an adjoining room, the opening to the adjoining rooms shall be unobstructed and shall have an area not less than 8 percent of the floor area of the interior room or space, but not less than 25 square feet (2.3 m²). The minimum openable area to the outdoors shall be based on the total floor area being ventilated.

402.4 Openings below grade. Where openings below grade provide required natural ventilation, the outside horizontal clear space measured perpendicular to the opening shall be one and one-half times the depth of the opening. The depth of the opening shall be measured from the average adjoining ground level to the bottom of the opening.

SECTION 403
MECHANICAL VENTILATION

403.1 Ventilation system. Mechanical ventilation shall be provided by a method of supply air and return or exhaust air. The amount of supply air shall be approximately equal to the amount of return and exhaust air. The system shall not be prohibited from producing negative or positive pressure. The system to convey ventilation air shall be designed and installed in accordance with Chapter 6.

Ventilation supply systems shall be designed to deliver the required rate of supply air to the occupied zone within an occupied space. The occupied zone shall have boundaries measured at 3 inches (76 mm) and 72 inches (1829 mm) above the floor and 24 inches (610 mm) from the enclosing walls.

403.2 Outdoor air required. The minimum ventilation rate of required outdoor air shall be determined in accordance with Section 403.3.

403.2.1 Recirculation of air. The air required by Section 403.3 shall not be recirculated. Air in excess of that required by Section 403.3 shall not be prohibited from being recirculated as a component of supply air to building spaces, except that:

1. Ventilation air shall not be recirculated from one dwelling unit to another or to dissimilar occupancies.
2. Supply air to a swimming pool and associated deck areas shall not be recirculated unless such air is dehumidified to maintain the relative humidity of the area at 60 percent or less. Air from this area shall not be recirculated to other spaces.
3. Where mechanical exhaust is required by Table 403.3, recirculation of air from such spaces shall be prohibited. All air supplied to such spaces shall be exhausted, including any air in excess of that required by Table 403.3.

403.2.2 Transfer air. Except where recirculation from such spaces is prohibited by Table 403.3, air transferred from occupied spaces is not prohibited from serving as makeup air for required exhaust systems in such spaces as kitchens, baths, toilet rooms, elevators and smoking lounges. The amount of transfer air and exhaust air shall be sufficient to provide the flow rates as specified in Sections 403.3 and 403.3.1. The required outdoor air rates specified in Table 403.3 shall be introduced directly into such spaces or into the occupied spaces from which air is transferred or a combination of both.

403.3 Ventilation rate. Ventilation systems shall be designed to have the capacity to supply the minimum outdoor airflow rate determined in accordance with Table 403.3 based on the occupancy of the space and the occupant load or other parameter as stated therein. The occupant load utilized for design of the ventilation system shall not be less than the number determined from the estimated maximum occupant load rate indicated in Table 403.3. Ventilation rates for occupancies not represented in Table 403.3 shall be determined by an approved engineering analysis. The ventilation system shall be designed to supply the required rate of ventilation air continuously during the period the building is occupied, except as otherwise stated in other provisions of the code.

Exception: The occupant load is not required to be determined, based on the estimated maximum occupant load rate indicated in Table 403.3 where approved statistical data document the accuracy of an alternate anticipated occupant density.

403.3.1 System operation. The minimum flow rate of outdoor air that the ventilation system must be capable of supplying during its operation shall be permitted to be based on the rate per person indicated in Table 403.3 and the actual number of occupants present.

403.3.2 Common ventilation system. Where spaces having different ventilation rate requirements are served by a common ventilation system, the ratio of outdoor air to total supply air for the system shall be determined based on the space having the largest outdoor air requirement or shall be determined in accordance with the following formula:

$$Y = \frac{X}{(1 + X - Z)} \qquad \textbf{(Equation 4-1)}$$

where

$Y = V_{ou}/V_{p}$ = Corrected fraction of outdoor air in system supply.

$X = V_{ou}/V_{st}$ = Uncorrected fraction of outdoor air in system supply

$Z = V_{oa}/V_{st}$ = 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_{ou} = Corrected total outdoor airflow rate.

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

V_{ou} = Sum of outdoor airflow rates for all branches on system.

V_{oa} = Outdoor airflow rate required in critical spaces.

V_{p} = Supply flow rate in critical space.

TABLE 403.3
REQUIRED OUTDOOR VENTILATION AIR

OCCUPANCY CLASSIFICATION	ESTIMATED MAXIMUM OCCUPANT LOAD, PERSONS PER 1,000 SQUARE FEET[a]	OUTDOOR AIR (Cubic feet per Minute (cfm) Per person) UNLESS NOTED[b]
Correctional facilities		
Cells		
without plumbing fixtures	20	20
with plumbing fixtures	20	20
Dining halls	100	15
Guard stations	40	15
Dry Cleaners, laundries		
Coin-operated dry cleaner	20	15
Coin-operated laundries	20	15
Commercial dry cleaner	30	30
Commercial laundry	10	25
Storage, pick up	30	35
Education		
Auditoriums	150	15
Classrooms	50	15
Corridors	—	0.10 cfm/ft²
Laboratories	30	20
Libraries	20	15
Locker rooms[h]	—	0.50 cfm/ft²
Music rooms	50	15
Smoking lounges[f,g]	70	60
Training shops	30	20
Food and beverage service		
Bars, cocktail lounges	100	30
Cafeteria, fast food	100	20
Dining rooms	70	20
Kitchens (cooking)[f,i]	20	15
Hospitals, nursing and convalescent homes		
Autopsy rooms[h]	—	0.50 cfm/ft²
Medical procedure rooms	20	15
Operating rooms	20	30
Patient rooms	10	25
Physical therapy	20	15
Recovery and ICU	20	15
Hotels, motels, resorts and dormitories		
Assembly rooms	120	15
Bathrooms[f,g]	—	35 cfm per room
Bedrooms	—	30 cfm per room
Conference rooms	50	20
Dormitory sleeping areas	20	15
Gambling casinos	120	30
Living rooms	—	30 cfm per room
Lobbies	30	15
Offices		
Conference rooms	50	20
Office spaces	7	20
Reception areas	60	15
Telecommunication centers and data entry	60	20

(continued)

TABLE 403.3—continued
REQUIRED OUTDOOR VENTILATION AIR

OCCUPANCY CLASSIFICATION	ESTIMATED MAXIMUM OCCUPANT LOAD, PERSONS PER 1,000 SQUARE FEET[a]	OUTDOOR AIR (Cubic feet per Minute (cfm) Per person) UNLESS NOTED[b]
Private dwellings, single and Multiple		
Living areas[c]	Based upon number of bedrooms. First bedroom: 2; each additional bedroom: 1	0.35 air changes per hour[c] or 15 cfm per person, whichever is greater
Kitchens[d]	—	100 cfm intermittent or 25 cfm continuous
Toilet rooms and bathrooms[d]	—	mechanical exhaust capacity of 50 cfm intermittent or 20 cfm continuous
Garages, separate for each dwelling	—	100 cfm per car
Garages, common for multiple units[b]	—	1.5 cfm/ft²
Public spaces		
Corridors and utilities	—	0.05 cfm/ft²
Elevators[d]	—	1.00 cfm/ft²
Locker rooms[d]	—	0.5 cfm/ft²
Toilet rooms[f,g]	—	75 cfm per water closet or urinal
Shower room (per shower head)[f,g]		50 cfm intermittent or 20 cfm continuous
Smoking lounges[f,g]	70	60
Retail stores, sales floors and Showroom floors		
Basement and street	—	0.30 cfm/ft²
Dressing rooms	—	0.20 cfm/ft²
Malls and arcades	—	0.20 cfm/ft²
Shipping and receiving	—	0.15 cfm/ft²
Smoking lounges[f]	70	60
Storage rooms	—	0.15 cfm/ft²
Upper floors	—	0.20 cfm/ft²
Warehouses	—	0.05 cfm/ft²
Specialty shops		
Automotive service stations	—	1.5 cfm/ft²
Barber	25	15
Beauty	25	25
Clothiers, furniture	—	0.30 cfm/ft²
Florists	8	15
Hardware, drugs, fabrics	8	15
Nail salon[b]	—	25
Pet shops	—	1.00 cfm/ft²
Reducing salons	20	15
Supermarkets	8	15

(continued)

IMC, UMC, OR ASHRAE 62.1-2007???

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Standards Development Process

ASHRAE develops standards for both its members and others professionally concerned with refrigeration processes and the design and maintenance of indoor environments.

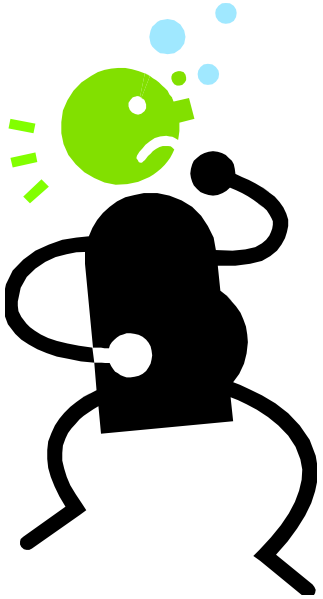
Learn about the standards development process here

Why do we need a ventilation standard?

- Help insure indoor air quality acceptable to human occupants
- Minimize potential for adverse health effects

How do we define “Acceptable Indoor Air Quality”?

- “Air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and which a substantial majority (80% or more) of the people exposed do not express dissatisfaction.”



PROCEDURES

- Ventilation Rate Procedure
- IAQ Procedure

IAQ Procedure

- Outdoor intake rates and other system design parameters are based on an analysis of contaminant sources, contaminant concentration targets, and perceived acceptability targets
- This is pretty hard to do, don’t you think?

IAQ Procedure

- Figure out what contaminants will be present
- Figure out the sources and source strengths
- Figure out acceptable levels
- Figure out how to ventilate to maintain at acceptable levels
- Document all of this!
- This is not very practical for a practicing consulting engineer

Ventilation Rate Procedure

- Verify outside air quality meets EPA ambient air quality standards
- Treat outside air if required
- Carefully locate outside air intakes

zone: one occupied space or several occupied spaces with similar occupancy category (see Table 6-1), *occupant density*, *zone air distribution effectiveness* (see Section 6.2.2.2), and *zone primary airflow* (see Section 6.2.5.1) per unit area.

Note: A ventilation zone is not necessarily an independent thermal control zone; however, spaces that can be combined for load calculations can often be combined into a single zone for ventilation calculations.

4. OUTDOOR AIR QUALITY

Outdoor air quality shall be investigated in accordance with Sections 4.1 and 4.2 prior to completion of ventilation system design. The results of this investigation shall be documented in accordance with Section 4.3.

4.1 Regional Air Quality. The status of compliance with national ambient air quality standards shall be determined for the geographic area of the building site. In the United States, compliance status shall be either in "attainment" or "nonattainment" with the National Ambient Air Quality Standards (NAAQS)[1] for each pollutant shown in Table 4-1. In the United States, areas with no EPA compliance status designation shall be considered "attainment" areas.

4.2 Local Air Quality. An observational survey of the building site and its immediate surroundings shall be conducted during hours the building is expected to be normally occupied to identify local contaminants from surrounding facilities that may be of concern if allowed to enter the building.

4.3 Documentation. Documentation of the outdoor air quality investigation shall be reviewed with building owners or their representative and shall include the following:

1. Regional air quality compliance status.

   Note: Regional outdoor air quality compliance status for the United States is available from the U.S. Environmental Protection Agency located under www.epa.gov.

2. Local survey information, which may include the following:
   a. Date of observations
   b. Time of observations
   c. Area surveyed
   d. Description of nearby facilities
   e. Observation of odors or irritants

meet the requirements of Sections 5.1.1 and 5.1.2.

5.1.1 Location and Size of Openings. Naturally ventilated spaces shall be permanently open to and within 8 m (25 ft) of operable wall or roof openings to the outdoors, the openable area of which is a minimum of 4% of the net occupiable floor area. Where openings are covered with louvers or otherwise obstructed, openable area shall be based on the free unobstructed area through the opening. Where interior spaces without direct openings to the outdoors are ventilated through adjoining rooms, the opening between rooms shall be permanently unobstructed and have a free area of not less than 8% of the area of the interior room nor less than 25 ft^2 (2.3 m^2).

5.1.2 Control and Accessibility. The means to open required operable openings shall be readily accessible to building occupants whenever the space is occupied.

TABLE 4-1 National Primary Ambient Air Quality Standards for Outdoor Air as Set by the U.S. Environmental Protection Agency

Contaminant	Long Term			Short Term		
	Concentration		Averaging	Concentration		Averaging
	$\mu g/m^3$	ppm		$\mu g/m^3$	ppm	
Sulfur dioxide	80	0.03	1 year[b]	365	0.14	24 hours[a]
Particles (PM 10)	50	—	1 year[b,g]	150	—	24 hours[a]
Particles (PM 2.5)	15	—	1 year[b,e]	65	—	24 hours[f]
Carbon monoxide				40,000	35	1 hour[a]
				10,000	9	8 hours[a]
Oxidants (ozone)					0.08	8 hours[c]
					0.12	1 hour[h]
Nitrogen dioxide	100	0.053	1 year[b]			
Lead	1.5	—	3 months[d]			

[a]Not to be exceeded more than once per year.
[b]Annual arithmetic mean.
[c]The three-year average of the fourth-highest daily maximum eight-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.
[d]Three-month period is a calendar quarter.

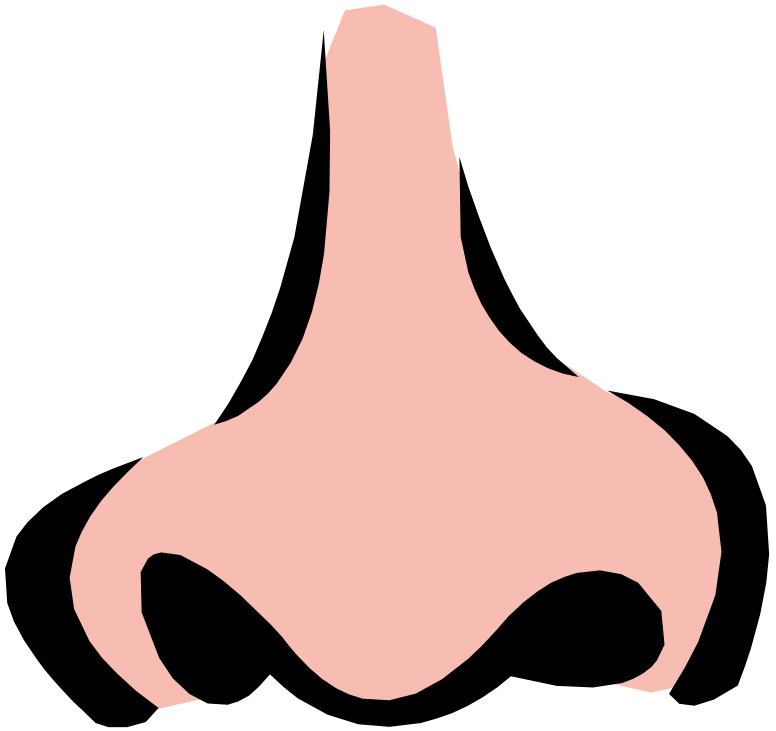
TABLE 5-1 Air Intake Minimum Separation Distance

Object	Minimum Distance, ft (m)
Significantly contaminated exhaust (Note 1)	15 (5)
Noxious or dangerous exhaust (Notes 2 and 3)	30 (10)
Vents, chimneys, and flues from combustion appliances and equipment (Note 4)	15 (5)
Garage entry, automobile loading area, or drive-in queue (Note 5)	15 (5)
Truck loading area or dock, bus parking/idling area (Note 5)	25 (7.5)
Driveway, street, or parking place (Note 5)	5 (1.5)
Thoroughfare with high traffic volume	25 (7.5)
Roof, landscaped grade, or other surface directly below intake (Notes 6 and 7)	1 (0.30)
Garbage storage/pick-up area, dumpsters	15 (5)
Cooling tower intake or basin	15 (5)
Cooling tower exhaust	25 (7.5)

Note 1: Significantly contaminated exhaust is exhaust air with significant contaminant concentration, significant sensory-irritation intensity, or offensive odor.
Note 2: Laboratory fume hood exhaust air outlets shall be in compliance with NFPA 45-1991[3] and ANSI/AIHA Z9.5-1992.[4]
Note 3: Noxious or dangerous exhaust is exhaust air with highly objectionable fumes or gases and/or exhaust air with potentially dangerous particles, bioaerosols, or gases at concentrations high enough to be considered harmful. Information on separation criteria for industrial environments can be found in the ACGIH Industrial Ventilation Manual [5] and in the *ASHRAE Handbook—HVAC Applications*.[6]
Note 4: Shorter separation distances are permitted when determined in accordance with (a) Chapter 7 of ANSI Z223.1/NFPA 54-2002[7] for fuel gas burning appliances and equipment, (b) Chapter 6 of NFPA 31-2001[8] for oil burning appliances and equipment, or (c) Chapter 7 of NFPA 211-2003[9] for other combustion appliances and equipment.
Note 5: Distance measured to closest place that vehicle exhaust is likely to be located.
Note 6: No minimum separation distance applies to surfaces that are sloped more than 45 degrees from horizontal or that are less than 1 in. (3 cm) wide.
Note 7: Where snow accumulation is expected, distance listed shall be increased by the expected average snow depth.

Ventilation Rate Procedure
Three Easy Steps!

- Determine “breathing zone outdoor air flow”



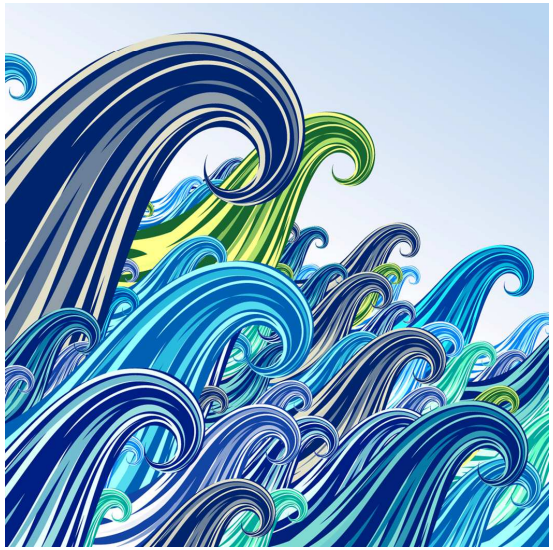
Two components: Per person plus per square foot

$$V_{bz}$$

Determine Zone Outdoor Airflow

- Correct breathing zone outdoor airflow for air distribution effectiveness

$$V_{oz}$$



Determine Total Outdoor Airflow

- Correct zone outdoor airflow for multiple zones and system ventilation efficiency

$$V_{ot}$$

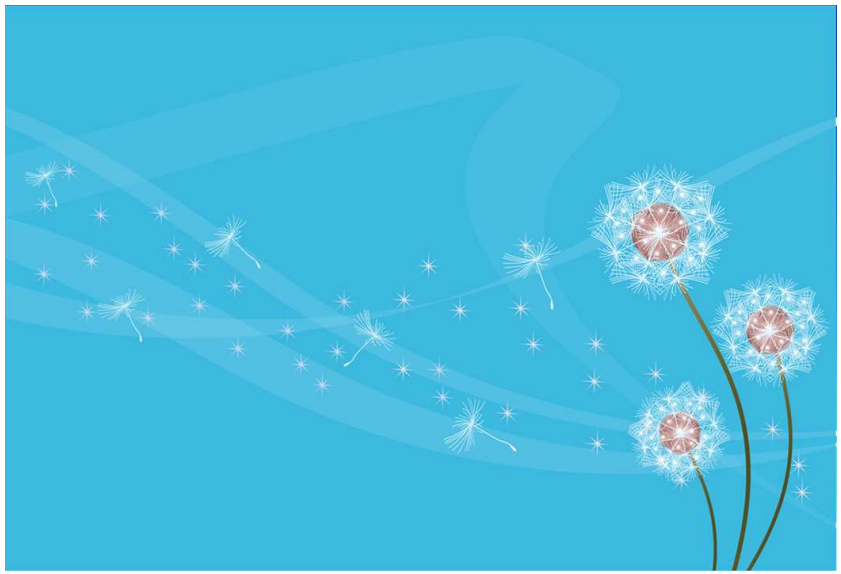


TABLE 6-1 MINIMUM VENTILATION RATES IN BREATHING ZONE

(This table is not valid in isolation; it must be used in conjunction with the accompanying notes.)

Occupancy Category	People Outdoor Air Rate R_p		Area Outdoor Air Rate R_a		Notes	Default Values			Air Class
						Occupant Density (see Note 4)	Combined Outdoor Air Rate (see Note 5)		
	cfm/person	L/s•person	cfm/ft^2	L/s•m^2		#/1000 ft^2 or #/100 m^2	cfm/person	L/s•person	
Correctional Facilities									
Cell	5	2.5	0.12	0.6		25	10	4.9	2
Day room	5	2.5	0.06	0.3		30	7	3.5	1
Guard stations	5	2.5	0.06	0.3		15	9	4.5	1
Booking/waiting	7.5	3.8	0.06	0.3		50	9	4.4	2
Educational Facilities									
Daycare (through age 4)	10	5	0.18	0.9		25	17	8.6	2
Classrooms (ages 5-8)	10	5	0.12	0.6		25	15	7.4	1
Classrooms (age 9 plus)	10	5	0.12	0.6		35	13	6.7	1
Lecture classroom	7.5	3.8	0.06	0.3		65	8	4.3	1
Lecture hall (fixed seats)	7.5	3.8	0.06	0.3		150	8	4.0	1
Art classroom	10	5	0.18	0.9		20	19	9.5	2
Science laboratories	10	5	0.18	0.9	E	25	17	8.6	-
Wood/metal shop	10	5	0.18	0.9		20	19	9.5	2
Computer lab	10	5	0.12	0.6		25	15	7.4	1
Media center	10	5	0.12	0.6	A	25	15	7.4	1
Music/theater/dance	10	5	0.06	0.3		35	12	5.9	1
Multi-use assembly	7.5	3.8	0.06	0.3		100	8	4.1	1
Food and Beverage Service									
Restaurant dining rooms	7.5	3.8	0.18	0.9		70	10	5.1	2
Cafeteria/fast food dining	7.5	3.8	0.18	0.9		100	9	4.7	2
Bars, cocktail lounges	7.5	3.8	0.18	0.9		100	9	4.7	2
General									
Conference/meeting	5	2.5	0.06	0.3		50	6	3.1	1
Corridors	-	-	0.06	0.3		-			1
Storage rooms	-	-	0.12	0.6	B	-			1
Hotels, Motels, Resorts, Dormitories									
Bedroom/living Room	5	2.5	0.06	0.3		10	11	5.5	1
Barracks sleeping areas	5	2.5	0.06	0.3		20	8	4.0	1
Lobbies/prefunction	7.5	3.8	0.06	0.3		30	10	4.8	1
Multi-purpose assembly	5	2.5	0.06	0.3		120	6	2.8	1

Single Zone Systems

- Fairly straightforward

1. Add people and area rate together to determine breathing zone rate

   $V_{bz} = R_p \times P_z + R_a \times A_z$

Single Zone Systems

2. Determine zone outdoor airflow (V_{oz}) by correcting for zone air distribution effectiveness (V_{bz}/E_z)

   $V_{oz} = V_{bz} / E_z$

Table 6-2 – Zone Air Distribution Effectiveness

air distribution configuration	Ez
ceiling supply cool ceiling or floor return	1.0
ceiling supply warm (15℉ > space) ceiling return	0.8
ceiling supply warm (<15℉ >space) ceiling return	1.0
floor supply cool (mix to 4.5 ft) ceiling return	1.0
floor supply cool (disppa) ceiling return	1.0

Single Zone Systems

3. Outdoor air intake flow (V_{ot}) is equal to zone outdoor airflow

   $V_{ot} = V_{oz}$

Multiple Zone Systems

- A little more involved

1. Add people and area rate together to determine breathing zone rate (V_{bz}) for each zone.
2. Determine zone outdoor airflow (V_{oz}) by correcting for zone air distribution effectiveness (V_{bz}/E_z) for each zone.
3. Determine outdoor air intake flow (V_{ot}) for the system.

100% Outdoor Air Systems

- Outdoor air intake flow (V_{ot}) = Sum of all Zone outdoor airflows (V_{oz})
- Add them up and you’re finished

Multiple Zone Systems

- A little more involved for mixed air systems

1. Add people and area rate together to determine breathing zone rate (V_{bz}) for each zone.
2. Determine zone outdoor airflow (V_{oz}) by correcting for zone air distribution effectiveness (V_{bz}/E_z) for each zone.
3. Determine outdoor air intake flow (V_{ot}) for the system.

Multiple Zone Recirculating Systems
Determining Outdoor Intake Volume

- Determine Primary Outdoor Air Fraction for each zone

  $Z_p = V_{oz}/V_{pz}$

- V_{pz} is total air – use minimum for VAV system zones

Multiple Zone Recirculating Systems

- Determine Uncorrected Outdoor Air Intake
- Occupant diversity x people CFM for all zones
- Add area CFM for all zones to the total diversified people CFM

Multiple Zone Recirculating Systems

- Determine Outdoor Air Intake by correcting for System ventilation efficiency (table 6-3) – Use the highest Zone primary air fraction

TABLE 6-2
Zone Air Distribution Effectiveness

Air Distribution Configuration	E_z
Ceiling supply of cool air	1.0
Ceiling supply of warm air and floor return	1.0
Ceiling supply of warm air 15°F (8°C) or more above space temperature and ceiling return.	0.8
Ceiling supply of warm air less than 15°F (8°C) above space temperature and ceiling return provided that the 150 fpm (0.8 m/s) supply air jet reaches to within 4.5 ft (1.4 m) of floor level. Note: For lower velocity supply air, E_z = 0.8.	1.0
Floor supply of cool air and ceiling return provided that the 150 fpm (0.8 m/s) supply jet reaches 4.5 ft (1.4 m) or more above the floor. Note: Most underfloor air distribution systems comply with this provision.	1.0
Floor supply of cool air and ceiling return, provided low-velocity displacement ventilation achieves unidirectional flow and thermal stratification	1.2
Floor supply of warm air and floor return	1.0
Floor supply of warm air and ceiling return	0.7
Makeup supply drawn in on the opposite side of the room from the exhaust and/or return	0.8
Makeup supply drawn in near to the exhaust and/or return location	0.5

1. "Cool air" is air cooler than space temperature.
2. "Warm air" is air warmer than space temperature.
3. "Ceiling" includes any point above the breathing zone.
4. "Floor" includes any point below the breathing zone.
5. As an alternative to using the above values, E_z may be regarded as equal to air change effectiveness determined in accordance with ASHRAE Standard 129[1.5] for all air distribution configurations except unidirectional flow.

TABLE 6-3
System Ventilation Efficiency

Max (Z_p)	E_v
≤ 0.15	1.0
≤ 0.25	0.9
≤ 0.35	0.8
≤ 0.45	0.7
≤ 0.55	0.6
> 0.55	Use Appendix A

1. "Max Z_p" refers to the largest value of Z_p calculated using Equation 6-5, among all the zones served by the system.
2. For values of Z_p between 0.15 and 0.55, one may determine the corresponding value of E_v by interpolating the values in the table.
3. The values of E_v in this table are based on a 0.15 average outdoor air fraction for the system [i.e., the ratio of the uncorrected outdoor air intake V_{ou} to the total zone primary airflow for all the zones served by the air handler]. For systems with higher values of the average outdoor air fraction, this table may result in unrealistically low values of E_v and the use of Appendix A may yield more practical results.

6.2.9 Ventilation in Smoking Areas. Smoking areas shall have more ventilation and/or air cleaning than comparable no-smoking areas. Specific ventilation rate requirements cannot be determined until cognizant authorities determine the concentration of smoke that achieves an acceptable level of risk. Air from smoking areas shall not be recirculated or transferred to no-smoking areas.

6.3 Indoor Air Quality Procedure

The Indoor Air Quality (IAQ) Procedure is a performance-based design approach in which the building and its ventilation system are designed to maintain the concentrations of specific contaminants at or below certain limits identified during the building design and to achieve the design target level of perceived indoor air quality acceptability by building

Table 6-3 System Ventilation Efficiency

Max (Z_p)	E_v
<=0.15	1.0
<=0.25	0.9
<=0.35	0.8
<=0.45	0.7
<=0.55	0.6
>0.55	Use Appendix A

Other Requirements

- Ventilation air flow must be maintained during any load condition and at all times the space is occupied

Other Requirements

- Drain pans must drain
- Maintenance access to equipment required
- Building envelope designed for moisture control
- Insulate to prevent condensation
- Airstream surfaces must resist mold growth and erosion

Other Requirements

- Plenum supply of OA is tricky
- Exhaust ducts must be negative or sealed to SMACNA seal class A
- Combustion air must be provided & products of combustion vented
- Minimum exhaust rates are prescribed for certain spaces
- Provide balance dampers

Outdoor Air Intakes

- Must manage rain entrainment
- Must manage snow entrainment
- Must have bird screens
- Outdoor equipment must prevent rain intrusion

Filters

- Minimum MERV 6 filters required ahead of wet coils

Relative Humidity

- If dehumidifying, limited to 65% or less at design dew point condition

Smoking Areas

- Separate “ETS Free Areas” from “ETS Areas”
- ETS free areas must be positive relative to adjacent ETS areas
- Other requirements apply
- Smoking areas must have more ventilation. Standard doesn’t say how much more.

- Air movement within building must observe air classification requirements

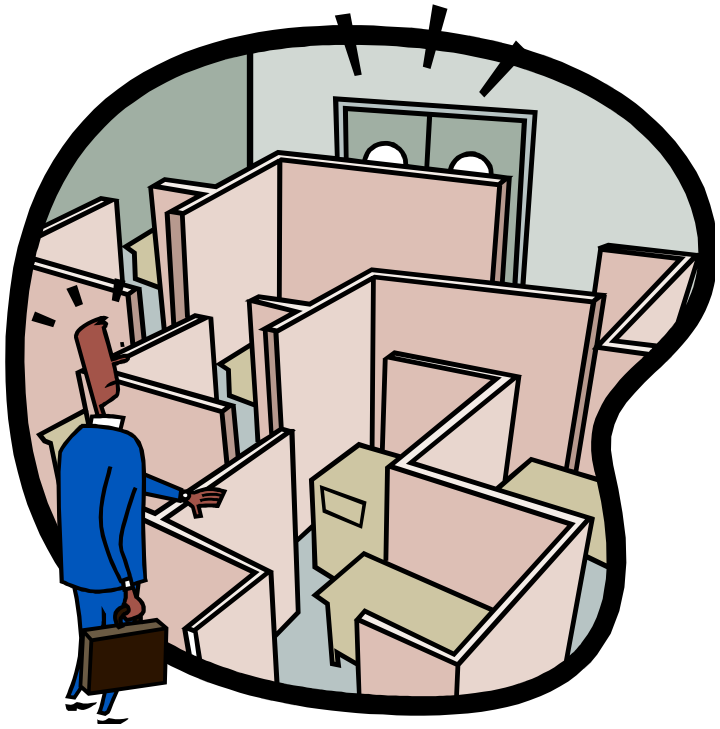


TABLE 5-2 Other Space Types

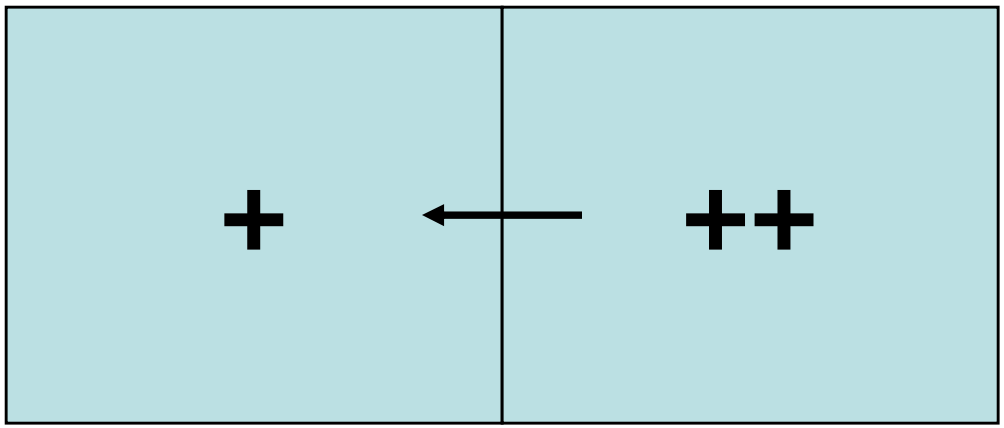
Description	Air Class
Spaces ancillary to Class 2 spaces	2
Kitchenettes	2
Break rooms	1
Coffee stations	1
Private toilet/bath	2
Employee locker rooms	2
Storage rooms, chemical	4
Equipment rooms	1
Electrical/telephone closets	1
Elevator machine rooms	1
Refrigerating machinery rooms	3
Laundry rooms, central	2
Laundry rooms within dwelling units	1
Soiled laundry storage	3
Janitors closet, trash room	3
General chemical/biological laboratories	3
University/college laboratories	2
Paint spray booths	4
Daycare sickroom	3

TABLE 5-3 Airstreams

Description	Air Class
Diazo printing equipment discharge	4
Commercial kitchen grease hoods	4
Commercial kitchen hoods other than grease	3
Laboratory hoods	4
Residential kitchen vented hoods	3

- Short term conditions
- CO2 measurement and control

Space Pressurization



Building Must be Positive

A Word About Clarifications

Sometimes there are unstated motives

Construction, startup, and O&M requirements apply

Now we get to educate our owners and contractors too!

- Be sure filters are in place if air handlers are used during construction
- Protect materials from moisture
- Balance ventilation air
- Field test drain pans if they’re not certified
- Provide documentation
- Maintenance schedule for owners