Appendix B. Air

Guidelines for Environmental Infection Control in Health-Care Facilities (2003)

AT A GLANCE

The appendix for Air guidelines from the Guidelines for Environmental Infection Control in Health-Care Facilities (2003).

ON THIS PAGE

Airborne Contaminant Removal

Table B.1. Air changes/hour (ACH) and time required for airborne-contaminant removal by efficiency *

ACH § ¶	Time (mins.) required for removal 99% efficiency	Time (mins.) required for removal 99.9% efficiency
2	138	207
4	69	104
6+	46	69
8	35	52
10+	28	41
12+	23	35
15+	18	28
20	14	21
50	6	8

The number of air changes per hour and time and efficiency.

* This table is revised from Table S3-1 in reference 4 and has been adapted from the formula for the rate of purging airborne contaminants presented in reference 1435.

+ Denotes frequently cited ACH for patient-care areas.

§ Values were derived from the formula:

t2 – t1 = – [ln (C2 / C1) / (Q / V)] X 60, with t1 = 0

where

- t1 = initial timepoint in minutes
- t2 = final timepoint in minutes
- C1 = initial concentration of contaminant
- C2 = final concentration of contaminant
- C2 / C1 = 1 – (removal efficiency / 100)
- Q = air flow rate in cubic feet/hour
- V = room volume in cubic feet
- Q / V = ACH

¶ Values apply to an empty room with no aerosol-generating source. With a person present and generating aerosol, this table would not apply. Other equations are available that include a constant generating source. However, certain diseases (e.g., infectious tuberculosis) are not likely to be aerosolized at a constant rate. The times given assume perfect mixing of the air within the space (i.e., mixing factor = 1). However, perfect mixing usually does not occur. Removal times will be longer in rooms or areas with imperfect mixing or air stagnation.213 Caution should be exercised in using this table in such situations. For booths or other local ventilation enclosures, manufacturers' instructions should be consulted.

Air Sampling for Aerosols Containing Legionellae

Air sampling is an insensitive means of detecting *Legionella pneumophila,* and is of limited practical value in environmental sampling for this pathogen. In certain instances, however, it can be used to

a. demonstrate the presence of legionellae in aerosol droplets associated with suspected bacterial reservoirs

b. define the role of certain devices [e.g., showers, faucets, decorative fountains, or evaporate condensers] in disease transmission; and

c. quantitate and determine the size of the droplets containing legionellae.[1436] Stringent controls and calibration are necessary when sampling is used to determine particle size and numbers of viable bacteria.[1437] Samplers should be placed in locations where human exposure to aerosols is anticipated, and investigators should wear a NIOSH-approved respirator (e.g., N95 respirator) if sampling involves exposure to potentially infectious aerosols.

Methods used to sample air for legionellae include impingement in liquid, impaction on solid medium, and sedimentation using settle plates.[1436] The Chemical Corps.-type all-glass impingers (AGI) with the stem 30 mm from the bottom of the flask have been used successfully to sample for legionellae.[1436] Because of the velocity at which air samples are collected, clumps tend to become fragmented, leading to a more accurate count of bacteria present in the air. The disadvantages of this method are

a. the velocity of collection tends to destroy some vegetative cells

b. the method does not differentiate particle sizes; and

c. AGIs are easily broken in the field.

Yeast extract broth (0.25%) is the recommended liquid medium for AGI sampling of legionellae;[1437] standard methods for water samples can be used to culture these samples.

Andersen samplers are viable particle samplers in which particles pass through jet orifices of decreasing size in cascade fashion until they impact on an agar surface.[1218] The agar plates are then removed and incubated. The stage distribution of the legionellae should indicate the extent to which the bacteria would have penetrated the respiratory system. The advantages of this sampling method are

a. the equipment is more durable during use

b. the sampler can cetermine the number and size of droplets containing legionellae;

c. the agar plates can be placed directly in an incubator with no further manipulations; and

d. both selective and nonselective BCYE agar can be used. If the samples must be shipped to a laboratory, they should be packed and shipped without refrigeration as soon as possible.

Calculation of Air Sampling Results

Assuming that each colony on the agar plate is the growth from a single bacteria-carrying particle, the contamination of the air being sampled is determined from the number of colonies counted. The airborne microorganisms may be reported in terms of the number per cubic foot of air sampled.[1218]

For solid agar impactor samplers:

C / (R H P) = N

where

N = number of organisms collected per cubic foot of air sampledC = total plate countR = airflow rate in cubic feet per minuteP = duration of sampling period in minutes

For liquid impingers:

(C H V) / (Q H P H R) = N

where

C = total number of colonies from all aliquots platedV = final volume in mL of collecting mediaQ = total number of mL platedP, R, and N are defined as above

Ventilation Specifications for Health-Care Facilities

The following tables from the AIA *Guidelines for Design and Construction of Hospitals and Health-Care Facilities, 2001* are reprinted with permission of the American Institute of Architects and the publisher (The Facilities Guidelines Institute).[120]

Note: This table is Table 7.2 in the AIA guidelines, 2001 edition. Superscripts used in this table refer to notes following the table.

Table B.2. Ventilation requirements for areas affecting patient care in hospitals and outpatient facilities[1]

Format Change [February 2017]

The format of this section was changed to improve readability and accessibility. The content is unchanged.

Surgery and critical care

Area designation	Air movement relationship to adjacent area[2]	Minimum air changes of outdoor air per hour[3]	Minimum total air change per hour [4,5]	All air exhausted directly to outdoors[6]	Recirculated by means of room units[7]	Relative humidity[8] (%)	Design temperature[9] (degrees F [C])
Operating/surgical cystoscopic rooms[10,]	Out	3	15	–	No	30–60	68–73 (20–23)[12]

Area designation	Air movement relationship to adjacent area[2]	Minimum air changes of outdoor air per hour[3]	Minimum total air change per hour [4,5]	All air exhausted directly to outdoors[6]	Recirculated by means of room units[7]	Relative humidity[8] (%)	Design temperature[9] (degrees F [C])
[11]							
Delivery room[10]	Out	3	15	–	No	30–60	68–73 (20–23)
Recovery room[10]	–	2	6	–	No	30–60	70–75 (21–24)
Critical and intensive care	–	2	6	–	No	30–60	70–75 (21–24)
Newborn intensive care	–	2	6	–	No	30–60	72–78 (22–26)
Treatment room[13]	–	–	6	–	–	–	75 (24)
Trauma room[13]	Out	3	15	–	No	30–60	70–75 (21–24)
Anesthesia gas storage	In	–	8	Yes	–	–	–
Endoscopy	In	2	6	–	No	30–60	68–73 (20–23)
Bronchoscopy[11]	In	2	12	Yes	No	30–60	68–73 (20–23)
ER waiting rooms	In	2	12	Yes[14, 15]	–	–	70–75 (21–24)
Triage	In	2	12	Yes[14]	–	–	70–75 (21–24)
Radiology waiting rooms	In	2	12	Yes[14, 15]	–	–	70–75 (21–24)
Procedure room	Out	3	15	–	No	30–60	70–75 (21–24)

Ventilation requirements for surgery and critical care areas.

Nursing

Area designation	Air movement relationship to adjacent area[2]	Minimum air changes of outdoor air per hour[3]	Minimum total air change per hour [4,5]	All air exhausted directly to outdoors[6]	Recirculated by means of room units[7]	Relative humidity[8] (%)	Design temperature[9] (degrees F [C])
Patient room	–	2	6[16]	–	–	–	70–75 (21–24)
Toilet room	In	–	10	Yes	–	–	–
Newborn nursery suite	–	2	6	–	No	30–60	72–78 (22–26)
Protective environment room[11, 17]	Out	2	12	–	No	–	75 (24)
Airborne infection isolation room[17, 18]	In	2	12	Yes[15]	No	–	75 (24)

Area designation	Air movement relationship to adjacent area[2]	Minimum air changes of outdoor air per hour[3]	Minimum total air change per hour [4,5]	All air exhausted directly to outdoors[6]	Recirculated by means of room units[7]	Relative humidity[8] (%)	Design temperature[9] (degrees F [C])
Isolation alcove or anteroom[17, 18]	In/Out	–	10	Yes	No	–	–
Labor/delivery/recovery	–	2	6[16]	–	–	–	70–75 (21–24)
Labor/delivery/recovery/ postpartum	–	2	6[16]	–	–	–	70–75 (21–24)
Patient corridor	–	–	2	–	–	–	–

Ventilation requirements for nursing areas.

Ancillary/Radiology[19]

Area designation	Air movement relationship to adjacent area[2]	Minimum air changes of outdoor air per hour[3]	Minimum total air change per hour [4,5]	All air exhausted directly to outdoors[6]	Recirculated by means of room units[7]	Relative humidity[8] (%)	Design temperature[9] (degrees F [C])
X-ray (surgical/critical care and catheterization)	Out	3	15	–	No	30-60	70–75 (21–24)
X-ray (diagnostic & treatment)	–	–	6	–	–	–	75 (24)
Darkroom	In	–	10	Yes	No	–	–

Ventilation requirements for radiology areas.

Laboratory

Area designation	Air movement relationship to adjacent area[2]	Minimum air changes of outdoor air per hour[3]	Minimum total air change per hour [4,5]	All air exhausted directly to outdoors[6]	Recirculated by means of room units[7]	Relative humidity[8] (%)	Design temperature[9] (degrees F [C])
General[19]	–	–	6	–	–	–	75 (24)
Biochemistry[19]	Out	–	6	–	No	–	75 (24)
Cytology	In	–	6	Yes	No	–	75 (24)
Glass washing	In	–	10	Yes	–	–	75 (24)
Histology	In	–	6	Yes	No	–	75 (24)
Microbiology[19]	In	–	6	Yes	No	–	75 (24)
Nuclear medicine	In	–	6	Yes	No	–	75 (24)

Area designation	Air movement relationship to adjacent area[2]	Minimum air changes of outdoor air per hour[3]	Minimum total air change per hour [4,5]	All air exhausted directly to outdoors[6]	Recirculated by means of room units[7]	Relative humidity[8] (%)	Design temperature[9] (degrees F [C])
Pathology	In	–	6	Yes	No	–	75 (24)
Serology	Out	–	6	–	No	–	75 (24)
Sterilizing	In		10	Yes	–	–	–
Autopsy room[11]	In	–	12	Yes	No	–	–
Nonrefrigerated body-holding room	In	–	10	Yes	–	–	70 (21)
Pharmacy	Out	–	4	–	–	–	–

Ventilation requirements for laboratory areas.

Diagnostic and treatment

Area designation	Air movement relationship to adjacent area[2]	Minimum air changes of outdoor air per hour[3]	Minimum total air change per hour [4,5]	All air exhausted directly to outdoors[6]	Recirculated by means of room units[7]	Relative humidity[8] (%)	Design temperature[9] (degrees F [C])
Examination room	–	–	6	–	–	–	75 (24)
Medication room	Out	–	4	–	–	–	–
Treatment room	–	–	6	–	–	–	75 (24)
Physical therapy and hydrotherapy	In	–	6	–	–	–	75 (24)
Soiled workroom or soiled holding	In	–	10	Yes	No	–	–
Clean workroom or clean holding	Out	–	4	–	–	–	–

Ventilation requirements for diagnostic and treatment areas.

Sterilizing and supply

Area designation	Air movement relationship to adjacent area[2]	Minimum air changes of outdoor air per hour[3]	Minimum total air change per hour [4,5]	All air exhausted directly to outdoors[6]	Recirculated by means of room units[7]	Relative humidity[8] (%)	Design temperature[9] (degrees F [C])
ETO-sterilizer room	In	–	10	Yes	No	30-60	75 (24)

Area designation	Air movement relationship to adjacent area[2]	Minimum air changes of outdoor air per hour[3]	Minimum total air change per hour [4,5]	All air exhausted directly to outdoors[6]	Recirculated by means of room units[7]	Relative humidity[8] (%)	Design temperature[9] (degrees F [C])
Sterilizer equipment room	In	–	10	Yes	–	–	–

Ventilation requirements for sterilizing and supply areas.

Central medical and surgical supply

Area designation	Air movement relationship to adjacent area[2]	Minimum air changes of outdoor air per hour[3]	Minimum total air change per hour [4,5]	All air exhausted directly to outdoors[6]	Recirculated by means of room units[7]	Relative humidity[8] (%)	Design temperature[9] (degrees F [C])
Soiled or decontamination room	In	–	6	Yes	No	–	68–73 (20–23)
Clean workroom	Out	–	4	–	No	–	75 (24)
Sterile storage	Out	–	4	–	–	30-60	–

Ventilation requirements for central medical and surgical supply areas.

Service

Area designation	Air movement relationship to adjacent area[2]	Minimum air changes of outdoor air per hour[3]	Minimum total air change per hour [4,5]	All air exhausted directly to outdoors[6]	Recirculated by means of room units[7]	Relative humidity[8] (%)	Design temperature[9] (degrees F [C])
Food preparation center[20]	–	–	10	–	No	–	–
Ware washing	In	–	10	Yes	No	–	–
Dietary day storage	In	–	2	–	–	–	–
Laundry, general	–	–	10	Yes	–	–	–
Soiled linen (sorting and storage)	In	–	10	Yes	No	–	–
Clean linen storage	Out	–	2	–	–	–	–
Soiled linen and trash chute	In	–	10	Yes	No	–	–

Area designation	Air movement relationship to adjacent area[2]	Minimum air changes of outdoor air per hour[3]	Minimum total air change per hour [4,5]	All air exhausted directly to outdoors[6]	Recirculated by means of room units[7]	Relative humidity[8] (%)	Design temperature[9] (degrees F [C])
room							
Bedpan room	In	–	10	Yes	–	–	–
Bathroom	In	–	10	–	–	–	75 (24)
Janitor's closet	In	–	10	Yes	No	–	–

Ventilation requirements for service areas.

Notes:

1. The ventilation rates in this table cover ventilation for comfort, as well as for asepsis and odor control in areas of acute care hospitals that directly affect patient care and are determined based on health-care facilities being predominantly "No Smoking" facilities. Where smoking may be allowed, ventilation rates will need adjustment. Areas where specific ventilation rates are not given in the table shall be ventilated in accordance with ASHRAE Standard 62, *Ventilation for Acceptable Indoor Air Quality*, and ASHRAE *Handbook – HVAC Applications*. Specialized patient care areas, including organ transplant units, burn units, specialty procedure rooms, etc., shall have additional ventilation provisions for air quality control as may be appropriate. OSHA standards and/or NIOSH criteria require special ventilation requirements for employee health and safety within health-care facilities.

2. Design of the ventilation system shall provide air movement which is generally from clean to less clean areas. If any form of variable air volume or load shedding system is used for energy conservation, it must not compromise the corridor-to-room pressure balancing relationships or the minimum air changes required by the table.

3. To satisfy exhaust needs, replacement air from the outside is necessary. Table B2 does not attempt to describe specific amounts of outside air to be supplied to individual spaces except for certain areas such as those listed. Distribution of the outside air, added to the system to balance required exhaust, shall be as required by good engineering practice. Minimum outside air quantities shall remain constant while the system is in operation.

4. Number of air changes may be reduced when the room is unoccupied if provisions are made to ensure that the number of air changes indicated is reestablished any time the space is being utilized. Adjustments shall include provisions so that the direction of air movement shall remain the same when the number of air changes is reduced. Areas not indicated as having continuous directional control may have ventilation systems shut down when space is unoccupied and ventilation is not otherwise needed, if the maximum infiltration or exfiltration permitted in Note 2 is not exceeded and if adjacent pressure balancing relationships are not compromised. Air quantity calculations must account for filter loading such that the indicated air change rates are provided up until the time of filter change-out.

5. Air change requirements indicated are minimum values. Higher values should be used when required to maintain indicated room conditions (temperature and jumidity), based on the cooling load of the space (lights, equipment, people, exterior walls and windows, etc.).

6. Air from areas with contamination and/or odor problems shall be exhausted to the outside and not recirculated to other areas. Note that individual circumstances may require special consideration for air exhaust to the outside, (e.g., in intensive care units in which patients with pulmonary infection are treated) and rooms for burn patients.

7. Recirculating room HVAC units refer to those local units that are used primarily for heating and cooling of air, and not disinfection of air. Because of cleaning difficulty and potential for buildup of contamination, recirculating room units shall not be used in areas marked "No." However, for airborne infection control, air may be recirculated within individual isolation rooms if HEPA filters are used. Isolation and intensive care unit rooms may be ventilated by reheat induction units in which only the primary air supplied from a central system passes through the reheat unit. Gravity-type heating or cooling units such as radiators or convectors shall not be used in operating rooms and other special care areas. See this table's Appendix I for a description of recirculation units to be used in isolation rooms (A7).

8. The ranges listed are the minimum and maximum limits where control is specifically needed. The maximum and minimum limits are not intended to be independent of a space's associated temperature. The humidity is expected to be at the higher end of the range when the temperature is also at the higher end, and vice versa.

9. Where temperature ranges are indicated, the systems shall be capable of maintaining the rooms at any point within the range during normal operation. A single figure indicates a heating or cooling capacity of at least the indicated temperature. This is usually applicable when patients may be undressed and require a warmer environment. Nothing in these guidelines shall be construed as precluding the use of temperatures lower than those noted when the patients' comfort and medical conditions make lower temperatures desirable. Unoccupied areas such as storage rooms shall have temperatures appropriate for the function intended.

10. National Institute for Occupational Safety and Health (NIOSH) criteria documents regarding "Occupational Exposure to Waste Anesthetic Gases and Vapors," and "Control of Occupational Exposure to Nitrous Oxide" indicate a need for both local exhaust (scavenging) systems and general ventilation of the areas in which the respective gases are utilized.

11. Differential pressure shall be a minimum of 0.01" water gauge (2.5 Pa). If alarms are installed, allowances shall be made to prevent nuisance alarms of monitoring devices.

12. Some surgeons may require room temperatures which are outside of the indicated range. All operating room design conditions shall be developed in consultation with surgeons, anesthesiologists, and nursing staff.

13. The term "trauma room" as used here is the operating room space in the emergency department or other trauma reception area that is used for emergency surgery. The "first aid room" and/or "emergency room" used for initial treatment of accident victims may be ventilated as noted for the "treatment room." Treatment rooms used for bronchoscopy shall be treated as Bronchoscopy rooms. Treatment rooms used for cryosurgery procedures with nitrous oxide shall contain provisions for exhausting waste gases.

14. In a ventilation system that recirculates air, HEPA filters can be used in lieu of exhausting the air from these spaces to the outside. In this application, the return air shall be passed through the HEPA filters before it is introduced into any other spaces.

15. If it is not practical to exhaust the air from the airborne infection isolation room to the outside, the air may be returned through HEPA filters to the air-handling system exclusively serving the isolation room.

16. Total air changes per room for patient rooms, labor/delivery/recovery rooms, and labor/delivery/recovery/postpartum rooms may be reduced to 4 when supplemental heating and/or cooling systems (radiant heating and cooling, baseboard heating, etc.) are used.

17. The protective environment airflow design specifications protect the patient from common environmental airborne infectious microbes (i.e., *Aspergillus* spores). These special ventilation areas shall be designed to provide directed airflow from the cleanest patient care area to less clean areas. These rooms shall be protected with HEPA filters at 99.97 percent efficiency for a 0.3 µm sized particle in the supply airstream. These interrupting filters protect patient rooms from maintenance-derived release of environmental microbes from the ventilation system components. Recirculation HEPA filters can be used to increase the equivalent room air exchanges. Constant volume airflow is required for consistent ventilation for the protected environment. If the facility determines that airborne infection isolation is necessary for protective environment patients, an anteroom should be provided. Rooms with reversible airflow provisions for the purpose of switching between protective environment and airborne infection isolation functions are not acceptable.

18. The infectious disease isolation room described in these guidelines is to be used for isolating the airborne spread of infectious diseases, such as measles, varicella, or tuberculosis. The design of airborne infection isolation (AII) rooms should include the provision for normal patient care during periods not requiring isolation precautions. Supplemental recirculating devices may be used in the patient room to increase the equivalent room air exchanges; however, such recirculating devices do not provide the outside air requirements. Air may be recirculated within individual isolation rooms if HEPA filters are used. Rooms with reversible airflow provisions for the purpose of switching between protective environment and AII functions are not acceptable.

19. When required, appropriate hoods and exhaust devices for the removal of noxious gases or chemical vapors shall be provided (see Section 7.31.D14 and 7.31.D15 in the AIA guideline [reference 120] and NFPA 99).

20. Food preparation centers shall have ventilation systems whose air supply mechanisms are interfaced appropriately with exhaust hood controls or relief vents so that exfiltration or infiltration to or from exit corridors does not compromise the exit corridor restrictions of NFPA 90A, the pressure requirements of NFPA 96, or the maximum defined in the table. The number of air changes may be reduced or varied to any extent required for odor control when the space is not in use. See Section 7.31.D1.p in the AIA guideline (reference 120).

Appendix I:

A7. Recirculating devices with HEPA filters may have potential uses in existing facilities as interim, supplemental environmental controls to meet requirements for the control of airborne infectious agents. Limitations in design must be recognized. The design of either portable or fixed systems should prevent stagnation and short circuiting of airflow. The supply and exhaust locations should direct clean air to areas where health-care workers are likely to work, across the infectious source, and then to the exhaust, so that the healthcare worker is not in position

between the infectious source and the exhaust location. The design of such systems should also allow for easy access for scheduled preventative maintenance and cleaning.

A11. The verification of airflow direction can include a simple visual method such as smoke trail, ball-in-tube, or flutterstrip. These devices will require a minimum differential air pressure to indicate airflow direction.

Note: This table is Table 8.1 in the AIA guidelines, 2001 edition. Superscripts used in this table refer to notes following the table.

Table B.3. Pressure relationships and ventilation of certain areas of nursing facilities[1]

Area designation	Air movement relationship to adjacent area[2]	Minimum air changes of outdoor air per hour[3]	Minimum total air change per hour [4]	All air exhausted directly to outdoors[5]	Recirculated by means of room units[6]	Relative humidity[7] (%)	Design temperature[8] (degrees F [C])
Resident room	–	2	2	–	–	–[9]	70–75 (21–24)
Resident unit corridor	–	–	4	–	–	–[9]	–
Resident gathering areas	–	4	4	–	–	–	–
Toilet room	In	–	10	Yes	No	–	–
Dining rooms	–	2	4	–	–	–	75 (24)
Activity rooms, if provided	–	4	4	–	–	–	–
Physical therapy	In	2	6	–	–	–	75 (24)
Occupational therapy	In	2	6	–	–	–	75 (24)
Soiled workroom or soiled holding	In	2	10	Yes	No	–	–
Clean workroom or clean holding	Out	2	4	–	–	(Max. 70)	75 (24)
Sterilizer exhaust room	In	–	10	Yes	No	–	–
Linen and trash chute room, if provided	In	–	10	Yes	No	–	–
Laundry, general, if provided	–	2	10	Yes	No	–	–
Soiled linen sorting and storage	In	–	10	Yes	No	–	–
Clean linen storage	Out	–	2	Yes	No	–	–
Food preparation facilities[10]	–	2	10	Yes	No	–	–

Area designation	Air movement relationship to adjacent area[2]	Minimum air changes of outdoor air per hour[3]	Minimum total air change per hour [4]	All air exhausted directly to outdoors[5]	Recirculated by means of room units[6]	Relative humidity[7] (%)	Design temperature[8] (degrees F [C])
Dietary warewashing	In	–	10	Yes	No	–	–
Dietary storage areas	–	–	2	Yes	No	–	–
Housekeeping rooms	In	–	10	Yes	No	–	–
Bathing rooms	In	–	10	Yes	No	–	75 (24)

Pressure relationships and ventilation of certain areas.

Notes:

1. The ventilation rates in this table cover ventilation for comfort, as well as for asepsis and odor control in areas of nursing facilities that directly affect resident care and are determined based on nursing facilities being predominantly "No Smoking" facilities. Where smoking may be allowed, ventilation rates will need adjustment. Areas where specific ventilation rates are not given in the table shall be ventilated in accordance with ASHRAE Standard 62, *Ventilation for Acceptable Indoor Air Quality,* and ASHRAE *Handbook – HVAC Applications.* OSHA standards and/or NIOSH criteria require special ventilation requirements for employee health and safety within nursing facilities.

2. Design of the ventilation system shall, insofar as possible, provide that air movement is from clean to less clean areas. However, continuous compliance may be impractical with full utilization of some forms of variable air volume and load shedding systems that may be used for energy conservation. Areas that do require positive and continuous control are noted with "Out" or "In" to indicate the required direction of air movement in relation to the space named. Rate of air movement may, of course, be varied as needed within the limits required for positive control. Where indication of air movement direction is enclosed in parentheses, continuous directional control is required only when the specialized equipment or device is in use or where room use may otherwise compromise the intent of movement from clean to less clean. Air movement for rooms with dashes and nonpatient areas may vary as necessary to satisfy the requirements of those spaces. Additional adjustments may be needed when space is unused or unoccupied and air systems are deenergized or reduced.

3. To satisfy exhaust needs, replacement air from outside is necessary. Table B.3 does not attempt to describe specific amounts of outside air to be supplied to individual spaces except for certain areas such as those listed. Distribution of the outside air, added to the system to balance required exhaust, shall be as required by good engineering practice.

4. Number of air changes may be reduced when the room is unoccupied if provisions are made to ensure that the number of air changes indicated is reestablished any time the space is being utilized. Adjustments shall include provisions so that the direction of air movement shall remain the same when the number of air changes is reduced. Areas not indicated as having continuous directional control may have ventilation systems shut down when space is unoccupied and ventilation is not otherwise needed.

5. Air from areas with contamination and/or odor problems shall be exhausted to the outside and not recirculated to other areas. Note that individual circumstances may require special consideration for air exhaust to outside.

6. Because of cleaning difficulty and potential for buildup of contamination, recirculating room units shall not be used in areas marked "No." Isolation rooms may be ventilated by reheat induction units in which only the primary air supplied from a central system passes through the reheat unit. Gravity-type heating or cooling units such as radiators or convectors shall not be used in special care areas.

7. The ranges listed are the minimum and maximum limits where control is specifically needed. See A8.31.D in the AIA guideline (reference 120) for additional information.

8. Where temperature ranges are indicated, the systems shall be capable of maintaining the rooms at any point within the range. A single figure indicates a heating or cooling capacity of at least the indicated temperature. This is usually applicable where residents may be undressed and require a warmer environment. Nothing in these guidelines shall be construed as precluding the use of temperatures lower than those noted when the residents' comfort and medical conditions make lower temperatures desirable. Unoccupied areas such as storage rooms shall have temperatures appropriate for the function intended.

9. See A8.31.D1 in the AIA guideline (reference 120).

10. Food preparation facilities shall have ventilation systems whose air supply mechanisms are interfaced appropriately with exhaust hood controls or relief vents so that exfiltration or infiltration to or from exit corridors does not compromise the exit corridor restrictions of NFPA 90A, the pressure requirements of NFPA 96, or the maximum defined in the table. The number of air changes may be reduced or varied to any extent required for odor control when the space is not in use.

Table B.4. Filter efficiencies for central ventilation and air conditioning systems in general hospitals*

Area designation	Minimum number of filter beds	Filter bed no.1 (%)*	Filter bed No. 2 (%)*
All areas for inpatient care, treatment, and diagnosis, and those areas providing direct service or clean supplies, such as sterile and clean processing, etc.	2	30	90
Protective environment room	2	30	99.97
Laboratories	1	80	n/a
Administrative, bulk storage, soiled holding areas, food preparation areas, and laundries	1	30	n/a

Filter efficiencies for central ventilation, listing number of filter beds and efficiency (%) of each for hospitals.

Note: This table is Table 7.3 in the AIA guidelines, 2001 edition.

*Additional roughing or prefilters should be considered to reduce maintenance required for filters with efficiency higher than 75%. The filtration efficiency ratings are based on average dust sopt efficiency per ASHRAE 52.1–1992.

Table B.5. Filter efficiencies for central ventilation and air conditioning systems in outpatient facilities*

Area designation	Minimum number of filter beds	Filter bed no.1 (%)*	Filter bed No. 2 (%)*
All areas for patient care, treatment, and/or diagnosis, and those areas providing direct service or clean supplies such as sterile and clean processing, etc.	2	30	90
Laboratories	1	80	n/a
Administrative, bulk storage, soiled holding areas, food preparation areas, and laundries	1	30	>n/a

Filter efficiencies for central ventilation in outpatient facilities.

Note: This table is Table 9.1 in the AIA guidelines, 2001 edition.

* Additional roughing or prefilters should be considered to reduce maintenance required for main filters. The filtration efficiency ratings are based on dust spot efficiency per ASHRAE 52.1–1992.

+ These requirements do not apply to small primary (e.g., neighborhood) outpatient facilities or outpatient facilities that do not perform invasive applications or procedures.

Table B.6. Filter efficiencies for central ventilation and air conditioning systems in nursing facilities

Area designation	Minimum number of filter beds	Filter bed no.1 (%)*	Filter bed No. 2 (%)*
All areas for inpatient care, treatment, and/or diagnosis, and those areas providing direct service or clean supplies	2	30	80
Administrative, bulk storage, soiled holding, laundries, and food preparation areas	1	30	n/a

Filter efficiencies for central ventilation, in nursing facilities.

Note: This table is Table 8.2 in the AIA guidelines, 2001 edition.

*The filtration efficiency ratings are based on average dust spot efficiency as per ASHRAE 52.1–1992.

Table B.7. Filter efficiencies for central ventilation and air conditioning systems in psychiatric hospitals

Area designation	Minimum number of filter beds	Filter bed no.1 (%)*	Filter bed No. 2 (%)*
All areas for inpatient care, treatment, and diagnosis, and those areas providing direct services	2	30	90
Administrative, bulk storage, soiled holding, laundries, and food preparation areas	1	30	n/a

Filter efficiencies for central ventilation in psychiatric hospitals.

Note: This table is Table 11.1 in the AIA guidelines, 2001 edition.

* The filtration efficiency ratings are based on average dust spot efficiency as per ASHRAE 52.1–1992.

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