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equipment: devices for heating, ventilating, and/or air conditioning, including but not limited to furnaces, boilers, air conditioners, heat pumps, chillers, and heat exchangers.

essential accessories: those components of a system required to allow proper operation of that system that are reasonably subject to mechanical failure (e.g., pumps, fans, control air compressors). Humidifiers, controls, and tanks are not included in this definition.

high-risk immunocompromised patients: patients who have the greatest risk of infection caused by airborne or waterborne microorganisms. These patients include but are not limited to allogeneic stem-cell transplant patients and intensive chemotherapy patients.

infection control risk assessment (ICRA): a determination of the potential risk of transmission of various infectious agents in the facility, a classification of those risks, and a list of required practices for mitigating those risks during construction or renovation.

immunocompromised patients: patients whose immune mechanisms are deficient because of immunologic disorders (e.g., human immunodeficiency virus [HIV] infection or congenital immune deficiency syndrome), chronic diseases (e.g., diabetes, cancer, emphysema, or cardiac failure), or immunosuppressive therapy (e.g., radiation, cytotoxic chemotherapy, antirejection medication, or steroids) (see CDC [2003] in Informative Appendix B).

inpatient: a patient whose stay at the health care facility is anticipated to require twenty-four hours or more of patient care.

invasive imaging procedure room: a room in which radiographic imaging is used and in which instruments or devices are inserted into patients through the skin or body orifice under sterile conditions for diagnosis and/or treatment.

nonaspirating diffuser: a diffuser that has unidirectional downward airflow from the ceiling with minimum entrainment of room air. Classified as ASHRAE Group E, these diffusers generally have very low average velocity. For the purposes of this standard, the performance of these diffusers is to be measured in terms of average velocity.

nursing facility: a facility that provides resident care, treatment, and services areas (including skilled nursing, subacute care, and Alzheimer's and other dementia facilities).

patient-care area: an area used primarily for the provision of clinical care to patients. Such care includes monitoring, evaluation, and treatment services.

protective environment (PE) room: 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.

triage: the process of determining the severity of the illness of or injury to patients so that those who have the most emergent illnesses/injuries can be treated immediately and those less severely injured can be treated later or in another area.

4. COMPLIANCE

4.1 Compliance Requirements

4.1.1 New Buildings. New buildings shall comply with the provisions of this standard.

4.1.2 Existing Buildings

4.1.2.1 Additions to Existing Buildings. Additions shall comply with the provisions of this standard.

4.1.2.2 Alterations to Existing Buildings. Portions of a heating, ventilating, and air-conditioning system and other systems and equipment that are being altered shall comply with the applicable requirements of this standard.

4.1.2.2.1 Heating, Ventilation, and Air-Conditioning System Alterations. Alterations to mechanical systems serving the building heating, cooling, or ventilating needs shall comply with the requirements of Section 6, "Systems and Equipment," applicable to those specific portions of the building and its systems that are being altered. Any new mechanical equipment installed in conjunction with the alteration as a direct replacement of existing mechanical equipment shall comply with the provisions of Sections 6.2, 6.4, 6.5, and 6.6.

4.1.2.2.2 Space Alterations. Alterations to spaces listed in Table 6.4 shall comply with the requirements of Section 6.7 and Section 7, "Space Ventilation," applicable to those specific portions of the building and its systems that are being altered. Any alteration to existing health care space in a building that will continue to treat patients during construction shall comply with Sections 8.1, 8.3, 8.4, and 8.5.

4.2 Administrative Requirements. Administrative requirements relating to permit requirements, enforcement by the authority having jurisdiction, interpretations, claims of exemption, approved calculation methods, rights of approved calculation methods, and rights of appeal are specified by the authority having jurisdiction.

4.3 Compliance Documents

4.3.1 General. Compliance documents are those plans, specifications, engineering calculations, diagrams, reports, and other data that are approved as part of the permit by the authority having jurisdiction. The compliance documents shall include all specific construction-related requirements of the owner's infection control risk assessment.

4.3.2 Construction Details. Compliance documents shall contain all pertinent data and features of the building, equipment, and systems in sufficient detail to allow a determination of compliance by the authority having jurisdiction and to indicate compliance with the requirements of this standard.

4.3.3 Supplemental Information. Supplemental information necessary to verify compliance with this standard, such as calculations, worksheets, compliance forms, vendor literature, or other data, shall be made available when required by the authority having jurisdiction.

4.4 Alternate Materials, Methods of Construction, or Design. The provisions of this standard are not intended to prevent the use of any material, method of construction, design, or building system not specifically prescribed herein, provided such construction, design, or building system has

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been approved by the authority having jurisdiction as meeting the intent of this standard.

4.5 Informative Appendices. The informative appendices to this standard and informative notes located within this standard contain recommendations, explanations, and other nonmandatory information and are not part of this standard.

4.6 Criteria Ranges. This standard often specifies a range of values that will comply with a specific requirement of the standard. If it is permitted by the authority having jurisdiction, compliance with this requirement may be achieved by the presentation of compliance documents that demonstrate a system's ability to perform within the specified range.

5. PLANNING

Owners/managers of health care facilities shall prepare a detailed program that shall include the clinical service expected in each space, the specific user equipment expected to be used in each space, and any special clinical needs for temperature, humidity, and pressure control. This program shall be prepared in the planning phase of design.

6. SYSTEMS AND EQUIPMENT

Air-handling and distribution systems are required to provide health care facilities not only with a comfortable environment but also with ventilation to dilute and remove contaminants, to provide conditioned air, and to assist in controlling the transmission of airborne infection. In order to meet these requirements, air-handling and distribution systems shall be designed according to the requirements of this standard.

6.1 Utilities

6.1.1 Ventilation Upon Loss of Electrical Power. The space ventilation and pressure relationship requirements of Table 7.1 be maintained for the following spaces, even in the event of loss of normal electrical power:

a. AII rooms
b. PE rooms
c. Operating rooms (Class B and C surgery), including delivery rooms (Caesarean)

(For further information, see NFPA [2012] in Informative Appendix B.)

6.1.2 Heating and Cooling Sources

6.1.2.1 Provide heat sources and essential accessories in number and arrangement sufficient to accommodate the facility needs (reserve capacity), even when any one of the heat sources or essential accessories is not operating due to a breakdown or routine maintenance. The capacity of the remaining source(s) shall be sufficient to provide for domestic hot water, sterilization, and dietary purposes and to provide heating for operating, delivery, birthing, labor, recovery, emergency, intensive care, nursery, and inpatient rooms. (For further information, see FGI [2010] in Informative Appendix B.) Fuel sufficient to support the owner's facility operation plan upon loss of fuel service shall be provided on site.

Exception: Reserve capacity is not required if the ASHRAE 99% heating dry-bulb temperature for the facility is greater than or equal to 25°F (–4°C).

6.1.2.2 For central cooling systems greater than 400 tons (1407 kW) peak cooling load, the number and arrangement of cooling sources and essential accessories shall be sufficient to support the owner's facility operation plan upon a breakdown or routine maintenance of any one of the cooling sources.

6.2 Air-Handling-Unit Design

6.2.1 Air-Handling-Unit Casing. The casing of the air-handling unit shall be designed to prevent water intrusion, resist corrosion, and permit access for inspection and maintenance. All airstream surfaces of air-handling units—e.g., interior surfaces and components—shall comply with Section 5.4 of ANSI/ASHRAE Standard 62.1, *Ventilation for Acceptable Indoor Air Quality.*[12] (For more information, see ASHRAE [2010b, 2005b] in Informative Appendix B.)

6.3 Outdoor Air Intakes and Exhaust Discharges

6.3.1 Outdoor Air Intakes

6.3.1.1 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 birdscreen of mesh no smaller than 0.5 in. (13 mm).

6.3.1.2 Relief Air. Relief air is exempt from the 25-foot (8-metre) separation requirement. Relief air is defined as the Class 1 air (for further information see Standard 62.1 [ASHRAE 2010b] in Informative Appendix B) that could be returned to the air-handling unit from the occupied spaces but is being discharged to the outdoors to maintain building pressurization (such as during air-side economizer operation).

Roof Locations. Intakes on top of buildings shall be located with the bottom of the air intake a minimum of 3 ft (1 m) above roof level.

6.3.1.3 Areaways. In the case of an areaway, the bottom of the air intake opening shall be at least 6 ft (2 m) above grade. The bottom of the air intake opening from the areaway into the building shall be at least 3 ft (1 m) above the bottom of the areaway. (See Figure A-3 in Informative Appendix A.)

6.3.2 Exhaust Discharges. Exhaust discharge outlets that discharge air from AII rooms, bronchoscopy rooms, emergency department waiting rooms, nuclear medicine laboratories, radiology waiting rooms, and laboratory chemical fume hoods shall

a. be designed so that all ductwork within the building is under negative pressure;

Exception: Ductwork located within mechanical equipment rooms. Positive-pressure exhaust ductwork located within mechanical equipment rooms shall be sealed in accordance with SMACNA duct leakage Seal Class A.[10]

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TABLE 6.4 Minimum Filter Efficiencies

Space Designation (According to Function)	Filter Bank No. 1 (MERV)[a]	Filter Bank No. 2 (MERV)[a]
Operating rooms (Class B and C surgery); inpatient and ambulatory diagnostic and therapeutic radiology; inpatient delivery and recovery spaces	7	14
Inpatient 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; Procedure rooms (Class A surgery), and associated semirestricted spaces	13[b]	NR
Administrative; bulk storage; soiled holding spaces; food preparation spaces; and laundries	7	NR
All other outpatient spaces	7	NR
Nursing facilities	13	NR
Psychiatric hospitals	7	NR
Resident care, treatment, and support areas in inpatient hospice facilities	13	NR
Resident care, treatment, and support areas in assisted living facilities	7	NR

NR = not required

Notes:

a. The minimum efficiency reporting value (MERV) is based on the method of testing described in ANSI/ASHRAE Standard 52.2*, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size* ([ASHRAE 2012] in Informative Appendix B).

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

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.

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 (IEST [2005] in Informative Appendix B).

b. discharge in a vertical direction at least 10 ft (3 m) above roof level and shall be located not less than 10 ft horizontally from air intakes, openable windows/doors, or areas that are normally accessible to the public or maintenance personnel and that are higher in elevation than the exhaust discharge; and

c. be located such that they minimize the recirculation of exhausted air back into the building.

6.4 Filtration. Filter banks shall be provided in accordance with Table 6.4. Each filter bank with an efficiency of greater than MERV 12 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. (For further information, see FGI [2010] and CDC [2003] in Informative Appendix B.) All of the air provided to a space shall be filtered in accordance with Table 6.4, except as otherwise indicated in Section 7.1 for spaces that allow recirculating HVAC room units.

6.4.1 First Filtration Bank. Filter Bank No. 1 shall be placed upstream of the heating and cooling coils such that all mixed air is filtered.

6.4.2 Second Filtration Bank. Filter Bank No. 2 shall be installed downstream of all wet-air cooling coils and the supply fan. All second filter banks shall have sealing interface surfaces.

6.4.3 Filter Bank Blank-Off Panels. Filter bank blank-off panels shall be permanently attached to the filter bank frame, constructed of rigid materials, and have sealing surfaces equal to or greater than the filter media installed within the filter bank frame.

6.4.4 Filter Frames. Filter frames shall be durable and proportioned to provide an airtight fit with the enclosing ductwork. All joints between filter segments and enclosing ductwork shall have gaskets or seals to provide a positive seal against air leakage.

6.5 Heating and Cooling Systems

6.5.1 Cooling Coils and Drain Pans. Cooling coils and drain pans shall comply with the requirements of ANSI/ASHRAE Standard 62.1.[12]

6.5.2 Radiant Cooling Systems. If radiant cooling panels are utilized, the chilled-water temperature shall always remain above the dew-point temperature of the space.

6.5.3 Radiant Heating Systems. If radiant heating is provided for an AII room, a protective environment room, a wound intensive-care unit (burn unit), an operating room or a procedure room (for any class of surgery), either flat and smooth radiant ceiling or wall panels with exposed cleanable surfaces or radiant floor heating shall be used. Gravity-type heating or cooling units, such as radiators or convectors, shall not be used in operating rooms and other special-care areas.

6.5.4 Cooling Towers. Cooling towers shall be located so that drift is directed away from air-handling unit intakes. They shall meet the requirements of Section 6.3.2.

6.6 Humidifiers. When outdoor humidity and internal moisture sources are not sufficient to meet the requirements of

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TABLE 6.7.2 Supply Air Outlets

Space Designation (According to Function)	Supply Air Outlet Classification[a]
Operating rooms, procedure rooms (all class A, B, and C surgeries[b])	Primary supply diffusers Group E, nonaspirating additional supply diffusers, Group E
Protective environment (PE) rooms	Group E, nonaspirating
Wound intensive-care units (burn units)	Group E, nonaspirating
Trauma rooms (crisis or shock)	Group E, nonaspirating
AII rooms	Group A or Group E
Single-bed patient rooms[c]	Group A, Group D, or Group E
All other patient-care spaces	Group A or Group E
All other spaces	No requirement

Notes:

a. Refer to the 2009 *ASHRAE Handbook—Fundamentals*, Chapter 20 (see ASHRAE [2009] in Informative Appendix B), for definitions related to outlet classification and performance.

b. Surgeons may require alternate air distribution systems for some specialized surgeries. Such systems shall be considered acceptable if they meet or exceed the requirements of this standard.

c. Air distribution systems using Group D diffusers shall meet the following requirements:
   1. The system shall be designed according to "Design Guidelines" in Chapter 7 of *ASHRAE System Performance Evaluation and Design Guidelines for Displacement Ventilation*.[11]
   2. The supply diffuser shall be located where it cannot be permanently blocked (e.g., opposite the foot of the bed.)
   3. The room return/exhaust grille shall be located in the ceiling, approximately above the head of the patient bed.
   4. The transfer grille to the toilet room shall be located above the occupied zone.

Table 7.1, humidification shall be provided by means of the health-care facility air-handling systems. Locate humidifiers within air-handling units or ductwork to avoid moisture accumulation in downstream components, including filters and insulation. Steam humidifiers shall be used. Chemical additives used for steam humidifiers serving health care facilities shall comply with FDA requirements.[1] A humidity sensor shall be provided, located at a suitable distance downstream from the steam injection source. Controls shall be provided to limit duct humidity to a maximum value of 90% rh when the humidifier is operating. Humidifier steam control valves shall be designed so that they remain off whenever the air-handling unit is not in operation. Duct takeoffs shall not be located within the humidifier's absorption distance.

6.7 Air Distribution Systems

6.7.1 General. Maintain the pressure relationships required in 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 return systems or fully ducted exhaust systems. The following additional surgery and critical-care patient-care areas that do not require a pressure relationship to adjacent areas shall also be served by fully ducted return or exhaust systems: (1) recovery rooms, (2) critical- and intensive-care areas, (3) intermediate-care areas, and (4) wound intensive-care units (burn units). In inpatient facilities, patient-care areas shall utilize ducted systems for return and exhaust air. Where space pressure relationships are required, the air distribution system design shall maintain them, taking into account recommended maximum filter loading, heating-season lower airflow operation, and cooling-season higher airflow operation. Airstream surfaces of the air distribution system downstream of Filter Bank No. 2, shall comply with Section 5.4 of ANSI/ASHRAE Standard 62.1.[12] The air distribution system shall be provided with access doors, panels, or other means to allow convenient access for inspection and cleaning. (For further information, see ASHRAE Standard 62.1 [2010b] in Informative Appendix B.)

6.7.2 Air Distribution Devices. All air distribution devices shall meet the following requirements:

a. Surfaces of air distribution devices shall be suitable for cleaning. Supply air outlets in accordance with Table 6.7.2 shall be used.
b. The supply diffusers in operating rooms (Classes B and C surgeries) shall be designed and installed to allow for internal cleaning.
c. Psychiatric, seclusion, and holding-patient rooms shall be designed with security diffusers, grilles, and registers.

6.7.3 Smoke Barriers. Where smoke barriers are required, heating, ventilating, and air-conditioning zones shall be coordinated with compartmentation to minimize ductwork penetrations of fire and smoke barriers

6.7.4 Smoke and Fire Dampers

a. Maintenance access shall be provided at all dampers.
b. All damper locations shall be shown on design drawings.
c. Air-handling systems shall be arranged such that damper activation will not damage ducts.

6.7.5 Duct Penetrations. Ducts that penetrate construction intended to protect against x-ray, magnetic, radio frequency interference (RFI), or other radiation shall not impair the effectiveness of the protection, nor shall the treatment of these penetrations impair the ventilation of the space served.

6.8 Energy Recovery Systems

6.8.1 General. Energy recovery systems shall be located upstream of Filter Bank No. 2. If energy recovery systems are utilized, the systems shall not allow for any amount of cross-contamination of exhaust air back to the supply airstream via