A7.~~12~~15.D. For example, separate facilities should be provided for such incompatible materials as acids and bases, and vented storage should be provided for volatile solvents.

A7.~~13~~16.D4. The facilities should be similar to a residential environment.

A7.~~14~~17.B2~~2~~3. All installed ~~RO~~ reverse osmosis water and dialysis solution piping should be accessible.

A7.17.B24. Due to the nature of the dialyzing process and the nature of the patient's illness, the temperature should be maintained at 72° to 78°F (22° to 26°C) with minimum humidity levels of 30 to 60 percent.

A7.~~16~~19.B. Autopsy rooms should be equipped with downdraft local exhaust ventilation.

A7.20.B3. Floor drainage may also be required, depending on the extent of compounding conducted.

A7.21.A. Consideration may also be required for meals to VIP suites, and for cafeterias for staff, ambulatory patients, and visitors as well as providing for nourishments and snacks between scheduled meal service.

A7.~~21~~24.A2. Clean Assembly/Workroom
Access to the sterilization room should be restricted. This room should contain Hi-Vacuum or gravity steam sterilizers and sterilization equipment to accommodate heat-sensitive equipment (ETO sterilizer) and ETO aerators. This room is used exclusively for the inspection, assembly, and packaging of medical/surgical supplies and equipment for sterilization. ~~Area~~ It should contain work~~-~~tables, counters, a handwashing station, ultrasonic storage facilities for backup supplies and instrumentation, and a drying cabinet or equipment. The area should be spacious enough to hold sterilizer carts for loading of prepared supplies for sterilization.

A7.~~30~~33.B2. Elevator car doors should have a clear opening of not less than 4.5 feet (1.37 meters).

A7.33.C1. The underlying frameworks of waste management are waste minimization and segregation. Different components of the waste stream must be kept separate from each other; facilities should seek to minimize all components of each waste stream. At a minimum, the functional program includes consideration of regular trash, medical/ infectious waste, hazardous waste, and low-level radioactive waste. The program should address the development of effective collection, transport, pest control, and storage systems; waste management and contingency planning; protecting the health and safety of workers; and proper siting of all on-site waste treatment technologies.

Optimizing waste management has programmatic and space impacts throughout the facility, at points where waste is generated, collected, and staged for disposal. For facilities or municipalities with recycling programs in place, particular consideration should be given to sorting and staging areas. The following elements are examples that may be considered:

a. Building should include adequate space to accommodate bins/carts for appropriate waste segregation such as recyclables, infectious waste, sharps, etc. Corridors and materials handling systems should be designed to achieve an efficient movement of waste from points of generation to storage or treatment while minimizing the risk to personnel.

b. Dedicated storage and flow space and cleaning/sanitation facilities should facilitate reuse of items such as medical products, food service items, and the like to eliminate disposables and reduce waste.

c. Space should be included for autoclaves, shredders, and other technologies for processing medical waste prior to removals to landfill. Secure storage should be provided for staging fluorescent lamps for recycling.

A7.33.C2.a. The EPA has identified medical waste incineration as a significant contributor to air pollution worldwide. Health care facilities should seek to minimize incineration of medical waste, consistent with local and state regulations and public health goals.

A7.33.C2.b. When incinerators are used, consideration should be given to the recovery of waste heat from on-site incinerators used to dispose of large amounts of waste materials. Incinerators should be designed in a manner fully consistent with protection of public and environmental health, both on-site and off-site, and in compliance with federal, state, and local statutes and regulations. Toward this end, permit applications for incinerators and modifications thereof should be supported by Environmental Assessments and/or Environmental Impact Statements (EISs) and/or Health Risk Assessments (HRAs) as may be required by regulatory agencies. Except as noted below, such assessments should utilize standard U.S. EPA methods, specifically those set forth in U.S. EPA guidelines, and should be fully consistent with U.S. EPA guidelines for health risk assessment. Under some circumstances, however, regulatory agencies having jurisdiction over a particular project may require use of alternative methods.

A7.30.C2.d. When incinerators are used, consideration should be given to the recovery of waste heat from on-site incinerators used to dispose of large amounts of waste materials.

A7.30.C2.e. Incinerators should be designed in a manner fully consistent with protection of public and environmental health, both on-site and off-site, and in compliance with federal, state, and local statutes and regulations. Toward this end, permit applications for incinerators and modifications thereof should be supported by Environmental Assessments and/or Environmental Impact Statements (EISs) and/or Health Risk Assessments (HRAs) as may be required by regulatory agencies. Except as noted below, such assessments should utilize standard U.S. EPA methods, specifically those set forth in U.S. EPA guidelines, and should be fully consistent with U.S. EPA guidelines for health risk assessment. Under some circumstances, however, regulatory agencies having jurisdiction over a particular project may require use of alternative methods.

A7.34.A1. Remodeling and work in existing facilities may present special problems. As practicality and funding permit, existing insulation, weather stripping, etc., should be brought up to standard for maximum economy and efficiency. Consideration should be given to additional work that may be needed to achieve this.

A7.34.A4. Systems with excessive installation and/or maintenance costs that negate long-range energy savings should be avoided.

A7.34.D Protection of HVAC systems against chemical, biological, and radiological attack should be considered. System design features that should be evaluated include protection of outside air intakes, location of return air grilles, and types of filtration. The following two documents provide additional information regarding these issues:

- *Guidance for Protecting Building Environments from Airborne Chemical, Biological, or Radiological Attacks*, Department of Health and Human Services/Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health, May 2002.

- "Protecting Buildings and their Occupants from Airborne Hazards" (draft), Army Corps of Engineers, TI 853-01, October 2001.

A7.34.D1. Owing to potential operational problems for the ultraviolet germicidal irradiation (UVGI) lamps, and the fact that the effectiveness of UVGI is dependent on the airflow pattern in the room, use of UVGI may be considered as a supplement to the ventilation system design, rather than the main control mechanism. The ACH of the room should therefore be set as if no UVGI system is installed.

A7.~~31~~34.D3 Requirements to minimize cross-~~-~~contamination between fresh air intakes and various exhaust outlets may be determined by engineering modeling or calculations performed in accordance with the ASHRAE *Handbook of Fundamentals.*

A7.~~31~~34.D4. 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, ~~e.g.,~~ 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).

The recommended air flow rate in an operating room is 20to 25 air changes per hour (ACH) for ceiling heights between 9 feet (2.74 meters) and 12 feet (3.66 meters). The system should provide a single directional flow regime, with both high and low exhaust locations. A face velocity of around 25 to 35 fpm (0.13 to 0.18 m/s) is sufficient from the non-aspirating diffuser array provided that the array size itself is set correctly. The non-aspirating diffuser array size should be set appropriately such that it covers at least the area footprint of the table plus a reasonable margin around it. In the cited study, this margin is 21 inches (0.53 meter) on the short side and 12 inches (0.3 meter) on the long side.

The above conclusions were derived from studies conducted by the National Institutes of Health, titled "Comparison of Operating Room Ventilation Systems in the Protection of the Surgical Site" (Memarzadeh 2002) and "Effect of Operation Room Geometry and Ventilation System Parameter Variations on the Protection of the Surgical Site (Memarzadeh 2004).

A7.~~31~~34.D6. See *Industrial Ventilation: A Manual of Recommended Practice*, published by the American Conference of Governmental Industrial Hygienists (www.acgih.org), for additional information.

A7.~~31~~34.D9. One way to achieve basic humidification may be ~~accomplished~~ by a steam-~~-~~jacketed manifold-~~-~~type humidifier~~,~~ with a condensate separator that delivers high-quality steam. Additional booster humidification (if required) should be provided by steam-~~-~~jacketed humidifiers for each individually controlled area. Steam to be used for humidification may be generated in a separate steam generator. The steam generator feedwater may be supplied either from soft or reverse osmosis water. Provisions should be made for periodic cleaning.

A7.~~31~~34.D25. Whenever possible, the gluteraldehyde should be captured at the source. If this is not possible, the room should be exhausted at a rate of 15 air changes.

A7.~~31~~34.E3.c. There are several ways to treat domestic water systems to kill *Legionella* and opportunistic waterborne pathogens. Complete removal of these organisms is not feasible, but methods to reduce the amount include hyperchlorination (free chlorine, chlorine dioxide, monochloramine), elevated hot water temperature, ozone injection, silver/copper ions, and ultraviolet light. Each of these options has advantages and disadvantages. While increasing the hot water supply temperature to 140°F (60°C) is typically considered the easiest option, the risk of scalding, especially to youth and the elderly, is significant. Additional consideration should be given to domestic water used in bone marrow transplant units. See CDC and ASHRAE Guideline 12, "Minimizing the Risk of Legionellosis Associated with Building Water Systems," for additional information. Another reference on this topic is "*Legionella* Control in Health Care Facilities," available from the American Society of Plumbing Engineers.

A7.~~31~~34.E4.e. Floor drains in cystoscopy operating rooms have been shown to disseminate a heavily contaminated spray during flushing. Unless flushed regularly with large amounts of fluid, the trap tends to dry out and permit passage of gases, vapors, odors, insects, and vermin directly into the operating room. For new construction, if the users insist on a floor drain ~~is insisted upon by the users~~, the drain plate should be located away from the operative site, and should be over a frequently flushed nonsplash, horizontal-flow type of bowl, preferably with a closed system of drainage. Alternative methods include (a) an aspirator/trap installed in a wall connected to the collecting trough of the operating table by a closed, disposable tube system, or (b) a closed system using portable collecting vessels. (See NFPA 99.)

A7.34.E13. Open decorative water features such as fountains may represent a reservoir for opportunistic human pathogens; thus they are not recommended for installation within any enclosed spaces of health care environments. The basin should be designed to be resistant to chemical corrosion with minimal droplet production. Exhaust ventilation should be provided directly above the water feature.

A7.35.D1. Light intensity for staff and patient needs should generally comply with health care guidelines set forth in the IES publication. Consideration should be given to controlling intensity and/or wavelength to prevent harm to the patient's eyes (i.e., retina damage to premature infants and cataracts due to ultraviolet light).

Many procedures are available to satisfy lighting requirements, but the design should consider light quality as well as quantity for effectiveness and efficiency. While light levels in the IES publication are referenced herein, those publications include other useful guidance and recommendations which the designer is encouraged to follow.

A7.35.F5. Special attention should be paid to safety hazards associated with equipment cabling. Every attempt should be made to minimize these hazards, where practical.

A7.~~32~~35.F~~8~~6. Refer to NFPA 99 for a description of the essential electrical system.

A7.~~33~~ 36 Hyperbaric Suite

~~General~~

~~The number of treatment stations should be based upon the expected workload and may include several work shifts per day.~~

~~The location should offer convenient access for outpatients. Accessibility to the unit from parking and public transportation should be a consideration.~~

~~Treatment Areas~~

~~Hyperbaric chambers for multiple occupancy (Class A) should be installed in accordance with NFPA 99.~~

Hyperbaric chambers for individual patients (Class B) should be installed in accordance with NFPA 99 in a room or suite adequately sized to provide the following clearances: chamber and side wall, 5 feet (1.52 meters); between chambers, 6 feet (1.83 meters); and between the chamber headboard and the wall, 3 feet (0.91 meter). A minimum passage space of 4 feet (1.22 meter) shall be provided at the foot of each chamber in addition to the required clearances for sliding patients' platforms in end-loading chambers.

Functional Elements

The following support spaces should be provided and may be shared with adjacent departments.

Patient waiting area. The area should be out of traffic, under staff control, and should have seating capacity in accordance with the functional program. When the hyperbaric suite is routinely used for outpatients and inpatients at the same time, separate waiting areas should be provided with screening for visual privacy between the waiting areas.

A control desk and reception area should be provided.

A holding area under staff control should accommodate inpatients on stretchers or beds. Stretcher patients should be out of the direct line of normal traffic. The patient holding area may be omitted for two or fewer individual hyperbaric chamber units.

Toilet rooms for the use of patients should be provided with direct access from the hyperbaric suite.

Dressing rooms for outpatients should be provided and should include a seat or bench, mirror, and provisions for hanging patients' clothing and for securing valuables. At least one dressing room should be provided to accommodate wheelchair patients.

An appropriate room for individual and family consultation with referring physicians should be provided for outpatients.

A clean storage space should be provided for clean supplies and linens. Handwashing stations should be provided with hands-free operable controls. When a separate storage room is provided, it may be shared with another department when conveniently located.

A soiled holding room should be provided with waste receptacles and soiled linen receptacles.

Storage for patients' belongings should be provided.

A housekeeping room should be provided and should contain a floor receptor or service sink and storage space for housekeeping supplies and equipment; it should be located nearby.

Appropriate areas should be available for male and female personnel for staff clothing change area and lounge. The areas should contain lockers, shower, toilet, and handwashing stations.

A waiting room, toilet with handwashing stations, drinking fountain, public telephone, and seating accommodations for waiting periods should be available or accessible to the unit.

Electrical Requirements

~~Grounding of hyperbaric chambers should be connected only to the equipment ground in accordance with NFPA 99 and NFPA 70.~~

~~Additional grounds such as earth or driven grounds should not be permitted.~~

Applicability

These guidelines shall apply to hyperbaric facilities designated for clinical hyperbaric oxygen therapy, including hospital-affiliated and freestanding facilities.

General Facility Requirements

Hyperbaric chambers shall be constructed in conformance with applicable construction codes (ASME, PVHO-1) and carry a "U" stamp.

The facility shall be constructed to comply with applicable local, state, and national construction codes governing the type of occupancy (health care, commercial, other) housing the hyperbaric chamber(s).

Architectural requirements. When a hyperbaric suite/clinic is provided, it shall meet the requirements of Chapter 20, NFPA 99, and Chapter 12, NFPA 101.

The following service areas shall be provided for the hyperbaric facility. If the hyperbaric facility is included as an integral portion of another service such as a wound care department, service areas may be shared:

1. Reception/control desk.

2. Patient waiting area. The waiting area should be large enough to accommodate the clinical program and chamber mix if also used as a holding area. The area shall be out of traffic, under staff control, and shall have seating capacity in accordance with the functional program. When the hyperbaric suite is routinely used for outpatients and inpatients at the same time, separate waiting areas shall be provided with screening for visual privacy between the waiting areas. Patient waiting areas may be omitted for two or less Class B hyperbaric chamber units.

3. Holding area. The area shall be out of traffic flow from the chamber and shall not obstruct access to the exits. A holding area under staff control shall accommodate inpatients on stretchers or beds. Stretcher patients shall be out of the direct line of normal traffic. The patient holding area may be omitted for two or less individual hyperbaric chamber units.

4. Patient record storage area. An area should be provided that is out of traffic flow and under staff control. This can be in the clinical area or located at the reception/control desk.

5. Patient toilet rooms. Toilet rooms shall be provided with handwashing fixtures with hands-free operable controls with direct access from the hyperbaric suite.

6. Patient dressing rooms. Dressing rooms for outpatients shall be provided and shall include a seat or bench, mirror, and provisions for hanging patients' clothing and for securing valuables. At least one dressing room shall be provided to accommodate wheelchair patients.

7. Staff facilities. Toilets with handwashing fixtures with hands-free operable controls may be outside the suite but shall be convenient for staff use.

8. Consultation/treatment rooms. Appropriate room for individual consultation and treatment with referring clinicians shall be provided.

9. Storage space. A clean storage space shall be provided for clean supplies and linens. Handwashing fixtures shall be provided with hands-free operable controls. When a separate storage room is provided, it may be shared with another department.

10. Soiled holding area. A soiled holding room shall be provided with waste receptacles and soiled linen receptacles.
Handwashing stations. A lavatory equipped for handwashing with hands-free operable controls shall be located in the room where the hyperbaric chambers are located.

11. Housekeeping room. The housekeeping room shall contain a floor receptor or service sink and storage space for housekeeping supplies and equipment, and shall be located nearby.

12. Gas cylinder room. This room should be large enough to accommodate the storage of enough (H) cylinders and manifolds for the reserve breathing gases required for chamber operations. The minimum room size should be able to house eight (H) cylinders and two gas manifolds, consisting of at least two (H) cylinders on each manifold.

13. Compressor room. This area should be large enough to house the chamber compressors, accumulator tanks, fire suppression system and their ability to meet the requirements of NFPA 99, Chapter 20. The reserve breathing gases could also be housed here if it is in close proximity to the chamber room.

Multiplace (NFPA Class "A" Chamber) Facilities

The facility housing a Class A chamber shall be designed to allow rapid or emergency removal of patients and staff.

In the case of multiple Class A chambers installed in a single setting, or a Class A chamber that contains multiple compartments, the rapid or emergency removal of a patient or personnel from one chamber/compartment shall not restrict in any way the rapid and simultaneous removal of patients or personnel from all other chambers/compartments.

A minimum of two exits should be provided for the chamber room unless a single exit opens directly to a primary evacuation hallway.

The space required to house Class A chambers and supporting equipment should be defined by NFPA 99, Chapter 20 and the equipment manufacturer, but in any case shall not be less than the following:

Class A Hyperbaric Chamber Clearances
Minimum clearances around a (Class A) hyperbaric chamber shall be as follows:

1. Chamber entry should be designed for gurney/stretcher access: 10 feet (3.04 meters).

2. Entries designed for wheeled gurneys shall be provided with access ramps that are flush with the chamber entry doorway.

3. Chambers that utilize fixed internal stretcher frames and transfer gurneys shall be designed to allow immediate removal of the patient upon chamber depressurization.

4. Chamber man lock entries or compartments utilizing circular entry hatchways: 4 feet (1.21 meters).

5. The chamber should have a minimum of 4 feet (1.21 meters) of clearance all the way around the chamber, except as specified with regard to entry areas.

6. If the chamber control console is immediately adjacent to the chamber, a minimum passageway of 4 feet (1.21 meters) shall be provided between the control console and any obstruction.

Monoplace (Class B) Facilities

1. In the case of multiple Class B chambers installed in a single setting, the rapid or emergency removal of a patient from one chamber shall not restrict in any way the rapid and simultaneous removal of patients from all other chambers.

2. A minimum of two exits should be provided for the chamber room unless a single exit opens directly to a primary evacuation hallway.

3. Exit doorways shall have a minimum opening of 46 inches. (1.16 meters)

4. The space required to house Class B chambers and supporting equipment should be defined by the equipment manufacturer, but in any case shall not be less than the following:

5. The space housing Class B chambers shall conform to NFPA 99, Chapter 20 requirements.

Class B Hyperbaric Chamber Clearances
Minimum clearances between individual (Class B) hyperbaric chambers shall be as follows:

1. Chamber and side wall, 18 inches (45.72 centimeters). **Exception:** If any chamber controls, ventilation valves, or other operator-adjustable devices are located on or under the chamber adjacent to the side wall, minimum clearance shall be 36 inches (91.44 centimeters).

2. Between control side of two chambers, 48 inches (1.21 meters).

3. Between back side of two chambers, 24 inches (60.96 centimeters)

4. A minimum passage of 14 inches (35.56 centimeters) shall be provided at the foot end of each chamber. An oxygen shut-off valve shall be provided for each chamber and shall be unobstructed by the chamber and located as to be immediately accessible to the chamber operator.

5. A minimum space of 102 inches (2.59 meters) shall be available at the head end of the chamber to allow for the safe insertion and removal of the patient from the chamber.

6. Any electrical service outlets located within 10 feet of the Class B chamber entrance shall be sited no less than 3 feet (0.91 meter) above floor level.