

**Table 3 Ventilation Requirements for Areas Affecting Patient Care in Hospitals and Outpatient Facilities**

| Function Space  | Pressure Relationship to Adjacent Areas <sup>a</sup> | Minimum Air Changes of Outside Air per Hour <sup>b</sup> | Minimum Total Air Changes per Hour <sup>c</sup> | All Air Exhausted Directly to Outside <sup>m</sup> | Air Recirculated Within Room Units <sup>d</sup> | Relative Humidity, <sup>n</sup> % | Design Temperature, <sup>o</sup> °F |
|---|--|--|---|--|---|-----------------------------------|-------------------------------------|
| <b>Surgery and Critical Care</b>                                |  |  |   |  |   |                                   |                                     |
| Operating room (recirculating air system)                       | Positive   | 5  | 25  | —  | No  | 45 to 55                          | 62 to 80                            |
| Operating/surgical cystoscopic rooms <sup>e, p, q</sup>         | Positive   | 5  | 25  | —  | No  | 45 to 55                          | 68 to 73 <sup>f</sup>               |
| Delivery room <sup>p</sup>                                      | Positive   | 5  | 25  | —  | No  | 45 to 55                          | 68 to 73                            |
| Recovery room <sup>p</sup>                                      | *  | 2  | 6   | —  | No  | 45 to 55                          | 75 ± 2                              |
| Critical and intensive care                                     | *  | 2  | 6   | —  | No  | 30 to 60                          | 70 to 75                            |
| Newborn intensive care  | *  | 2  | 6   | —  | No  | 30 to 60                          | 72 to 78                            |
| Treatment room <sup>s</sup>                                     | *  | —  | 6   | —  | —   | 30 to 60                          | 75                                  |
| Nursery suite   | Positive   | 5  | 12  | —  | No  | 30 to 60                          | 75 to 80                            |
| Trauma room <sup>f, s</sup>                                     | Positive   | 5  | 12  | —  | No  | 45 to 55                          | 62 to 80                            |
| Anesthesia gas storage  | Negative   | —  | 8   | Yes  | —   | —                                 | —                                   |
| GI Endoscopy  | Negative   | 2  | 6   | —  | No  | 30 to 60                          | 68 to 73                            |
| Bronchoscopy <sup>q</sup>                                       | Negative   | 2  | 12  | Yes  | No  | 30 to 60                          | 68 to 73                            |
| Emergency waiting rooms   | Negative   | 2  | 12  | Yes  | —   | 30 to 60                          | 74 ± 2                              |
| Triage  | Negative   | 2  | 12  | Yes  | —   | —                                 | 70 to 75                            |
| Radiology waiting rooms   | Negative   | 2  | 12  | Yes <sup>t, u</sup>                                | —   | —                                 | 70 to 75                            |
| <b>Nursing</b>  |  |  |   |  |   |                                   |                                     |
| Patient room  | *  | 2  | 6 <sup>v</sup>                                  | —  | —   | 30 (W), 50 (S)                    | 75 ± 2                              |
| Toilet room <sup>g</sup>  | Negative   | Optional   | 10  | Yes  | No  | —                                 | —                                   |
| Newborn nursery suite   | *  | 2  | 6   | —  | No  | 30 to 60                          | 72 to 78                            |
| Protective environment room <sup>i, q, w</sup>                  | Positive   | 2  | 12  | —  | No  | —                                 | 75                                  |
| Airborne infection isolation room <sup>h, q, x</sup>            | Negative   | 2  | 12  | Yes <sup>u</sup>                                   | No  | —                                 | 75                                  |
| Isolation alcove or anteroom <sup>w, x</sup>                    | Pos./Neg.  | 2  | 10  | Yes  | No  | —                                 | —                                   |
| Labor/delivery/recovery/postpartum (LDRP)                       | *  | 2  | 6 <sup>v</sup>                                  | —  | —   | 30 (W), 50 (S)                    | 75 ± 2                              |
| Public corridor   | Negative   | 2  | 2   | —  | —   | —                                 | —                                   |
| Patient corridor  | *  | 2  | 4   | —  | —   | —                                 | —                                   |
| <b>Ancillary</b>  |  |  |   |  |   |                                   |                                     |
| <b>Radiology<sup>y</sup></b>                                    |  |  |   |  |   |                                   |                                     |
| X-ray (diagnostic and treatment)                                | *  | 2  | 6   | —  | —   | 40 (W), 50 (S)                    | 78 to 80                            |
| X-ray (surgery/critical care and catheterization)               | Positive   | 3  | 15  | —  | No  | 30 to 60                          | 70 to 75                            |
| Darkroom  | Negative   | 2  | 10  | Yes <sup>j</sup>                                   | No  | —                                 | —                                   |
| Laboratory, general <sup>y</sup>                                | Negative   | 2  | 6   | Yes  | No  | 30 to 60                          | 74 ± 2                              |
| Laboratory, bacteriology  | Negative   | 2  | 6   | Yes  | No  | 30 to 60                          | 74 ± 2                              |
| Laboratory, biochemistry <sup>y</sup>                           | Positive   | 2  | 6   | —  | No  | 30 to 60                          | 74 ± 2                              |
| Laboratory, cytology  | Negative   | 2  | 6   | Yes  | No  | 30 to 60                          | 74 ± 2                              |
| Laboratory, glasswashing  | Negative   | Optional   | 10  | Yes  | —   | —                                 | —                                   |
| Laboratory, histology   | Negative   | 2  | 6   | Yes  | No  | 30 to 60                          | 74 ± 2                              |
| Microbiology <sup>y</sup>                                       | Negative   | —  | 6   | Yes  | No  | 30 to 60                          | 74 ± 2                              |
| Laboratory, nuclear medicine                                    | Negative   | 2  | 6   | Yes  | No  | 30 to 60                          | 74 ± 2                              |
| Laboratory, pathology   | Negative   | 2  | 6   | Yes  | No  | 30 to 60                          | 74 ± 2                              |
| Laboratory, serology  | Positive   | 2  | 6   | Yes  | No  | 30 to 60                          | 74 ± 2                              |
| Laboratory, sterilizing   | Negative   | Optional   | 10  | Yes  | No  | 30 to 60                          | 74 ± 2                              |
| Laboratory, media transfer                                      | Positive   | 2  | 4   | —  | No  | 30 to 60                          | 74 ± 2                              |
| Autopsy room <sup>q</sup>                                       | Negative   | 2  | 12  | Yes  | No  | —                                 | —                                   |
| Nonrefrigerated body-holding room <sup>k</sup>                  | Negative   | Optional   | 10  | Yes  | No  | —                                 | 70                                  |
| Pharmacy  | Positive   | 2  | 4   | —  | —   | 30 to 60                          | 74 ± 2                              |
| <b>Administration</b>   |  |  |   |  |   |                                   |                                     |
| Admitting and Waiting Rooms                                     | Negative   | 2  | 6   | Yes  | —   | 30 to 60                          | 74 ± 2                              |
| <b>Diagnostic and Treatment</b>                                 |  |  |   |  |   |                                   |                                     |
| Bronchoscopy, sputum collection, and pentamidine administration | Negative   | 2  | 12  | Yes  | —   | 30 to 60                          | 74 ± 2                              |
| Examination room  | *  | 2  | 6   | —  | —   | 30 to 60                          | 74 ± 2                              |
| Medication room   | Positive   | 2  | 4   | —  | —   | 30 to 60                          | 74 ± 2                              |
| Treatment room  | *  | 2  | 6   | —  | —   | 30 (W), 50 (S)                    | 75 ± 2                              |
| Physical therapy and hydrotherapy                               | Negative   | 2  | 6   | —  | —   | 30 to 60                          | 72 to 78/up to 80                   |
| Soiled workroom or soiled holding                               | Negative   | 2  | 10  | Yes  | No  | 30 to 60                          | 72 to 78                            |
| Clean workroom or clean holding                                 | Positive   | 2  | 4   | —  | —   | —                                 | —                                   |
| <b>Sterilizing and Supply</b>                                   |  |  |   |  |   |                                   |                                     |
| ETO-sterilizer room   | Negative   | —  | 10  | Yes  | No  | 30 to 60                          | 72 to 78                            |
| Sterilizer equipment room                                       | Negative   | —  | 10  | Yes  | No  | 30 to 60                          | 74 ± 2                              |
| <b>Central medical and surgical supply</b>                      |  |  |   |  |   |                                   |                                     |
| Soiled or decontamination room                                  | Negative   | 2  | 6   | Yes  | No  | 30 to 60                          | 72 to 78                            |
| Clean workroom  | Positive   | 2  | 4   | —  | No  | 30 to 60                          | 72 to 78                            |
| Sterile storage   | Positive   | 2  | 4   | —  | —   | Under 50                          | 74 ± 2                              |

**Table 3 Ventilation Requirements for Areas Affecting Patient Care in Hospitals and Outpatient Facilities (Continued)**

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|--------------------------------------|--|--|---|--|---|-----------------------------------|-------------------------------------|
| Service                              |  |  |   |  |   |                                   |                                     |
| Food preparation center <sup>l</sup> | *  | 2  | 10  | Yes  | No  | —                                 | —                                   |
| Warewashing                          | Negative   | Optional   | 10  | Yes  | No  | —                                 | —                                   |
| Dietary day storage                  | *  | Optional   | 2   | —  | No  | —                                 | —                                   |
| Laundry, general                     | Negative   | 2  | 10  | Yes  | No  | —                                 | —                                   |
| Soiled linen sorting and storage     | Negative   | Optional   | 10  | Yes  | No  | —                                 | —                                   |
| Clean linen storage                  | Positive   | 2 (Optional)   | 2   | —  | —   | —                                 | —                                   |
| Linen and trash chute room           | Negative   | Optional   | 10  | Yes  | No  | —                                 | —                                   |
| Bedpan room                          | Negative   | Optional   | 10  | Yes  | No  | —                                 | —                                   |
| Bathroom                             | Negative   | Optional   | 10  | Yes  | No  | —                                 | 72 to 78                            |
| Janitor's closet                     | Negative   | Optional   | 10  | Yes  | No  | —                                 | —                                   |

(W) = winter

(S) = summer

\* = Continuous directional control not required

<sup>a</sup> Where continuous directional control is not required, variations should be minimized; in no case should a lack of directional control allow spread of infection from one area to another. Boundaries between functional areas (wards or departments) should have directional control. Lewis (1988) describes ways to maintain directional control by applying air-tracking controls. Ventilation system design should provide air movement, generally from clean to less clean areas. If any VAV or load-shedding system is used for energy conservation, it must not compromise pressure-balancing relationships or minimum air changes required by the table. See note z for additional information.

<sup>b</sup> Ventilation rates in this table cover ventilation for comfort, as well as for asepsis and odor control in areas of acute-care hospitals that directly affect patient care. Ventilation rates in accordance with ASHRAE *Standard 62*, Ventilation for Acceptable Indoor Air Quality, should be used for areas for which specific ventilation rates are not given. Where a higher outside air requirement is called for in *Standard 62* than here, use the higher value.

<sup>c</sup> Total air changes indicated should be either supplied or, where required, exhausted. Number of air changes can be reduced when the room is unoccupied, if the pressure relationship is maintained and the number of air changes indicated is reestablished any time the space is used. Air changes shown are minimum values. Higher values should be used when required to maintain room temperature and humidity conditions based on the cooling load of the space (lights, equipment, people, exterior walls and windows, etc.).

<sup>d</sup> Recirculating HEPA filter units used for infection control (without heating or cooling coils) are acceptable. Gravity-type heating or cooling units such as radiators or convectors should not be used in operating rooms and other special-care areas.

<sup>e</sup> For operating rooms, 100% outside air should be used only when codes require it and only if heat recovery devices are used.

<sup>f</sup> "Trauma room" here is a first-aid room and/or emergency room used for general initial treatment of accident victims. The operating room in the trauma center that is routinely used for emergency surgery should be treated as an operating room.

<sup>g</sup> See section on Patient Rooms for discussion of central toilet exhaust system design.

<sup>h</sup> "Airborne infectious isolation rooms" here are those that might be used for infectious patients in the average community hospital. The rooms are negatively pressurized. Some may have a separate anteroom. See the section on Infectious Isolation Unit for more information.

<sup>i</sup> Protective-environment rooms are those used for immunosuppressed patients, positively pressurized to protect the patient. Anterooms are generally required and should be negatively pressurized with respect to the patient room.

<sup>j</sup> All air need not be exhausted if darkroom equipment has scavenging exhaust duct attached and meets ventilation standards of NIOSH, OSHA, and local employee exposure limits.

<sup>k</sup> A nonrefrigerated body-holding room is only applicable to facilities that do not perform autopsies onsite and use the space for short periods while waiting for the body to be transferred.

<sup>l</sup> Food preparation centers should have an excess of air supply for positive pressurization when hoods are not in operation. The number of air changes may be reduced or varied for odor control when the space is not in use. Minimum total air changes per hour should be that required to provide proper makeup air to kitchen exhaust systems. (See Chapter 31, Kitchen Ventilation.) Also, exfiltration or infiltration to or from exit corridors must not compromise exit corridor restrictions of NFPA *Standard 90A*, pressure requirements of NFPA *Standard 96*, or the maximum defined in the table. The number of air changes may be reduced or varied as required for odor control when the space is not in use. See AIA (2001), Section 7.31.D1.p.

<sup>m</sup> Areas with contamination and/or odor problems should be exhausted to the outside and not recirculated to other areas. Individual circumstances may require special consideration for air exhaust to the outside (e.g., intensive care units where patients with pulmonary infection are treated, rooms for burn patients). To satisfy exhaust needs, replacement air from the outside is necessary. Minimum outside air quantities should remain constant while the system is in operation.

<sup>n</sup> Relative humidity ranges listed are minimum and maximum limits where control is specifically needed. These limits are not intended to be independent of space temperature. For example, relative humidity is expected to be at the higher end of the range when the temperature is also at the higher end, and vice versa.

<sup>o</sup> For indicated temperature ranges, systems should be capable of maintaining the rooms at any point within the range during normal operation. A single figure indicates a heating or cooling capacity to at least meet the indicated temperature. This is usually applicable when patients may be undressed and require a warmer environment. Use of lower temperature is acceptable when patients' comfort and medical conditions require those conditions.

<sup>p</sup> NIOSH *Criteria Documents 75-137* and *96-107* on waste anesthetic gases and nitrous oxide indicate a need for both local exhaust (scavenging) systems and general ventilation of areas in which these gases are used.

<sup>q</sup> Differential pressure between space and corridors should be a minimum of 0.01 in. of water. If monitoring device alarms are installed, allowances should be made to prevent nuisance alarms.

<sup>r</sup> Because some surgeons or surgical procedures may require room temperatures outside the indicated range, operating room design conditions should be developed in consort with all users, surgeons, anesthesiologists, and nursing staff.

<sup>s</sup> The first-aid and/or emergency room used for initial treatment of accident victims can be ventilated as for the treatment room. Treatment rooms used for cryosurgery with nitrous oxide should have provisions for exhausting waste gases.

<sup>t</sup> In a recirculating ventilation system, HEPA filters can be used instead of exhausting the air to the outside; return air should pass through the HEPA filters before being introduced to any other spaces.

<sup>u</sup> If exhausting air from an airborne-infection isolation room to the outside is not practical, the air may be returned through HEPA filters to the air-handling system exclusively serving the isolation room.

<sup>v</sup> Total air changes per room for patient rooms, and labor/delivery/recovery/postpartum rooms may be reduced to four when using supplemental heating and/or cooling systems (radiant heating and cooling, baseboard heating, etc.).

<sup>w</sup> Protective-environment airflow design specifications protect the patient from common environmental airborne infectious microbes (e.g., *Aspergillus* spores). They should provide directed airflow from the cleanest patient area to less clean areas. HEPA filters at 99.9% efficiency to 0.3 μm should be used in the supply airstream, to protect patient rooms from environmental microbes in ventilation system components. Recirculation HEPA filters can be used to increase equivalent room air exchanges. Constant-volume airflow is required for consistent ventilation. If design criteria indicate that airborne-infection isolation is necessary for protective-environment patients, an anteroom should be provided. Rooms with reversible airflow provisions (to allow switching between protective-environment and airborne-infection isolation) are not acceptable (AIA 2001).

<sup>x</sup> "Infectious disease isolation (AII) room" here is one used to isolate the airborne spread of infectious diseases, such as measles, varicella, or tuberculosis. Design should include provision for normal patient care during periods not requiring isolation. Supplemental recirculating devices may be used in the patient room to increase the equivalent room air exchanges; however, they do not provide outside air requirements. Air may be recirculated within individual isolation rooms if HEPA filters are used. Rooms with reversible airflow provisions (to allow switching between protective-environment and AII) are not acceptable (AIA 2001).

<sup>y</sup> When required, provide appropriate hoods and exhaust devices for noxious gases or vapors [AIA (2001), see Section 7.31.D14 and 7.31.D15, and NFPA *Standard 99*].

<sup>z</sup> Simple visual methods such as smoke trail, ball-in-tube, or flutterstrip can be used to verify airflow direction. These devices require a minimum differential air pressure to indicate airflow direction. Per AIA (2001) guidelines, recirculating devices with HEPA filters may be used in existing facilities as interim, supplemental environmental controls to meet requirements for airborne infectious agents control. Design limitations must be recognized. Either portable or fixed systems should prevent stagnation and short-circuiting of airflow. Supply and exhaust locations should direct clean air to work areas across the infectious source, and then to the exhaust, so that health care workers are not positioned between the infectious source and the exhaust. Systems design should also allow easy access for scheduled preventative maintenance and cleaning.