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HVAC

EQUATIONS

DATA

AND RULES OF

THUMB

SECOND EDITION

MINIMUM VENTILATION RATES (Continued)

Occupancy Category	Outdoor Air Rate (1)		Default Values (2)		
	People CFM/Person	Area CFM/SF	Occupant Density People/1,000 SF	CFM per Person	CFM per SF
Places of Religious Worship	5.0	0.06	120	6	0.66
Courtrooms	5.0	0.06	70	6	0.41
Legislative Chambers	5.0	0.06	50	6	0.31
Libraries	5.0	0.12	10	17	0.17
Lobbies	5.0	0.06	150	5	0.81
Museums (children's)	7.5	0.12	40	11	0.42
Museums/Galleries	7.5	0.06	40	9	0.36
Retail					
Sales (except as below)	7.5	0.12	15	16	0.23
Mall Common Areas	7.5	0.06	40	9	0.36
Barber Shop	7.5	0.06	25	10	0.27
Beauty and Nail Salons	20.0	0.12	25	25	0.62
Pet Shops (animal areas)	7.5	0.18	10	26	0.26
Supermarkets	7.5	0.06	8	15	0.12
Coin-Operated Laundries	7.5	0.06	20	11	0.21
Sports And Entertainment					
Sports Arena (play areas)	-	0.30	-	-	0.30
Gym, Stadium (play area)	-	0.30	30	-	0.30
Spectator Areas	7.5	0.06	150	8	1.18
Swimming Pool (pool and decks)	-	0.48	-	-	0.48
Disco/Dance Floors	20.0	0.06	100	21	2.06
Health Club/Aerobics Rooms	20.0	0.06	40	22	0.86
Health Club/Weight Rooms	20.0	0.06	10	26	0.26
Bowling Alley (seating)	10.0	0.12	40	13	0.52
Gambling Casinos	7.5	0.18	120	9	1.08
Game Arcades	7.5	0.18	20	17	0.33
Sages, Studios	10.0	0.06	70	11	0.76
Healthcare Facilities					
Patient Rooms	25	-	10	25	-
Medical Procedure Rooms	15	-	20	15	-
Operating Rooms	30	-	20	30	-
Recovery and ICU	15	-	20	15	-
Autopsy Rooms	-	0.50	20	-	0.50
Physical Therapy	15	-	20	15	-
Residential Facilities (Single, Multiple)					
Living Rooms	0.35 AC/hr. 15 CFM/P whichever is greater				
Kitchens	100 CFM Intermittent 25 CFM Continuous				
Baths, Toilets	50 CFM Intermittent 20 CFM Continuous				
Garages—separate for each dwelling unit	100 CFM per Car				
Garages—common for several units	1.5 CFM/SF				

Notes:

- 1 Outdoor air rates are based on no-smoking occupancies. Total outdoor air rate for the space is the sum of the people airflow rate and the area airflow rate. Airflow rates based on the net occupiable space.
- 2 Default occupant densities should be used when occupancies are not known. Default outdoor air values are based on default occupancy density.
- 3 Outdoor air volumes must be corrected as follows:

4. Class 4: Air with highly objectionable fumes or gases or with potentially dangerous particle, bio-aerosols, or gases, at such high concentrations as to pose a health hazard. Class 4 air shall not be recirculated or transferred to any space or recirculated within the space of origin. This includes:
 - a. Commercial kitchen grease hoods.
 - b. Laboratory hoods.
 - c. Paint spray booths.
 - d. Diazo printing equipment discharges.
 - e. Chemical storage rooms.
 - f. Auto repair rooms.
 - g. Parking garages.

B. ASHRAE Standard 62.2-2004

1. Outdoor air must be provided to each dwelling unit in accordance with the following table.

Floor Area Square Feet	Number of Bedrooms				
	0-1	2-3	4-5	6-7	>7
<1,500	30	45	60	75	90
1,501-3,000	45	60	75	90	105
3,001-4,500	60	75	90	105	120
4,501-6,000	75	90	105	120	135
6,001-7,500	90	105	120	135	150
>7,500	105	120	135	150	165

Notes:

- 1 In lieu of the preceding table, the following equation may be used to determine the minimum outdoor air quantity.

$$Q_{OA} = 0.01 \times A_{FLOOR} + 7.5 \times (N_{BR} - 1)$$

Q_{OA} = Quantity of Outdoor Air—CFM.

A_{FLOOR} = Floor Area of Residence—Square Feet.

N_{BR} = Number of Bedrooms—Minimum of 1.

- 2 Exhaust Requirements

- a. Intermittent:
 1. Kitchen: 100 CFM.
 2. Bathroom: 50 CFM.
- b. Continuous:
 1. Kitchen: 5.0 AC/hr.
 2. Bathroom: 20 CFM.

B. 2006 Guidelines for Design and Construction of Health Care Facilities—AIA Committee on Architecture for Health and U.S. Department of Health and Human Services

Area Designation	Pressure Relationship	Minimum OA AC/hr.	Minimum Total AC/hr.	All Air Exhaust to Outdoors
Nursing Units				
Patient Rooms	0	2	6	-
Toilet Rooms	Neg	-	10	Yes
Newborn Nursery Suites	0	2	6	-
Protective Environment Rooms (PERs)	Pos	2	12	-
PER Alcove or Anterooms	Pos	-	10	Yes
Isolation Rooms (IRs)	Neg	2	12	Yes
(IR) Alcove or Anterooms	Neg	-	10	Yes
Patient Corridors	0	-	2	-

(Continued)

Area Designation	Pressure Relationship	Minimum OA AC/hr.	Minimum Total AC/hr.	All Air Exhaust to Outdoors
Obstetrical Facilities				
Delivery Rooms	Pos	3	15	-
Labor/Delivery/Recovery	-	2	6	-
Labor/Delivery/Recovery/Postpartum	-	2	6	-
Emergency, Surgery, and Critical Care				
Operating/Surgical Cystoscopic Rooms	Pos	3	15	-
Recovery Rooms	0	2	6	-
Critical and Intensive Care	0	2	6	-
Intermediate Care	0	2	6	-
Newborn Intensive Care	0	2	6	-
Treatment Rooms	0	-	6	-
Trauma Rooms	Pos	3	15	-
Bronchoscopy	Neg	2	12	Yes
Triage	Neg	2	12	Yes
ER Waiting Rooms	Neg	2	12	Yes
Procedure Rooms	Pos	3	15	-
Laser Eye Rooms	Pos	3	15	-
X-Ray (Surgical/Critical Care and Catheterization)	Pos	3	15	-
Anesthesia Gas Storage	Neg	-	8	Yes
Support Areas				
Medication Rooms	Pos	-	4	-
Clean Workrooms or Clean Holding	Pos	-	4	-
Soiled Workrooms or Soiled Holding	Neg	-	10	Yes
Diagnostic and Treatment Areas				
Examination Rooms	0	-	6	-
Treatment Rooms	0	-	6	-
Physical Therapy and Hydrotherapy	Neg	-	6	-
Gastrointestinal Endoscopy Rooms	0	2	6	-
Endoscopic Instrument Processing Rooms	Neg	-	10	Yes
Imaging: X-Ray (Diagnostic and Treatment)	0	-	6	-
Imaging: Darkrooms	Neg	-	10	Yes
Imaging: Waiting Rooms	Neg	2	12	Yes
Laboratory: General	0	-	6	-
Laboratory: Biochemistry	Neg	-	6	Yes
Laboratory: Cytology	Neg	-	6	Yes
Laboratory: Glass Washing	Neg	-	10	Yes
Laboratory: Histology	Neg	-	6	Yes
Laboratory: Microbiology	Neg	-	6	Yes
Laboratory: Nuclear Medicine	Neg	-	6	Yes
Laboratory: Pathology	Neg	-	6	Yes
Laboratory: Serology	Neg	-	6	Yes
Laboratory: Sterilizing	Neg	-	10	Yes
Autopsy Rooms	Neg	-	12	Yes
Non-Refrigerated Body-Holding Rooms	Neg	-	10	Yes
Service Areas				
Pharmacies	Pos	-	4	-
Food Preparation Centers	0	-	10	-

(Continued)

Area Designation	Pressure Relationship	Minimum OA AC/hr.	Minimum Total AC/hr.	All Air Exhaust to Outdoors
Warewashing	Neg	-	10	Yes
Dietary Day Storage	Neg	-	2	-
Laundry, General	0	-	10	Yes
Soiled Linen (Sorting and Storage)	Neg	-	10	Yes
Clean Linen Storage	Pos	-	2	-
Soiled Linen and Trash Chute Rooms	Neg	-	10	Yes
Bedpan Rooms	Neg	-	10	Yes
Bathrooms	Neg	-	10	-
Housekeeping Rooms	Neg	-	10	Yes
Sterilizing and Supply				
ETO Sterilizer Rooms	Neg	-	10	Yes
Sterilizer Equipment Rooms	Neg	-	10	Yes
Central Medical and Surgical Supply: Soiled or Decontamination Rooms	Neg	-	6	Yes
Central Medical and Surgical Supply: Clean Workrooms	Pos	-	4	-
Central Medical and Surgical Supply: Sterile Storage	Pos	-	4	-

Notes:

- 1 Pos = Positive Pressure Relationship
- 2 Neg = Negative Pressure Relationship
- 3 0 = Neutral Pressure Relationship

8.02 Enclosed Parking Garages

A. 2003 IMC and 2006 IMC

- 1. Ventilation rates:
 - a. Minimum: 0.05 CFM/SF.
 - b. Design: 1.5 CFM/SF.
- 2. Mechanical ventilation systems may reduce the 1.5 CFM/SF ventilation requirement when the system operates automatically upon detection of a concentration of CO of 25 ppm by approved automatic detection devices.

B. Enclosed Parking Garage Design Recommendations

- 1. Exhaust 1.5 CFM/SF at one end of the garage on each floor using a masonry plenum or ductwork (a floor-to-floor exhaust plenum is normally easier because floor-to-floor heights are generally limited in a garage and ductwork does not fit). Exhaust 1/2 of the air high and 1/2 of the air low. This will remove contaminants that are heavier than air (flammable vapors) and contaminants that are lighter than air (carbon monoxide).
- 2. Supply approximately 1.5 CFM/SF at the other end of the garage on each floor using a masonry plenum or ductwork (a floor-to-floor supply plenum is normally easier because floor-to-floor heights are generally limited in a garage and ductwork does not fit). Supply 1/2 of the air high and 1/2 of the air low. This exhaust and supply design will provide a sweeping air motion through the garage. Depending on the location of the entrances and exits to the garage, the supply quantity may be reduced to allow air to enter through the entrances and exits provided that short circuiting of the supply air is prevented.
- 3. Utilize VFDs to control the speed and the airflow of the fan based on CO detection system. Note that the minimum garage ventilation rate is only 4 percent of the design airflow (0.05 CFM/SF divided by 1.5 CFM/SF). A single fan operated by a VFD will only

8.06 Toilet Rooms

A. ASHRAE Standard 62-2001: 50 CFM/Water Closet and Urinal

B. 2003/IMC: 75 CFM/Water Closet and Urinal

C. 2006 IMC: 75 CFM/Water Closet and Urinal

D. Recommended Design Requirements

1. 2.0 CFM/sq.ft.
2. 10 AC/hr.
3. 100 CFM/water closet and urinal.
4. Toilet room ventilation:
 - a. For toilet rooms with high fixture densities (stadiums, auditoriums), the 75 CFM/water closet and urinal dictates.
 - b. For toilet rooms with ceiling heights over 12 feet, the 10 AC/hr. dictates.
 - c. For toilet rooms with ceiling heights 12 feet and under, the 2.0 CFM/sq.ft. dictates.
 - d. If toilet rooms are designed for a 100 CFM/water closet or urinal, you will always meet the 2.0 CFM/sq.ft. and the 10 AC/hr. recommended airflow requirements.

8.07 Electrical Rooms

A. Recommended Minimum Ventilation Rate

1. 2.0 CFM/sq.ft.
2. 10.0 AC/hr.
3. 5 CFM/KVA of transformer.

B. Electrical Room Design Guidelines

1. Determine heat gain from transformers, panelboards, and other electrical equipment contained in the electrical room. Then, determine required airflow for ventilation or tempering of space.
2. Generally, electrical equipment rooms only require ventilation to keep equipment from overheating. Most electrical rooms are designed for 95°F to 104°F; however, consult the electrical engineer for equipment temperature tolerances. If space temperatures 90°F and below are required by equipment, air conditioning (tempering) of the space will be required.
3. If outside air is used to ventilate the electrical room, the electrical room design temperature will be 10°F to 15°F above outside summer design temperatures.
4. If conditioned air from an adjacent space is used to ventilate the electrical room, the electrical room temperature can be 10°F to 20°F above the adjacent spaces.

8.08 Mechanical Rooms

A. Recommended Minimum Ventilation Rate

1. 2.0 CFM/sq.ft.
2. 10.0 AC/hr.

B. Mechanical Equipment Room Design Guidelines

1. Determine heat gain from motors, pumps, fans, transformers, panelboards, and other mechanical and electrical equipment contained in the mechanical room. Then, determine the required airflow for the ventilation or tempering of space.
2. Generally, mechanical equipment rooms only require ventilation. Most mechanical rooms are designed for 95°F to 104°F; however, verify mechanical equipment temperature