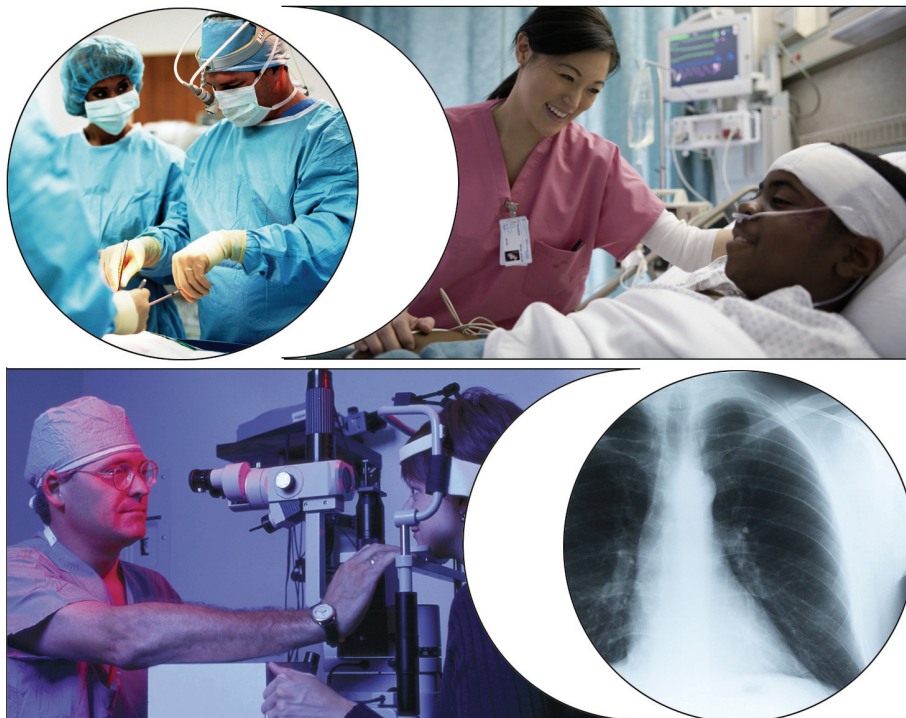




Health-Care HVAC



Updated Guidelines for Design and Construction Of Hospital and Health Care Facilities

By Paul Ninomura, P.E., Member ASHRAE, Chris Rousseau, P.E., Member ASHRAE, and Judene Bartley

The latest edition of the *Guidelines for Design and Construction of Hospital and Health Care Facilities 1* will be published this month. With assistance from the U.S. Department of Health and Human Services, the Guidelines is revised periodically and published by the American Institute of Architects Academy of Architecture for Health, and Facility Guidelines Institute (FGI). The *Guidelines* provide minimum ventilation

for health-care facilities. The *Guidelines* also are adopted or adapted and enforced by 42 states and the Joint Commission on the Accreditation of Healthcare Organizations. The 2006 edition has some notable changes to the ventilation and ventilation-related recommendations.

Specific Room Ventilation Changes

The 2006 edition has revised ventilation requirements for some existing room types

as well as added ventilation requirements for some new room types (listed in Table 7.2, "Ventilation Requirements for Areas Affecting Patient Care Hospitals and Outpatient Facilities"). The room types that are new or changed from the 2001 edition of the *Guidelines* are summarized in Table 1. The rationale supporting the revisions is as described next.

Intermediate Care. Intermediate care units are new in this edition. In-



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intermediate care units, sometimes referred to as step-down units, are used in acute care hospitals for patients who require frequent monitoring of vital signs and/or nursing intervention that exceeds the level needed in a regular medical/surgical unit, but less than that provided in a critical care unit. The ventilation requirements are similar to that of patient rooms (2 outside air changes per hour (ACH)/6 total ACH).

Laser Eye Room. Requirements for this room will be introduced in this edition. This reflects the increasing number of laser eye surgery procedures. The ventilation requirements (3 outside ACH/15 total ACH) are similar to that of an operating room.

X-Ray (Surgical/Critical Care and Catheterization). This room was previously listed under Ancillary and is now located under Surgery and Critical Care to better reflect its function. No changes were made to the requirements.

Gastrointestinal Endoscopy Room. The Gastrointestinal Endoscopy room has replaced the Endoscopy room (as described in the 2001 edition). The name changed to confirm the intended procedures anticipated in the room. The requirement for room airflow to be “in” was deleted. As a result, the flow of airborne contaminants from adjacent rooms and spaces into the Gastrointestinal Endoscopy room will be eliminated. The airflow change to inward flow in the 2001 *Guidelines* addressed previously expressed concerns for odor containment. Surveys conducted after publication of the 2001 edition determined that the airborne contaminants were primarily associated with chemical sterilants or disinfectants used on endoscopic instruments during post-procedure cleaning (patient procedures and instrument processes frequently occur in the same room). The 2006 edition now distinguishes the patient procedure room from that used for instrument disinfection/sterilization procedures. The change supports the principle of maintaining a clean area for the patient procedure.^{2,3}

Endoscopic Instrument Processing Room. This is a room added to the table in this edition. Typically, this room is ad-

acent to the Gastrointestinal Endoscopy room. It is used for cleaning endoscopic equipment and instruments. The relative room airflow is indicated to be inwards to contain odors from the equipment sterilization process.

Biochemistry and Serology Laboratories. The only change is that the pressure relationship has been changed from “out” to “in.” Since 2001, questions have been posed as to why biochemistry and serology labs require positive pressure, particularly given the changing microtechniques used in modern clinical laboratories. In an attempt to provide a basis for continuing to recommend positive airflow in these specific sites, the *Guidelines* steering committee undertook a review of ventilation in laboratories. After an informal survey of current practice and an extensive literature search, no original research on this specific issue was located. The committee determined that existing recommendations were likely based on theoretical rationale and past practice. Therefore, the pressure relationships for these two laboratory types were changed to “in” to be consistent with other types of clinical laboratory.

Operating Room Air Distribution. The *Guidelines* now recognizes that the air-distribution pattern in an operating room is equally important to the number of air exchanges (ACH). Non-aspirating diffusers are recommended and sized to provide a face velocity of 25 to 35 cfm/ft² (127 to 178 L/s per m²) in accordance with current research⁴ recommendations. In the appendix, additional recommendations include the size and placement of an array of diffusers above the surgical table.

About the Authors

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Operating Room Space Conditions. A psychrometric chart (*Figure 1*) is now included to indicate the ranges of acceptable space conditions in operating rooms. The text in previous editions was a continuing source of misinterpretations. Compliance is achieved when the relative humidity is maintained between 30% to 60% RH, and when the temperature is maintained between 68°F and 73°F (20°C and 23°C).

Other Ventilation Associated Issues

Ceilings. The construction of ceilings is important, and the 2006 edition provides some needed guidance on this subject. Monolithic ceilings in operating rooms have been defined to exclude diffusers and related appurtenances associated with the air supply diffusers installed in the ceiling. Airborne Infection Isolation and Protective Environment rooms were added to the list of semirestricted spaces, thus requiring that lay-in ceiling tiles be gasketed or clipped down in these areas. This was included to enable the required differential pressure to be maintained in these rooms.

Return Air Plenums. The use of the ceiling plenum for return air has been limited in the 2006 edition. In patient care areas (any place a patient might normally receive treatment), return air shall flow through ductwork back to the air-handling unit. This improves the control of the return air volume and path, and assists in maintaining the relative pressure relationships for patient care areas.

Infection Control Risk Assessment (ICRA). The section related to the ICRA has been revised significantly. The intent is to clearly define activities applicable to new buildings vs. renovation of existing structures. The expanded ICRA categorizes requirements associated with design, construction or remediation. HVAC related issues include the location of special ventilation and filtration such as for emergency department waiting and intake areas. Air-handling and ventilation needs in surgical services, airborne infection isolation and protective environment rooms, laboratories, local exhaust systems for hazardous agents and other special systems have also been addressed.

Filter Housing Blank-Off Panels. Historically, the *Guidelines* have required relatively high efficiency filtration for central air-handling units. The overall efficacy of the filter installation has been compromised often by poor installation.

	Air Movement Relationship to Adjacent Area	Minimum Air Changes Of Outdoor Air Per Hour	Minimum Total Air Changes Per Hour
Surgery and Critical Care			
Intermediate Care	—	2	6
Gastrointestinal Endoscopy Room	Out	2	6
Endoscopic Instrument Processing Room	In	—	10
Laser Eye Room	Out	3	15
X-ray (Surgical/Critical Care and Catheterization)	Out	3	15
Ancillary			
Lab Biochemistry	In	—	6
Lab Serology	In	—	6

Table 1: Ventilation requirements for areas affecting patient care in hospital and outpatient facilities.

Gaps exist between the filter cartridges and the filter frames, or if blank-off panels are provided, they are not permanently attached and are subsequently installed improperly after the first filter change. These gaps circumvent the purpose of the filters (by allowing air to take the path of least resistance and bypass the filter). The 2006 edition includes a requirement that blank-off panels be permanently attached to the frame and have seals equivalent to those provided for the filter cartridges. Typically, these blank-off panels would be sheet metal.

MERV Ratings. MERV ratings (ANSI/ASHRAE Standard 52.2-1999, *Method of Testing General Ventilation Air Cleaning Devices for Removal by Particle Size*) have been included in addition to dust spot efficiency. This acknowledges the industry acceptance of Standard 52.2 in lieu of ASHRAE Standard 52.1-1992, *Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter*.

O&M Manuals. The 2006 edition includes a new requirement for owners to be provided with detailed maintenance and operation information at the completion of a project, including energy rating information. This requirement is intended to provide operators with sufficient information to successfully and efficiently operate their facilities.

Boiler Plant Capacity. The 2006 edition reintroduces the requirement for reserve boiler plant capacity for space heating in critical areas for climates where the design dry-bulb temperature is less than 25°F (−4°C). The reserve capacity shall be sufficient to provide hot water service for clinical, dietary, and patient use; steam for sterilization and dietary purposes;



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and space heating for operating, delivery, labor, recovery, nurseries and intensive care.

Measurements Prior to Renovation Projects. A requirement has been added to measure (prior to the start of construction) the air and water flow of any utility that will be affected by a renovation project. This is intended to address both the issue of sufficient capacity to serve the renovated area and to maintain the existing service capacity for non-renovated areas.

One example would be a single floor nursing unit renovation. Prior to the completion of the design, field measurements would be obtained indicating the static pressure at the anticipated point of connection to the supply air, return air, exhaust air and hot water reheat risers, and at each major connection, those risers on other floors. This information would be used by the designers for two purposes:

1. To assist in the verification that sufficient capacity exists in the risers for the new work, or determine if additional work on the system is required; and
2. To allow the utilities serving other floors to be rebalanced after the modifications are made to ensure that utility service is not reduced on these floors.

To keep this requirement reasonable, it is limited to work that affects more than 10% of the system in question (chilled or hot water system, air-handling unit zone, exhaust fan system, etc.).

Expanded, New, and Reorganized Chapters

Chapters 13, Hospice; 14, Assisted Living; and 15, Adult Day Health Care have been greatly expanded. The mechanical recommendations address basic HVAC system performance.

A new chapter addressing small primary care hospitals has been added. The ventilation requirements are indicated in Chapter 7, General Hospital. To avoid confusion and discrepancies between similar components of different chapters, common engineering

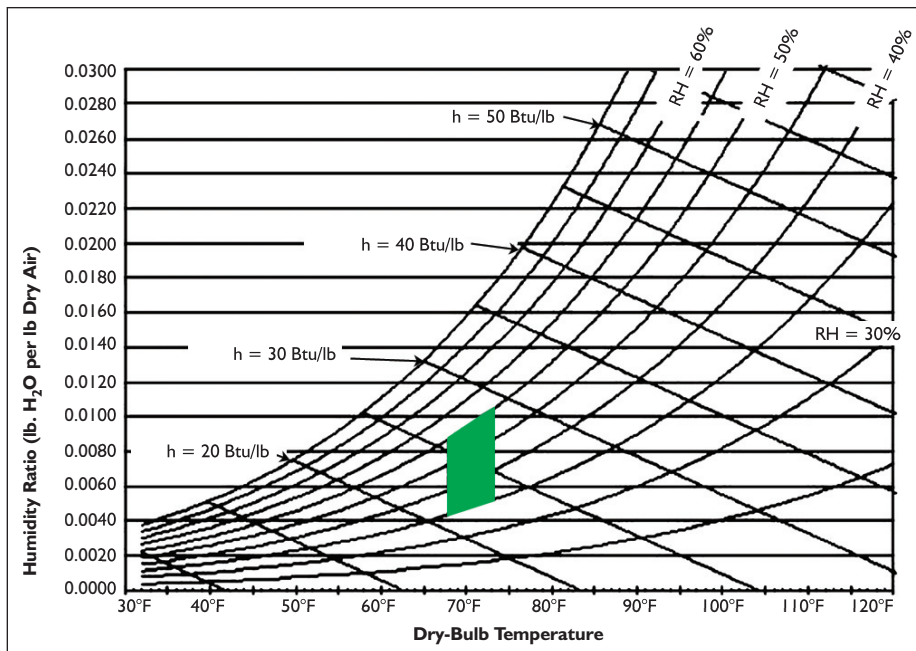


Figure 1: Psychrometric chart, indicating zone of acceptable operating room space conditions.

requirements will be relocated to an overall engineering chapter. A new chapter, section, and paragraph numbering system will be implemented to allow easy reference of specific requirements.

Sustainable Design

Sustainable design is introduced in Chapter 2, Environment of Care. In keeping with the current trends towards “green” design, additional information has been added to this chapter. The requirement is that sustainable design be considered. No specific items are mandated. Additional information about how current sustainable fea-

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tures relate to the health-care environment is included in the appendix.

This chapter also addresses the therapeutic environment. Concerns for water features that may soothe patients also may pose health risks. The appendix suggests because items such as fountains and other open decorative water features may represent a reservoir for opportunistic human pathogens they are not recommended for installation within any enclosed spaces of health care environments. If provided, the space enclosing the water feature should be exhausted. However, enclosed aquariums are not subject to exhaust recommendations.

Outstanding Issues for the Next Edition

Several issues are not resolved in the 2006 edition for various reasons. Some of these items relate to boiler plant redundancy and emergency operation, refrigeration plant redundancy and emergency operation, surge capacity for airborne infection isolation rooms in an emergency, coordination with proposed ASHRAE Standard 170P, *Ventilation of Healthcare Facilities*, ventilation of construction sites of renovation projects, and humidity conditions in operating rooms. To allow more information to be provided for current issues, an approach is planned to disseminate formal interpretations and updated information on a shorter cycle than the update of the main document is planned.

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Summary

The changes in the ventilation recommendations of the *Guidelines* reflect:

1. The application of new research, e.g., operating rooms;⁴ and
2. Consistency with the medical program requirements, e.g., Endoscopy, Procedure Room use, etc., established on evidence-based clinical research and sound principles of asepsis.^{2,3}

These changes are the result of a multidisciplinary review of the ventilation requirements, and the ventilation recommendations are based on definitive scientific basis.

References

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