ANSI/ASHRAE/ASHE Standard 170-2008

Ventilation Standard For Health Care Facilities

By Paul Ninomura, P.E., Member ASHRAE; and **Richard Hermans, P.E.,** Member ASHRAE

Some disparity has existed in ASHRAE recommendations related to ventilation recommendations for health care facilities. ANSI/ASHRAE Standard 62.1-2007, *Ventilation for Acceptable Indoor Air Quality,* and the *2007 ASHRAE Handbook—HVAC Applications* have some differences in their recommendations. Although Standard 62.1 is an ANSI standard, the recommendations of the *ASHRAE Handbook* were often more used for health care applications than the Standard 62.1 recommendations.

In recognition of this disparity, ASHRAE established a standard project committee to develop a standard for ventilation in health care facilities. Standard 170 has been in development since 2002. There have been four public review comment periods. The cognizant technical committee (TC) is TC 9.6, Healthcare Facilities.

ANSI/ASHRAE/ASHE Standard 170-2008, *Ventilation of Health Care Facilities* was published last month. This ANSI standard is cosponsored by the American Society of Healthcare Engineers (ASHE). The standard provides minimum ventilation requirements for hospitals, nursing facilities, and outpatient facilities and is one member of a family of documents that provide guidance, regulation, and mandates to designers of health care facilities. As with other members of this family, it is foremost a mandatory minimum requirement and may not offer the latest state-of-the-art best practice for

About the Authors

Paul Ninomura, P.E., is a mechanical engineer at Indian Health Service, Seattle. He served as vice-chairman, ASHRAE Standard Project Committee (SPC)170, and is a past and current revision committee member for the FGI Guidelines for Design and Construction of Healthcare Facilities. **Richard Hermans, P.E.,** is director of applications at McQuay International in Minneapolis, Minn. He chaired SPC 170 and is an ASHRAE director at large.

Function of Space	Pressure Relationship to Adjacent Areas (n)	Minimum Air Changes of Outdoor Air Per Hour	Minimum Total Air Changes Per Hour	All Room Air Exhausted Directly to Outdoors (j)	Air Recirculated By Means of Room Units (a)	Relative Humidity (k) (%)	Design Temperature (l) (°F/°C)
Surgery and Critical Care							
Class B and C Operating Room (m), (n), (o)	Positive	4	20	N/R	No	30–60	68–75/20–24
Operating/Surgical Cystoscopic Rooms, (m), (n) (o)	Positive	4	20	N/R	No	30–60	68–75/20–24
Delivery Room (Caesarean) (m), (n), (o)	Positive	4	20	N/R	No	30–60	68–75/20–24
Substerile Service Area	N/R	2	6	N/R	No	N/R	N/R
Recovery Room	N/R	2	6	N/R	No	30–60	70–75/21–24
Critical and Intensive Care	Positive	2	6	N/R	No	30–60	70–75/21–24
Wound Intensive Care (Burn Unit)	Positive	2	6	N/R	No	40–60	70–75/21–24
Newborn Intensive Care	Positive	2	6	N/R	No	30–60	70–75/21–24
Treatment Room (p)	N/R	2	6	N/R	N/R	30–60	70–75/21–24
Trauma Room (Crisis or Shock) (c)	Positive	3	15	N/R	No	30–60	70–75/21–24
Medical/Anesthesia Gas Storage (r)	Negative	N/R	8	Yes	N/R	N/R	N/R
Laser Eye Room	Positive	3	15	N/R	No	30–60	70–75/21–24
ER Waiting Rooms (q)	Negative	2	12	Yes	N/R	Max. 65	70–75/21–24

Table 1: Excerpt from Table 7.1 "Design Parameters" from the ANSI/ASHRAE/ASHE Standard 170-2008.

health care ventilation design. Other documents, like the *HVAC Design Manual for Hospitals and Clinics*[1] provide more depth and detail for the designer.

In addition, many jurisdictions use or refer to the *Guidelines for Design and Construction of Health Care Facilities*,[2] which is maintained by the Facilities Guidelines Institute. The 2006 version of the *Guidelines* was published by the American Institute of Architects.

Guidance

The focal point of the standard is Table 7.1, "Design Parameters." (An excerpt of the design parameters is shown in *Table 1*.) This table is structured similarly to a table in the *Guidelines for Design and Construction of Health Care Facilities*, i.e., Table 2.1-2, "Ventilation Requirements for Areas Affecting Patient Care in Hospitals and Outpatient Facilities."

Table 7.1, Design Parameters includes a column titled "Pressure Relationship to Adjacent Areas." This reflects the HVAC design engineering approach to this parameter. The *Guidelines* use the criteria of "airflow relationship to adjacent areas," which reflects a traditional approach that has been favored by authorities having jurisdiction (AHJ).

The values in Table 7.1 are similar to those in the *Guidelines*. An exception is the values indicated for Class B and C operating rooms, operating/surgical cystoscopic rooms, and delivery rooms. (The standard requires 4/20 ACH in contrast to the 3/15 ACH recommended by the *Guidelines*.)

A minor but practical enhancement is related to line items in the table where "no requirements" are indicated. The table shows "N/R" meaning that the designer has no mandatory requirement to control that particular parameter. For example, a patient room may be designed to be positive, negative, or neutral with respect to adjacent spaces.

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Operating Rooms

In Class B and C operating rooms, the airflow needs to be unidirectional, downwards, and the average velocity of the diffusers shall be 25 to 35 cfm/ft^2 (127 L/s · m^2 to 178 L/s · m^2). (Average velocity is specified as cfm/ft^2 so it is clear that the critical parameter is the average airflow velocity that is measured at the face of the supply diffuser.) The diffusers need to be concentrated to provide an airflow pattern over the patient and surgical team. This aligns with the results of research that studied particulate concentration as a function of air-distribution patterns and air exchange rates for operating rooms.[3] A minimum positive pressure differential of 0.01 in. w.c. (+2.5 Pa) with respect to all adjoining spaces is required.

Reserve Cooling Sources

Reserve capacity is required for certain large cooling systems with some exceptions. The standard states that "The number and arrangement of cooling sources and related essential accessories shall be sufficient to support the owner's facility operation plan upon breakdown or routine maintenance of any one of the cooling sources." Reserve capacity is required by this standard if 1) the total central cooling plant capacity is greater than 400 ton (1407 kW); and 2) the building is located in geographic parts of the country where the 1% cooling dry-bulb temperature is more than 85°F (29°C) (*2005 ASHRAE Handbook—Fundamentals*). Considerable latitude is afforded by the owner's facility operation plan, e.g., the plan can allow for specific duration of time that the facility can operate without cooling, the plan can allow load shedding to maintain service to critical spaces, etc.

Filters

The standard specifies a minor difference from the recommendations in the *Guidelines*. The first filter banks are indicated to be MERV 7 filters in the standard. The *Guidelines* recommend a MERV 8 filter. Investigation by the ASHRAE project committee concluded that MERV 7 filters are more readily available and the filtration efficiency is equally satisfactory.

Radiant Cooling and Heating Systems

Although radiant panels have been used in health care applications for some time, application guidance had not been previously addressed (neither in the *Guidelines* nor Chapter 7, Health Care Facilities, of the *ASHRAE Handbook*. Minimum criteria are provided in this standard. The dew-point criteria are intended to control the agglomeration of condensation. The minimum criteria are:

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 airborne infection isolation room, a protective environment room, a wound intensive care unit (burn unit), or a room for any class of surgery, either flat and smooth radiant ceiling panels with exposed cleanable surfaces or radiant floor heating shall be used.

Isolation Rooms

The standard provides some clarifying guidance for the airborne infection isolation room. The exhaust from the room should include the exhaust from the toilet and the anteroom (where provided). The location of the exhaust grille is specified to be in the vicinity of the head of the bed in alignment with CDC guidelines.[4] The allowable air leakage can be quantified during the design because of the differential pressure control requirement, i.e., 0.01 in. w.c. (2.5 Pa).

The Standard's guidance for airborne infection isolation rooms:

c) All exhaust air from the Airborne Infection Isolation (AII) rooms, associated anterooms and associated toilet rooms shall be discharged

directly to the outdoors without mixing with exhaust air from any other non-Airborne Infection Isolation room or exhaust system.

d) 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.

e) The room envelope shall be sealed to limit leakage air flow at 0.01 in. w.c. (2.5 Pa) differential pressure across the envelope.

f) Differential pressure between AII rooms and adjacent spaces that have a different function shall be a minimum of –0.01 in. w.c. (–2.5 Pa).

The standard does not require any particular air volume flow rate differential to an AII room. To do so would then establish a mandatory effective leakage area in the room envelope. This is manifest from the following equation (Equation 28) found in the *2005 ASHRAE Handbook—Fundamentals* in Chapter 27, Ventilation and Infiltration.

$$Q = C_3 C_D A\sqrt{2\Delta p / \rho} \quad (1)$$

where

Q = Airflow rate, cfm

C_D = Discharge coefficient for opening, dimensionless

A = Cross-sectional area of opening, ft^2

ρ = Air density, lb_m/ft^3

Δp = Pressure difference across opening, in. of w.c.

C_3 = Unit of conversion factor = 776

Air Distribution Devices

Table 6.2 "Supply Air Outlets" (*Table 2*) prescribes supply air diffusers in accordance with the classification systems in Chapter 33, Space Air Diffusion, of the *2005 ASHRAE Handbook—Fundamentals.* This provides implicit guidance regarding acceptable air distribution patterns. (This is an example where the standard acknowledges that the ventila-

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tion for health care occupancies must address more than simply the air exchange rates.)

Ventilation Upon Loss of Electrical Power

The standard addresses that ventilation and pressure requirements for Airborne Isolation, Protective Environment and Class B and C Operating Rooms, and Delivery Rooms shall be maintained in the event of loss of normal electrical power. This conforms with the provisions of NFPA 99, *Standard for Health Care Facilities*.[5] (Refer to Section 4.4 of NFPA 99 for a specific list of equipment that should be on the essential electrical system.).

Summary

This new standard provides clear and concise language that describes the required minimum ventilation design parameters for health care facilities. It is intended that this standard will eventually supplant Normative Appendix E, Ventilation Rates for Health Care Facilities, in Standard 62.1.

Space Designation (According to Function)	Supply Air Outlet Classification
Class A, B and C Surgeries	Group E, Nonaspirating
Protective Environment (PE) Rooms	Group E, Nonaspirating
Wound Intensive Care Units (Burn Units)	Group E, Nonaspirating
Trauma Rooms (Crisis or Shock)	Group E, Nonaspirating
Airborne Infection Isolation (AII)	Group A
All other areas	Group A or Group E

Table 2: Excerpt from Table 6.2 "Supply Air Outlets" from ANSI/ASHRAE/ASHE Standard 170-2008.

References

1. ASHRAE. 2003. *HVAC Design Manual for Hospitals and Clinics.*

2. AIA. 2006. *Guidelines for Design and Construction of Health Care Facilities.* Washington, D.C.: American Institute of Architects.

3. Memarzadeh, F. and A. Manning. 2002. "Comparison of operating room ventilating systems in the protection of the surgical site." *ASHRAE Transactions* 108(2):3–15.

4. CDC. 2003. *Guidelines for Environmental Infection Control in Health-Care Facilities.* Atlanta: Centers for Disease Control.

5. NFPA. 2005. NFPA 99, *Health Care Facilities*. Massachusetts: National Fire Protection Association.