HEALTHCARE
GUIDELINES AND STANDARDS

APPLICATION NOTE LC-126

INTRODUCTION

This publication provides excerpts from some of the many guidelines and standards that pertain to the construction and operation of hospital and medical facilities, primarily concerning ventilation systems that maintain and control room pressurization. The intent of the publication is to provide owners, engineers, architects and hospital personnel an overview of the standards and guidelines that pertain to the design and operation of today's medical facilities. Excerpts have been taken that apply to planning, safety, operation and system design.

This document is arranged by topic. Effort has been made to present the statements that best summarize the document as it pertains to safety and containment of the ventilation system.

The excerpts in most cases are worded as they appear in the standard or guideline, though in some instances may be out of context. Please review the actual guideline or standard for more detailed information and to make the best interpretation of each statement.

NOTE:
On June 20, 2016, the Center for Medicare and Medicaid Services (CMS) adopted the 2012 NFPA 99 HCFC standard, and began the enforcement of it on July 6, 2016. The NFPA 99 standard references the older ASHRAE 170-2008 standard, not the current ASHRAE 107-2013 that new healthcare facilities are designed to. This application note highlights potential areas for confusion this may cause and should be viewed as a helpful reference by engineers and facilities personnel in preparation for inspection by CMS.

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GENERAL DESIGN

ANSI /ASHRAE /ASHE Standard 170-2013

6.1 Utilities	*The space ventilation and pressure relationship requirements of Table 7-1 shall be maintained… even in the event of loss of normal electrical power.*
6.1.2.1 Heating and Cooling Sources	*Provide heat sources and essential accessories in number and arrangement to accommodate the facility needs, even when any one of the heat sources is not operating due to a breakdown or routine maintenance.*
6.3.1.1 Outdoor Air Intakes General	*Outdoor air intakes for air-handling units shall be located a minimum of 25 ft. (8 m) from cooling towers and all exhaust and vent discharges. Outdoor air intakes shall be located such that the bottom of the air intake is at least 6 ft. (2 m) above grade. New facilities with moderate to high risk of natural or man-made extraordinary incidents shall locate air intakes away from public access. All intakes shall be designed to prevent the entrainment of wind-driven rain, shall contain features for draining away precipitation, and shall be equipped with a bird screen of mesh no small than 0.5 in. (13mm).*
	The below highlighted text section "Exception" for gas fired RTUs is not included in the 2008 Standard but is part of 2013. *Exception: For gas-fired, packaged rooftop unit, the separation distance of the unit's outdoor air intake from its flue may be less than 25ft (8m). The separation distance prescribed in Table 5-1, "Air Intake Minimum Separation Distance," in ANSI/ASHRAE Standard 62.1.*
6.3.2.1 Exhaust Discharges-General	*Exhaust discharge air from the AII rooms, bronchoscopy rooms, and sputum collection and pentamidine administration rooms, Emergency Department public waiting areas, nuclear medicine hot labs, radiology waiting rooms programmed to hold patients who are waiting for chest x-rays for diagnosis of respiratory disease, pharmacy hazardous-drug exhausted enclosures, and laboratory work area chemical fume hoods shall* *a. Be designed so that all ductwork within the building is under negative pressure;* *b. Be located such that they minimize the recirculation of exhausted air back into the building.*
	The highlighted text below is no longer a part of 2013, but is currently part 2008: *Discharge in a vertical direction at least 10 ft. (3m) above the roof level and shall be located not less than 10 ft. horizontally from the air intakes, open able windows/doors, or areas that are normally accessible to the public or maintenance personnel and that are higher in elevation that the exhaust discharge;*

6.3.2.2 Additional Requirements	***ASHRAE 2008 does not include any of the 6.3.2.2 requirements.*** *a. Exhaust discharge outlets from AII rooms, bronchoscopy and sputum collection exhaust, pharmacy hazardous-drug exhausted enclosures, and laboratory work area chemical fume hoods shall additionally be arranged to discharge to atmosphere in a vertical direction (with no rain cap or other device to impede the vertical momentum) and at least 10 ft. (3m) above the adjoining roof level.* *b. Exhaust discharge outlets from laboratory work area chemical fume hoods shall discharge with a stack velocity of at least 2500 fpm (1180 L/s)* *c. Exhaust discharge outlets from AII rooms, bronchoscopy and sputum collection exhaust, and laboratory work area chemical fume hoods shall be located not less than 25ft (8m) horizontally from outdoor air intakes, openable windows/doors, and areas that are normally accessible to the public.* ***Exception to section 6.3.2.2 (c):** If permitted by the authority having jurisdiction, an alternate location (e.g. located adjacent to an air intake but with the exhaust discharge point above the top of the air intake) may be utilized. The submitted reentrainment analysis shall demonstrate than an exhaust discharge outlet located at a distance less than 25 ft (8m) horizontally provides a lower concentration of reentrainment than all the areas located at a distance greater than 25 ft (8m) horizontally on the roof level where the exhaust discharge is located.*
6.4 Filtration	*Filter banks shall be provided in accordance with Table 6-1. Each filter bank with an efficiency of greater than MERV12 shall be provided with an installed manometer or differential pressure measuring device that is readily accessible and provides a reading of differential static pressure across the filter to indicate when the filter needs to be changed.* *First Filtration Bank:* *Filter Bank No. 1 shall be placed upstream of the heating and cooling coils such that all mixed air is filtered.* *Second Filtration Bank:* *Filter shall be installed downstream of all wet air cooling coils and the supply fan. All second filter banks shall have sealing interface surfaces.*
6.6 Humidifiers	*When outdoor humidity and internal moisture sources are not sufficient to meet the requirements of Table 7-1, humidification shall be provided by means of the facility air-handling systems. Steam or adiabatic high-pressure water atomizing humidifiers shall be used.*
6.6.1 General Requirements	*a. Locate humidifiers within air-handling units or ductwork to avoid moisture accumulation in downstream components, including filters and insulation…. Controls shall be provided to limit the duct humidity to a maximum value of 90%RH when the humidifier is operating….* *b. A humidity sensor shall be provided, located at a suitable distance downstream from the injection source*
6.7 Air Distribution Systems	*Maintain the pressure relationships required by Table 7-1 in all modes of HVAC system operation, except as noted in the table. Spaces listed in Table 7-1 that have required pressure relationships shall be served by fully ducted returns. The air-distribution design shall maintain the required space pressure relationships, taking into account recommended maximum filter loading, heating-season lowered airflow operation, and cooling-season higher airflow operation….*

7. Space Ventilation

The ventilation requirements of his standard are minimum requirements that provide control of environmental comfort, asepsis, and odor in health care facilities. However, because they are minimum requirements and because of the diversity of the population and variations in susceptibility and sensitivity, these requirements do not provide assured protection from discomfort, airborne transmission of contagions, and odors.

7.1 General Requirements.

The following general requirements shall apply for space ventilation:

a) Spaces shall be ventilated according to Table 7-1.

1. *Design of the ventilation system shall provide air movement that 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 shall not compromise the pressure balancing relationships or the minimum air changes required by the table.*

3. *For design purposes, the minimum number of total air changes indicated shall be either supplied for positive pressure rooms or exhausted for negative pressure rooms. Space that are required in Table7.1 to be at a negative pressure relationship and are not required to be exhausted shall utilize the supply airflow rate to compute the minimum TACH required. For spaces that require a positive or negative pressure relationship, the number of air changes can be reduced when the space is unoccupied, provided that the required pressure relationship to adjoining spaces is maintained while the space is unoccupied and that the minimum number of air changes indicated is reestablished anytime the space becomes occupied. Controls intended to switch the required pressure relationships between spaces from positive to negative, and vice versa, shall not be permitted. Air change rates in excess of the minimum values are expected in some cases in order to maintain room temperature and humidity conditions based upon the space cooling or heating load.*

4. *The entire Minimum Outdoor Air Changes per Hour required by Table 7.1 for the space shall meet the filtration requirements of Section 6.4.*

5. *For spaces where table 7.1 permits air to be recirculated by room units, the portion of the Minimum Total Air Changes per Hour required for a space that is greater than the Minimum Outdoor Air Changes per Hour required component may be provided by recirculating room HVAC units. Such recirculating room HVAC units shall*

   i Not receive nonfiltered, nonconditioned outdoor air;

   ii Serve only a single space; and

   iii Provide a minimum MERV 6 filter for airflow passing over any surface that is designed to condense water. This filter shall be located upstream of any such cold surface, so that all of the air passing over the cold surface is filtered.

2) Air filtration for spaces shall comply with Table 6-1.

3) Supply air outlets for spaces shall comply with Table 6-2.

FGI Guidelines for Design and Construction of Health Care Facilities 2010

2.1-2.4 Special Patient Care Rooms

2.1-2.4.2.1 General	*(3) Location. AII rooms shall be located within individual nursing units or grouped as a separate isolation nursing unit. When not required for patients with airborne infectious diseases, use of these rooms for normal acute care patients shall be permitted.*
2.1-8.2.3.2 Duct linings	*(1) Duct linings exposed to air movement shall not be used in ducts serving operating rooms, delivery rooms, LDR rooms, nurseries, protective environment rooms, and critical care units. This requirement shall not apply to mixing boxes and sound attenuators that have special coverings over such lining.*
2.1-8.2.4.3 Exhaust systems	*d) Airborne infection isolation rooms shall not be served by exhaust systems incorporating a heat wheel.*

AIRBORNE INFECTION ISOLATION ROOM

Definition:

ANSI /ASHRAE /ASHE Standard 170-2013

3. Definitions	*The isolation of patients infected with organisms spread by airborne droplet nuclei less than 5 μm in diameter …*

FGI Guidelines for Design and Construction of Health Care Facilities 2010

A room designated for persons having or suspected of having an infection that is spread through coughing or other ways of suspending droplets of pathogens into the air (e.g., tuberculosis, smallpox).

ASHRAE HANDBOOK, HVAC APPLICATIONS 1995

Chapter 7 Health Care Facilities

Infection Sources and Control Measures

Viral Infection	*… isolation rooms and isolation anterooms with appropriate ventilation-pressure relationships are the primary means used to prevent the spread of airborne viruses in the he hospital environment.*
Nursing	*Infectious Isolation Unit. The infectious isolation room is used to protect the remainder of the hospital from the patients' infectious diseases. Recent multidrug-resistant strains of tuberculosis have increased the importance of pressurization, air change rates, filtration , and air distribution design…*

Center for Disease Control and Prevention Guidelines

Morbidity and Mortality Weekly Report (MMWR)

Guidelines for Environmental Infection Control in Health-Care Facilities, 2003

Recommendations — Air

I. Air-Handling Systems in Health-Care Facilities	*A. Use AIA guidelines as minimum standards where state or local regulations are not in place for design and construction of ventilation systems in new or renovated health-care facilities. Ensure that existing structures continue to meet the specifications in effect at the time of construction...*
	E. Conduct an infection-control risk assessment (ICRA) and provide an adequate number of AII and PE rooms (if required) or other areas to meet the needs of the patient population.

Construction

ANSI /ASHRAE /ASHE Standard 170-2013

7.2 Additional Room Specific Requirements

7.2.1 Airborne Infection Isolation (AII) Rooms.	*Ventilation for AII rooms shall meet the following requirements whenever an infectious patient occupies the room:*
	c. Exhaust air grilles or registers in the patient room shall be located directly above the patient bed on the ceiling or on the wall near the head of the bed unless it can be demonstrated that such a location is not practical.
7.2.3 Combination Airborne Infectious Isolation/Protective Environment (AII/PE) Rooms	*Ventilation for AII/PE rooms shall meet the following requirements:*
	a. Supply air diffusers shall be located above the patient bed.
	b. Exhaust grilles or registers shall be located near the patient room door.

ASHRAE HANDBOOK, HVAC APPLICATIONS 1995

Chapter 7 Health Care Facilities

Hospital Facilities	*The basic difference between air conditioning for hospital and that of other building types stem from (1) the need to restrict air movement in and between the various departments; (2) the specific requirements for ventilation and filtration to dilute and remove contamination in the form of odor, airborne microorganisms and viruses, and hazardous chemical and radioactive substance; (3) the different temperature and humidity requirements for various areas; and (4) the design sophistication needed to permit accurate control of environmental conditions.*
Air Quality Air Movement	*… In general, outlets supplying air to sensitive ultra-clean areas and highly contaminated areas should be located on the ceiling, with perimeter or several exhaust inlets near the floor. This arrangement provides a downward movement of clean air through the breathing and working zones to the contaminated floor area for exhaust…*

Center for Disease Control and Prevention Guidelines

Morbidity and Mortality Weekly Report (MMWR)

Guidelines for Environmental Infection Control in Health-Care Facilities, 2003

Recommendations — Air

IV. Infection-Control and Ventilation Requirements for AII Rooms	*A Incorporate certain specifications into the planning and construction of AII units* *2. Ensure that rooms are well-sealed by properly constructing windows, doors, and air-intake and exhaust ports; when monitoring indicates air leakage, locate the leak and make necessary repairs.* *3. Install self-closing devices on all AII room exit doors.* *5. Direct exhaust air to the outside, away from air-intake and populated areas. If this is not practical, air from the room can be recirculated after passing through a HEPA filter.*

Ventilation

ANSI /ASHRAE /ASHE Standard 170-2013

7.2 Additional Room Specific Requirements

7.2.1 Airborne Infection Isolation (AII) Rooms.	*Ventilation for AII rooms shall meet the following requirements whenever an infectious patient occupies the room:* *b. All air from the AII room shall be exhausted directly to the outdoors.* ***Exception:*** *AII rooms that are retrofitted from standard patient rooms from which it is impractical to exhaust directly outdoors may be provided with recirculated air from the room's exhaust, on the condition that the air first pass through a HEPA filter.* *c. All exhaust air from the AII rooms, associated anterooms, and associated toilet rooms shall be discharged directly to the outdoors without mixing with exhaust air from any other non-AII room or exhaust system.*

ASHRAE HANDBOOK, HVAC APPLICATIONS 1995

Chapter 7 Health Care Facilities

Hospital Facilities

Air Quality Air Movement	*Systems serving highly contaminated areas, such as autopsy rooms and isolation rooms for contagious ... patients, should maintain a ... negative air pressure with these rooms relative to adjoining rooms or the corridor. The pressure is obtained by supplying less air to the area than is exhausted from it. This induces a flow of air into the area around the perimeters of doors and prevents an outward airflow...*

Center for Disease Control and Prevention Guidelines

Morbidity and Mortality Weekly Report (MMWR)

Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-Care Facilities, 1994
Introduction

II. Recommendations

E. Management of Hospitalized Patients Who Have Confirmed or Suspected TB

3. The TB isolation Room

…For the purposes of reducing concentrations of droplet nuclei, TB isolation and treatment rooms in existing health-care facilities should have an airflow of ≥6 ACH. Where feasible, the airflow rate shall be increased to ≥12 ACH…New construction or renovation of existing health-care facilities should be designed so that TB isolation rooms achieve an airflow of ≥12 ACH.

Supplement 3: Engineering Controls

B. General Ventilation

3. Airflow direction in the facility

a. Directional airflow

The general ventilation system should be designed and balanced so that air flows from less contaminated (i.e., more clean) to more contaminated (less clean) areas. For example, air should flow from corridors (cleaner areas) into TB isolation rooms (less clean areas) to prevent spread of contaminants to other areas…

Morbidity and Mortality Weekly Report (MMWR)

Guidelines for Environmental Infection Control in Health-Care Facilities, 2003

Recommendations — Air

IV. Infection-Control and Ventilation Requirements for AII Rooms

A.4. Provide ventilation to ensure ≥12 ACH for renovated rooms and new rooms, and ≥6 ACH for existing AII rooms.

Room Pressure Differential

ANSI /ASHRAE /ASHE Standard 170-2013

7.2 Additional Room Specific Requirements

7.2.1 Airborne Infection Isolation (AII) Rooms.

Ventilation for AII rooms shall meet the following requirements whenever an infectious patient occupies the room:

e. The room envelope shall be sealed to provide a minimum differential pressure of 0.01 in. wc (2.5 Pa) across the envelope.

f. Differential pressure between AII rooms and adjacent spaces that are not AII rooms shall be a minimum of -0.01 in wc (-2.5 Pa). Spaces such as the toilet room and the anteroom (if present) that are directly associated with the AII room and open directly into the AII room are not required to be designed with a minimum pressure difference from the AII room but are still required to maintain the pressure relationships to adjacent areas specified in Table 7-1.

g. When an anteroom is provided, the pressure relationships shall be as follows: (1) the AII room shall be at a negative pressure with respect to the anteroom, and (2) the anteroom shall be at a negative pressure with respect to the corridor.

7.2.3 Combination Airborne Infectious Isolation/Protective Environment (AII/PE) Rooms

Ventilation for II/PE rooms shall meet the following requirements:

c. The pressure relationship to adjacent areas for the required anteroom shall be one of the following:

- *The anteroom shall be at a positive pressure with respect to both the AII/PE room and the corridor or common space.*
- *The anteroom shall be at a negative pressure with respect to both the AII/PE room and the corridor or common space.*

FGI Guidelines for Design and Construction of Health Care Facilities 2010

2.1-8.2.2 HVAC Requirements for Specific locations

2.1-8.2.2.1 Airborne infection isolation (AII) rooms

The AII room is used for isolating the airborne spread of airborne infectious diseases (e.g., measles, varicella, tuberculosis).

1) Use of AII rooms for routine patient care during periods not requiring isolation precautions shall be permitted. Differential pressure requirements shall remain unchanged when the AII room is used for routine patient care.

3) When an anteroom is provided, airflow shall be from the corridor into the anteroom and from the anteroom into the patient room.

Center for Disease Control and Prevention Guidelines

Morbidity and Mortality Weekly Report (MMWR)

Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-Care Facilities, 1994

Introduction

Supplement 3: Engineering Controls

II. Ventilation

B General Ventilation

4. Achieving negative pressure in a room

a. Pressure differential

The minimum pressure difference necessary to achieve and maintain negative pressure that will result in airflow into the room is very small (0.001 inch of water)…To establish negative pressure in a room that has a normally functioning ventilation system, the room supply and exhaust air flows are first balanced to achieve an exhaust flow of either 10% or 50 cubic feet per minute (cfm) greater than the supply (whichever is the greater). In most situations, this specification should achieve a negative pressure of at least 0.001 inch of water.

Morbidity and Mortality Weekly Report (MMWR)

Guidelines for Environmental Infection Control in Health-Care Facilities, 2003

Recommendations — Air

IV. Infection Control and Ventilation Requirements for AII Rooms

A.1. Maintain continuous negative air pressure (2.5 Pa [0.01 inch water gauge]) in relation to the air pressure in the corridor;

C. Implement environmental infection-control measures for persons with diagnosed or suspected airborne infectious diseases.

1. Use AII rooms for patients with or suspected of having an airborne infection who also require cough-inducing procedures, or use an enclosed booth that is engineered to provide 1) ≥12 ACH; 2) air supply and exhaust rate sufficient to maintain a 2.5 Pa (0.01-inch water gauge) negative pressure difference with respect to all surrounding spaces with an exhaust rate of ≥50 ft^3/min; and 3) air exhausted directly outside away from air intakes and traffic or exhausted after HEPA filtration before recirculation.

3. Place smallpox patients in negative pressure rooms at the onset of their illness, preferably using a room with an anteroom, if available…

OSHA Instructions CPL 2.106

Subject: Enforcement Procedures and scheduling for Occupational Exposure to Tuberculosis

5. Engineering Controls	*b. Isolation and treatment rooms in use by individuals with suspected or confirmed infectious TB disease shall be kept under negative pressure to induce airflow into the room from all surrounding areas…*

Room Pressure Monitors

ANSI /ASHRAE /ASHE Standard 170-2013

7.2 Additional Room Specific Requirements

7.2.1 Airborne Infection Isolation (AII) Rooms.	*Ventilation for AII rooms shall meet the following requirements whenever an infectious patient occupies the room:* *b. Each AII room shall comply with requirements of Tables 6-1, 6-2, and 7-1. AII rooms shall have a permanently installed device and/or mechanism to constantly monitor the differential air pressure between the room (when occupied by patients with a suspected airborne infectious disease) and the corridor, whether or not there is an anteroom. A local visual means shall be provided to indicate whenever negative differential pressure is not maintained.*
7.2.3 Combination Airborne Infectious Isolation/Protective Environment (AII/PE) Rooms	*Ventilation for II/PE rooms shall meet the following requirements:* *d. AII/PE rooms shall have two permanently installed devices and/or mechanisms to constantly monitor the differential air pressure. One device and/or mechanism shall monitor the pressure differential between the AII/ PE room and the anteroom. The second device and/or mechanism shall monitor the pressure differential between the anteroom and the corridor or common space. For each device and/or mechanism, a local visual means shall be provided to indicate whenever differential pressure is not maintained.*

FGI Guidelines for Design and Construction of Health Care Facilities 2010

2.1-8.2.2 HVAC Requirements for Specific locations 2.1-8.2.2.1 Airborne infection isolation (AII) rooms.	*The AII room is used for isolating the airborne spread of airborne infectious diseases (e.g., measles, varicella, tuberculosis).* *2) Each AII room shall have a permanently installed visual mechanism to constantly monitor the pressure status of the room when occupied by patients with an airborne infectious disease. The mechanism shall monitor the pressure differential between the AII room and the corridor, whether or not there is an anteroom between the corridor and the AII room.*

ASHRAE HANDBOOK, HVAC APPLICATIONS 1995

Chapter 7 Health Care Facilities

Hospital Facilities Specific Design Criteria Surgery and Critical Care	*The following conditions are recommended for operation, catheterization, cystoscopic, and fracture rooms:* *…4. Differential pressure indication device should be installed to permit air pressure readings in the rooms.*

Center for Disease Control and Prevention Guidelines

Morbidity and Mortality Weekly Report (MMWR)

Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-Care Facilities, 1994
Introduction

Supplement 3: Engineering Controls

II. Ventilation

B General Ventilation

4. Achieving negative pressure in a room

c. Monitoring negative pressure

The negative pressure in a room can be monitored by visually observing the direction of airflow (e.g., using smoke tubes) or by measuring the differential pressure between the room and its surrounding area…

II. Ventilation (cont.)

Differential pressure-sensing devices also can be used to monitor negative pressure. They can provide either periodic (noncontinuous) pressure measurements or continuous pressure monitoring. The continuous monitoring component may simply be a visible and/or audible warning signal that air pressure is low. In addition, it may also provide a pressure readout signal, which can be recorded for later verification or used to automatically adjust the facility's ventilation control system…

Pressure-measuring devices should sense the room pressure just inside the airflow path into the room (e.g., at the bottom of the door). Unusual airflow patterns within the room can cause pressure variations; for example, the air can be at negative pressure at the middle of a door and at positive pressure at the bottom of the same door. If the pressure-sensing ports of the device cannot be located directly across the airflow path, it will be necessary to validate that the negative pressure at the sensing point is and remains the same as the negative pressure across the flow path…

Pressure-sensing devices should incorporate an audible warning with a time delay to indicate that a door is open. When the door to the room is opened, the negative pressure will decrease. The time-delayed signal should allow sufficient time for persons to enter or leave the room without activating the audible warning…

Periodic checks are required to ensure that the desired negative pressure is present and that the continuous monitor devices, if used, are operating properly. ... If pressure-sensing devices are used, negative pressure should be verified at least once a month by using smoke tubes or taking pressure measurements.

Morbidity and Mortality Weekly Report (MMWR)

Guidelines for Environmental Infection Control in Health-Care Facilities, 2003

Recommendations — Air

IV. Infection Control and Ventilation Requirements for AII Rooms

A.1. … monitor air pressure periodically; preferably daily, with audible manometers or smoke tubes at the door (for existing AII rooms), or with a permanently installed visual monitoring mechanism. Document the results of monitoring.

OSHA Instructions CPL 2.106

Subject: Enforcement Procedures and scheduling for Occupational Exposure to Tuberculosis

5. *Engineering Controls*

…Note: The employer must assure that AFB isolation rooms are maintained under negative pressure. At a minimum, the employer must use nonirritating smoke trails or some other indicator to demonstrate that direction of air flow is from the corridor into the isolation/treatment room with the door closed.

Operations and Maintenance

ANSI /ASHRAE /ASHE Standard 170-2013

A1 O&M In Health Care Facilities

A1.3 Airborne Infection Isolation (AII) Rooms. AII rooms should remain under negative pressure relative to all adjoining rooms whenever an infectious patient is present. They should be tested for negative pressure daily whenever an infectious patient is present.

A1.4 Filters. Final filters and filter frames should be visually inspected for pressure drop and for bypass monthly. Filters should be replaced based on pressure drop with filters that provide the efficiencies specified in Table 6-1.

PROTECTIVE ENVIRONMENT ROOM

Definition:

ANSI /ASHRAE /ASHE Standard 170-2013

3. Definitions

A patient room that is designed according to this standard and intended to protect a high risk immunocompromised patient from human and environmental airborne pathogens.

FGI Guidelines for Design and Construction of Health Care Facilities 2010

A room or unit used to protect the profoundly immunosuppressed patient with prolonged neutropenia (i.e., a patient undergoing an allogeneic or autologous bone marrow/stem cell transplant) from common environmental airborne infectious microbes (e.g., Aspergillus spores). The differentiating factors between protective environment rooms and other patient rooms are the requirements for filtration and positive air pressure relative to adjoining spaces.

Center for Disease Control and Prevention Guidelines

Morbidity and Mortality Weekly Report (MMWR)

Guidelines for Environmental Infection Control in Health-Care Facilities, 2003

Recommendations — Air

I. Air-Handling Systems in Health-Care Facilities

A. Use AIA guidelines as minimum standards where state or local regulations are not in place for design and construction of ventilation systems in new or renovated health-care facilities. Ensure that existing structures continue to meet the specifications in effect at the time of construction...

E. Conduct an infection-control risk assessment (ICRA) and provide an adequate number of AII and PE rooms (if required) or other areas to meet the needs of the patient population.

OSHA Instructions CPL 2.106

Subject: Enforcement Procedures and scheduling for Occupational Exposure to Tuberculosis

5. *Engineering Controls*

   a. *…Individuals with suspected or confirmed infectious TB disease must be placed in a respiratory acid-fast bacilli (AFB) isolation room…AFB isolation refers to a negative pressure room or an area that exhausts room air directly outside or through HEPA filters if recirculation is unavoidable.*

Construction

ANSI /ASHRAE /ASHE Standard 170-2013

7.2.2 Protective Environment (PE) Rooms.	*Ventilation for PE rooms shall meet the following requirements:* *c. Air distribution patterns within the protective environment room shall conform to the following:* *i. Supply air diffusers shall be above the patient bed, unless it can be demonstrated that such a location is not practical. Diffuser design shall limit air velocity at the patient bed to limit discomfort...* *ii. Return/exhaust grilles or registers shall be located near the patient room door.*

ASHRAE HANDBOOK, HVAC APPLICATIONS 1995

Chapter 7 Health Care Facilities

Hospital Facilities	*The basic difference between air conditioning for hospital and that of other building types stem from* *1) the need to restrict air movement in and between the various departments;* *2) the specific requirements for ventilation and filtration to dilute and remove contamination in the form of odor, airborne microorganisms and viruses, and hazardous chemical and radioactive substance;* *3) the different temperature and humidity requirements for various areas; and* *4) the design sophistication needed to permit accurate control of environmental conditions.*
Air Quality Air Movement	*… In general, outlets supplying air to sensitive ultra-clean areas and highly contaminated areas should be located on the ceiling, with perimeter or several exhaust inlets near the floor. This arrangement provides a downward movement of clean air through the breathing and working zones to the contaminated floor area for exhaust….*

Center for Disease Control and Prevention Guidelines

Morbidity and Mortality Weekly Report (MMWR)

Guidelines for Environmental Infection Control in Health-Care Facilities, 2003

Recommendations — Air

III. Infection Control and Ventilation Requirements for PE rooms	*D. Incorporate ventilation engineering specifications and dust-controlling processes into the planning and construction of new PE units.* *1. Install central or point-of-use HEPA filters for supply (incoming) air.* *2. Ensure that rooms are well-sealed by 1) properly construction windows, doors, and intake and exhaust ports; 2) maintaining ceilings that are smooth and free of fissures, open joints, and crevices; 3) sealing walls above and below the ceiling; and 4) monitoring for leakage and making any necessary repairs…* *7. Install self-closing devices on all room exit doors in PE rooms.*

Ventilation

ANSI /ASHRAE /ASHE Standard 170-2013

7.2.2 Protective Environment (PE) Rooms.	*Ventilation for PE rooms shall meet the following requirements:* *E) PE rooms retrofitted from standard patient rooms may be ventilated with recirculated air, provided that air first passes through a HEPA filter …*

FGI Guidelines for Design and Construction of Health Care Facilities 2010

2.2-8.2.2.2 Protective environment (PE) rooms.	*(2) Supply air to PE rooms, and to anterooms if provided, shall pass through HEPA filters just before entering the room. For a suite of rooms, installation of the HEPA filters upstream of the suite shall be permitted.*
2.2-8.2.2.3 Combination airborne infection isolation/protective environment (AII/PE) room	*(2) Exhaust air from the combination AII/PE room and anteroom shall comply with the requirements of AII rooms.*

Center for Disease Control and Prevention Guidelines

Morbidity and Mortality Weekly Report (MMWR)

Guidelines for Environmental Infection Control in Health-Care Facilities, 2003

Recommendations — Air

III. Infection Control and Ventilation Requirements for PE Rooms	*F) D.3. Ventilate the room to maintain ≥12 ACH.*

Room Pressure Differential

ANSI /ASHRAE /ASHE Standard 170-2013

7.2.2 Protective Environment (PE) Rooms.	*Ventilation for PE rooms shall meet the following requirements:* *a. The room envelope shall be sealed to provide a minimum differential pressure of 0.01 in. wc (2.5 Pa) across the envelope.* *d. Differential pressure between PE rooms and adjacent spaces that are not PE rooms shall be a minimum of +0.01 in. wc (+2.5 Pa). Spaces such as the toilet room and the anteroom (if present) that are directly associated with the PE room and open directly into the PE room are not required to be designed with a minimum pressure difference from the PE room but are still required to maintain the pressure relationships to adjacent areas specified in Table 7-1.* *f. When an anteroom is provided, the pressure relationships shall be as follows: (1) the PE room shall be at a positive pressure with respect to the anteroom, and (2) the anteroom shall be at a positive pressure with respect to the corridor.*
7.2.3 Combination Airborne Infectious Isolation/Protective Environment (AII/PE) Rooms.	*c. The pressure relationship to adjacent areas for the required anteroom shall be one of the following:* • *The anteroom shall be at a positive pressure with respect to both the AII/PE room and the corridor or common space.* • *The anteroom shall be at a negative pressure with respect to both the AII/PE room and the corridor or common space.*

FGI Guidelines for Design and Construction of Health Care Facilities 2010

2.2-8.2.2.2 Protective environment (PE) rooms.	*(1) These special ventilation areas shall be designed to provide directed airflow from the cleanest patient care area to less clean areas.* *(2) Supply air to PE rooms, and to anterooms if provided, shall pass through HEPA filters just before entering the room. For a suite of rooms, installation of the HEPA filters upstream of the suite shall be permitted.* *(4) When an anteroom is provided, airflow shall be from the patient room into the anteroom and from the anteroom into the corridor.*
2.2-8.2.2.3 Combination airborne infection isolation/protective environment (AII/PE) room	*(2) Exhaust air from the combination AII/PE room and anteroom shall comply with the requirements of AII rooms.* *(3) The air flow pattern for the anteroom shall be one of the following:* *a. Air flow from the anteroom to both the patient room and the corridor, or* *b. Air flow from both the patient room and the corridor into the anteroom.* *(4) Rooms with reversible airflow provisions for the purpose of switching between protective environment and airborne infection isolation functions shall not be permitted.*

ASHRAE HANDBOOK, HVAC APPLICATIONS 1995

Chapter 7 Health Care Facilities

Air Quality Air Movement	*The operation room … which requires air that is free of contamination, must be positively pressurized relative to adjoining rooms or corridors to prevent any airflow from theses relative highly contaminated areas.*

Specific Design Criteria

Protective Isolation Units	*...In the case where the patient is immunosuppressed but not contagious, a positive pressure should be maintained…A positive pressure should also be maintained between the entire unit and the adjacent areas to preserve sterile conditions.*

Center for Disease Control and Prevention Guidelines

Morbidity and Mortality Weekly Report (MMWR)

Guidelines for Environmental Infection Control in Health-Care Facilities, 2003

Recommendations — Air

III. Infection Control and Ventilation Requirements for PE Rooms	*D.5. Maintain positive room air pressure (≥2.5 Pa [0.01 inch water gauge]) in relation to the corridor.*

Room Pressure Monitors

ANSI /ASHRAE /ASHE Standard 170-2013

7.2.2 Protective Environment (PE) Rooms.	*Ventilation for PE rooms shall meet the following requirements:* *b. Each PE room shall comply with requirements of Tables 6-1, 6-2, and 7-1. PE rooms shall have a permanently installed device and/or mechanism to constantly monitor the differential air pressure between the room and the corridor when occupied by patients requiring a protective environment whether or not there is an anteroom. A local visual means shall be provided to indicate whenever negative differential pressure is not maintained.*
7.2.3 Combination Airborne Infectious Isolation/Protective Environment (AII/PE) Rooms.	*Ventilation for AII/PE rooms shall meet the following requirements:* *d. AII/PE rooms shall have two permanently installed devices and/or mechanisms to constantly monitor the differential air pressure. One device and/or mechanism shall monitor the pressure differential between the AII/ PE room and the anteroom. The second device and/or mechanism shall monitor the pressure differential between the anteroom and the corridor or common space. For each device and/or mechanism, a local visual means shall be provided to indicate whenever differential pressure is not maintained.*

FGI Guidelines for Design and Construction of Health Care Facilities 2010

2.2-8.2.2.2 Protective environment (PE) rooms.	*(3) Each PE room shall have a permanently installed visual mechanism to constantly monitor the pressure status of the room when occupied by a patient requiring a protective environment. The mechanism shall monitor the pressure differential between the PE room and the corridor or common space, whether or not there is an anteroom between the corridor or common space and the PE room.*
2.2-8.2.2.3 Combination airborne infection isolation/protective environment (AII/PE) room	*(5) Each combination AII/PE room shall have two permanently installed visual mechanisms to constantly monitor the pressure status of the room when occupied by patients with an airborne infectious disease and/or requiring a protective environment. One mechanism shall monitor the pressure differential between the patient room and the anteroom. The second mechanism shall monitor the pressure differential between the anteroom and the corridor.*

ASHRAE HANDBOOK, HVAC APPLICATIONS 1995

Chapter 7 Health Care Facilities

Hospital Facilities Specific Design Criteria Surgery and Critical Care	*The following conditions are recommended for operation, catheterization, cystoscopic, and fracture rooms:* *4. Differential pressure indication device should be installed to permit air pressure readings in the rooms.*

Center for Disease Control and Prevention Guidelines

Morbidity and Mortality Weekly Report (MMWR)

Guidelines for Environmental Infection Control in Health-Care Facilities, 2003

Recommendations — Air

III. Infection Control and Ventilation Requirements for PE Rooms	*D.6. Maintain airflow patterns and monitor these on a daily basis by using permanently installed visual means of detecting airflow in new or renovated construction, or by using other visual methods (e.g., flutter strips or smoke tubes) in existing PE units. Document the monitoring results.*

Operations and Maintenance

ANSI /ASHRAE /ASHE Standard 170-2013

A1 O&M In Health Care Facilities	*A1.2 Protective Environment (PE) Rooms. PE rooms should remain under positive pressure with respect to all adjoining rooms whenever an immunocompromised patient is present. PE rooms should be tested for positive pressure daily when an immunocompromised patient is present. When HEPA filters are present within the diffuser of protective environment rooms, the filter should be replaced based on pres-sure drop.*
	A1.4 Filters. Final filters and filter frames should be visually inspected for pressure drop and for bypass monthly. Filters should be replaced based on pressure drop with filters that provide the efficiencies specified in Table 6-1.

PHARMACIES

Use of Isolators

United States Pharmacopeia
Chapter <797>
Pharmaceutical Compounding – Sterile Preparations, 2004

Responsibility of Compounding Personnel	*…Compounding personnel are adequately skilled, educated, instructed and trained to correctly perform and document the following activities in their sterile compounding duties:*
	c. Use laminar flow clean-air hoods, barrier isolates and other contamination control devices that are appropriate for the risk level;
Cleanrooms and Barrier Isolators	*In general, sterile product preparation facilities utilize laminar airflow workbenches (LAFWs) to provide an adequate critical site environment…*

Required Air Quality

United States Pharmacopeia
Chapter <797>
Pharmaceutical Compounding – Sterile Preparations, 2004

Environmental Controls	*Engineering controls reduce the potential for airborne contamination in workspaces by limiting the amount and size of contaminants in the CSP processing environment. Primary engineering controls are used and generally include horizontal flow clean benches, vertical flow clean benches, biological safety cabinets, and barrier isolators. Primary environmental control must provide at least ISO Class 5 quality of air to which sterile ingredients and components of CSPs are directly exposed. Secondary engineering controls generally provide a buffer zone or buffer room as a core for the location of the workbenches or isolators…*
	Buffer or cleanroom areas in which LAFWs are located are to provide at least ISO Class 8 air quality…

OPERATING ROOMS

Definition:

ANSI /ASHRAE /ASHE Standard 170-2013

3. Definitions

A room in the surgical suite that meets the requirements of a restricted area and is designated and equipped for performing surgical or other invasive procedures. An aseptic field is required for all procedures performed in an OR. Any form of anesthesia may be administered in an OR if proper anesthesia gas administration devices are present and waste anesthesia gas disposal systems are provided.

ASHRAE 2013 simplified the definition of an Operating room to follow FGI guidelines. ASHRAE 2008 had the below definitions.

Class A Surgery: Provides minor surgical procedures performed under topical, local, or regional anesthesia without preoperative sedation.

Class B Surgery: Provides minor or major surgical procedures performed in conjunction with oral, parenteral, or intravenous sedation or performed with the patient under analgesic or dissociative drugs.

Class C Surgery: Provides major surgical procedures that require general or regional block anesthesia and/or support of vital bodily functions.

FGI Guidelines for Design and Construction of Health Care Facilities 2010

A room designated and equipped for performing surgical operations that requires a restricted environment.

Construction

ANSI /ASHRAE /ASHE Standard 170-2013

7.4 Surgery Rooms

7.4.1 Operating Rooms

a. *The airflow shall be unidirectional, downwards and the average velocity of the diffusers shall be 24 to 35 cfm/ft^2 (127 L/s/m^2 to 178 L/s/m^2). The diffusers shall be concentrated to provide an airflow pattern over the patient and surgical team…*

b. *The coverage area of the Primary Supply Diffuser Array shall extend a minimum of 12 in. (305 mm) beyond the footprint of the surgical table on each side. Within the portion of the primary supply diffuser array that consists of an area encompassing 12 in. (305mm) on each side of the surgical table. No more than 30%of this portion of the primary supply diffuser array area shall be used for non-diffuser uses such as lights, gas columns equipment booms, access panels, sprinklers, etc. Additional supply diffusers shall be permitted within the room, outside of the primary supply diffuser array, to provide additional ventilation to the operating room to achieve the environmental requirements of Table 7-3 relating to temperature, humidity, etc.*

The room shall be provided with at least two low sidewall return or exhaust grilles spaced at opposite corners or as far apart as possible, with the bottom of these grilles installed approximately 8 in. above the floor.

***Exception:** In addition to the required low return (or exhaust) air grilles, such grilles may be places high on the walls.*

FGI Guidelines for Design and Construction of Health Care Facilities 2010

2.1-8.2.2.5
Operating Rooms

1. *Air supply. In addition to the required low return (or exhaust) grilles, such grilles placed high on the walls shall be permitted.*

2.1-8.2.2.5
Operating and delivery rooms

1. *Air supply*
   a. *In new construction and major renovation work, air supply for cesarean delivery rooms shall be in accordance with section 7.4.1 (Class B and C Operating Rooms) of Part 6 (ASHRAE 170).*
   b. *In addition to the required low return (or exhaust) air grilles, such grilles placed high on the walls shall be permitted.*

Ventilation

FGI Guidelines for Design and Construction of Health Care Facilities 2010

3.1-8.2.2.5
Operating Rooms

2. *Ventilation rates*
   a. *Operating room ventilation systems shall operate at all times, except during maintenance and conditions requiring shutdown by the building's fire alarm system.*
   b. *During unoccupied hours, operating room air change rates may be reduced, provided that the positive room pressure is maintained as required in Part 6 (ASHRAE 170).*

A3.1-8.2.2.5 (2)

(a) *Ventilation rates for operating rooms. The operating and delivery room ventilation systems should operate at all times to maintain the air movement relationship to adjacent areas. The cleanliness of the spaces is compromised when the ventilation system is shut down. For example, airflow from a less clean space such as the corridor can occur, and standing water can accumulate in the ventilation system (near humidifiers or cooling coils).*

2.1-8.2.2.5
Operating and delivery rooms

2. *Ventilation rates*
   a. *Operating and delivery room ventilation systems shall operate at all times, except during maintenance and conditions requiring shutdown by the building's fire alarm system.*
   b. *During unoccupied hours, operating and delivery room air change rates may be reduced, provided the positive room pressure is maintained as required in Part 6.*
3. *Standards for special procedures. Where extraordinary procedures, such as organ transplants, justify special designs, installation shall properly meet performance needs as determined by applicable standards. These special designs should be reviewed on a case-by-case basis.*
4. *See Part 6 (ASHRAE 170) for additional ventilation requirements.*

Room Pressure Differential

ANSI /ASHRAE /ASHE Standard 170-2013

7.4 Surgery Rooms	*7.4.1 Operating Rooms, Operating/Surgical Cystoscopic Rooms, and Cesarean Delivery Rooms, these rooms shall be maintained at a positive pressure with respect to all adjoining spaces at all times. A pressure differential shall be maintained at a value of at least +0.01 in. wc (2.5 Pa). Each operating room shall have individual temperature control. Operating rooms shall be provided with primary supply diffusers that are designed as follows:*

ASHRAE HANDBOOK, HVAC APPLICATIONS 1995

Chapter 7 Health Care Facilities

Air Quality Air Movement	*The operation room … which requires air that is free of contamination, must be positively pressurized relative to adjoining rooms or corridors to prevent any airflow from theses relative highly contaminated areas.* *4. Differential pressure indication device should be installed to permit air pressure readings in the rooms.*

Specific Design Criteria

Surgery and Critical Care Operating Rooms	*The following conditions are recommended for operation, catheterization, cystoscopic, and fracture rooms:* *…3. Air Pressure should be maintained positive with respect to any adjoining rooms by supplying 15% excess air….*
Obstetrical	*The pressure in the obstetrical department should be positive or equal to that in other areas.*
Delivery Rooms	*The design for the delivery room should conform to the requirement of operating rooms.*
Nursing Intensive Care Unit	*... positive air pressure are recommended.*
Protective Isolation Units	*...In the case where the patient is immunosuppressed but not contagious, a positive pressure should be maintained…A positive pressure should also be maintained between the entire unit and the adjacent areas to preserve sterile conditions.*

Operations and Maintenance

ANSI /ASHRAE /ASHE Standard 170-2013

A1 O&M In Health Care Facilities	*A1.1 Operating Rooms. Each operating room should be tested for positive pressure semi-annually or on an effective preventative maintenance schedule. When HEPA filters are present within the diffuser of operating rooms, the filter should be replaced based on pressure drop.* *A1.4 Filters. Final filters and filter frames should be visually inspected for pressure drop and for bypass monthly. Filters should be replaced based on pressure drop with filters that provide the efficiencies specified in Table 6-1.*

TABLES

ANSI /ASHRAE /ASHE Standard 170-2013

Table 6-4 Minimum Filter Efficiencies

Space Designation (According to Function)	**Filter Bank Number 1** (MERV)[a]	**Filter Bank Number 2** (MERV)[a]
Operating room, inpatient and ambulatory diagnostic and therapeutic radiology, inpatient delivery and recovery services	7	14
In patient care, treatment, and diagnosis, and those spaces providing direct service or clean supplies and clean processing (except as noted below); AII rooms	7	14
Protective environment (PE) rooms	7	(HEPA)[c,d]
Laboratories; class A surgery and associated semi-restricted spaces	13[b]	NR*

* NR= not required

Note a: The minimum efficiency reporting value (MERV) is based on the method of testing described in *ANSI/ASHRAE Standard 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size* (see Informative Annex B: Bibliography).

Note b: Additional prefilters may be used to reduce maintenance for filters with efficiencies higher than MERV 7.

Note c: As an alternative, MERV-14 rated filters may be used in Filter Bank No. 2 if a tertiary terminal HEPA filter is provided for these spaces.

Note d: High-Efficiency Particulate Air (HEPA) filters are those filters that remove at least 99.97% of 0.3 micron-sized particles at the rated flow in accordance with the testing methods of IEST RP-CC001.3 (see Informative Annex B, Bibliography).

ANSI /ASHRAE /ASHE Standard 170-2013

Table 7-1 Design Parameters— From ANSI/ASHRAE/ASHE Standard 170-2013

	Pressure relationship to Adjacent Areas (n)	Minimum Outdoor ACH	Minimum Total ACH	AII Room Air Exhausted Directly to Outdoors (j)	Air recirculated by means of room units (a)	RH (k), %	Design Temperature (l), F/C
Surgery and Critical Care							
Operating rooms (m), (o)	Positive	4	20	NR	No	20-60	68-75 / 20-24
Operating/Surgical cystoscopic rooms (m), (o)	Positive	4	20	NR	No	20-60	68-75 / 20-24
Delivery room (Caesarean) (m), (o)	Positive	4	20	NR	No	20-60	68-75 / 20-24
Substerile service area	NR	2	6	NR	No	NR	NR
Recovery Room	NR	2	6	NR	No	20-60	70-75 / 21-24
Critical and intensive Care	NR	2	6	NR	No	30-60	70-75 / 21-24
Intermediate care (s)	NR	2	6	NR	NR	Max 60	70-75 / 21-24
Wound Intensive care (burn unit)	NR	2	6	NR	No	40-60	70-75 / 21-24
Newborn Intensive care	Positive	2	6	NR	No	30-60	72-78 / 22-26
Treatment room (p)	NR	2	6	NR	NR	20-60	70-75 / 21-24

Table 7-1 Design Parameters—From ANSI/ASHRAE/ASHE Standard 170-2013 (continued)

	Pressure relationship to Adjacent Areas (m)	Minimum Outdoor ACH	Minimum Total ACH	All Room Air Exhausted Directly to Outdoors (j)	Air recirculated by means of room units (a)	RH (k), %	Design Temperature (l), F/C
Surgery and Critical Care *(cont.)*							
Trauma room (crisis or shock) [c]	Positive	3	15	NR	No	20-60	70-75 / 21-24
Medical/anesthesia gas storage [r]	Negative	NR	8	Yes	NR	NR	NR
Laser Eye room	Positive	3	15	NR	No	20-60	70-75 / 21-24
Emergency Department Public Waiting area rooms [q]	Negative	2	12	Yes	NR	Max 65	70-75 / 21-24
Triage [q]	Negative	2	12	Yes	NR	Max 60	70-75 / 21-24
ER decontamination	Negative	2	12	Yes	No	NR	NR
Radiology Waiting Rooms[q], [w]	Negative	2	12	Yes	NR	Max 60	70-75 / 21-24
Procedure room[o], [d]	Positive	3	15	NR	No	20-60	70-75 / 21-24
Emergency department exam/treatment room (p)	NR	2	6	NR	NR	Max 60	70-75 / 21-24
Inpatient Nursing							
Patient Room	NR	2	6	NR	NR	Max 60	70-75 / 21-24
Toilet Room	Negative	NR	10	Yes	No	NR	NR
Newborn Nursery Suite	NR	2	6	NR	No	30-60	72-78 / 22-26
Protective Environment Room [t]	Positive	2	12	NR	No	max 60	70-75 / 21-24
Protective Environment Anteroom [t]	[e]	NR	10	NR	No	NR	NR
AII room [u]	Negative	2	12	Yes	No	max 60	70-75 / 21-24
AII anteroom [u]	NR	NR [e]	10	Yes	No	NR	NR
Combination AII/PE Room	Positive	2	12	Yes	No	max 60	70-75 / 21-24
Combination AII/PE Anteroom	[e]	NR	10	Yes	No	NR	NR
Labor/Delivery/Recovery/Postpartum (LDRP) [s]	NR	2	6	NR	NR	max 60	70-75 / 21-24
Labor/Delivery/Recovery (LDR) [s]	NR	2	6	NR	NR	max 60	70-75 / 21-24
Nourishment Area or Room	NR	NR	2	NR	NR	NR	NR
Patient Corridor	NR	NR	2	NR	NR	NR	NR
Continued Care Nursery	NR	2	6	NR	No	30-60	72-78 / 22-26
Nursing Facility							
Resident Room	NR	2	2	NR	NR	NR	70-75 / 21-24
Resident gathering/activity/dining	NR	4	4	NR	NR	NR	70-75 / 21-24
Physical Therapy	Negative	2	6	NR	NR	NR	70-75 / 21-24
Occupational Therapy	NR	2	6	NR	NR	NR	70-75 / 21-24
Bathing Room	Negative	NR	10	Yes	NR	NR	70-75 / 21-24

Table 7-1 Design Parameters—From ANSI/ASHRAE/ASHE Standard 170-2013 (continued)

	Pressure relationship to Adjacent Areas (n)	Minimum Outdoor ACH	Minimum Total ACH	All Room Air Exhausted Directly to Outdoors (j)	Air recirculated by means of room units (a)	RH (k), %	Design Temperature (l), F/C
Radiology							
X-Ray (diagnostic and treatment)	NR	2	6	NR	NR	Max 60	72-78 / 22-26
X-Ray (surgery/critical care and catheterization)	Positive	3	15	NR	No	Max 60	70-75 / 21-24
Darkroom (g)	Negative	2	10	Yes	No	NR	NR
Diagnostic and Treatment							
Bronchoscopy, sputum collection, and pentamidine administration (n)	Negative	2	12	Yes	No	NR	68-73 / 20-23
Laboratory work area, general (v) (f)	Negative	2	6	NR	NR	NR	70-75 / 21-24
Laboratory work area, bacteriology (v) (f)	Negative	2	6	Yes	NR	NR	70-75 / 21-24
Laboratory work area, biochemistry (v) (f)	Negative	2	6	Yes	NR	NR	70-75 / 21-24
Laboratory work area, cytology (v) (f)	Negative	2	6	Yes	NR	NR	70-75 / 21-24
Laboratory work area, glass washing (f)	Negative	2	10	Yes	NR	NR	NR
Laboratory work area, histology (v) (f)	Negative	2	6	Yes	NR	NR	70-75 / 21-24
Laboratory work area, microbiology (v) (f)	Negative	2	6	Yes	NR	NR	70-75 / 21-24
Laboratory work area, nuclear medicine (v) (f)	Negative	2	6	Yes	NR	NR	70-75 / 21-24
Laboratory work area, pathology (v) (f)	Negative	2	6	Yes	NR	NR	70-75 / 21-24
Laboratory work area, serology (v) (f)	Negative	2	6	Yes	NR	NR	70-75 / 21-24
Laboratory work area, sterilizing (f)	Negative	2	10	Yes	NR	NR	70-75 / 21-24
Laboratory work area, media transfer (v) (f)	Positive	2	4	NR	NR	NR	70-75 / 21-24
Autopsy room (n)	Negative	2	12	Yes	No	NR	68-75 / 20-24
Nonrefrigerated body-holding room (h)	Negative	NR	10	Yes	No	NR	70-75 / 21-24
Pharmacy (b)	Positive	2	4	NR	NR	NR	NR
Special Examination Room (aa)	NR	2	6	NR	NR	Max 60	70-75 / 21-24
Medication Room	Positive	2	4	NR	NR	Max 60	70-75 / 21-24
Gastrointestinal endoscopy procedure room	Positive	2	6	NR	No	30-60	68-73 / 20-23
Endoscope cleaning	Negative	2	10	Yes	No	NR	NR
Treatment room	NR	2	6	NR	NR	Max 60	70-75 / 21-24
Hydrotherapy	Negative	2	6	NR	NR	NR	72-80 / 22-27
Physical Therapy	Negative	2	6	NR	NR	Max 65	72-80 / 22-27
ECT Procedure Room	NR	2	4	NR	NR	Max 60	72-78 / 22-26
General Examination Room	NR	2	4	NR	NR	Max 60	70-75 / 21-24

Table 7-1 Design Parameters—From ANSI/ASHRAE/ASHE Standard 170-2013 (continued)

	Pressure relationship to Adjacent Areas (n)	Minimum Outdoor ACH	Minimum Total ACH	All Room Air Exhausted Directly to Outdoors (j)	Air recirculated by means of room units (a)	RH (k), %	Design Temperature (l), F/C
Sterilizing							
Sterilizer Equipment Room	Negative	NR	10	Yes	No	NR	NR
Sterile Processing Department (z)							
Soiled or Decontamination room	Negative	2	6	Yes	No	NR	60-73 / 16-23
Clean workroom	Positive	2	4	NR	No	Max 60	67-73 / 20-23
Sterile Storage Room	Positive	2	4	NR	NR	Max 60	Max 75/24
Service							
Food Preparation Center [(i)]	NR	2	10	NR	No	NR	72-78 / 22-26
Ware Washing	Negative	NR	10	Yes	No	NR	NR
Dietary Storage	NR	NR	2	NR	No	NR	72-78 / 22-26
Laundry, general	Negative	2	10	Yes	No	NR	NR
Soiled Linen (Sorting and Storage)	Negative	NR	10	Yes	No	NR	NR
Clean Linen Storage	Positive	NR	2	NR	NR	NR	72-78 / 22-26
Linen and Trash Chute Room	Negative	NR	10	Yes	No	NR	NR
Bedpan Room	Negative	NR	10	Yes	No	NR	NR
Bathroom	Negative	NR	10	Yes	No	NR	72-78 / 22-26
Janitor's Closet	Negative	NR	10	Yes	No	NR	NR
Support Space							
Soiled Workroom or soiled holding	Negative	2	10	Yes	No	NR	NR
Clean workroom or clean holding	Positive	2	4	NR	NR	NR	NR
Hazardous material storage	Negative	2	10	Yes	No	NR	NR

Notes:

[a.] except where indicated by a "no" in this column, recirculating room HVAC units (with heating or cooling coils) are acceptable for providing that portion of the minimum total air changes per hour that is permitted by section 7.1 (subparagraph [a][5]). because of the cleaning difficulty and potential for buildup of contamination, recirculating room units shall not be used in areas marked "no." Recirculating devices with HEPA filters shall be permitted in existing facilities as interim, supplemental environmental controls to meet requirements for the control of airborne infectious agents. The design of either portable or fixed systems should prevent stagnation and short circuiting of airflow. The design of such systems shall also allow for easy access for scheduled preventative maintenance and cleaning.

[b.] pharmacy compounding areas may have additional air change, differential pressure and filtering requirements beyond the minimum of this table depending on the type of pharmacy, the regulatory requirements (which may include adoption of USP 797), the associated level of risk of the work (see USP [2012]), and the equipment utilized in the spaces.

[c.] the term trauma room as used herein is a first aid room and/or emergency room used for general initial treatment of accident victims. the operating room within the trauma center that is routinely used for emergency surgery is considered to be an operating room by this standard.

[d.] pressure relationships need not be maintained when the room is unoccupied.

[e.] see section 7.2 and its subsection for pressure-relationship requirements.

[f.] Higher ventilation rates above the total ACH listed shall be used when dictated by the laboratory program requirements and the hazard level of the potential contaminants in each laboratory work area. Lower total ACH ventilation rates shall be permitted when a Hazard Assessment performed as part of an effective Laboratory Ventilation Management Plan per the ANSI/AIHA/ASSE Z9.5, Laboratory Ventilation Standard [13] determines that either (a) acceptable exposure concentrations in the laboratory work area can be achieved with a lower minimum total ACH ventilation rate than is listed in Table 7.1 or (b) a demand control approach with active sensing of contaminants or appropriate surrogates is used as described in ASHRAE

Handbook, HVAC Applications, Chapter 16, "Laboratories" (see ASHRAE [2015] in Informative Appendix B).
ADDED INTO ASHRAE 170-2013, not included in 2008.

g. all air need not be exhausted if darkroom equipment has a scavenging exhaust duct attached and meets ventilation standards regarding NIOSH, OSHA, and local employee exposure limits.2, 3

h. a nonrefrigerated body-holding room is applicable only to facilities that do not perform autopsies on-site and use the space for short periods while waiting for the body to be transferred.

i. minimum total air changes per hour (ach) shall be that required to provide proper makeup air to kitchen exhaust systems as specified in ANSI/ASHRAE standard 154.4 in some cases, excess exfiltration or infiltration to or from exit corridors compromises the exit corridor restrictions of NFPA 90a,5 the pressure requirements of NFPA 96,6 or the maximum defined in the table. during operation, a reduction to the number of air changes to any extent required for odor control shall be permitted when the space is not in use.

j. in some areas with potential contamination and/or odor problems, exhaust air shall be discharged directly to the outdoors and not recirculated to other areas. individual circumstances may require special consideration for air exhausted to the outdoors. to satisfy exhaust needs, constant replacement air from the outdoors is necessary when the system is in operation.

k. the RH ranges listed are the minimum and/or maximum limits where control is specifically needed.

l. systems shall be capable of maintaining the rooms within the range during normal operation. lower or higher temperature shall be permitted when patients' comfort and/or medical conditions require those conditions.

m. 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 oxide7 indicate a need for both local exhaust (scavenging) systems and general ventilation of the areas in which the respective gases are utilized. refer to NFPA 99 for other requirements.8

n. if pressure monitoring device alarms are installed, allowances shall be made to prevent nuisance alarms. short term excursions from required pressure relationships shall be allowed while doors are moving or temporarily open. simple visual methods such as smoke trail, ball-in-tube, or flutterstrip shall be permitted for verification of airflow direction.

o. surgeons or surgical procedures may require room temperatures, ventilation rates, humidity ranges, and/or air distribution methods that exceed the minimum indicated ranges.

p. treatment rooms used for bronchoscopy shall be treated as bronchoscopy rooms. treatment rooms used for procedures with nitrous oxide shall contain provisions for exhausting anesthetic waste gases.

q. in a recirculating ventilation system, HEPA filters shall be permitted instead of exhausting the air from these spaces to the outdoors provided that the return air passes through the HEPA filters before it is introduced into any other spaces. the entire minimum total air changes per hour of recirculating airflow shall pass through HEPA filters. When these areas open to larger, nonwaiting spaces, the exhaust air volume shall be calculated based on the seating area of the waiting area. (Note: the intent here is to not require the olume calculation to include a very large space[e.g. an atrium] just because a waiting area opens to it.)

r. see NFPA 99 for further requirements.8

s. for intermediate care, labor/delivery/recovery rooms, and labor/delivery/recovery/postpartum rooms, four total ach shall be permitted when supplemental heating and/or cooling systems (radiant heating and cooling, baseboard heating, etc.) are used.

t. the protective environment airflow design specifications protect the patient from common environmental airborne infectious microbes (i.e., aspergillus spores). recirculation HEPA filters shall be permitted to increase the equivalent room air exchanges; however, the outdoor air changes are still required. constant volume airflow is required for consistent ventilation for the protected environment. the pressure relationship to adjacent spaces shall remain unchanged if the PE room is utilized as a normal patient room. rooms with reversible airflow provisions for the purpose of switching between protective environment and AII functions shall not be permitted.

u. the AII room described in this standard shall be used for isolating the airborne spread of infectious diseases, such as measles, varicella, or tuberculosis. supplemental recirculating devices using HEPA filters shall be permitted in the AII room to increase the equivalent room air exchanges; however, the minimum outdoor air changes are still required. AII rooms that are retrofitted from standard patient rooms from which it is impractical to exhaust directly outside may be recirculated with air from the AII room, provided that the air first passes through a HEPA filter. when the AII room is not utilized for airborne infection isolation, the pressure relationship to adjacent areas, when measured with the door closed, shall remain unchanged and the minimum total air change rate shall be 6 ach.

v. Room temperature ranges that exceed the minimum indicated range shall be permitted if required by the laboratory program or laboratory equipment.

w. The requirement that all room air is exhausted directly to outdoors applies only to radiology waiting rooms programmed to hold patients who are waiting for chest x-rays for diagnosis of respiratory disease.

x. If the planned space is designated in the organization's operational plan to be utilized for both bronchoscopy and gastrointestinal endoscopy, the design parameters for "bronchoscopy, sputum collection, and pentamidine administration" shall be used.

y. For single-bed patient rooms using Group D diffusers, a minimum of six total ACH shall be provided and calculated based on the volume from the finished floor to 6ft (1.83m) above the floor.

z. See AAMI standard ST79[D] for additional information for these spaces.

aa. Examination rooms programmed for use by patients with undiagnosed gastrointestinal symptoms, undiagnosed respiratory symptoms, or undiagnosed skin symptoms.

Center for Disease Control and Prevention Guidelines

Morbidity and Mortality Weekly Report (MMWR)

Guidelines for Environmental Infection Control in Health-Care Facilities, 2003

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

	Air Movement relationship to adjacent area (2)	Minimum air changes of outdoor air per hour (3)	Minimum total air changes per hour (4) (5)	All air exhausted directly to outdoors (6)	Recirculated by means of room units (7)	Relative Humidity (%) (8)	Design Temperature F (9)	Design Temperature C (9)
Surgery and Critical Care								
Operating/Surgical Cystoscopic Rooms (10,11)	Out	3	15	–	No	30-60	68-73 (12)	20-23 (12)
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	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 Rooms	Out	3	15	–	No	30-60	70-75	21-24
Nursing								
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	Out	2	12	–	No	–	75	24
Airborne Infection Isolation Room	In	2	12	Yes (15)	No	–	75	24
Isolation Alcove or Anteroom	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	–	–	–	–	–
Ancillary								
Radiology	–	–	–	–	–	–	–	–
X-ray (surgical/critical care and catheterization) (19)	Out	3	15	–	No	30-60	70-75	21-24
X-ray (diagnostic & treatment)	–	–	6	–	–	–	75	24
Darkroom	In	–	10	Yes	No	–	–	–

Table B.2 Ventilation requirements for areas affecting patient care in hospitals and outpatient facilities (continued)

	Air Movement relationship to adjacent area (2)	Minimum air changes of outdoor air per hour (3)	Minimum total air changes per hour (4) (5)	All air exhausted directly to outdoors (6)	Recirculated by means of room units (7)	Relative Humidity (%) (8)	Design Temperature F (9)	Design Temperature C (9)
Laboratory								
General [19]	–	–	6	–	–	–	75	24
Biochemistry [19]	Out	–	6	–	No	–	75	24
Cytology	In	–	6	Yes	No	–	75	24
Glass Washing	In	–	10	Yes	–	–	–	–
Histology	In	–	6	Yes	No	–	75	24
Microbiology [19]	In	–	6	Yes	No	–	75	24
Nuclear Medicine	In	–	6	Yes	No	–	75	24
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	–	–	–	–	–
Diagnostic and Treatment								
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	–	–	–	–	–
Sterilizing and Supply								
ETO-Sterilizer Room	In	–	10	Yes	No	30-60	72	24
Sterilizer Equipment Room	In	–	10	Yes	–	–	–	–
Central Medical and Surgical Supply	–	–	–	–	–	–	–	–
Soiled or Decontamination Room	In	–	6	Yes	No	–	68-73	20-23
Clean Workroom	Out	–	4	–	No	30-60	75	24
Sterile Storage	Out	–	4	–	–	(Max.) 70	–	–

Table B.2 Ventilation requirements for areas affecting patient care in hospitals and outpatient facilities (continued)

Service	Air Movement relationship to adjacent area (2)	Minimum air changes of outdoor air per hour (3)	Minimum total air changes per hour (4) (5)	All air exhausted directly to outdoors (6)	Recirculated by means of room units (7)	Relative Humidity (%) (8)	Design Temperature F (9)	Design Temperature C (9)
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 Room	In	–	10	Yes	No	–	–	–
Bedpan Room	In	–	10	Yes	–	–	–	–
Bathroom	In	–	10	–	–	–	75	24
Janitor's Closet	In	–	10	Yes	No	–	–	–

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 hospital 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 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 with 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 the 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 the 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 humidity), 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 the those local units that are used primarily for heating and cooling or 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 inspection 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 to 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% efficiency for a 0.3mm 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 functions are not acceptable.

(18) The infectious disease isolation room described in these guideline 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 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.D14.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 controls of airborne infectious agents. Limitations in design must be recognized. The design of either portable or fixed systems should prevent stagnation and short circulating of air flow. 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 health-care 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.

Table 2.1-2 From FGI

Ventilation Requirements For Areas Affecting Patient Care In Hospitals and Outpatient Facilities

Area Designation	Air Movement relationship to adjacent areas	Minimum air changes of outdoor air per hour	Minimum total air changes per hour	All air exhausted directly to outdoor [1]	Recirculated by means of room units (a)	Relative Humidity (k) %	Design Temperature (1) (F/C)
Nursing Units							
Combination AII/PE room [2]	P	2	12	Yes	No	NR	75 [24]
Anteroom [2]	N/P	NR	10	NR	No	NR	NR
Diagnostic and Treatment Areas							
Dialysis treatment area	NR	2	6	NR	NR	30-60	72-78 [22-26]
Dialyzer reprocessing room	N	NR	10	Yes	No	NR	NR
Imaging							
Nuclear medicine hot lab	N	NR	6	Yes	No	NR	75 [24]
Nuclear medicine treatment room	N	NR	6	Yes	NR	NR	70-75 [21-24]

Note: Lettered footnotes refer to footnotes in Part 6, Table 7-1.

[1] Additional ventilation requirements can be found in Table 7-1 of Part 6 (ANSI/ASHRAE/ASHE 170: Ventilation of Health Care Facilities).

[2] 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.

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