

**Guidelines for
Construction
and
Equipment of
Hospital and
Medical
Facilities**

1987 Edition

GUIDELINES

The American Institute of Architects
Committee on
Architecture for Health
with assistance from
U.S. Department of Health and
Human Services
Public Health Service
Health Resources and
Services Administration
Bureau of Maternal and
Child Health and
Resources Development
Office of Health Facilities

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Preface to the 1987 Edition

This is the latest in a 40-year series of guidelines to aid in the design and construction of hospital and medical facilities.

The original *General Standards* appeared in the *Federal Register* on February 14, 1947, as part of the implementing regulations for the Hill-Burton program. The standards were revised from time to time as needed. In 1973, the document was retitled *Minimum Requirements of Construction and Equipment for Hospital and Medical Facilities* to emphasize that the requirements were generally minimum, rather than recommendations of ideal, standards.

Sections 603(b) and 1620(2) of the Public Health Service Act require the secretary of the Department of Health and Human Services (HHS) to prescribe by regulation general standards of construction, modernization, and equipment for projects assisted under Title VI and Title XVI, respectively, of the act. Since Title VI and Title XVI grant and loan authorities have expired, there is no need to retain the standards in regulation.

In 1984, HHS removed from regulation the requirements relating to minimum standards of construction, modernization, and equipment of hospitals and other medical facilities, as cited in the *Minimum Requirements*, DHEW Publication No. (HRA) 81-14500. To reflect the nonregulatory status, the title was changed to *Guidelines for Construction and Equipment of Hospital and Medical Facilities*.

It is emphasized that projects with respect to which applications were approved or grants awarded under Titles VI and XVI, but for which full project reimbursement has not yet been made, may be subject to continuing compliance with the *Guidelines* as incorporated by reference in the Code of Federal Regulations, Title 42, Parts 53 and 124, at the time of the initial approval.

The *Guidelines* will be used by HHS to assess Department of Housing and Urban Development Section 242 applications for hospital mortgage insurance and the Indian Health Service construction projects. The *Guidelines* may also be used by other entities, such as state licensure agencies. For this reason, regulatory language was retained. The 1987 edition of the *Guidelines* follows these principles.

This edition of the *Guidelines* reflects the work of advisory groups from private, state, and federal sectors, representing expertise in design, operation, and construction of health facilities. Advisory group members reviewed the 1983-84 edition of the *Guidelines* line by line, revising details as necessary to accommodate current health care procedures and to provide a desirable environment for patient care at a reasonable facility cost.

As in the past, these *Guidelines* standards are performance oriented for desired results. Prescriptive measurements, where given, have been carefully considered relative to generally recognized standards and do not require detail specification. For example, experience has shown that it would be extremely difficult to design a patient bedroom smaller than the size suggested and have space for functions and procedures that are normally expected.

Authorities adopting these *Guidelines* standards should encourage design innovations and grant exceptions where the intent of the standards is met. These standards assume that appropriate architectural and engineering practice and compliance with applicable codes will be observed as part of normal professional service and require no separate detailed instructions.

In some facility areas or sections, it may be desirable to exceed the *Guidelines* standards for optimum function. For example, door widths for inpatient hospital rooms are noted as 3 feet 8 inches, which satisfies most applicable codes, to permit passage of patient beds. However, wider widths of 3 feet 10 inches or even 4 feet may be desirable to reduce damage to doors and frames where frequent movement of beds and large equipment may occur. The decision to exceed the standards should be made by the individuals involved.

This edition provides added emphasis on energy conservation measures to the extent that the quality of patient care is not reduced. Portions of the document *Energy Considerations for Hospital Construction and Equipment*, DHHS Publication No. (HRS-M-HF) 84-1A, have been incorporated into this edition as an appendix. Summaries of these and other major changes are outlined on the following pages.

As in previous editions, details of plan preparation, specifications, engineering procedures, etc., are omitted. These may appear in other technical manuals. Instances where details are mentioned are for emphasis only.

This publication supersedes DHHS Publication No. (HRS-M-HF) 84-1, DHEW Publication No. (HRA) 81-14500, DHEW Publication No. (HRA) 79-14500, and DHEW Publication No. (HRA) 76-4000.

Inquiries or questions on the *Guidelines* may be addressed to the following groups:

American Institute of Architects
Committee on Architecture for Health
1735 New York Avenue, N.W.
Washington, D.C. 20006

Health Resources and Services Administration
Bureau of Maternal and Child Health and Resources Development
Division of Assistance and Recovery
5600 Fishers Lane, Room 11A-19
Rockville, Maryland 20857

Office of Engineering Services
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26 Federal Plaza
New York, New York 10267.

Major Additions and Revisions

The general format and technical content follow the previous document, *Guidelines for Construction and Equipment of Hospital and Medical Facilities*. When necessary, changes were made to clarify that these are model standards that may be adopted as requirements by authorities having jurisdiction or used as a basic guide for other standards.

Listed below are major document additions and revisions made in conformance with current needs and state-of-the-art medical and design procedures:

1. Portions of the document, "Energy Considerations for Hospital Construction and Equipment" have been incorporated as an appendix to emphasize the potential for energy conservation without adverse effect on patient care. While problems of providing capital for specific energy conservation projects relative to reimbursement procedures are recognized, projects should demonstrate cost-effectiveness beyond first cost considerations. It is hoped that the long-range economic benefits of life cycle analyses, including energy conservation measures, will be self-evident to those responsible for financial decisions even when no regulatory authority is involved. Fortunately in new work, the majority of energy conservation measures can be accomplished for continuing savings with very small or no additional capital expenditures.
2. Modernization guidelines now state that when 50 percent or more of the total area of a wing or building is changed due to construction, the entire wing or building should be changed to comply with applicable sections of the *Guidelines* and with appropriate parts of the National Fire Protection Association 101 Life Safety Code (NFPA 101) covering New Health Care Occupancies.
3. Design standards for insuring handicapped access are now based upon either the Uniformed Federal Accessibility Standards (UFAS) or the American National Standards Institute standard A117.1 (ANSI A117.1) in accordance with the local authority having jurisdiction. The exception is federally assisted construction, which must be based upon UFAS. Since design standards for the handicapped are based upon UFAS or ANSI A117.1, subsections A-P of section 1.3 have been deleted and referenced to these national standards.
4. For clarification, equipment has been classified as fixed, movable, and major technical.
5. The psychiatric nursing unit addresses the treatment of nonambulatory medical unit inpatients until the medical condition of such patients allows for transfer to the psychiatric nursing unit. Finishes, furnishings, and lighting that promote a residential rather than an institutional atmosphere are addressed, as well as appropriate fire safety considerations.
6. The minimum finish ceiling height has been revised from 8 feet (2.44 meters) to 7 feet 10 inches (2.38 meters). This permits the installation of a typical metal grid system to support a suspended ceiling on standard 8-foot (2.44-meter) gypsum dry wall panels. This avoids the need to cut 10-foot (3.04-meter) dry wall panels to obtain an 8-foot (2.44-meter) clear ceiling height, and thus eliminates considerable waste of dry wall.
7. Sections 7.27(A)(B) design foundations have been deleted; these items will be appropriately addressed by applicable federal, state, and local codes and standards.
8. To reflect current technology, a new section on nuclear medicine services has been added. The radiology section has also been updated to the state-of-the-art.
9. To reflect current trends in labor and delivery services, obstetrical facility areas have been reclassified. A new area is described for combination labor/delivery/recovery (LDR) rooms and labor/delivery/recovery/postpartum (LDRP) rooms as birthing facilities.
10. Ventilation standards (Table 3) have been clarified and revised to allow for design freedom. The relative humidity range in the operating room has been changed from 45 through 60 to 50 through 60 percent. To reflect the state-of-the-art, the following hospital areas have been added: LDR; soiled utility; clean utility; ethylene trioxide sterilizer room; general, nuclear medicine, pathology, and cytology laboratories. Table 3 is now used as the sole reference for ventilation standards of all occupancies covered in the document.
11. Accepted national codes are referred to as model codes and are not referenced with a date. In general, the latest issue may be considered as an interpretation or clarification of previous code requirements.
12. Section 10, Rehabilitation Facilities, is an addition to the document. It covers various configurations of rehabilitation facilities, such as organized departments within hospitals, outpatient clinics, and free-standing rehabilitation centers.

Acknowledgments

The Committee on Architecture for Health of the American Institute of Architects (AIA) was privileged to convene and work with an interdisciplinary task force to revise the *Guidelines for Construction and Equipment of Hospital and Medical Facilities*.

This revised document is the result of many hours of concentrated work by dedicated professionals from private practice, professional organizations, and state and federal agencies. The AIA wishes to express its sincere gratitude to the following persons and organizations represented on the task force:

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1. INTRODUCTION

1.1 General

- A. This document contains information intended as model standards for constructing and equipping new medical facility projects. For brevity and convenience these standards are presented in "code language." Use of words such as *shall* is mandatory only where applied by an adopting authority having jurisdiction. Insofar as practical, these standards relate to desired performance or results or both. Details of construction and engineering are assumed to be part of good design practice and local building regulations.
- B. This document covers health facilities common to communities in this country. Facilities with unique services will require special consideration. However, sections herein may be applicable for parts of any facility and may be used where appropriate.
- C. The model standards are not intended to restrict innovations and improvements in design or construction techniques. Accordingly, authorities adopting these standards as codes may approve plans and specifications which contain deviations if it is determined that the respective intent or objective has been met. Requests for interpretations may be submitted to HHS's Division of Assistance and Recovery, Bureau of Maternal and Child Health and Resources Development, Health Resources and Services Administration (HRSA), Parklawn Building, 5600 Fishers Lane, Rockville, Maryland 20857. However, the HRSA emphasizes that these standards are not federal regulations except when specifically adopted by authorities having jurisdiction. Where this document is used by other programs or agencies without the HRSA involvement, interpretations will be for intent only. Final implementation may be subject to requirements of the authority having jurisdiction.
- D. Some projects may be subject to the regulations of several different programs, including those of state, local, and federal authorities. While every effort has been made for coordination, individual project requirements should be verified, as appropriate. Some State authorities may require sprinklers throughout the facility regardless of the type of construction, while others will require unique seismic design considerations. Mental health projects may also be subject to standards such as those set forth in *Principles for Accreditation of Community Mental Health Service Programs*, prepared by the Joint Commission on Accreditation of Hospitals, 875 North Michigan Avenue, Chicago, Illinois 60611.
- Should requirements be conflicting or contradictory, the authority having primary responsibility for resolution should be consulted.
- E. The Health Care Financing Administration, which is responsible for Medicare and Medicaid reimbursement, has adopted the National Fire Protection Association 101 Life Safety Code (NFPA 101). Facilities participating in Medicare and Medicaid programs shall comply with that code.
- F. The sponsor shall provide for each project a functional program for the facility that describes the purpose of the project, the projected demand or utilization, staffing patterns, departmental relationships, space requirements, and other basic information relating to fulfillment of the institution's objectives. This program may include a description of each function or service; the operational space required for each function; the number of staff or other occupants of the various spaces; the numbers, types, and sizes (in net square feet) of all spaces; the major design features; the systems of operation; and the interrelationships of various functions and spaces. The functional program should include a description of those services necessary for the complete operation of the facility. Those services available elsewhere in the institution or community need not be duplicated in the facility. The functional program should also address the potential future expansion of essential services which may be needed to accommodate increased demand. The approved functional program shall be made available for use in the technical review of project drawings and specifications.

1.2 Modernization

- A. Where modernization or replacement work is done within an existing facility, all new work or additions, or both, shall comply, insofar as practical, with applicable sections of the *Guidelines* and with appropriate parts of NFPA 101, covering New Health Care Occupancies. Where major structural elements make total compliance impractical or impossible, exceptions should be considered. This does not guarantee that an exception will be granted, but does attempt to minimize restrictions on those improve-

ments where total compliance would not substantially improve safety, but would create an unreasonable hardship. (For example, a facility may plan to replace a flammable ceiling with noncombustible material but lacks funds to do other corrective work.) These standards should not be construed as prohibiting a single phase of improvement. However, they are not intended as an encouragement to ignore deficiencies when resources are available to correct life-threatening problems.

- B. When construction is complete, the facility shall satisfy functional requirements for the appropriate classification (general hospital, skilled nursing facility, etc.) in an environment that will provide acceptable care and safety to all occupants.
- C. In modernization projects and those making additions to existing facilities, only that portion of the total facility affected by the project shall comply with applicable sections of the *Guidelines* and with appropriate parts of NFPA 101 covering New Health Care Occupancies.
- D. Those existing portions of the facility which are not included in the modernization or renovation but which are essential to the functioning of the complete facility, as well as existing building areas that receive less than substantial amounts of new work shall, at a minimum, comply with that section of NFPA 101 for Existing Health Care Occupancies.
- E. Conversion to other appropriate use or replacement should be considered when cost prohibits compliance with acceptable standards.
- F. When a building is converted from one occupancy to another, it shall comply with the new occupancy requirements. For purpose of life safety, a conversion from a hospital to a nursing home or vice versa is not considered a change in occupancy.
- G. When parts of an existing facility essential to continued overall facility operation cannot comply with particular standards, those standards may be temporarily or permanently waived if patient care and safety are not jeopardized.
- H. Modernization or alterations or both, including new additions, shall not diminish the safety level that existed prior to the start of the work; however, safety in excess of that required for new facilities is not required to be retained.
- I. Nothing in these standards shall be construed as restrictive to a facility that chooses to do work or alterations as part of a phased long-range safety improvement plan. It is emphasized that all hazards to

life and safety and all areas of noncompliance with applicable codes and regulations, should be corrected as soon as possible in accordance with a plan of correction.

1.3 Special Design Standards for the Handicapped

The public is increasingly aware of barriers that make reasonable use of facilities difficult or impossible for the handicapped. This has resulted in a number of national and local accessibility requirements intended to help insure the rights of all individuals to be self-sufficient. The best known and often used requirements are those based upon American National Standards Institute (ANSI) A117.1. The federal government has also issued accessibility standards for the handicapped titled *Uniform Federal Accessibility Standards* (UFAS) effective 7 August 1984. The UFAS apply only to federally assisted construction, but may provide useful guidance for projects which are not federally assisted. The regional HHS staff may be contacted for current recommendations and requirements applicable to federally assisted projects, including information about the UFAS.

State and local standards for accessibility may be more stringent than UFAS or ANSI A117.1. Designers, therefore, must assume responsibility for verification of all applicable requirements.

1.4 Provisions for Disasters

- A. Facilities shall be designed and constructed to withstand the force assumptions of the local code, or *Draft Seismic Standards for Federal Buildings*, NBSIR-81-2195, or later revisions, as prepared by the Interagency Committee on Seismic Safety in Construction. **Note:** This standard is based closely on the seismic requirements of the Uniform Building Code but includes clarifications and modifications such as seismic zone delineation. For those facilities that must remain operational during a disaster, special design consideration is needed for protecting essential services such as emergency generators, heating systems, water, etc.

Construction requirements of NSBIR-81-2195 may be approved for a reduced occupancy importance

factor of one for ambulatory patient facilities. Studies indicate patients may be transferred to other nearby facilities during time of disaster (see section 7.29F).

In multi-story buildings which are subdivided into separate units by seismic joints, each unit shall be provided with an exit stairway to permit evacuation without crossing the seismic joints. Construction and coverage of all seismic joints shall be designed to minimize passage of fire and/or smoke horizontally or vertically.

- B.** As appropriate, design and structural provisions shall be made for protecting occupants and for continuing essential services where there is a history of hurricanes, tornadoes, flooding, earthquakes or other natural disasters.

Note: Provisions taken against damage from seismic tremors do not automatically insure that adequate protection from wind damage exists.

- C.** Flood Protection, Executive Order No. 11296, was issued to minimize financial loss from flood damage to facilities constructed with federal assistance. In accordance with that order, possible flood effects shall be considered when selecting and developing the site. Insofar as possible, new facilities shall *not* be located on designated flood plains. Where this is unavoidable, consult the HHS regional office for the latest applicable regulations pertaining to flood insurance and protection measures that may be required.
- D.** Should normal operations be disrupted, the facility shall provide adequate storage capacity for, or a functional program contingency plan to obtain, the following supplies: food, sterile supplies, pharmacy supplies, linen, and water for sanitation. Such storage capacity or plans shall be sufficient for at least four continuous days of operation.

1.5 Codes and Standards

- A.** Every health facility shall provide and maintain a safe environment for patients, personnel, and visitors.
- B.** References made in this document to appropriate model codes and standards do not, generally, duplicate wording of the referenced codes.

NFPA's standards, especially the NFPA 101, are the basic codes of reference; but other codes and/or standards may be included as part of these standards. In the absence of state or local requirements, the project shall also comply with approved nationally recognized building codes except as modified in the latest edition of the NFPA 101, and/or herein.

Design standards for insuring accessibility for the handicapped may be based upon either UFAS or ANSI A117.1, in accordance with the local authority having jurisdiction. Federally assisted construction shall comply with UFAS.

Referenced code material is contained in the issue current at the time of this publication. The latest revision of code material is usually a clarification of intent and/or general improvement in safety concepts and may be used as an explanatory document for earlier code editions. Questions of applicability should be addressed as the need occurs.

C. Equivalency

Insofar as practical, these model standards have been established to obtain a desired performance result. Prescriptive limitations, when given, such as exact minimum dimensions or quantities, describe a condition that is commonly recognized as a practical standard for normal operation. For example, reference to a room area is for patient, equipment, and staff activities; this avoids the need for complex descriptions of procedures for appropriate functional planning.

In all cases where specific limits are described, equivalent solutions will be acceptable if the authority having jurisdiction approves them as meeting the intent of these standards. *Nothing in this document shall be construed as restricting innovations that provide an equivalent level of performance with these standards in a manner other than that which is prescribed by this document, provided that no other safety element or system is compromised in order to establish equivalency.*

The National Bureau of Standards (NBS) has developed a procedure for HHS that determines equivalency to certain NFPA 101 requirements. The Fire Safety Evaluation System (FSES), as developed by the NBS and included in NFPA 101, appendix C, may be useful for evaluating existing facilities which may be affected by modernization. However, for purposes of these standards, the FSES shall not be used as a substitute for the basic NFPA 101 nor shall it be used as a design code for new construction or major renovation in existing facilities.

Where existing structural conditions make strict compliance with NFPA 101 impractical, results of the FSES evaluation shall be considered to allow for possible equivalencies, so long as the entire building passes the FSES evaluation.

D. English/Metric Measurements

Metric standards of measurement are the norm for most international commerce and are being used increasingly in health facilities in the United States. Where measurements are a part of this document, English units are given as the basic standards with metric units in parenthesis.

E. List of Referenced Codes and Standards

Codes and standards which have been referenced in whole or in part in the various sections of this document are listed below. Names and addresses of originators are also included for information. The issues available at the time of publication are used. Later issues will normally be acceptable where requirements for function and safety are not reduced; however, editions of different dates may have portions renumbered or retitled. Care must be taken to insure that appropriate sections are used.

American National Standards Institute. Standard A17.1 (ANSI A17.1), *American National Standard Safety Code for Elevators, Dumbwaiters, Escalators, and Moving Stairs*.

American National Standards Institute. Standard A117.1 (ANSI A117.1), *American Standard Specification for Making Buildings and Facilities Accessible to and Usable by the Physically Handicapped*.

American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE). *Handbook of Fundamentals*.

American Society of Heating Refrigerating and Air Conditioning Engineers. Standard 52-76, (ASHRAE 52-76), *Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter*.

Building Officials and Codes Administrators International, Inc. *The BOCA Basic Building Code*.

Building Officials and Codes Administrators International, Inc. *The BOCA Basic Plumbing Code*.

Code of Federal Regulations. Title 10, parts 20 and 35, *Handling of Nuclear Materials*.

Code of Federal Regulations. Title 29, part 1910, *Employee Safety and Health*.

Compressed Gas Association (CGA). *Standards for Medical-Surgical Vacuum Systems in Hospitals*.

DOP Penetration Test Method. MIL, STD no. 282, *Filter Units, Protective Clothing, Gas-Masking Components and Related Products: Performance Test Methods*.

General Services Administration, Department of Defense, Department of Housing and Urban Development, U.S. Postal Service. *Uniform Federal Accessibility Standard (UFAS)*.

Health Education and Welfare. HEW publication no. (FDA)78-2081, (available through GPO), *Food Service Sanitation Manual*.

Hydronics Institute. *Boiler Ratings: I-B-R, Cast Iron, and SBI Steel Boilers*.

Illuminating Engineering Society of North America. IESNA publication CP29, *Lighting for Health Facilities*.

International Conference of Building Officials (ICBO). *Uniform Building Code*.

National Association of Plumbing-Heating-Cooling Contractors (PHCC). *National Standard Plumbing Code*.

National Council on Radiation Protection (NCRP). *Medical X-ray and Gamma Ray Protection for Energies Up to 10 MeV Equipment Design and Use*.

National Council on Radiation Protection (NCRP). *Radiation Protection Design Guidelines for 0.1-100, MeV Particle Accelerator Facilities*.

National Council on Radiation Protection (NCRP). *Medical X-ray and Gamma Ray Protection for Energies up to 10 MeV Structural Shielding Design and Evaluation*.

National Bureau of Standards Interagency Report. NBSIR 81-2195, *Draft Seismic Standards for Federal Buildings Prepared by Interagency Committee on Seismic Safety in Construction* (available from NTIS as no. PB81-163842).

National Fire Protection Association. Standard 20 (NFPA 20), *Centrifugal Fire Pumps*.

NFPA 70. *National Electrical Code*.

NFPA 72A. *Standard for the Installation, Maintenance, and Use of Local Protectives Signaling Systems.*

NFPA 72E. *Standard for Automatic Fire Detectors.*

NFPA 80. *Standard for Fire Doors and Windows.*

NFPA 82. *Standard on Incinerators, Waste and Linen Handling Systems and Equipment.*

NFPA 90A. *Standard for the Installation of Air Conditioning and Ventilation Systems.*

NFPA 96. *Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.*

NFPA 99. "Use of Inhalation Anesthetics (Flammable and Nonflammable)," *Standard for Health Care Facilities*, chap. 3, formerly NFPA 56A.

NFPA 99. "Laboratories in Health Related Institutions," *Standard for Health Care Facilities*, chap. 7, formerly NFPA 56C.

NFPA 99. "Standard for Nonflammable Medical Gas Systems," *Standard for Health Care Facilities*, formerly NFPA 56E.

NFPA 99. "Essential Electrical Systems for Health Care Facilities," *Standard for Health Care Facilities*, chap. 8, formerly NFPA 76A.

NFPA 99. "Safe Use of Electricity in Patient Care Areas of Hospitals," *Standard for Health Care Facilities*, chap. 9, formerly NFPA 76B.

NFPA 101. *Life Safety Code.*

NFPA 110. *Emergency and Standby Power Systems.*

NFPA 253. *Standard Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.*

NFPA 255. *Method of Test Surface Burning Characteristics of Building Materials.*

NFPA 258. *Standard Research Test Method for Determining the Smoke Generation of Solid Materials.*

NFPA 701. *Standard Method of Fire Tests for Flame Resistant Textiles and Films.*

NFPA 801. *Recommended Fire Protection Practice for Facilities Handling Radioactive Materials.*

Southern Building Code Congress International, Inc. *Standard Building Code.*

Underwriter's Laboratories, Inc. Publication no. 181.

F. Availability of Codes and Standards

The codes and standards referenced in various sections throughout this document can be ordered, if they are government publications, from the Superintendent of Documents, U.S. Government Printing Office (GPO), Washington, D.C. 20402. Copies of nongovernment publications can be obtained at the addresses listed below.

Air Conditioning and Refrigeration Institute
1501 Wilson Blvd.
Arlington, Va. 22209

American National Standards Institute
1430 Broadway
New York, N.Y. 10018

American Society for Testing and Materials
1916 Race Street
Philadelphia, Pa. 19103

American Society of Heating, Refrigerating, and Air-Conditioning Engineers
1741 Tullie Circle, NE
Atlanta, Ga. 30329

Architectural and Transportation Barriers Compliance Board (ATBCB)
Office of Technical Services
330 C Street, SW
Washington, D.C. 20202

Building Officials and Code Administrators
4051 West Flossmoor Road
Country Club Hills, Ill. 60477

Compressed Gas Association
1235 Jefferson-Davis Highway
Arlington, Va. 22202

Hydronics Institute
35 Russo Place
Berkeley Heights, N.J. 07922

2. ENERGY CONSERVATION

Illuminating Engineering Society of North America
(IESNA)
IES Publication Sales
345 East 47th Street
New York, N.Y. 10017

International Conference of Building Officials
5360 South Workman Mill Road
Whittier, Calif. 90601

National Association of Plumbing-Heating-Cooling
Contractors
Box 6808
180 S. Washington Street
Falls Church, Va. 22046

National Council on Radiation Protection and
Measurement
7910 Woodmont Avenue, Suite 1016
Bethesda, Md. 20814

National Fire Protection Association
Batterymarch Park
Quincy, Mass. 02264

National Technical Information System (NTIS)
5285 Port Royal Road
Springfield, Va. 22161

Naval Publications and Form Center
5801 Tabor Avenue
Philadelphia, Pa. 19120
(for DOP Penetration Test Method)

Southern Building Code Congress International, Inc.
900 Montclair Road
Birmingham, Ala. 35213

Underwriter's Laboratories, Inc.
333 Pfingsten Road
Northbrook, Il. 60062

2.1 General

The importance of energy conservation shall be considered in all phases of facility development or renovation. Proper planning and selection of mechanical and electrical systems, as well as efficient utilization of space and climatic characteristics, can significantly reduce overall energy consumption. The quality of the health facility environment must, however, be supportive of the occupants and functions served. Design for energy conservation shall not adversely affect patient health, safety, or accepted personal comfort levels. New and innovative systems which accommodate these considerations while preserving cost effectiveness are encouraged. A discussion of energy conservation considerations is included as an appendix.

3. SITE

3.1 Location

A. Accessibility

The site of any medical facility shall be conveniently accessible both to the community and to service vehicles, including fire protection apparatus, etc.

B. Availability of Transportation

Facilities shall be located so that they are accessible to public transportation where available.

C. Security

Health facilities shall have security measures for patients, personnel, and the public consistent with the conditions and risks inherent in the location of the facility. These measures shall include a program designed to protect human and capital resources.

D. Availability of Utilities

Facilities shall be located to insure that reliable utilities (water, gas, sewer, electricity) are available. The water supply shall have the capacity to provide normal usage plus fire-fighting requirements. The electricity shall be of stable voltage and frequency.

3.2 Facility Site Design

A. Roads

Paved roads shall be provided within the property for access to all entrances; to loading and unloading docks (for delivery trucks); and to all exterior walls (for fire equipment). Hospitals with an organized emergency service shall have the emergency access well marked to facilitate entry from the public roads or streets serving the site. Other vehicular or pedestrian traffic should not conflict with access to the emergency station. In addition, access to emergency services shall be located to incur minimal damage from floods and other natural disasters. Paved walkways shall be provided for pedestrian traffic.

B. Parking

Parking shall be made available for patients, staff, and visitors, as described in the individual sections for specific facility types. (See UFAS or ANSI A117.1 for parking requirements for the handicapped.)

3.3 Environmental Pollution Control

Public Law 91-190, National Environmental Policy Act, requires that the site and project be developed to minimize any adverse environmental effects on the neighborhood and community. (Consult the HHS regional office and authorities having jurisdiction for the latest applicable regulations pertaining to environmental pollution, such as noise, air, and traffic, including air traffic, that may be applicable.)

4. EQUIPMENT

4.1 General

All equipment necessary for the operation of the facility shall be shown and identified on the drawing or equipment list as necessary to insure overall coordination. The design shall indicate provisions for the installation of large and special items of equipment and for service accessibility.

4.2 Classification

Equipment requirements will vary to suit individual construction projects, therefore careful planning should be done. When construction, modernization, and alteration programs are planned, classification of equipment is as follows:

A. Fixed Equipment

Fixed equipment is permanently affixed to the building or permanently connected to a service distribution system designed and installed during construction for the specific use of the equipment. It includes items such as fume hoods, sterilizers, communication systems, walk-in refrigerators, and built-in casework (cabinets). Equipment with quick-disconnect connections to utilities are not necessarily considered as fixed. Such fixed equipment is usually included as part of the construction contract.

B. Movable Equipment

Movable equipment includes general and office-type furnishings, wheeled equipment, plug-in-type monitoring equipment, and other portable items such as operating tables, laboratory centrifuges, food service trucks, treatment and examination tables, patient room furnishings, and audiovisual equipment. Such movable equipment and furnishings are not usually included in construction contracts.

C. Major Technical Equipment

Major technical equipment is specialized equipment (medical or nonmedical), customarily installed by the manufacturer or vendor, which requires close coordination between owner, building designer, installer, construction contractors, and trades. Such major technical equipment is not always included in

construction contracts; when it is not included, it should be shown in construction documents (plans and specifications) as owner-provided or not-in-contract for purposes of identification and coordination. Major technical equipment may require special structural designs, electromechanical requirements, or other considerations. It includes items such as X-ray and other imaging equipment, radiation therapy equipment, lithotripters, hydrotherapy tanks, audiometry testing chambers, laundry equipment, computers, and similar equipment.

4.3 Equipment Shown on Drawings

Equipment which is not included in the construction contract but which requires mechanical or electrical service connections or construction modifications shall, insofar as practical, be identified on the design development drawings to assure its coordination with the architectural, mechanical, and electrical phases of construction.

5. CONSTRUCTION

5.1 Construction Phasing

Projects involving alterations and/or additions to existing buildings should be programmed and phased to minimize disruptions of retained, existing functions. Access, exits, and fire protection shall be so maintained that the occupants' safety will not be jeopardized during construction.

5.2 Nonparticipating Conditions

It is not always financially feasible to modernize the entire existing structure in accordance with these standards. In such cases, authorities having jurisdiction may grant approval to renovate portions of the structure if facility operation, handicapped access, and patient safety in the renovated areas are not jeopardized by the existing features of sections retained without complete corrective measures. In major modernization projects and additions to existing facilities, those unrenovated areas that do not comply with NFPA 101 requirements for existing buildings, shall be separated from sections to be modernized by fire walls or partitions rated not less than two-hour fire resistance, extending through the full height of the building, and by labeled fire doors of class "B" 1½-hour construction.

6. RECORD DRAWINGS AND MANUALS

6.1 Drawings

Upon occupancy of the building or portion thereof, the owner shall be provided with a complete set of legible drawings showing construction, fixed equipment, and mechanical and electrical systems, as installed or built. Drawings shall include a fire protection plan for each floor reflecting NFPA 101 requirements.

6.2 Equipment Manuals

Upon completion of the contract, the owner shall be furnished with a complete set of manufacturers' operating, maintenance, and preventive maintenance instructions; parts lists; and procurement information with numbers and a description for each piece of equipment. Operating staff shall also be provided with instructions on how to properly operate systems and equipment. Required information shall include energy ratings as needed for future conservation calculations.

6.3 Design Data

The owners shall be provided with complete design data for the facility. This shall include structural design loadings; summary of heat loss assumption and calculations; estimated water consumption; and electric power requirements of installed equipment. All such data shall be supplied to facilitate future alterations, additions, and changes, including, but not limited to, energy audits and retrofit for energy conservation (see appendix).

7. GENERAL HOSPITAL

7.1 General Considerations

A. Functions

The sponsor shall provide for each project a program of function for the facility in accordance with section 1.1F of this document.

B. Standards

The general hospital shall meet all the standards described herein. Deviations shall be described and justified in the functional program for specific approval by the authorities having jurisdiction.

C. Sizes

Department size will depend upon program requirements and organization of services within the hospital. Some functions may be combined or shared provided that the layout does not compromise safety standards and medical and nursing practices.

D. Provisions for Handicapped

Facilities shall be accessible to and usable by physically handicapped public, staff, and patients. (See section 1.3. of this document.)

E. Parking

Each facility shall have parking space to satisfy the needs of patients, employees, staff, and visitors. *A formal parking study is desirable.* In the absence of such a study, provide one space for each bed plus one space for each employee normally present on any single weekday shift. This ratio may be reduced in an area convenient to public transportation or public parking facilities, or where carpool or other arrangements to reduce traffic have been developed. Additional parking may be required to accommodate outpatient and other services. Separate and additional space shall be provided for emergency and delivery vehicles.

F. Swing Beds

Swing beds are a group of beds or an entire unit that may be quickly converted from one category of use to another. For maximum flexibility of operations, it may be desirable to include provisions for swing beds. For example, a provision for converting long-term beds to acute-care beds may be made. When this concept is included, care shall be taken to include requirements for all intended categories. Facility design for swing beds often requires additional corridor doors and provisions for switching nurses call operations from one nurses station to another depending on use.

7.2 Nursing Unit (Medical, Surgical, and Postpartum Care)

See other sections of this document for special care areas such as recovery rooms, intensive care units, pediatric units, rehabilitation units, and skilled-nursing units.

Each nursing unit shall include the following (see section 1.2 for waiver of standards where existing conditions make absolute compliance impractical):

A. Patient Rooms

Each patient room shall meet the following standards:

1. Maximum room capacity shall be four patients.

Note: When more than four beds are set up in one room, patient satisfaction, as well as ability to provide effective care, is often reduced. In addition, increased operating costs may quickly offset any initial construction savings realized from reduced floor area.

2. Patient room areas, exclusive of toilet rooms, closets, lockers, wardrobes, alcoves, or vestibules, shall be at least 100 square feet (9.29 square meters) for single-bed rooms, and 80 square feet (7.43 square meters) per bed for multiple-bed rooms. Minor encroachments, including columns and lavatories, *that do not interfere with functions* may be ignored when determining space requirements for patient rooms. In multiple-bed rooms, a clearance of 3 feet 8 inches (1.12 meters) shall be available at the foot of each bed to permit the passage of equipment and beds. The areas noted herein are intended as recognized minimums and do not prohibit use of larger rooms where required for needs and functions.

3. Each room shall have a window in accordance with section 7.28A(11) of this document.

Note: Windows are important for the psychological well-being of many patients, as well as for meeting fire safety code requirements. They are also essential for continued use of the area in the event of mechanical ventilation system failure.

4. Nurses calling systems shall be provided in accordance with section 7.30G of this document.
5. In new construction, handwashing facilities shall be provided in each patient room. In renovation and modernization projects, the lavatory may be omitted from the bedroom where a water closet and lavatory are provided in a toilet room designed to serve one single-bed room, or one two-bed room. This exception does not apply to postpartum rooms which must have a lavatory within each bedroom.

whether or not a lavatory is also included in the toilet room.

6. Each patient shall have access to a toilet room without having to enter the general corridor area. One toilet room shall serve no more than four beds and no more than two patient rooms. The toilet room shall contain a water closet and a lavatory and the door should swing outward or be double acting. The lavatory may be omitted from a toilet room if each patient room served by that toilet contains a lavatory for handwashing.

Note: In most acute care hospitals, type of patient care and availability of staff assistance will make strict compliance with handicapped accessibility requirements unnecessary.

7. Each patient shall have within his/her room a separate wardrobe, locker, or closet suitable for hanging full-length garments and for storing personal effects.

8. In multiple-bed rooms, visual privacy shall be provided for each patient. The design for privacy shall not restrict patient access to the entrance, lavatory, or toilet.

B. Service Areas

Provisions for the services noted below shall be located in or be readily available to each nursing unit. The size and location of each service area will depend upon the numbers and types of beds served. Identifiable spaces are required for each of the indicated functions. Each service area may be arranged and located to serve more than one nursing unit but, unless noted otherwise, at least one such service area shall be provided on each nursing floor. Where the words *room* or *office* are used, a separate, enclosed space for the one named function is intended; otherwise, the described area may be a specific space in another room or common area.

1. Administrative center or nurses station.
2. Nurses office for floor staff.
3. Administrative supplies storage.
4. Lavatories for handwashing, conveniently accessible to the nurses station, drug distribution station, and nourishment center. One lavatory may serve several areas if convenient to each.
5. Charting facilities.
6. Toilet room(s) for staff.
7. Staff lounge facilities. These facilities may be centrally located on another floor.
8. Securable closets or cabinet compartments for the personal effects of nursing personnel, conveniently located to the duty station. At a minimum, these shall be large enough for purses and billfolds. Coats may be stored in closets or cabinets on each floor or in a central staff locker area.

9. Multipurpose room(s) for staff and patient conferences, education, demonstrations, and consultation. These rooms must be accessible to each nursing unit. They may be on other floors if convenient for regular use. One such room may serve several nursing units and/or departments.

10. Examination and treatment room(s). This room may be omitted if all rooms in the facility are single-bed patient rooms. The examination and treatment room(s) may serve several nursing units and may be on a different floor if conveniently located for routine use. Examination rooms shall have a minimum floor area of 120 square feet (11.2 square meters) excluding space for vestibule, toilets, and closets. The room shall contain a lavatory or sink equipped for handwashing; storage facilities; and a desk, counter, or shelf space for writing.

11. Clean workroom or clean holding room. If the room is used for preparing patient care items, it shall contain a counter, handwashing, and storage facilities. If the room is used only for storage and holding as part of a system for distribution of clean and sterile supply materials, the work counter and handwashing facilities may be omitted.

12. Soiled workroom. This room shall contain a clinical sink or equivalent flushing-rim fixture; a sink equipped for handwashing; a work counter; waste receptacles; and a linen receptacle. Rooms used only for temporary holding of soiled material need not contain handwashing sinks or work counters. However, if the flushing-rim sink is omitted, other provisions for disposal of liquid waste at each unit may be added.

13. Drug distribution station. Provision shall be made for 24-hour distribution of medications. This may be done from a medicine preparation room or unit, from a self-contained medicine dispensing unit, or by another system. If used, a medicine preparation room or unit shall be under visual control of nursing staff. It shall contain a work counter, sink, refrigerator, and locked storage for controlled drugs, and shall have a minimum area of 50 square feet (4.65 square meters). A self-contained medicine dispensing unit may be located at the nurses station, in the clean workroom, or in an alcove. Provide for convenient access to handwashing facilities. (Standard cup-sinks provided in many self-contained units are not adequate for handwashing.)

14. Clean linen storage. Each nursing unit shall contain a designated area for clean linen storage. This may be within the clean workroom, a separate

closet, or an approved distribution system on each floor. If a closed cart system is used, storage may be in an alcove. It must be out of the path of normal traffic.

15. Nourishment station. This shall contain a sink, work counter, refrigerator, storage cabinets, and equipment for serving nourishment between scheduled meals. Provisions and space shall be included for separate temporary storage of unused and soiled dietary trays not picked up at meal time.

16. Ice machine. Each nursing unit shall have equipment to provide ice for treatments and nourishment. Ice-making equipment may be in the clean work room or at the nourishment station under staff control. Ice intended for human consumption shall be from self-dispensing ice makers.

17. Equipment storage room. Provide appropriate room(s) for equipment such as I.V. stands, inhalators, air mattresses, cots, walkers, etc. This may serve more than one floor when conveniently located for 24-hour access.

18. Storage space for stretchers and wheelchairs located away from normal traffic.

19. Showers, bathtubs, and sitz baths. When individual bathing facilities are not provided in patient rooms, there shall be at least one shower and/or bathtub for each 12 beds, or a fraction thereof.

There shall be at least one shower for each 12 postpartum beds or a fraction thereof. Each bathtub, sitz bath, or shower shall be in an individual room or enclosure that provides privacy for bathing, drying, and dressing. Special bathing facilities, including space for attendant, shall be provided for patients on stretchers, carts, and wheelchairs at the ratio of one per 100 beds or a fraction thereof. This may be on a separate floor if convenient for use.

20. Emergency equipment storage. Space shall be provided for emergency equipment that is under direct control of the nursing staff, such as a cardiopulmonary resuscitation (CPR) cart. This space shall be in close proximity to the nurses station, but out of normal traffic.

21. Janitors closet. One janitors closet shall be provided for each nursing unit or nursing floor. It shall be directly accessible from the unit or floor and may serve more than one nursing unit on a floor. At least one janitors closet per floor shall contain a service sink or receptor and provisions for storage of supplies. **Note:** This is in addition to separate janitors closets that may be required for the exclusive use of specific services.

C. Isolation Room(s)

Note: Details and numerical ratios of this section apply to those areas of the facility covered by new design, including replacement and/or major renovation. Existing nursing units and beds not affected by project work that have approved isolation proce-

dures may be acceptable without changes or additions. Existing beds that are retained without change and psychiatric beds need not be counted in the ratios required below.

At least one isolation room, designed to minimize infection hazards to or from the patient, shall be provided for each 30 acute care beds or a fraction thereof (except as noted above). These may be located within individual nursing units and used for normal acute care when not required for isolation cases, or they may be grouped as a separate isolation unit. Each isolation room shall contain only one bed and shall comply with the acute-care patient room section of this document as well as the following:

1. Room entry shall be through a work area that provides for aseptic control, including facilities that are separate from patient areas for handwashing, gowning, and storage of clean and soiled materials. The work area entry may be a separate enclosed anteroom. The vestibule workspace open to the room may be used for other functions when not needed for isolation. However, where the program function requires strict isolation, at least one isolation room may need to be designed for entry only through an enclosed anteroom.

2. Separate enclosed anteroom(s) for isolation rooms are not required as a minimum but, if used, viewing panel(s) shall be provided for observation of each patient by staff from the anteroom.

3. One separate anteroom may serve several isolation rooms.

4. Toilet, bathtub (or shower), and handwashing facilities are required for each isolation room. These shall be arranged to permit access from the bed area without the need to enter or pass through the work area of the vestibule or anteroom.

5. In facilities where procedures such as those for organ transplants, burn therapy, and immunosuppressive treatments are performed, special design provisions, including special ventilation, will be necessary to meet the needs of the functional program.

D. Seclusion Room(s) for Disturbed Medical Patients

The hospital shall provide one or more single bedrooms for patients needing close supervision for medical and/or psychiatric care. This may be part of the psychiatric unit described in section 7.6 of this document. If the single bedroom(s) is part of the acute-care nursing unit, the provisions of section 7.6A shall apply, with the following exceptions: each

room shall be for single occupancy; each shall be located to permit staff observation of the entrance; and each shall be designed to minimize the potential for escape, hiding, injury, or suicide. If vision panels are used for observation of patients, the arrangement shall insure patient privacy and prevent casual observation by visitors and other patients.

7.3 Intensive Care Unit

The intensive care unit (ICU) requires special space and equipment considerations for effective staff functions. In addition, space arrangement shall include provisions for immediate access of emergency equipment from other departments.

Not every hospital will provide all types of intensive care. Some hospitals may have a small combined unit; others may have separate, sophisticated units for highly specialized treatments. Still other hospitals may not be able to construct or staff even the most basic unit. Intensive care units that serve a community need shall comply in size, number, and type with these standards and with the functional program. The following standards are intended for the more common types of intensive care services and shall be appropriate to needs defined in functional programs. Where specialized services are required, additions and/or modifications shall be made as necessary for efficient, safe, and effective patient care.

A. Intensive Care (General)

The following shall apply to all types of intensive care units unless otherwise noted. (See section 7.28 of this document for detail and finish standards; section 7.31 for mechanical standards; and section 7.32 for electrical standards.) Each unit shall comply with the following provisions:

1. The location shall offer convenient access from the emergency, respiratory therapy, laboratory, radiology, surgery, and other essential departments and services. It shall be located so that the medical emergency resuscitation teams may be able to respond promptly to ICU emergency calls within minimum travel time.
2. The location shall be arranged to eliminate the need for through traffic.
3. There shall be a nursing station.
4. Each unit shall contain equipment for continuous monitoring, with visual displays for each patient. Monitors shall have a high/low alarm and the capability to provide hard copy of wave forms needed for patient care.

5. A nurses call shall be provided at each bed for summoning assistance. The call system for the unit shall include provisions for an emergency code resuscitation alarm to summon assistance from outside the ICU.

6. Each bed shall have visual access, other than skylights, to the outside environment with not less than one outside window in each suite. Distance from the patient bed to the outside window shall not exceed 50 feet (15 meters). When partitioned cubicles are used, patients' view to outside windows may be through no more than two separate vision panels.

7. Each patient bed area should have space at each bedside for visitors, and provisions for visual privacy from casual observation by other patients and visitors.

8. When private rooms or cubicles are provided, view panels shall have drapes or curtains which may be closed. Doors to these spaces shall be at least 3 feet 8 inches (1.1 meters) wide and arranged to minimize interference with movement of beds and large equipment. Sliding doors may be used for access to cubicles within a suite, provided that hardware used minimizes jamming possibilities and that floor tracks do not impede wheeled equipment or present a tripping hazard. Separate rooms or cubicles for single-patient use shall be at least 120 square feet (11.2 square meters). Multiple-bed space shall contain at least 100 square feet (9.3 square meters) per bed. (Note: Programmatic function will usually require more space than this standard.) At least one private room or cubicle shall be provided in each ICU for patients requiring isolation and/or separation. An anteroom is not required for isolation or separation.

9. Each ICU shall have emergency cardiopulmonary resuscitation carts that are located out of traffic but convenient for access.

10. Each ICU shall have a medication dispensing station or unit under staff control with locked storage for controlled drugs. The station or unit shall provide for emergency drugs as well as routine medication.

11. Each ICU shall have staff handwashing facilities convenient to nurses stations and patient bed areas. There shall be at least one lavatory for every three patient beds in open plan areas, and one in each patient room or cubicle.

The following additional service spaces shall be immediately available within each intensive care suite.

These may be shared by more than one intensive care unit provided that direct access is available from each.

12. Bedpan-flushing-and-storage facilities (may be in soiled work room).

13. A soiled-holding-and-work area with clinical sink or equivalent flushing-rim fixture and handwashing facilities.

14. A room or space for storage and distribution of clean medical and surgical supplies.

15. A clean linen closet or cart alcove (see section 7.2B(14) of this document).

16. A nourishment station, including a refrigerator, storage cabinet(s), ice dispenser, and equipment for heating food and drinks.

17. A room or an alcove designated for storing equipment used in patient care. Such storage areas shall not interfere with the flow of traffic.

18. Provisions for the secure storage of staff personal effects (may be locked drawers or cabinets). Coats, etc., may be stored in staff locker rooms.

The following may be provided outside the unit if conveniently accessible.

19. A janitors closet with a floor receptor or service sink and storage space for cleaning equipment and supplies.

20. A visitors waiting room with convenient access to telephones and toilets. One waiting room may serve several ICUs.

21. Staff lounges and toilets located so that staff may be recalled quickly to the patient area in emergencies.

22. Multipurpose room(s). These rooms for conferences, training sessions, and demonstrations may be shared and located in other parts of the facility, but must be accessible for use by staff, patients, and patients' families.

23. Administrative office(s) may be separate from or combined with other such offices in the facility.

24. Provisions for 24-hour equipment repair and/or replacement services, or for standby electronic equipment. Such services may be provided on- or offsite. Work areas should include equipment, utilities, and work benches appropriate for the maintenance, repair, calibration, and routine testing of electronic equipment.

25. Sleeping and personal care accommodations for staff on 24-hour, on-call work schedules.

B. Medical/Surgical Intensive Care

In addition to the standards set forth in section 7.3A, the following standards apply to medical/surgical intensive care units:

1. Units may be set up as open wards, with beds separated by curtains, or as separate enclosed rooms/cubicles.

2. If an open ward plan is used, the total room-to-bed ratio shall be at least one enclosed private patient room or fixed cubicle for every six ward beds, or two enclosed private patient rooms or fixed cubicles for every eight ward beds. This is to provide for medical isolation or psychological needs.

C. Coronary Intensive Care

Coronary patients have special needs. They are often fully aware of their surroundings but still need immediate and critical emergency care. In addition to the standards set forth in section 7.3A, the following standards apply to the coronary intensive care unit:

1. Each coronary patient shall have a separate room or enclosure for acoustical and visual privacy.

2. Each coronary patient shall have access to a toilet directly from his/her room or cubicle. (Portable commodes may be used in lieu of individual toilets, but provisions must be made for their storage, servicing, and odor control.)

3. Provisions shall be made for visual display of cardiac monitoring equipment both at each patient's bed location and at the nurses station.

D. Combined Medical/Surgical and Cardiac Intensive Care

If medical, surgical, and cardiac intensive care services are combined in one intensive care unit, at least 50 percent of the beds must be located in private rooms or cubicles. (Note: Medical/surgical patients may utilize open areas or private ICU rooms as needed and available but, insofar as possible, cardiac patients should not be accommodated in open ward areas.) When 50 percent of the beds are in private enclosed spaces within a combined unit, the standards set forth in section 7.3B(2) for additional separate enclosed rooms *do not* apply.

E. Pediatric and Neonatal Intensive Care

Critically ill pediatric patients, from neonates to adolescents, have unique physical and psychological needs. Not every hospital can or should attempt to have a separate pediatric intensive care unit. Many hospitals will be able to safely transfer their patients to other facilities offering appropriate services. If a facility has a specific pediatric intensive care unit, the functional program must include consideration for staffing, control, and the safe transportation of critically ill pediatric patients, along with life support and environmental systems, from other areas. The pediatric intensive care unit may

be an open-ward plan. The total room-to-bed ratio in open-ward plans shall provide for at least one private room for every six ward beds. If the pediatric intensive care unit has all private or semiprivate rooms, a seclusion and/or isolation room at the rate of not less than one to ten beds shall be provided.

In addition to the standards previously listed for ICU units, each pediatric intensive care unit shall include:

1. Space at each bedside for visiting parents.
2. Sleeping space for parents who may be required to spend long hours with the patient. This space may be within the patient room or separate from the patient area, but must be in communication with the ICU staff.
3. Consultation/demonstration room within, or convenient to, the pediatric ICU suite for private discussions.
4. Provisions for nutritional needs including infant formula preparation and/or storage. These may be outside the pediatric ICU suite but must be available for use at all times.
5. Separate storage cabinets or closets for toys and games for use by the pediatric patients.
6. Additional storage for cots, bed linens, and other items needed to accommodate parents overnight.
7. Provisions for bedside and bed-end clearances for neonatal bassinets, incubators, and warmers equal to those for adult beds. There shall be 6 feet (1.83 meters) between bassinets and/or incubators.
8. Space allowances for pediatric beds and cribs equal to those required for adult beds, because of the variations in sizes and the potential for change.
9. Examination and treatment room(s).

F. Other Specialty Intensive Care Units

Because of the unique requirements of specialty intensive care units, no attempt has been made to suggest guidelines for the various specialty units that may be found in the larger medical center. Insofar as applicable, the preceding guidelines shall be used. Adaptations, adjustments, and additions shall be made as needed for the programmatic functional needs of staff and patients, with special consideration for access and inclusion of necessary auxiliary services.

7.4 Newborn Nurseries

Note: Newborn infants shall be housed in nurseries that comply with the standards below. Location shall be convenient to the postpartum nursing unit and obstetrical facilities. The nurseries shall be located and arranged to preclude the need for

nonrelated pedestrian traffic. No nursery shall open directly into another nursery. See section 7.5 of this document for pediatric nurseries. See section 7.3E for intensive care units for neonatal infants.

A. General

Each nursery shall contain:

1. At least one lavatory, equipped with handwashing controls that can be operated without use of hands, for each eight infant stations.
2. Nurses emergency calling system (see section 7.32 of this document) for summoning assistance without leaving the patient area.
3. Glazed observation windows to permit the viewing of infants from public areas, workrooms, and adjacent nurseries.
4. Convenient, accessible storage for linens and infant supplies at each nursery room.

See mechanical and electrical sections for ventilation, oxygen, suction, air, and electrical standards.

B. Full-Term Nursery

Each full-term nursery room shall contain no more than 16 infant stations. The minimum floor area shall be 24 square feet (2.23 square meters) for each infant station, exclusive of auxiliary work areas. When a rooming-in program is used, the total number of bassinets provided in these units may be appropriately reduced, but the full-term nursery may not be omitted in its entirety from any facility that includes delivery services. (When facilities use a rooming-in program in which all infants are returned to the nursery at night, a reduction in nursery size may not be practical.)

C. Continuing Care Nursery

Hospitals having 25 or more maternity beds shall have a separate nursery that provides continuing care for infants requiring close observation (for example, those with low birth weight). The minimum floor area per infant shall be 50 square feet (4.5 square meters), exclusive of auxiliary work areas, with provisions for at least 4 feet (1.21 meters) between and at all sides of bassinets.

D. Charting Facilities

E. Workroom(s)

Each nursery room shall be served by a connecting workroom. The workroom shall contain scrubbing and gowning facilities at the entrance for staff and housekeeping personnel; work counter, refrigerator;

storage for supplies; and a lavatory or sink equipped for handwashing. One workroom may serve more than one nursery room provided that required services are convenient to each.

The workroom serving the continuing care nursery may be omitted if equivalent work and storage areas and facilities, including those for scrubbing and gowning, are provided within that nursery. Space required for work areas located within the nursery is in addition to the area required for infant care.

Adequate provision shall be made for storage of emergency cart(s) and equipment out of traffic and for the sanitary storage and disposal of soiled waste.

F. Infant Examination and Treatment Areas

Such areas, when required by the functional program, shall contain a work counter, storage facilities, and a lavatory equipped for handwashing.

G. Infant Formula Facilities

1. Where infant formula is prepared onsite, direct access from the formula preparation room to any nursery room is prohibited. The room may be located near the nursery or at other appropriate locations in the hospital, but must include:

a. Cleanup facilities for washing and sterilizing supplies. This area shall include a lavatory or sink equipped for handwashing, facilities for bottle washing, a work counter, and sterilization equipment.

b. Separate room for preparing infant formula. This room shall contain a hot plate, refrigerator, work counter, formula sterilizer, storage facilities, and a lavatory or sink equipped for handwashing.

c. Refrigerated storage and warming facilities for infant formula accessible for use by nursery personnel at all times.

2. If a commercial infant formula is used, the separate clean up and preparation rooms may be omitted. The storage and handling may be done in the nursery workroom or in another appropriate room in the hospital that is conveniently accessible at all hours. The preparation area shall have a work counter, a sink equipped for handwashing, and storage facilities.

H. Janitors Closet

A janitors closet or room for the exclusive use of the nursery unit shall be provided. It shall contain a floor receptor or service sink and storage space for housekeeping equipment and supplies.

7.5 Pediatric and Adolescent Unit

Note: If practical, young children and adolescents shall be housed in a nursing unit separate from adults.

The unit shall meet the following standards:

A. Patient Rooms

The spatial standards noted in section 7.2A of this document shall be applied to pediatric and adolescent nursing units, except that the maximum number of beds permitted in each dedicated pediatric room may be eight instead of four. Because of size variation and the need to change from cribs to beds, and vice-versa, space provided for cribs shall be similar to that for beds. Additional provisions for hygiene, toilets, sleeping, and personal belongings shall be included where the program indicates that parents will be allowed to remain with young children. *Existing* crib areas with at least 60 square feet (6.5 square meters) of clear area for each crib and no more than six cribs or beds in a room may continue to be used if the use complies with the functional program (see section 7.3E for pediatric intensive care units and 7.4 for newborn nurseries).

B. Nursery

To minimize the possibility of cross infection, each nursery room serving pediatric patients shall contain no more than eight bassinets; each bassinet shall have a minimum clear floor area of 40 square feet (3.7 square meters). Each room shall contain a lavatory equipped for handwashing operable without hands, a nurses emergency calling system, and a glazed viewing window for observing infants from public areas and workrooms. (Limitation on number of patients in a nursery room does not apply to the pediatric intensive care unit.)

C. Nursery Workrooms

Each nursery shall be served by a connecting workroom. It shall contain gowning facilities at the entrance for staff and housekeeping personnel; workspace with a work counter; storage facilities; and a lavatory or sink equipped for handwashing. One workroom may serve more than one nursery.

D. Examination and Treatment

Examination and treatment rooms separate from nursing care areas shall be provided for pediatrics and adolescents. Each room shall contain not less than 100 square feet (9.3 square meters) of usable space. It shall contain a work counter, storage facilities, and lavatory equipped for handwashing. A separate area for infant examination and treatment

may be provided within the pediatric nursery workroom.

E. Service Areas

The service areas in the pediatric and adolescent nursing units shall conform to section 7.2B of this document and shall also meet the following standards:

1. Multipurpose or individual room(s) shall be provided for dining, education, and recreation. Insulation, isolation, and structural provisions shall minimize the transmission of impact noise through the floor, walls, or ceiling of these multipurpose room(s).
2. Space for preparation and storage of infant formula shall be provided within the unit or other convenient location with 24-hour access. Provisions shall be made for continuation of special formula that may have been prescribed for the infant prior to admission or readmission.
3. Patient toilet room(s), in addition to those serving bed areas, shall be conveniently located to multipurpose room(s) and to each central bathing facility.
4. Storage closets or cabinets for toys, educational, and recreational equipment shall be provided.
5. Storage space shall be provided to permit exchange of cribs and adult beds. Provisions shall also be made for storage of equipment and supplies (including cots or recliners, extra linen, etc.) for parents who may remain with the patient overnight.
6. At least one room for isolation shall be provided in each pediatric unit as described in section 7.2C of this document.
7. Separate clean and soiled utility rooms shall be provided as described in section 7.2B.

7.6 Psychiatric Nursing Unit

When part of a general hospital, these units shall be designed for the care of inpatients. Nonambulatory inpatients may be treated in a medical unit until their medical condition allows for transfer to the psychiatric nursing unit. See section 7.2D of this document for psychiatric care in a medical unit. Provisions shall be made in the design for adapting the area for various types of psychiatric therapies.

The environment of the unit should be characterized by a feeling of openness with emphasis on natural light and exterior views. Various functions should be accessible from common areas while not compromising desirable levels of patient privacy. Interior finishes, lighting, and furnishings should suggest a residential rather than an institutional setting. These should, however, conform with

applicable fire safety codes. Security and safety devices should not be presented in a manner to attract or challenge tampering by patients.

Details of such facilities should be as described in the approved functional program. Each nursing unit shall provide the following:

A. Patient Rooms

The standard noted in section 7.2A of this document shall apply to patient rooms in psychiatric nursing units except as follows:

1. Windows or vents in psychiatric units shall be arranged and located so that they can be opened from the inside to permit venting of combustion products and to permit any occupant direct access to fresh air in emergencies. The operation of operable windows shall be restricted to inhibit possible escape or suicide. Where windows or vents require the use of tools or keys for operation, the tools or keys shall be located on the same floor in a prominent location accessible to staff. Windows in existing buildings designed with approved, engineered smoke control systems may be of fixed construction. Where glass fragments pose a hazard to certain patients, safety glazing and/or other appropriate security features shall be used.
2. A nurses call system is not required, but if it is included, provisions shall be made for easy removal, or for covering call button outlets.
3. Bedpan-flushing devices may be omitted from patient room toilets in psychiatric nursing units.
4. Handwashing facilities are not required in patient rooms.
5. Visual privacy in multibed rooms (e.g., cubicle curtains) is not required.

B. Service Areas

The standards noted in section 7.2B of this document shall apply to service areas for psychiatric nursing units with the following modifications:

1. Drug distribution unit shall include provisions for security against unauthorized access.
2. Food service within the unit may be one, or a combination, of the following:
 - a. A nourishment station.
 - b. A kitchenette designed for patient use with staff control of heating and cooking devices.
 - c. A kitchen service within the unit including a sink equipped for handwashing, storage space, refrigerator, and facilities for meal preparation.
3. Storage space for stretchers and wheelchairs may be outside the psychiatric unit, provided that

provisions are made for convenient access as needed for handicapped patients.

4. In psychiatric nursing units, a bathtub or shower shall be provided for each six beds not otherwise served by bathing facilities within the patient rooms. Bathing facilities should be designed and located for patient convenience and privacy.

5. A separate charting area shall be provided with provisions for acoustical privacy. A viewing window to permit observation of patient areas by the charting nurse or physician may be used if the arrangement is such that patient files cannot be read from outside the charting space.

6. At least two separate social spaces, one appropriate for noisy activities and one for quiet activities, shall be provided. The combined area shall be at least 40 square feet (3.72 square meters) per patient with at least 120 square feet (11.1 square meters) for each of the two spaces. This space may be shared by dining activities.

7. Space for group therapy shall be provided. This may be combined with the quiet space noted above when the unit accommodates not more than 12 patients, and when at least 225 square feet (21 square meters) of enclosed private space is available for group therapy activities.

8. Patient laundry facilities with an automatic washer and dryer shall be provided.

The following elements shall also be provided, but may be either within the psychiatric unit or immediately accessible to it unless otherwise dictated by the program:

9. Room(s) for examination and treatment with a minimum area of 100 square feet (9.3 square meters). Examination and treatment room(s) for medical-surgical patients may be shared by the psychiatric unit patients. (These may be on a different floor if conveniently accessible.)

10. Separate consultation room(s) with minimum floor space of 100 square feet (9.3 square meters) each, provided at a room-to-bed ratio of one consultation room for each 12 psychiatric beds. The room(s) shall be designed for acoustical and visual privacy and constructed to achieve a noise reduction of at least 45 decibels.

11. Psychiatric units each containing 15 square feet (1.39 square meters) of separate space per patient for occupational therapy, with a minimum total area of at least 200 square feet (18.6 square meters), whichever is greater. Space shall include provision for handwashing, work counter(s), storage, and displays. Occupational therapy areas may serve more than one nursing unit. When psychiatric nursing unit(s) contain less than 12 beds, the occupational therapy functions may be performed within the noisy activities area, if at least an additional 10

square feet (0.9 square meters) per patient served is included.

12. A conference and treatment planning room for use by the psychiatric unit.

C. Isolation Room(s)

The standards of section 7.2C in this document for isolation rooms *do not* apply to a psychiatric nursing unit. Psychiatric beds are not to be included in the bed count ratio to establish the number of beds required for medical isolation.

D. Seclusion Treatment Room

There shall be at least one seclusion room for up to 24 beds or a major fraction thereof. The seclusion treatment room is intended for short-term occupancy by a violent or suicidal patient. Within the psychiatric nursing unit, this space provides for patients requiring security and protection. The room(s) shall be located for direct nursing staff supervision. Each room shall be for only one patient. It shall have an area of at least 60 square feet (5.6 square meters) and shall be constructed to prevent patient hiding, escape, injury, or suicide. If a facility has more than one psychiatric nursing unit, the number of seclusion rooms shall be a function of the total number of psychiatric beds in the facility. Seclusion rooms may be grouped together. Special fixtures and hardware for electrical circuits shall be used. Doors shall be 3 feet 8 inches (1.1 meters) wide, and shall permit staff observation of the patient while also maintaining provisions for patient privacy. Seclusion treatment rooms shall be accessed by an anteroom or vestibule which also provides direct access to a toilet room. The toilet room and anteroom shall be large enough to safely manage the patient.

Where the interior of the seclusion treatment room is padded with combustible materials, these materials shall be of a type acceptable to the local authority having jurisdiction. The room area, including floor, walls, ceilings, and all openings shall be protected with not less than one-hour-rated construction.

7.7 Surgical Facilities

Note: The number of operating rooms and recovery beds and the sizes of the service areas shall be based on the expected surgical workload. The surgi-

cal suite shall be located and arranged to prevent nonrelated traffic through the suite. See sections 7.28, 7.31 and 7.32 of this document for details, ventilation, and electrical standards.

Additions to, and adaptations of, the following elements shall be made for the special-procedure operating rooms found in larger facilities.

The following shall be provided:

A. Surgery

1. General operating room(s). Each room shall have a minimum clear area of 360 square feet (33.5 square meters) with a minimum of 18 feet (5 meters) clear dimension between fixed cabinets and built-in shelves; and a system for emergency communication with the surgical suite control station. X-ray film illuminator(s) for handling at least two films simultaneously shall also be provided. (For modernization projects, see section 7.7A5 of this document.)

2. A room for orthopedic surgery. When included, this room shall, in addition to the above, have enclosed storage space for splints and traction equipment. Storage may be outside the operating room but must be conveniently located. If a sink is used for the disposal of plaster of Paris, a sink trap shall be provided.

3. Room(s) for cardiovascular surgery. When included, this room shall have, in addition to the above, a minimum clear area of 400 square feet (44.39 square meters), exclusive of fixed cabinets and built-in shelves. An additional room in the clean area of the surgical suite, preferably adjoining this operating room, shall be designated as a pump room where extracorporeal pump(s), supplies and accessories are stored and serviced. Appropriate plumbing connections shall be provided in both the cardiovascular operating room and the pump room.

4. Room(s) for surgical cystoscopic and other endoscopic procedures. This room shall be as noted for general operating rooms except that each room shall have a minimum clear area of 250 square feet (23.23 square meters) exclusive of fixed cabinets and built-in shelves.

5. The functional program may require additional clear space, plumbing, and mechanical facilities to accommodate special functions in one or more of these rooms. When existing functioning operating rooms are modified, and it is impractical to increase the square foot area because of walls or structural members, the operating room may continue in use when requested by the hospital.

B. Recovery Room(s)

Each room shall contain a medication distribution station; handwashing facilities; nurses station with charting facilities; clinical sink; provisions for bed-pan cleaning; and storage space for stretchers, supplies, and equipment. The design shall provide space for additional equipment described in the functional program and for clearance space of at least 3 feet (.92 meters) between patient beds and between patient bedsides and adjacent walls. Provisions shall be made for isolation of infectious patients. In new construction, at least one door to the recovery room shall access directly from the surgical suite without crossing public hospital corridors. Separate and additional recovery space may be necessary to accommodate surgical outpatients. (See sections 7.7C(15), 7.7C(17) and 9.5 of this document.)

C. Service Areas

Services, except for the enclosed soiled workroom mentioned in item 7.7C(6) and the janitors closet in item 7.7C(20), may be shared with the obstetrical facilities if the functional program reflects this concept. Service areas, when shared with delivery rooms, shall be designed to avoid the passing of patients or staff between the operating room and the delivery room areas. The following services shall be provided:

1. A control station located to permit visual observation of all traffic into the suite.
2. A supervisors office or station.
3. A sterilizing facility(ies) with high-speed autoclave(s) for emergency use. Other facilities for processing and sterilizing reusable instruments, etc., may be located in another hospital department such as central services.
4. Medication storage and distribution station including refrigeration.
5. Scrub facilities. Two scrub positions shall be provided near the entrance to each operating room. Two scrub positions may serve two operating rooms if both are located adjacent to the entrance of each operating room. Scrub facilities should be arranged to minimize incidental splatter on nearby personnel, medical equipment, or supply carts. In new construction, view windows at scrub stations permitting observation of room interiors shall be provided.
6. An enclosed soiled workroom for the exclusive use of the surgical suite staff (or a soiled-holding room that is part of a system for the collection and disposal of soiled material). The soiled workroom shall contain a clinical sink or equivalent flushing-type fixture, work counter, sink equipped for handwashing, waste receptacle, and linen receptacle. When a soiled holding room is used, the clinical sink and work counter may be omitted from that

room. Soiled work and/or storage areas shall not have direct connection with operating rooms or other sterile activities.

7. Fluid waste disposal facilities. These shall be located convenient to, but not connected with, the operating rooms. (A clinical sink or equivalent equipment in a soiled workroom or in a soiled holding room would meet this standard if convenient for use.)

8. Clean workroom or a clean supply room. A clean workroom is required when clean materials are assembled within the surgical suite prior to use. A clean workroom shall contain a work counter, a sink equipped for handwashing, and space for clean and sterile supplies. If the functional program defines a system for the storage and distribution of clean and sterile supplies in a clean supply room, the counter and sink may be omitted.

9. Medical gas storage facilities. Flammable anesthetics, if used, shall be stored in a separate room in accordance with section 7.29 of this document. Main storage of medical gases may be outside or inside the facility. Provision shall be made for additional separate storage of reserve gas cylinders necessary to complete at least one day's procedures.

10. The anesthesia workroom for cleaning, testing, and storing anesthesia equipment shall contain work counter(s) and sink(s). Provisions shall be made for separate storage of clean and soiled items.

11. Equipment storage room(s) for equipment and supplies used in surgical suite.

12. Staff clothing change areas. Appropriate areas shall be provided for male and female personnel (orderlies, technicians, nurses, and doctors) working within the surgical suite. The areas shall contain lockers, showers, toilets, lavatories equipped for handwashing, and space for donning scrub suits and booties. These areas shall be arranged to encourage a one-way traffic pattern so that personnel entering from outside the surgical suite can change and move directly into the surgical suite.

13. Staff lounge and toilet facilities. Separate or combined lounges for male and female staff shall be provided. Lounge(s) shall be designed to minimize the need to leave the suite and to provide convenient access to the recovery room.

14. Dictation and report preparation area. This may be accessible from the lounge area.

15. Outpatient surgery change areas. If the functional program defines outpatient surgery as part of the surgical suite, a separate area shall be provided where outpatients may change from street clothing into hospital gowns and be prepared for surgery. This would include a waiting room, locker(s), toilet(s), and clothing change or gowning area.

16. Provisions shall be made for preparation, testing, and obtaining vital signs of patients for outpatient surgery.

17. Outpatient recovery. If the functional program includes outpatient surgery, provisions shall be made for separating outpatients, not subjected to general anesthesia, from inpatients. This requirement may be satisfied by separate rooms or by the scheduling of surgical procedures. A patient toilet room directly accessible from outpatient recovery shall be provided. Smaller facilities with no more than two surgical procedure rooms may use the same space for outpatient recovery as that used for preoperative preparation.

18. Patient holding area. In facilities with two or more operating rooms, an area shall be provided to accommodate stretcher patients waiting for surgery. This holding area shall be under the visual control of the nursing staff.

19. Storage areas for portable X-ray equipment, stretchers, fracture tables, warming devices, auxiliary lamps, etc. These areas shall be out of corridors and traffic.

20. Janitors closet. A closet containing a floor receptor or service sink and storage for housekeeping supplies and equipment shall be provided for the exclusive use of the surgical suite.

21. Area for preparation and examination of frozen sections. This may be part of the general laboratory if immediate results are obtainable without unnecessary delay in the the completion of surgery.

22. Ice machine to supply ice for patient use and treatments.

23. Provisions for refrigerated blood bank storage.

24. See section 9.5 of this document concerning the separate outpatient surgical unit.

7.8 Obstetrical Facilities

Note: Obstetrical facilities shall be as required according to the functional program. The obstetrical suite shall be located and arranged to prohibit nonrelated traffic through the suite. When delivery and operating rooms are in the same suite, access and service arrangements shall be such that neither staff nor patients need to travel through one area to reach the other.

Provisions shall be made for performing Caesarean sections in accordance with the functional program and as required by appropriate authorities. The obstetrical suite shall include the following elements:

A. Delivery Room(s)

Each room shall have a minimum clear area of 300 square feet (27.87 square meters) exclusive of fixed cabinets and built-in shelves. If an operating room(s) is not immediately accessible to the obstetrical facilities, at least one delivery room shall be equipped for routine performance of Caesarean sections unless prohibited by state law, and shall have not less than 360 square feet (33.5 square meters) of clear area. An emergency communications system shall be connected with the obstetrical suite control station. Resuscitation facilities (electrical outlets, oxygen, suction, and compressed air) shall be provided for newborn infants within each delivery room, in addition to the facilities required for the mother.

B. Labor Room(s)

Each room shall be designed for either one or two beds with a minimum clear area of 100 square feet (9.3 square meters) per bed. Two labor beds shall be provided for each delivery room (labor/delivery/recovery [LDR] or labor/delivery/recovery/postpartum [LDRP] rooms may be substituted). In facilities which have only one delivery room, two separate labor rooms (LDR or LDRP rooms may be substituted) shall be provided. One of these labor rooms shall be at least 160 square feet (15 square meters) with at least two oxygen outlets and two suction outlets in order to function as an emergency delivery room. Each labor room shall contain a lavatory equipped for handwashing and have access to a toilet room. One toilet room may serve two labor rooms. Labor rooms shall have controlled access with doors that are arranged for observation from a nurses work station. At least one shower (may be separate from labor room if under staff control) for use of patients in labor shall be provided. A water closet shall be conveniently accessible to each shower facility. Windows in labor rooms if provided, shall be located, draped, or otherwise arranged, to preserve patient privacy from casual observation from outside the labor room.

C. Recovery Room(s)

Each recovery room (LDR or LDRP room may be substituted) shall contain at least two beds and have a nurses position with charting facilities located to permit visual control of all beds. Each room shall include facilities for medicine dispensing; handwashing; clinical sink with bedpan flushing device; and storage for supplies and equipment. The recovery room may be omitted in hospitals where the program indicates a work load of less than 1,500 births per year.

D. Labor/Delivery/Recovery (LDR) and Labor/Delivery/Recovery/Postpartum (LDRP) Facilities

When provided by the functional program, delivery procedures in accordance with birthing concepts may be performed in the following facilities:

1. LDR/LDRP rooms shall have a minimum of 200 square feet (18.58 square meters). If an operating room or other Caesarean section room is not immediately accessible to the LDR/LDRP facilities, at least one room shall be equipped for emergency Caesarean sections and shall have not less than 360 square feet (33.5 square meters) of clear area. An emergency communication system shall be connected to the LDR/LDRP facilities nurses station. Resuscitation facilities (electrical outlets, oxygen and suction) shall be provided for newborn infants within each LDR/LDRP room in addition to those provided for the mother.
2. Each LDR/LDRP room shall be for single occupancy and have access to an adjoining toilet with shower or tub. One toilet may serve two LDR/LDRP rooms. Each room shall be equipped with a lavatory for handwashing (handwashing sink with wrist blades is acceptable for scrubbing). Examination lights may be portable, but must be immediately accessible.
3. Finishes may be selected to create a homelike environment, but care should be exercised to facilitate ease of cleaning and resistance to strong detergents. Windows within a normal sightline that would permit observation into the room from the exterior shall be arranged or draped as necessary for patient privacy.

E. Service Areas

Individual rooms shall be provided as indicated in the following standards; otherwise, alcoves or other open spaces that do not interfere with traffic may be used. Services, except the soiled workroom mentioned in item 7.8E(7), the family waiting room in item 7.8E(3), and the janitors closet in item 7.8E(15), may be shared with the surgical facilities, if the functional program reflects this concept. Where shared, areas shall be arranged to avoid direct traffic between the delivery and operating rooms.

The following services shall be provided:

1. A control/nursing station located to restrict unauthorized traffic into the suite.
2. A supervisors office or station.
3. A family waiting room conveniently located to the labor room area with provisions for personal communication between fathers and staff. Toilets, telephones, and drinking fountains shall be convenient to the waiting room.

4. Sterilizing facilities with high speed autoclave(s) convenient to all delivery rooms.
5. A drug distribution station. Provisions shall be made for controlled storage, preparation, and distribution of medication.
6. Scrub facilities. Two scrub positions shall be provided near the entrance to each delivery room. Two scrub positions may serve two delivery rooms if they are located adjacent to the entrance of each delivery room. Scrub facilities should be arranged to minimize any splatter on nearby personnel or supply carts. In new construction, provide view windows at scrub stations to permit the observation of room interiors.
7. An enclosed soiled workroom for the exclusive use of the obstetrical suite staff, or a soiled holding room that is part of a system for the collection and disposal of soiled materials. The soiled workroom shall contain a clinical sink or equivalent flushing-type fixture; a work counter; a sink equipped for handwashing; a waste receptacle; and a linen receptacle. If a soiled holding room is used, the handwashing facility and work counter may be omitted. Soiled work and/or storage areas shall not have a direct connection with delivery rooms or other sterile activities.
8. Fluid waste disposal facilities provided in a location convenient to but not connected with the delivery rooms. (The clinical sink or equivalent equipment in a soiled workroom or soiled holding room would meet this standard.)
9. A clean workroom or a clean supply room. A clean workroom is required if clean materials are assembled within the obstetrical suite prior to use. A clean workroom shall contain a work counter, sink equipped for handwashing, and space for clean and sterile supplies. A clean supply room may be provided when the functional program defines a system for the storage and distribution of clean and sterile supplies not requiring the use of a clean workroom.
10. Anesthesia storage facilities. Storage space for reserve cylinders of medical gases shall be provided as needed. If flammable anesthetics are used, a separate room shall be provided for their storage in accordance with the details of section 7.29 of this document.
11. An anesthesia workroom for cleaning, testing and storing anesthesia equipment. It shall contain a work counter, sink, and provisions for separation of clean and soiled items.
12. Equipment storage room(s) for equipment and supplies used in the obstetrical suite.
13. Staff clothing change areas. Appropriate areas shall be provided for male and female personnel (technicians, nurses, aides, and doctors) working within the obstetrical suite. The areas shall contain lockers, showers, toilets, lavatories equipped for

handwashing, and space for donning and disposing scrub suits and booties. The clothing change area shall be designed for general one way traffic to minimize physical contact between clean and contaminated personnel.

14. Lounge and toilet facilities for obstetrical staff convenient to delivery, labor, and recovery areas. In addition, on-call rooms for physicians shall be provided.

15. Janitors closet. A closet containing a floor receptacle or service sink and storage space for housekeeping supplies and equipment shall be provided exclusively for the obstetrical suite.

16. An area for storing stretchers out of the path of normal traffic.

7.9 Emergency Service

(See section 9.6 of this document for the separate outpatient emergency unit)

A. Definition

Levels of emergency care range from elementary first aid to sophisticated surgical procedures such as repair of heart wounds. However, for these standards, emergency services are described in two broad categories: first aid and trauma.

1. Emergency first aid is care provided initially to stabilize a victim's condition and to minimize potential for further injury during transport to an appropriate service. As a general rule, emergency first aid is rendered by a trained emergency ambulance team or similar service, which then transports the victim directly to a hospital for further treatment. However, many victims are brought in private vehicles by untrained lay persons to the "nearest hospital" which may or may not have all required services. It is important that the hospital, in those cases, be able to alleviate traumatic conditions and arrange for appropriate transfer.

2. Emergency trauma care may range from the simple suturing of lacerations of Category IV, Basic Emergency Services, to full scale surgical/medical procedures of Category I, Comprehensive Emergency Services. Facilities that include emergency trauma care should provide for 24-hour service and complete emergency care leading to discharge to the patient's home or direct admission to the appropriate hospital.

Note: More detailed descriptions of emergency service categories may be available from the Committee on Trauma of the American College of Surgeons.

B. General

The extent and type of emergency service to be provided will depend upon community needs and the availability of other services within the area. While emergency first aid must be available at every hospital, full scale trauma services may be impractical and/or an unnecessary duplication. The existence of an expensive emergency trauma facility without adequate equipment and 24-hour staffing may be dangerous and life threatening if there is potential for delays in essential treatment caused by misdirection of victims who would otherwise be sent directly to an appropriate facility. The following standards are intended only as minimums. Additional facilities, as needed, shall be as required to satisfy the program.

Provisions for facilities to provide nonemergent treatment of outpatients are covered separately in section 9.3. Coordination between emergency and outpatient services is essential since medical examination is often necessary to determine the difference between emergency and nonemergent conditions. In addition, provisions for expansion of services into the outpatient department may be desirable during some peak periods and essential in times of disaster.

C. Emergency First Aid

At a minimum, each hospital shall have provisions for emergency first aid treatment for staff, employees and visitors, as well as for persons who may be unaware of or unable to immediately reach services in other facilities. This is not only for minor incidents that may require minimal care but also for persons with severe injuries who must receive immediate first aid and assistance for transport to other facilities.

Provisions for emergency first aid shall include:

1. A marked entrance, at grade level, protected from the weather.
2. A treatment room with not less than 120 square feet (11 square meters) of clear area, exclusive of toilets, waiting area, and storage. Each treatment room shall contain an examination light, work counter, handwashing facilities, X-ray film illuminators, cabinets, medication storage, and provisions for vacuum and oxygen. The treatment room may have additional space and provisions for several patients with cubicle curtains for privacy.
3. Storage out of traffic and under staff control for general medical/surgical emergency supplies and equipment such as resuscitator, defibrillator, splints, etc.
4. Provisions for reception, control, and public waiting.
5. A patient toilet room convenient to the treatment room(s).

6. Communication hookup to the Poison Control Center (with data and antidotes).

D. Emergency Trauma

When 24-hour trauma service is to be provided, the type, size, and number of the services shall be as defined in the functional program. As a minimum, the following shall be provided:

1. Grade level entrance sheltered from the weather with direct access from heliport (if included) and from public roads for ambulance and vehicle traffic. Entrance and driveway shall be clearly marked. If a raised platform is used for ambulance discharge, provide a ramp for pedestrian and wheelchair access.
2. Paved emergency access to permit discharge of patients from automobiles and ambulances, and temporary parking convenient to the entrance.
3. Reception and control station shall be located to permit staff observation and control of access to treatment area, pedestrian and ambulance entrances, and public waiting area.
4. Wheelchair and stretcher storage shall be provided for arriving patients. This shall be out of traffic with convenient access from emergency entrances.
5. Public waiting area with toilet facilities, drinking fountains, and telephones shall be provided.
6. Communication center shall be part of or convenient to control station and have radio, telephone, and intercommunication systems. (See Section 7.29F).
7. Each treatment/examination room(s) shall have at least 120 square feet (11 square meters) of clear floor space and shall contain work counter(s), cabinets, handwashing facilities, X-ray film illuminators, and examination lights.
8. Trauma room(s) for emergency trauma procedures, including emergency surgery shall have at least 240 square feet (21 square meters) of clear floor space. Each room shall have cabinets and emergency supply shelves, X-ray film illuminators, and examination lights. Additional space with cubicle curtains for privacy may be provided to accommodate more than one patient at a time in the trauma room.
9. Provisions for orthopedic and cast work. These may be in separate room(s) or in the trauma room. They shall include storage for splints and other orthopedic supplies, traction hooks, X-ray film illuminators, and examination lights. If a sink is used for the disposal of plaster of Paris, a sink trap shall be provided.

10. Scrub stations located convenient to each trauma and orthopedic room.

11. Convenient access to radiology and laboratory services.

12. Poison Control Center may be a part of the nurses station.

13. Provisions for disposal of solid and liquid waste. This may be a clinical sink with bedpan flushing device within the soiled workroom.

14. A storage area for crash cart, portable X-ray units, and other equipment located out of traffic and easily accessible to each trauma and treatment room.

15. A toilet room for patients.

16. Storage rooms for clean, soiled, or used supplies. Soiled and clean rooms shall be separated and have no direct connection.

17. Staff work and charting-area station with counters, cabinets, medication storage, and convenient access to handwashing facilities. This area may be combined with, or include, centers for reception control, poison control, and communication.

18. Locked cabinets or other secure storage within the nurses work area for staff personal effects.

19. Convenient access to staff toilets, lounge, and lockers.

20. Room(s), under staff visual control, for patients who may require observation prior to admission or discharge. One or more of the examination/treatment rooms may be used for this purpose.

21. Janitors closet within, or adjacent to, the trauma service areas.

E. Details and Finishes; Ventilation and Mechanical; Electrical Standards

See section(s) 7.28 of this document for details and finishes, section 7.31 for ventilation and mechanical, and section 7.32 for electrical standards.

7.10 Radiology Suite

Equipment and space shall be as necessary to accommodate the program functions. The radiology department provides diagnostic procedures, including fluoroscopy, radiography, mammography, computerized scanning, ultrasound, and other image-forming techniques. Radiotherapy, which includes the use of linear accelerators, isotopes, and betatrons, may also be practiced within the radiology department when the patient load is small and the required equipment and staff are small enough to fit within the department. In larger hospitals or in specialized hospitals, a separate area should be designated for this service.

A certified health physicist or appropriate state agency shall specify the type, location, and amount of radiation protection to be installed following the final approved department layout and equipment selection. The architect shall incorporate these specifications into the hospital building plans.

Specialized procedures, such as electron beam therapy, radiation treatment, scan units, computerized tomography, mammography, angiocardiology, etc. are not common to all facilities, and are not covered in this document. However, most medical imaging departments include some or all of these functions. When these and other procedures are part of the facility, function, design, and construction considerations shall be given to the specific needs for effective operation, accessibility, safety, and patient dignity. Such considerations should include, but are not limited to, the following:

Where radiation treatment is performed, a separate area for dosimetry calculation(s) shall be provided with ready access to the computer area. A separate room should also be provided for patient simulation and construction of patient positioning devices. Areas for the safe handling of radioactive materials shall be provided in accordance with prevailing local, state, and federal regulations and National Council on Radiation Protection and Measurement Report #33.

Where nuclear medicine services are offered, a separate laboratory for preparation, storage, and safe disposal of radioactive materials shall be provided. Special attention should be paid to providing adequate high volume ventilation equipment in accordance with prevailing regulations.

Where digital and electronic imaging equipment, such as computer tomography, digital angiography, magnetic resonance, and similar equipment is used, a separate computer area should be provided. See section 7.32 for power conditioning equipment.

As a minimum, each general hospital radiology suite shall include:

A. Service Access to and from Other Departments

Beds, stretchers, and wheelchairs should have ready access to and from other departments of the institution. The emergency room, surgery and recovery

rooms, cystoscopy, outpatient clinics, and clinical laboratories should be accessible to the radiology suite. Radiology should be located on the ground floor, if practical, because of equipment, electrical services, and expansion considerations.

B. Diagnostic Radiographic Room(s)

Radiographic and fluoroscopic procedures may be performed in one room or may be in separate rooms. Room(s) shall accommodate equipment, patients, stretchers, wheelchairs, and staff work area, and should be 250 square feet (23.0 square meters) for fluoroscopic and 180 square feet (16.2 square meters) for radiographic procedures. Flooring shall be adequate to meet load requirements for equipment, patients, and personnel. Ceiling-mounted equipment should have properly designed rigid support structures located above the finished ceiling. A lift-out type ceiling should be considered for ease of service, installation, and remodeling. This may be a 2 × 2 foot (60 × 60 centimeter) or a 2 × 4 foot (60 × 120 centimeter) grid system. Each radiographic room shall include a shielded control area with provision for two way communication during film exposure. These areas shall have provisions for viewing the entire examination table and the patient. Television cameras may be used for viewing.

C. Contrast Media Preparation

This area shall be provided with sink, counter, and storage to allow for mixing of contrast media. One preparation area, if conveniently located, may serve any number of radiographic rooms. Premixed commercial preparation, if used, may be stored in a convenient, clean utility room.

D. Dark Room

A dark room may be provided for processing film. If the processing equipment normally used does not require a dark room for loading and transfer, the dark room may be minimal for emergency and special procedures only.

E. Cleanup Facilities

Provisions for cleanup shall be located within the suite for convenient access and use. It shall include service sink or floor receptacle as well as storage space for equipment and supplies. If automatic film processors are used, a receptacle of adequate size with hot and cold water for cleaning the processor racks shall be provided.

F. Film Quality Control Area

Area or room shall be provided near the processor for viewing film immediately after it is processed. All view boxes shall be illuminated to provide light of the same color value and intensity for appropriate comparison of several adjacent films.

G. Computer Area

If a centralized computer area is necessary to accomplish the program, this computer should be in a separate room with access terminals available within the imaging rooms.

H. Sorting and Cutting

An area with appropriate equipment shall be provided for preparing processed film for use and file.

I. Consultation Area

An appropriate area for individual consultation with referring clinicians shall be provided. View boxes shall be illuminated to provide light of the same color value and intensity for appropriate comparison of several adjacent films.

J. Film Storage (Active)

A room with cabinets or shelves for filing patient film for immediate retrieval shall be provided.

K. Film Storage (Inactive)

A room or area for inactive film storage shall be provided. It may be outside the radiology suite, but must be under radiology's administrative control and properly secured to protect films against loss or damage.

L. Storage for Unexposed Film

Storage facilities for unexposed film shall include protection of film against exposure or damage. Film storage space shall not be warmer than the air of adjacent occupied areas.

M. Office(s) for Radiologist(s) and Assistants

These offices shall include provisions for individual consultation, viewing, and charting of film. View boxes shall be as described above.

N. Clerical Offices/Spaces

Office space shall be provided as necessary for the functional program.

O. Waiting Area (for Ambulatory and Wheelchair Patients)

The area shall be out of traffic, under staff control, and shall have seating capacity in accordance with the functional program. Space and access shall be arranged to accommodate wheelchairs. If the department 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.

P. Holding Area (for Patients on Stretchers or Beds)

In addition to waiting area for ambulatory and wheelchair patients, holding areas for patients on beds and stretchers shall be provided out of traffic and under control of staff.

Q. Patient Dressing Rooms

Dressing rooms shall be provided convenient to the waiting areas and radiographic room(s). Each room shall include a seat or bench, mirror, and provisions for hanging patients' clothing and for securing valuables. At least one dressing room in the radiographic suite shall be sized for access and use by handicapped patients.

R. Toilet Rooms with Handwashing Facilities

Toilet rooms shall be provided for patient use convenient to waiting area(s). Toilet rooms shall be usable and accessible for handicapped patients and shall be provided with an emergency call mechanism. Separate toilets shall be provided with direct access from each radiographic room routinely used for fluoroscopic procedures and arranged so that a patient may leave the toilet without having to reenter the fluoroscopic area. (Radiographic rooms used only occasionally for fluoroscopic procedures may utilize nearby patient toilets if they are located for immediate access.)

S. Staff Toilets

Toilets may be outside of the radiographic suite but shall be convenient for staff use.

T. Handwashing Facilities

Handwashing facilities shall be provided within each procedure room unless the room is used only for routine screening such as chest X-rays where the patient is not physically handled by staff.

U. Control Desk and Reception Area**V. Storage Facilities**

These shall be provided for clean and soiled linen supply and may be shared with another department.

W. Details and Finishes; Mechanical; Electrical

See sections 7.28 of this document for details and finishes; 7.31 for mechanical; and 7.32 for electrical.

7.11 Nuclear Medicine

Equipment and space shall be provided as necessary to accommodate the program functions. Specialized procedures, such as single photon emission, tomography, positron emission tomography, etc., are not common to most smaller facilities and therefore require specialized planning for equipment.

A separate laboratory for preparation, storage, and safe disposal of radioactive materials shall be provided in accordance with prevailing local, state, and federal regulations and the National Council on Radiation Protection and Measurement Report #33.

A certified health physicist or state agency shall specify the type, location, and amount of radiation protection to be installed following final approved department layout and equipment selection. The architect shall incorporate these specifications into the hospital building plans.

As a minimum, each nuclear medicine area shall include:

A. Service Access to and from Other Departments

Beds, stretchers, and wheelchairs should have access to and from other departments of the institution.

Inpatient units and supporting services, such as radiology and pathology, should be accessible to nuclear medicine. The emergency room and outpatient clinics should be in proximity.

B. Imaging and Study Rooms

The number of rooms should be adequate to accommodate the functional program. Space should be adequate to permit entry with wheelchairs, stretchers, and beds; and able to accommodate imaging equipment, electronic consoles and, if present, computer terminals.

Flooring should meet load requirements for equipment, patients, and personnel. Floors and walls should be constructed of materials that are easily decontaminated in case of radioactive spills. If possible, walls should contain necessary support systems for oxygen, suction, and vents for radioactive gases. If not possible, space should be provided in the room for mobile devices of support.

C. Radiopharmaceutical Storage and Preparation Area

If radiopharmaceutical preparation is performed onsite, an area adequate to house a radiopharmacy

shall be established and shielded. This area should include adequate space for storage of radionuclides, chemicals for preparation, dose calibrators, and record keeping. Floors and walls should be constructed of easily decontaminated materials. Vents and traps for radioactive gases should be provided if such are used. Hoods for pharmaceutical preparation shall meet applicable standards.

If preparations are prepared prior to purchase from a centralized or commercial radiopharmacy, the storage and calculation area may be considerably smaller than that required for onsite preparation. However, it still shall provide adequate space for dose calibration, quality assurance, and record keeping. This area may still require shielding from other portions of the facilities.

D. Dark Room

An onsite dark room should be available for film processing. If this is not possible, ready access to such a dark room should be provided. The dark room should contain protective storage facilities for unexposed film that guard the film against exposure or damage. If necessary, special refrigeration and humidity controls, separate from the ambient controls of adjacent occupied areas, should be provided.

E. Computer Area

If a centralized computer area is necessary to accomplish the program, this should be in a separate room with access terminals available within the imaging rooms.

F. Cleanup Facilities

Provisions for cleanup shall be located within the suite for convenient access and use. It shall include service sink or floor receptacle as well as storage space for equipment and supplies.

G. Film Storage (Active)

A room with cabinets or shelves for filing patient film for immediate retrieval shall be provided.

H. Film Storage (Inactive)

A room or area for inactive film storage shall be provided. It may be outside the radiology suite, but should be under radiology's administrative control and properly secured to protect film against loss or damage.

I. Consultation Area

View boxes shall be illuminated to provide light of the same color value and intensity for appropriate comparison of several adjacent films. Space should be provided for computer access and display terminals if such are included in the program.

J. Office(s) for Nuclear Medicine Physicians and Assistants

These offices shall include provisions for individual consultation, viewing, and charting of film. View boxes shall be as described above.

K. Clerical Offices/Spaces

Spaces shall be provided as necessary for radiology program function.

L. Waiting Area (for Ambulatory and Wheelchair Patients)

Area shall be out of traffic, under staff control, and shall have seating capacity in accordance with the functional program. Space and access shall be arranged to accommodate wheelchairs. If the department 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.

M. Holding Area (for Patients on Stretchers or Beds)

In addition to a waiting area for ambulatory and wheelchair patients, areas for beds and stretchers shall be provided out of traffic and under the control of staff.

N. Patient Dressing Rooms

Patient dressing rooms shall be provided convenient to the waiting area and imaging room(s). Each dressing room shall include a seat or bench, a mirror, and provisions for hanging patients' clothing and for securing valuables. At least one dressing room in the nuclear medicine area shall be sized for access and use by handicapped patients.

O. Toilet Room with Handwashing Facilities

Patient toilet rooms convenient to waiting and imaging area(s) shall be provided. Toilet rooms shall be accessible to and usable by handicapped patients and shall be equipped with an emergency call mechanism.

P. Staff Toilets

These should be convenient to the nuclear medicine laboratory.

Q. Handwashing Facilities

Handwashing facilities shall be provided within each procedure room. A shower unit should also be provided to insure adequate decontamination in the event radioactive material is spilled.

R. Control Desk and Reception Area**S. Storage Facilities**

These shall be provided for clean and soiled linen supply and may be shared with another department.

T. Details and Finishes; Mechanical; Electrical

See section 7.28 of this document for details and finishes; 7.31 for mechanical; and 7.32 for electrical.

7.12 Laboratory Suite

Laboratory facilities shall be provided for the performance of tests in hematology, clinical chemistry, urinalysis, microbiology, anatomic pathology, cytology, and blood banking to meet the workload described in the functional program. Certain procedures may be performed onsite or provided through a contractual arrangement with a laboratory service acceptable to the authority having local jurisdiction.

Provisions shall be made for the following procedures to be performed on-site: blood counts, urinalysis, blood glucose, electrolytes, blood urea and nitrogen (BUN), coagulation, and transfusions (type and cross-match capability). Provisions shall also be included for specimen collection and processing.

The following physical facilities shall be provided within the hospital:

- A.** Laboratory work counter(s) with space for microscopes, appropriate chemical analyzer(s), incubator(s), centrifuge(s), etc. shall be provided. Work areas shall include sinks with water and access to vacuum, gas, and electrical services as needed.
- B.** Refrigerated blood storage facilities for transfusions shall be provided. Blood storage refrigerator shall be equipped with temperature-monitoring and alarm signals.
- C.** Lavatory(ies) or counter sink(s) equipped for handwashing shall be provided. Counter sinks may also be used for disposal of nontoxic fluids.
- D.** Storage facilities, including refrigeration, for reagents, standards, supplies, and stained specimen microscope slides, etc. shall be provided.
- E.** Specimen (blood, urine, and feces) collection facility shall be provided. Blood collection area shall have work counter, space for patient seating, and handwashing facilities. Urine and feces collection

room shall be equipped with water closet and lavatory. This facility may be located outside the laboratory suite.

- F.** Chemical safety provisions including emergency shower, eyeflushing devices, and appropriate storage for flammable liquids, etc., shall be made.
- G.** Facilities and equipment for terminal sterilization of contaminated specimens before transport (autoclave or electric oven) shall be provided. (Terminal sterilization is not required for specimens that are incinerated on-site.)
- H.** If radioactive materials are employed, facilities shall be available for long-term storage and disposal of these materials. No special provisions will normally be required for body waste products from most patients receiving low level isotope diagnostic material. Requirements of authorities having jurisdiction should be verified.
- I.** Administrative areas including offices as well as space for clerical work, filing, and record maintenance shall be provided.
- J.** Lounge, locker, and toilet facilities shall be conveniently located for male and female laboratory staff. These may be outside the laboratory area and shared with other departments.

The functional program shall describe the type and location of all special equipment that is to be wired, plumbed, or plugged in, and the utilities required to operate each.

Note: Refer to NFPA code requirements applicable to hospital laboratories, including standards clarifying that hospital units do not necessarily have the same fire safety requirements as commercial chemical laboratories.

7.13 Rehabilitation Therapy Department**A. General**

Rehabilitation therapy is primarily for restoration of body functions and may contain one or several categories of services. If a formal rehabilitative therapy service is included in a project, the facilities and equipment shall be as necessary for the effective function of the program. Where two or more rehabilitative services are included, items may be shared, as appropriate.

B. Common Elements

Each rehabilitative therapy department shall include the following, which may be shared or provided as separate units for each service:

1. Office and clerical space with provision for filing and retrieval of patient records.
2. Reception and control station(s) with visual control of waiting and activities areas. (This may be combined with office and clerical space.)
3. Patient waiting area(s) out of traffic with provision for wheelchairs.
4. Patient toilets with handwashing facilities accessible to wheelchair patients.
5. Space(s) for storing wheelchairs and stretchers out of traffic while patients are using the services. These spaces may be separate from the service area but must be conveniently located.
6. A conveniently accessible janitors closet and service sink for housekeeping use.
7. Locking closets or cabinets within the vicinity of each work area for securing staff personal effects.
8. Convenient access to toilets and lockers.
9. Access to a demonstration/conference room.

C. Physical Therapy

If physical therapy is part of the service, the following, at least, shall be included.

1. Individual treatment area(s) with privacy screens or curtains. Each such space shall have not less than 60 square feet (5.6 square meters) of clear floor area.
2. Handwashing facilities for staff either within or at each treatment space. (One handwashing facility may serve several treatment stations.)
3. Exercise area and facilities.
4. Clean linen and towel storage.
5. Storage for equipment and supplies.
6. Separate storage for soiled linen, towels, and supplies.
7. Patient dressing areas, showers and lockers. These shall be accessible and usable by the handicapped.
8. Provisions shall be made for thermotherapy, diathermy, ultrasonics, and hydrotherapy when required by the functional program.

D. Occupational Therapy

If this service is provided, the following, at least, shall be included:

1. Work areas and counters suitable for wheelchair access.
2. Handwashing facilities.
3. Storage for supplies and equipment.

E. Prosthetics and Orthotics

If this service is provided, the following, at least, shall be included:

1. Workspace for technicians.
2. Space for evaluating and fitting, with provision for privacy.
3. Space for equipment, supplies, and storage.

F. Speech and Hearing

If this service is provided, the following, at least, shall be included:

1. Space for evaluation and treatment.
2. Space for equipment and storage.

7.14 Respiratory Therapy Service

The type and extent of respiratory therapy service in different institutions vary greatly. In some, therapy is delivered in large sophisticated units, centralized in a specific area; in others, basic services are provided only at patients' bedsides. If respiratory service is provided, the following elements shall be included as a minimum, in addition to those elements stipulated in sections 7.13B(1), (7), (8) and (9) of this document:

A. Storage for Equipment and Supplies**B. Space and Utilities for Cleaning and Sanitizing Equipment****C. Respiratory services shall be conveniently accessible on a 24-hour basis to the intensive care units.****D. If respiratory services such as testing and demonstration for outpatients are part of the program, additional facilities and equipment shall be provided as necessary for the appropriate function of the service, including but not limited to:**

1. Patient waiting area with provision for wheelchairs.
2. A reception and control station.
3. Patient toilets and handwashing facilities.
4. Room(s) for patient education and demonstration.

7.15 Morgue

These facilities shall be accessible through an exterior entrance and shall be located to avoid the need for transporting bodies through public areas.

A. The following elements shall be provided when autopsies are performed in the hospital:

1. Refrigerated facilities for body holding.
2. An autopsy room containing the following:
 - a. A work counter with a sink equipped for handwashing.
 - b. A storage space for supplies, equipment, and specimens.
 - c. An autopsy table.
 - d. A clothing change area with shower, toilet, and lockers.
 - e. A janitors service sink or receptacle for cleanup and housekeeping.

- B.** If autopsies are performed outside the facility, a well-ventilated, temperature-controlled, body-holding room shall be provided.

7.16 Pharmacy

A. General

The size and type of services to be provided in the pharmacy will depend upon the type of drug distribution system used, number of patients to be served, and extent of shared or purchased services. This shall be described in the functional program. The pharmacy room or suite shall be located for convenient access, staff control, and security. Facilities and equipment shall be as necessary to accommodate the functions of the program. (Satellite facilities if provided, shall include those items required by the program.) As a minimum, the following elements shall be included:

B. Dispensing

1. A pickup and receiving counter.
2. An area for reviewing and recording.
3. An extemporaneous compounding area.
4. A work counter and cabinets for pharmaceutical activities.
5. An area for temporary storage, exchange, and restocking of carts.
6. Security provisions for drugs and personnel in the dispensing counter area.

C. Manufacturing

1. A bulk compounding area.
2. Provisions for packaging and labeling.
3. A quality-control area.

D. Storage (may be cabinets, shelves, and/or separate rooms or closets)

1. Bulk storage.
2. Active storage.
3. Refrigerated storage.
4. Volatile fluids and alcohol storage constructed according to applicable fire safety codes for the substances involved.

5. Secure storage for narcotics and controlled drugs.
6. Storage for general supplies and equipment not in use.

E. Administration

1. Provision for cross-checking of medication and drug profiles of individual patients.
2. Poison control, reaction data, and drug information centers.
3. A separate room or area for office function including desk, filing, communication, and reference.
4. Provisions for patient counseling and instruction (may be in a room separate from the pharmacy).
5. A room for education and training (may be in a multipurpose room shared with other departments).

F. Other

1. Handwashing facilities shall be provided within each separate room where open medication is handled.
2. Provide for convenient access to toilet and locker.
3. If unit dose procedure is used, provide additional space and equipment for supplies, packaging, labeling, and storage, as well as for the carts.
4. If IV solutions are prepared in the pharmacy, provide a sterile work area with a laminar-flow bench and hood. The laminar-flow system shall include a nonhydroscopic filter rated at 99.97 percent (HEPA), as tested by DOP tests, and have a visible pressure gauge for detection of filter leaks or defects. Construction and space arrangements shall minimize the aspiration of unfiltered room air into the work area.
5. Provide for consultation and patient education when the functional program requires dispensing of medication to outpatients.

7.17 Dietary Facilities

A. General

Food service facilities and equipment shall comply with the standards of HEW publication no. (FDA) 78-2081, *Food Service Sanitation Manual*, and meet the requirements of the functional program. These facilities may consist of onsite or offsite conventional or convenience food preparation systems, or any appropriate combination thereof.

B. Functional Elements

If the dietary department is onsite, the following facilities, in the size and number appropriate for the type of food service selected, shall be provided:

1. A control station for receiving and controlling food supplies.
2. Storage space, including cold storage, for at least a 4-day supply of food. (Facilities in remote areas may require proportionally more food storage facilities.)
3. Food preparation facilities. Conventional food preparation systems require space and equipment for preparing, cooking, and baking. Convenience food service systems using frozen prepared meals, bulk packaged entrees, individual packaged portions, or those using contractual commissary services, require space and equipment for thawing, portioning, cooking, and/or baking.
4. Handwashing facility(ies) located in the food preparation area.
5. Facilities for assembly and distribution of patient meals.
6. Dining space for ambulatory patients, staff, and visitors.
7. Warewashing space located in a room or an alcove separate from the food preparation and serving area. Commercial-type warewashing equipment shall be provided. Space shall also be provided for receiving, scraping, sorting, and stacking soiled tableware and for transferring clean tableware to the using areas. Convenient handwashing facilities shall be available.
8. Potwashing facilities.
9. Storage areas and sanitizing facilities for cans, carts, and mobile-tray conveyors.
10. Waste storage facilities located in a separate room easily accessible to the outside for direct pickup or disposal.
11. Office(s) or desk spaces for dietitian(s) and/or a dietary service manager.
12. Toilets for dietary staff convenient to the kitchen area.
13. A janitors closet located within the dietary department. This shall include a floor receptor or service sink and storage space for housekeeping equipment and supplies.
14. Self-dispensing icemaking facilities. These may be located in the food preparation area or in a separate room, but must be easily cleanable and convenient to the dietary function.

7.18 Administration and Public Areas

The following shall be provided:

A. Entrance

This shall be at grade level, sheltered from inclement weather, and accessible to the handicapped.

B. Lobby

This shall include:

1. A counter or desk for reception and information.
2. Public waiting area(s).
3. Public toilet facilities.
4. Public telephones.
5. Drinking fountain(s).

C. Interview Space(s)

These shall include provisions for private interviews relating to social service, credit, and admissions.

D. Admissions Area

For initial admission of inpatients, the area shall include:

1. A separate waiting area for patients and accompanying persons.
2. A work counter or desk for staff.
3. A storage area for wheelchairs, out of the path of normal traffic.

E. General or Individual Office(s)

These shall be provided for business transactions, medical and financial records, and administrative and professional staff.

F. Multipurpose Room(s)

These shall be provided for conferences, meetings, and health education purposes, and include provisions for the use of visual aids. One multipurpose room may be shared by several services.

G. Storage for Office Equipment and Supplies**H. Quality Assurance and Utilization Review Area****7.19 Medical Records**

Rooms, areas, or offices for the following personnel and/or functions shall be provided:

A. Medical Records Administrator/Technician

- B. Review and Dictation
- C. Sorting, Recording, or Microfilming Records
- D. Record Storage

7.20 Central Services

The following shall be provided:

- A. **Receiving and Decontamination Room**
This room shall contain workspace and equipment for cleaning medical and surgical equipment and for disposing of used/soiled material. It shall include handwashing facilities. Lockers, showers, and toilets for staff employed in this area shall be provided if not available in other conveniently located employee facilities.
- B. **Clean Workroom**
This workroom shall contain handwashing facilities, workspace and equipment for terminal sterilizing of medical and surgical equipment and supplies. Clean and soiled work areas should be physically separated.
- C. **Storage Area for Clean Medical/Surgical Supplies and for Sterile Supplies**
(This area may be in the clean workroom.) Storage for packs etc., shall include provisions for ventilation, humidity, and temperature control.
- D. **Storage Room for Equipment Used in Delivery of Patient Care**
- E. **Storage Area or Room for Distribution Carts**

7.21 General Stores

In addition to supply facilities in individual departments, a central storage area shall also be provided. General stores may be located in a separate building on site with provisions for protection against inclement weather during transfer of supplies.

The following shall be provided:

- A. **Offstreet Unloading Facilities**

B. Receiving Area

C. General Storage Room(s)

General storage room(s) with a total area of not less than 20 square feet (1.86 square meters) per inpatient bed shall be provided. Storage may be in separate, concentrated areas within the institution or in one or more individual buildings onsite. A portion of this storage may be provided offsite.

D. Additional Storage Room(s)

Additional storage areas for outpatient facilities shall be provided in an amount not less than 5 percent of the total area of the outpatient facilities. This may be combined with and in addition to the general stores or be located in a central area within the outpatient department. A portion of this storage may be provided offsite.

7.22 Linen Services

A. General

Each facility shall have provisions for storing and processing of clean and soiled linen for appropriate patient care. Processing may be done within the facility, in a separate building on or off site, or in a commercial or shared laundry.

- B. Facilities and equipment shall be as required for cost effective operation as described in the functional program. At a minimum, the following elements shall be included:
 1. A separate room for receiving and holding soiled linen until ready for pickup or processing.
 2. A central, clean linen storage and issuing room(s), in addition to the linen storage required at individual patient units.
 3. Cart storage area(s) for separate parking of clean- and soiled-linen carts out of traffic.
 4. A clean-linen-inspection-and-mending room or area.
 5. Handwashing facilities in each area where unbagged, soiled linen is handled.
- C. If linen is processed outside the building, provisions shall also be made for:
 1. A service entrance, protected from inclement weather, for loading and unloading of linen.
 2. Control station for pickup and receiving.
- D. If linen is processed in a laundry facility which is part of the project (within or as a separate building), the following shall be provided in addition to that of 7.22(B):
 1. A receiving, holding, and sorting room for control and distribution of soiled linen. Discharge from

soiled linen chutes may be received within this room or in a separate room.

2. Laundry processing room with commercial type equipment which can process at least a seven day supply within the regular scheduled work week. This may require a capacity for processing a seven day supply in a 40-hour week.

3. Storage for laundry supplies.

4. Employee handwashing facilities in each room where clean or soiled linen is processed and handled.

5. Arrangement of equipment that will permit an orderly work flow and minimize cross-traffic that might mix clean and soiled operations.

6. Conveniently accessible staff lockers, showers, and lounge.

7.23 Facilities for Cleaning and Sanitizing Carts

Facilities shall be provided to clean and sanitize carts serving the central service department, dietary facilities, and linen services. These facilities may be centralized or departmentalized.

7.24 Employee Facilities

Lockers, lounges, toilets, etc. should be provided for employees and volunteers. These should be in addition to, and separate from, those required for medical staff and public.

7.25 Janitors Closets

In addition to the janitors closets required in certain departments, sufficient janitors closets shall be provided throughout the facility as required to maintain a clean and sanitary environment. Each shall contain a floor receptor or service sink and storage space for housekeeping equipment and supplies. There shall not be less than one janitor's closet for each floor.

7.26 Engineering Service and Equipment Areas

The following shall be provided as necessary for effective service and maintenance functions:

- A. Room(s) or separate building(s) for boilers, mechanical, and electrical equipment.
- B. Engineer's office(s) with file space and provisions for protected storage of facility drawings, records, manuals, etc.
- C. General maintenance shop(s) for repair and maintenance.
- D. Storage room for building maintenance supplies. Storage for solvents and flammable liquids shall comply with applicable NFPA codes.
- E. Separate area or room specifically for storage, repair, and testing of electronic and other medical equipment. The amount of space and type of utilities will vary with the type of equipment involved and types of outside contracts used.
- F. Yard equipment and supply storage areas shall be located so that equipment may be moved directly to the exterior without interference with other work.

7.27 Waste Processing Services

A. Storage and Disposal

Facilities shall be provided for sanitary storage and treatment or disposal of waste using techniques acceptable to the appropriate health and environmental authorities.

B. Incinerator

An incinerator shall be provided for the complete destruction of pathological waste. The incinerator may be shared by two or more nearby institutions. It may be acceptable in some jurisdictions to omit the incinerator if arrangements can be made with a licensed local service to pick up and incinerate pathological wastes.

1. Incinerators may also be used to dispose of other hospital waste where local regulations permit. All incinerators shall be designed and equipped for the actual quantity and type of waste to be destroyed and should meet all applicable air pollution regulations.

2. Incinerators with fifty-pounds-per-hour or greater capacities shall be in a separate room or outdoors; those with lesser capacities may be located in a separate area within the facility boiler

room. Rooms and areas containing incinerators shall have adequate space and facilities for incinerator charging and cleaning, as well as necessary clearances for work and maintenance. Provisions shall be made for operation, temporary storage, and disposal of materials so that odors and fumes do not drift back into occupied areas. Existing approved incinerator installations, which are not in separate rooms or outdoors, may remain unchanged provided they meet the above criteria.

3. The design and construction of incinerators and trash chutes shall comply with NFPA 82.

4. Consideration shall be given to the recovery of waste heat from onsite incinerators used to dispose of large amounts of waste materials.

C. Nuclear Waste Disposal

See *Code of Federal Regulations*, title X, parts 20 and 35, concerning the handling and disposal of nuclear materials in health care facilities.

7.28 General Standards for Details and Finishes

If approved by the authorities having jurisdiction, retained portions of existing facilities that are not required to be totally modernized due to financial or other hardships, may as a minimum, comply with applicable requirements of the Existing Health Care Occupancies Section of NFPA 101. However, a plan of correction for these portions should also be developed and implemented.

Details and finishes in new construction projects, including additions and alterations, shall comply with the following (see section 1.2 of this document concerning existing facilities where total compliance is structurally impractical):

A. Details

1. New work, including that in retained existing areas, shall, as far as structurally practical, comply with all applicable requirements of access for the handicapped. However, it is not intended that access requirements restrict new work by forcing unreasonable additions. (For example, the replacement of an existing, inadequate door may be impractical because of column interference and/or other factors.) The project scope might be expanded to include additional alterations necessary for access and use by the handicapped.

2. Compartmentation, exits, fire alarms, automatic extinguishing systems, and other fire prevention and fire protection measures, including that within existing facilities, shall comply with NFPA 101, with the following stipulation. The Fire-Safety

Evaluation System (FSES) of appendix C shall not be used as a substitute for the basic NFPA 101 design criteria for new construction or major renovation in existing facilities. (The FSES is intended as an evaluation tool for fire safety only.) See section 1.5 of this document for exceptions. **Note:** For most projects it is essential that third-party reimbursement requirements also be followed. Verify where these may be in excess of standards in this document.

3. Corridors in outpatient suites and in areas not commonly used for patient bed or stretcher transportation may be reduced in width to 5 feet (1.5 meters).

4. Location of items such as drinking fountains, telephone booths, vending machines, and portable equipment shall not restrict corridor traffic or reduce the corridor width below the model standard.

5. Rooms which contain bathtubs, sitz baths, showers, and/or water closets for inpatient use shall be equipped with doors and hardware permitting emergency access from the outside. When such rooms have only one opening or are small, the doors shall open outward or in a manner that will avoid pressing a patient who may have collapsed within the room. Similar considerations may be desirable for certain outpatient services.

6. If required by the program, door hardware on patient toilet rooms in psychiatric nursing units may be designed to allow staff to control access.

7. The minimum door width for inpatient bedrooms in new work shall be 3 feet 8 inches (1.11 meters) wide and 7 feet (2.13 meters) high to provide clearance for movement of beds. Existing doors of not less than 2 feet 10 inches (86.4 centimeters) wide may be considered for acceptance where function is not adversely affected and replacement is impractical. Doors to other rooms (including office and general areas that might be used by handicapped employees, visitors, or patients) used for stretchers (including hospital wheeled-bed stretchers) and/or wheelchairs shall have a minimum width of 2 feet 10 inches (86.4 centimeters). Jamb clearances on the doorknob side shall be provided for wheelchair access. **Note:** While these standards are intended for access by patients and patient equipment, size of office furniture, etc., shall also be considered.

8. All doors between corridors, rooms, or spaces subject to occupancy, except elevator doors, shall be of the swing type. Openings to showers, baths, patient toilets, ICU patient compartments with the break-away feature, and other such areas not leading to fire exits may be exempt from this standard.

9. Doors, except those to spaces such as small closets not subject to occupancy, shall not swing into corridors in a manner that might obstruct traffic flow or reduce the required corridor width.

(Large walk-in-type closets are considered inhabitable spaces.)

10. Windows and outer doors that frequently may be left open shall be equipped with insect screens.

11. Patient rooms or suites in new constructions intended for 24-hour occupancy shall have windows or vents that can be opened from the inside to vent noxious fumes and smoke products and to bring in fresh air in emergencies. Operation of such windows shall be restricted to inhibit possible escape or suicide. Where the operation of windows or vents require the use of tools or keys, these shall be on the same floor and easily accessible to staff. Windows in existing buildings designed with approved engineered smoke-control systems may be of fixed construction.

12. Doors, sidelights, borrowed lights, and windows glazed to within 18 inches (46 centimeters) of the floor shall be constructed of safety glass, wired glass, or plastic, break-resistant material that creates no dangerous cutting edges when broken. Similar materials shall be used for wall openings in active areas such as recreation and exercise rooms, unless otherwise required for fire safety. Safety glass or plastic glazing materials shall be used for shower doors and bath enclosures. Plastic and similar materials used for glazing shall comply with the flame-spread ratings of NFPA 101.

Safety glass or plastic glazing materials, as noted above, shall also be used for interior windows and doors, including those in pediatric and psychiatric unit corridors.

Note: Provisions of this paragraph concern safety from hazards of breakage. NFPA 101 contains additional requirements for glazing in exit corridors, etc., especially in buildings without sprinkler systems.

13. Linen and refuse chutes shall meet or exceed the following standards:

- a. Service openings to chutes shall comply with NFPA 101.
- b. The minimum cross-sectional dimension of gravity chutes shall be 2 feet (61 centimeters).
- c. Chute discharge into collection rooms shall comply with NFPA 101.
- d. Chutes shall meet the provisions as described in NFPA 82.

14. Dumbwaiters, conveyors, and material-handling systems shall not open directly into a corridor or exit, but shall open into a room enclosed by construction with a fire resistance rating of not less than one hour and with class C, ¾-hour labeled fire

doors. Service entrance doors to vertical shafts containing dumbwaiters, conveyors, and material handling systems shall be not less than class B, 1½-hour fire doors. Where horizontal conveyors and material-handling systems penetrate fire-rated walls or partitions, such openings must be provided with class B 1½-hour labeled fire doors for 2-hour walls and class C ¾-hour labeled fire doors for 1-hour walls or partitions.

15. Thresholds and expansion joint covers shall be flush with the floor surface to facilitate the use of wheelchairs and carts. Expansion and seismic joints shall be constructed to restrict the passage of smoke.

16. Grab bars shall be provided in all patient toilets, showers, bathtubs, and sitz baths at a wall clearance of 1½ inches (3.8 centimeters). Bars, including those which are part of such fixtures as soap dishes, shall be sufficiently anchored to sustain a concentrated load of 250 pounds (113.4 kilograms).

17. Location and arrangement of fittings for handwashing facilities shall permit their proper use and operation. Particular care should be given to the clearances required for blade-type operating handles.

18. Mirrors shall not be installed at handwashing fixtures in food preparation areas, nurseries, clean and sterile supply areas, scrub sinks, or other areas where asepsis control would be lessened by hair combing.

19. Provisions for hand drying shall be included at all handwashing facilities except scrub sinks. These provisions shall be paper or cloth units enclosed to protect against dust or soil and to insure single-unit dispensing. Hot air dryers are permitted provided that installation precludes possible contamination by recirculation of air.

20. Lavatories and handwashing facilities shall be securely anchored to withstand an applied vertical load of not less than 250 pounds (113.4 kilograms) on the fixture front.

21. Radiation protection requirements for X-ray and gamma ray installations shall conform with NCRP Report Nos. 33 and 49 and all applicable local requirements. Provision shall be made for testing completed installations before use. All defects must be corrected before approval. Testing is to be coordinated with local authorities to prevent duplication.

22. The minimum ceiling height shall be 7 feet 10 inches (2.38 meters), with the following exceptions:

- a. Boiler rooms shall have ceiling clearances not less than 2 feet 6 inches (76 centimeters) above

the main boiler header and connecting piping.

b. Ceilings in radiographic, operating and delivery rooms, and other rooms containing ceiling-mounted equipment or ceiling-mounted surgical light fixtures shall be of sufficient height to accommodate the equipment or fixtures and their normal movement.

c. Ceilings in corridors, storage rooms, and toilet rooms shall be not less than 7 feet 8 inches (2.34 meters) in height. Ceilings in small, normally unoccupied spaces may be reduced to a height of 7 feet (2.13 meters).

d. Suspended tracks, rails, and pipes located in the traffic path for patients in beds and/or on stretchers, including those in inpatient service areas, shall be not less than 7 feet (2.13 meters) above the floor. Clearances in other areas may be 6 feet 8 inches (2.03 meters).

e. Where existing structures make the above ceiling clearance impractical, clearances shall be as required to avoid injury to individuals up to 6 feet 4 inches (1.93 meters) tall.

23. Recreation rooms, exercise rooms, equipment rooms, and similar spaces where impact noises may be generated shall not be located directly over patient bed areas or delivery and operating suites, unless special provisions are made to minimize such noise.

24. Rooms containing heat-producing equipment, such as boiler or heater rooms or laundries, shall be insulated and ventilated to prevent the floor surface above and/or the adjacent walls of occupied areas from exceeding a temperature of 10°F (6°C) above ambient room temperature.

25. The noise reduction criteria shown in table 1 shall apply to partitions, floors, and ceiling construction in patient areas.

B. Finishes

1. Cubicle curtains and draperies shall be noncombustible or flame-retardant, and shall pass both the large and small scale tests of NFPA 701.

2. Materials and certain plastics known to produce noxious gases when burned shall not be used for mattresses, upholstery, and other items insofar as practical. (Typical "hard" floor coverings such as vinyl, vinyl asbestos, and rubber normally do not create a major fire or smoke problem.)

3. Floors in areas and rooms in which flammable anesthetic agents are stored or administered shall comply with NFPA 99. Conductive flooring may be omitted in anesthetizing areas where a written resolution is signed by the hospital board stating that no flammable anesthetic agents will be used and appropriate notices are permanently and conspicuously affixed to the wall in each such area and room.

4. Floor materials shall be easily cleanable and appropriately wear-resistant for the location. Floors in

Table 1
Sound Transmission Limitations in General Hospitals

	Airborne sound transmission class (STC) ^a	
	Partitions	Floors
New construction		
Patient room to patient room	45	40
Public space to patient room ^b	55	40
Service areas to patient room ^c	65	45
Existing construction		
Patient room to patient room	35	40
Public space to patient room ^b	40	40
Service areas to patient room ^c	45	45

^a Sound transmission class (STC) shall be determined by tests in accordance with methods set forth in ASTM E90 and ASTM E413. *Where partitions do not extend to the structure above, sound transmission through ceilings and composite STC performance must be considered.*

^b Public space includes corridors, lobbies, dining rooms, recreation rooms, treatment rooms, and similar space.

^c Service areas include kitchens, elevators, elevator machine rooms, laundries, garages, maintenance rooms, boiler and mechanical equipment rooms, and similar spaces of high noise. Mechanical equipment located on the same floor or above patient rooms, offices, nurses stations, and similar occupied space shall be effectively isolated from the floor.

areas used for food preparation or food assembly shall be water-resistant. Floor surfaces, including tile joints, shall be resistant to food acids. In all areas subject to frequent wet-cleaning methods, floor materials shall not be physically affected by germicidal cleaning solutions. Floors subject to traffic while wet (such as shower and bath areas, kitchens, and similar work areas) shall have a nonslip surface.

5. In new-construction or major renovation work, the floors and wall bases of operating and delivery rooms shall be monolithic and joint free. The floors and wall bases of kitchens, soiled workrooms, and other areas subject to frequent wet cleaning shall also be homogenous, but may have tightly sealed joints.

6. Wall finishes shall be washable, and in the immediate vicinity of plumbing fixtures shall be smooth and moisture-resistant. Finish, trim, floor, and wall construction in dietary and food preparation areas shall be free of insect- and rodent-harboring spaces.

7. Floors and walls penetrated by pipes, ducts, and conduits shall be tightly sealed to minimize entry of rodents and insects. Joints of structural elements shall be similarly sealed.

8. The finishes of all exposed ceilings and ceiling structures in areas normally occupied by patients or staff, and those in food preparation or food storage areas shall be readily cleanable with routine house-keeping equipment. Dietary and other areas where dust fallout would present a potential problem shall have finished ceilings. Ceilings and walls in operating and delivery rooms, isolation rooms, and sterile processing rooms shall be monolithic from wall to wall and free of fissures, open joints, or crevices that may retain or permit passage of dirt particles. Acoustic and/or lay-in ceilings, where used, shall be of the type that does not interfere with infection control.

Ceiling construction in psychiatric patient and seclusion room(s) shall be monolithic.

7.29 Design and Construction, Including Fire-Resistive Standards

A. Design

Every building and portion thereof shall be designed and constructed to sustain all live and dead loads, including seismic and other environmental forces, in accordance with accepted engineering practices and standards as prescribed by local jurisdiction or by one of the model building codes.

B. Construction

Construction shall comply with the applicable requirements of NFPA 101, the standards contained herein, and the requirements of authorities having jurisdiction. If there are no applicable local codes, one of the recognized model building codes shall be used (see section 1.5 of this document).

Note: NFPA 101 generally covers fire/safety requirements only, whereas most model codes also apply to structural elements. The fire/safety items of NFPA 101 would take precedence over other codes in case of conflict. Appropriate application of each would minimize problems. For example, some model codes require closers on all patient doors. NFPA 101 recognizes the potential fire/safety problems of this requirement and stipulates that if closers are used for patient room doors, smoke detectors should also be provided within each affected patient room.

C. Freestanding Buildings

Separate freestanding buildings for the boiler plant, laundry, shops, general storage or other nonpatient contact areas shall be built in accordance with applicable building codes for such occupancy.

D. Interior Finishes

Interior finishing materials shall comply with the flame-spread limitations and the smoke-production limitations indicated in NFPA 101. This does not apply to minor quantities of wood or other trim (see NFPA 101) or to wall covering less than four mil thick applied over a noncombustible base.

E. Insulation Materials

Building insulation materials, unless sealed on all sides and edges with noncombustible material, shall have a flame-spread rating of 25 or less and a smoke-developed rating of 150 or less when tested in accordance with NFPA 258.

F. Provisions for Disasters (See also section 1.4 of this document.)

1. An emergency-radio communication system shall be provided in each facility. This system shall operate independently of the building's service and emergency power systems during emergencies. The system shall have frequency capabilities to communicate with state emergency communication networks. Additional communication capabilities will be required of facilities containing a formal community emergency-trauma service or other specialty services (such as regional pediatric intensive care units) that utilize staffed patient transport units.

2. In regions where earthquakes have caused loss of life or extensive property damage, buildings and structures (including critical components of mechanical and electrical systems) shall be designed to withstand force assumptions in accordance with NBSIR 81-2195, *Draft Seismic Standard for Federal Buildings* and as noted herein and in section 1.4 of this document.

All hospitals should be constructed and reinforced to minimize the potential of serious injury to patients from any cause including earthquakes. In addition, hospitals that constitute the only source of emergency care and hospitalization in an area should be able to remain operational. New buildings can be designed and constructed to withstand severe seismic shock at minimal additional cost; how-

ever, it may be impractical to bring certain existing buildings into total compliance with current seismic standards. Authorities having jurisdiction should balance the practicality of required corrective measures against the potential for damage and the community need.

The occupancy importance factor shown in table C-1 of NBSIR 81-2195 may be reduced to 1.0 for construction if all of the following criteria are met:

a. The facility meets building code requirements in effect at the time of construction and is expected to retain its structural integrity to the extent that occupants will not suffer serious injury from collapse or failure due to regional seismic activity.

b. There are one or more additional appropriate facilities within 45 minutes normal travel time from the affected hospital to which at least 50 percent of the inpatients may be transferred in the event that the facility is temporarily or permanently nonfunctional.

c. The area hospital distribution is such that, if all facilities within any five-mile radius or within five-miles of any one fault line were rendered inoperative, there would still be functioning emergency hospital facilities outside the area of severe damage within 45 minutes normal travel time.

Note: Though seismic jolts may be felt for many miles, it is expected that major damage from seismic activity will be limited to a relatively small area around the epicenter and/or to each side of a fault line.

3. Unless specifically approved, hospitals shall not be built in areas subject to damage or inaccessibility due to natural floods. Where facilities may be subject to wind or water hazards, provision shall be made to ensure continuous operation.

7.30 Elevators

A. General

All hospitals having patient facilities (such as bedrooms, dining rooms, or recreation areas) or critical services (such as operating, delivery, diagnostic, or therapy) located on other than the grade-level entrance floor shall have electric or hydraulic elevators. Installation and testing of elevators shall comply with ANSI A17.1, UFAS or ANSI A117.1.

1. In the absence of an engineered traffic study the following guidelines for number of elevators shall apply:

a. At least one hospital-type elevator shall be installed when 1 to 59 patient beds are located on any floor other than the main entrance floor.

b. At least two hospital-type elevators shall be installed when 60 to 200 patient beds are located on floors other than the main entrance floor, or where the major inpatient services are located on a floor other than those containing patient beds. (Elevator service may be reduced for those floors providing only partial inpatient services.)

c. At least three hospital-type elevators shall be installed where 201 to 350 patient beds are located on floors other than the main entrance floor, or where the major inpatient services are located on a floor other than those containing patient beds. (Elevator service may be reduced for those floors which provide only partial inpatient services.)

d. For hospitals with more than 350 beds, the number of elevators shall be determined from a study of the hospital plan and the expected vertical transportation requirements.

2. Hospital-type elevator cars shall have inside dimensions that accommodate a patient bed with attendants. Cars shall be at least 5 feet (1.52 meters) wide by 7 feet 6 inches (2.29 meters) deep. Car doors shall have a clear opening of not less than 4 feet (1.22 meters) wide and 7 feet (2.13 meters) high.

Note: Additional elevators installed for visitors and material handling may be smaller than noted above, within restrictions set by standards for handicapped access.

3. Elevators shall be equipped with a two-way automatic level-maintaining device with an accuracy of $\pm \frac{1}{4}$ inch (± 0.7 centimeters). See UFAS or ANSI A117.1.

4. Each elevator, except those for material handling, shall be equipped with a two-way special service switch for staff use for bypassing all landing button calls and traveling directly to any floor. See UFAS or ANSI A117.1.

5. Elevator controls, landing calls, alarm buttons, and telephones (if provided) shall be in accordance with UFAS or ANSI A117.1.

6. Elevator call buttons and controls shall not be activated by heat or smoke. Light beams, if used for operating door reopening devices without touch, shall be used in combination with door-edge safety devices and shall be interconnected with a system of smoke detectors. This is so that the light control feature will be overridden or disengaged should it encounter smoke at any landing.

B. Field Inspection and Tests

Inspections and tests shall be made and the owner shall be furnished with written certification stating

that the installation meets the requirements set forth in this section as well as all applicable safety regulations and codes.

7.31 Mechanical Standards

A. General

1. The mechanical system should be designed for overall efficiency and life cycle costing. Details for cost-effective implementation of design features are interrelated and too numerous (as well as too basic) to list individually. Recognized engineering procedures shall be followed for the most economical and effective results. A well-designed system can generally achieve energy efficiency at minimal additional cost and simultaneously provide improved patient comfort. Different geographic areas may have climatic and use conditions that favor one system over another in terms of overall cost and efficiency. In no case shall patient care or safety be sacrificed for conservation (see appendix).

2. 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 shall be given to additional work that may be needed to achieve this.

3. Facility design consideration shall include site, building mass, orientation, configuration, fenestration, and other features relative to passive and active energy systems.

4. Insofar as practical, the facility should include provisions for recovery of waste cooling and heating energy (ventilation, exhaust, water and steam discharge, cooling towers, incinerators, etc.).

5. Facility design consideration shall include recognized energy-saving mechanisms such as variable-air-volume systems, load shedding, programmed controls for unoccupied periods (nights and weekends, etc.) and use of natural ventilation, site and climatic conditions permitting. Systems with excessive installation and/or maintenance costs that negate long-range energy savings should be avoided (see appendix).

6. Controls for air-handling systems shall be designed with an economizer cycle where appropriate to use outside air for required cooling and/or heating. (Use of mechanically circulated outside air does not reduce need for filtration.)

It may be practical in many areas to reduce or shut down mechanical ventilation during appropriate climatic and patient-care conditions and to use open windows for ventilation.

7. Major changes have been made to previous ventilation standards to permit maximum use of simplified systems, such as the variable-air-volume (VAV) supply. However, care must be taken in design to avoid possibility of large temperature differentials, high velocity supply, excessive noise, air stagnation, etc. Air supply and exhaust in rooms for which no minimum total air change rate is noted may vary down to zero in response to room load. For rooms listed in table 3, where VAV systems are permitted, minimum total air change shall be within limits noted. Temperature control shall also comply with these standards. To maintain asepsis control, airflow supply and exhaust should generally be controlled to ensure movement of air from "clean" to "less clean" areas, especially in critical areas.

8. Prior to acceptance of the facility, all mechanical systems shall be tested, balanced, and operated to demonstrate to the design engineer or his representative that the installation and performance of these systems conform to design intent. Test results shall be documented for maintenance files.

9. Upon completion of the equipment-installation contract, the owner shall be furnished with a complete set of manufacturers' operating, maintenance, and preventive maintenance instructions, a parts lists, and complete procurement information including equipment numbers and descriptions. Operating staff persons shall also be provided with instructions for properly operating systems and equipment. Required information shall include energy ratings as needed for future conservation calculations.

B. Thermal and Acoustical Insulation

1. Insulation within the building shall be provided to conserve energy, protect personnel, prevent vapor condensation, and reduce noise and vibration for the following:

- a. Boilers, smoke breeching, and stacks.
- b. Steam supply and condensate return piping.
- c. Heating, hot water supply, and return piping.
- d. Chilled water, refrigerant, and other process piping and equipment operating with fluid temperatures below the ambient dew point.
- e. Cold water supply and drainage piping on which condensation may occur.
- f. Domestic hot water piping, water heaters, tanks, generators, and converters.
- g. Heating, ventilating, air conditioning, and air-handling duct systems (including ducts, plenums and casings) with surface temperatures 9°F (5°C)

above or below the ambient dry-bulb or dew-point temperatures.

h. Other piping, ducts, and equipment where applicable.

2. Insulation on cold surfaces shall include an exterior vapor barrier. (Material that will not absorb or transmit moisture will not require a separate vapor barrier.)

3. Insulation, including finishes and adhesives on the exterior surfaces of ducts and equipment, shall have a flame-spread rating of 25 or less and a smoke-developed rating of 50 or less as determined by an independent testing laboratory in accordance with NFPA 255. The smoke-development rating for pipe insulation shall not exceed 150. This includes mechanical refrigeration and distribution equipment and hot water distribution equipment such as valves, pumps, chillers, etc.

4. Use of duct linings is generally discouraged as they increase energy costs by increasing system-pressure drops. Moreover, remodeling of lined duct systems destroys the integrity of the liner sealant. However, if linings are used in nonsensitive hospital areas, they shall meet the erosion test method described in Underwriters' Laboratories, Inc., publication no. 181. These linings (including coatings, adhesives, and exterior surface insulation on pipes and ducts in spaces used as air supply plenums) shall have a flame-spread rating of 25 or less and a smoke-developed rating of 50 or less, as determined by an independent testing laboratory in accordance with NFPA 255.

5. Duct linings exposed to air movement should not be used in ducts serving operating rooms, delivery rooms, LDR rooms, nurseries, and intensive care units. Where its use cannot be avoided, terminal filters of at least 90 percent efficiency shall be installed downstream of all lining material. This requirement shall not apply to mixing boxes and acoustical traps that have special coverings over such lining.

6. Asbestos insulation shall not be used in health facilities.

7. Existing accessible insulation within areas of facilities to be modernized shall be inspected, repaired, and/or replaced, as appropriate.

C. Steam and Hot Water Systems

1. Boilers shall have the capacity, based upon the net ratings published by the Hydronics Institute or another acceptable national standard, to supply the normal heating, hot water, and steam requirements of all systems and equipment. Their number and arrangement shall accommodate facility needs despite the breakdown or routine maintenance of any one boiler. The capacity of the remaining boiler(s) shall be sufficient to provide hot water service for clinical, dietary, and patient use; steam for sterilization

and dietary purposes; and heating for operating, delivery, birthing, labor, recovery, intensive care, nursery, and general patient rooms. However, reserve capacity for facility space heating is not required in geographic areas where a design dry-bulb temperature of 25°F (-4°C) or more represents not less than 99 percent of the total hours in any one heating month as noted in ASHRAE's *Handbook of Fundamentals*, under the "Table for Climatic Conditions for the United States."

2. Boiler accessories including feed pumps, heat-circulating pumps, condensate return pumps, fuel oil pumps, and waste heat boilers shall be connected and installed to provide both normal and standby service.

3. Supply and return mains and risers for cooling, heating, and steam systems shall be equipped with valves to isolate the various sections of each system. Each piece of equipment shall have valves at the supply and return ends.

D. Air Conditioning, Heating, and Ventilation Systems

1. The ventilation rates shown in table 3 shall be used only as model standards; they do not preclude the use of higher, more appropriate rates. All rooms and areas in the facility shall have provisions for ventilation. Though natural window ventilation for nonsensitive areas and patient rooms may be employed, weather permitting, availability of mechanical ventilation should be considered for use in interior areas and during periods of temperature extremes. Fans serving exhaust systems shall be located at the discharge end and shall be readily serviceable. Exhaust systems may be combined to enhance the efficiency of recovery devices required for energy conservation.

a. Facility design should utilize energy-conserving mechanisms, including recovery devices, variable air volume, load shedding, and systems to shut down or reduce ventilation of unoccupied areas, insofar as patient care is not compromised. When appropriate, mechanical ventilation should employ an economizer cycle that uses outside air to reduce heating- and cooling-system loads. Filtering requirements shall be met if outside air is used as part of the mechanical ventilation system. Innovative design that provides for additional energy conservation while meeting standards for acceptable patient care should be considered (see appendix).

b. Fresh air intakes shall be located at least 25 feet (7.62 meters) from exhaust outlets of ventilating systems, combustion equipment stacks, medi-

cal-surgical vacuum systems, plumbing vents, or areas that may collect vehicular exhaust or other noxious fumes. (Prevailing winds and/or proximity to other structures may require greater clearances.) Plumbing and vacuum vents that terminate at a level above the top of the air intake may be located as close as 10 feet (3.05 meters). The bottom of outdoor air intakes serving central systems shall be as high as practical, but at least 6 feet (1.83 meters) above ground level, or, if installed above the roof, 3 feet (91 centimeters) above roof level. Exhaust outlets from areas that may be contaminated shall be above roof level and arranged to minimize recirculation of exhaust air into the building.

c. The ventilation systems shall be designed and balanced according to the requirements shown in table 3 and in the applicable notes. (Also see note 8 of table 3 for reductions and shutdown of ventilation systems during room vacancy.)

d. In new-construction and major renovation work, air supply for operating and delivery rooms shall be from ceiling outlets near the center of the work area. This will most effectively control air movement. Return air shall be from the floor level. Each operating and delivery room shall have at least two return-air inlets located as remotely from each other as practical. (Design should consider turbulence and other factors of air movement to minimize fall of particulates onto sterile surfaces.) Where extraordinary procedures, such as organ transplants, justify special designs, installation shall properly meet performance needs as determined by applicable standards. These special designs should be reviewed on a case-by-case basis.

e. Air supply for nurseries, LDR rooms, and rooms used for invasive procedures shall be at or near the ceiling. Return air inlets shall be near the floor level.

f. Each space routinely used for administering inhalation anesthesia shall be equipped with a scavenging system to vent waste gases. If a vacuum system is used, the gas-collecting system shall be arranged so that it does not disturb patients' respiratory systems. Gases from the scavenging system shall be exhausted directly to the outside. The anesthesia evacuation system may be combined with the room exhaust system, provided that the part used for anesthesia gas scavenging exhausts directly to the outside and is not part of the recirculation system. Separate scavenging systems are not required for areas where gases are used only occasionally, such as the emergency room, offices for routine dental work, etc. Acceptable concentrations of anesthetizing agents are unknown at this time. The absence of specific data makes it difficult to set specific standards. However, any scavenging system should be designed to remove as much of the gas as possible from the room environment. It is assumed

that anesthetizing equipment will be selected and maintained to minimize leakage and contamination of room air.

g. The bottoms of ventilation (supply/return) openings shall be at least 3 inches (7.6 centimeters) above the floor.

h. All central ventilation or air conditioning systems shall be equipped with filters with efficiencies equal to, or greater than, those specified in table 2. Where two filter beds are required, filter bed no. 1 shall be located upstream of the air conditioning equipment and filter bed no. 2 shall be downstream of any fan or blowers. Filter efficiencies, tested in accordance with ASHRAE 52-76, shall be average except as noted otherwise. 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. A manometer shall be installed across each filter bed having a required efficiency of 75 percent or more including hoods requiring HEPA filters.

i. Reservoir-type water spray humidifiers shall not be used.

j. Air-handling duct systems shall meet the requirements of NFPA 90A and those contained herein.

k. Ducts that penetrate construction intended for X-ray or other ray protection shall not impair the effectiveness of the protection.

l. Fire and smoke dampers shall be constructed, located, and installed in accordance with the requirements of NFPA 101 and 90A. Fans, dampers, and detectors shall be interconnected so that damper activation will not damage ducts. Maintenance access shall be provided at all dampers. All damper locations should be shown on drawings. Dampers should be activated by fire or smoke sensors, not by fan cutoff alone. Switching systems for restarting fans may be installed for fire department use in venting smoke after a fire has been controlled. However, provisions should be made to avoid possible damage to the system due to closed dampers. When smoke partitions are required, heating, ventilation, and air conditioning zones shall be coordinated with compartmentation insofar as practical to minimize need to penetrate fire and smoke partitions.

m. Hoods and safety cabinets should not be used for normal exhaust of a space. If air change standards in table 3 do not provide sufficient air for proper operation of exhaust hoods and safety cabinets (when in use), supplementary makeup air (fil-

Table 2
**Filter Efficiencies for Central Ventilation and Air Conditioning Systems
 in General Hospitals**

Area designation	No. filter beds	Filter bed no. 1	Filter bed no. 2
All areas for inpatient care, treatment, and/or diagnosis, and those areas providing direct service or clean supplies such as sterile and clean processing, etc.	2	25	90
Laboratories	1	80	—
Administrative, bulk storage, soiled holding areas, food preparation areas, and laundries	1	25	—

Notes. Additional roughing or prefilters should be considered to reduce maintenance required for main filters. Ratings shall be based on ASHRAE 52-76.

tered and preheated) should be provided around these units to maintain the required airflow direction and exhaust velocity. Supplementary makeup air will avoid dependence upon infiltration from outdoor and/or from contaminated areas. Makeup systems for hoods shall be arranged to minimize "short circuit" of air movement and to avoid reduction in air velocity at the point of contaminant capture.

n. Laboratory hoods shall meet the following general standards:

- i. Have an average face-velocity of at least 75 feet per minute (0.38 meters per second).
- ii. Be connected to an exhaust system to the outside which is separate from the building exhaust system.
- iii. Have an exhaust fan located at the discharge end of the system.
- iv. Have an exhaust duct system of noncombustible corrosion-resistant material as needed to meet the planned usage of the hood.

o. Laboratory hoods shall meet the following special standards:

- i. Fume hoods, and their associated equipment in the air stream, intended for use with perchloric acid and other strong oxidants, shall be constructed of stainless steel or other material consistent with special exposures, and be provided with a water wash and drain system to permit periodic flushing of duct and hood. Electrical equipment intended for installation within such ducts shall be designed and constructed to resist penetration by water.

Lubricants and seals shall not contain organic materials. When perchloric acid or other strong oxidants are only transferred from one container to another, standard laboratory fume hoods and the associated equipment may be used in lieu of stainless steel construction. Fume hoods intended for use with radioactive isotopes shall be constructed of stainless steel or other material suitable for the particular exposure and shall comply with NFPA 801, *Facilities for Handling Radioactive Materials*. **Note:** Radioactive isotopes used for injections, etc., without probability of airborne particulates or gases may be processed in a clean-workbench-type hood where acceptable to the Nuclear Regulatory Commission.

- ii. In new construction and major renovation work, each hood used to process infectious or radioactive materials shall have a minimum face velocity of 150 feet per minute (0.76 meters per second) with suitable static-pressure-operated dampers and alarms to alert staff of fan shutdown. Each shall also have filters with a 99.97 percent efficiency (based on the DOP, dioctylphthalate test method) in the exhaust stream, and be designed and equipped to permit the safe removal, disposal, and re-

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Table 3
Ventilation Requirements for Areas Affecting Patient Care in Hospitals, Skilled Nursing, Outpatient, and Rehabilitation Facilities¹

Area designation	Air movement relationship to adjacent area ²	Minimum air changes outside air per hour ³	Minimum total air changes per hour ⁴	Recirculated by means of room units ⁴	All air exhausted directly outdoors ⁵	Relative humidity (%) ⁶	Design temperature (degrees) ⁷
Operating room ¹⁴	Out	3	15	No	—	50-60	70-75
Delivery room ¹⁴	Out	3	15	No	—	45-60	70-75
X-ray card. cath. and invas. spec. proc. ¹⁵	Out	3	15	No	—	45-60	70-75
Newborn nursery	—	1	6	No	—	30-60	75
Recovery room ¹⁴	—	2	6	No	—	30-60	70
Intensive care	—	2	6	No	—	30-60	70-75
Isolation room ¹⁰	In	—	6	No	Yes	—	70-75
Isolation alcove or anteroom ⁸	Out	—	10	No	Yes	—	—
Patient room	—	—	2	—	—	—	70-75
Labor delivery rooms (LDR)	—	—	2	—	—	—	70-75
Patient corridor	—	—	2	—	—	—	—
Examination room	—	—	6	—	—	—	75
Medication room	—	—	4	—	—	—	—
Pharmacy	—	—	4	—	—	—	—
Treatment room ⁹	—	—	6	—	—	—	75
Trauma room ⁹	Out	3	15	No	—	45-60	70-75
X-ray rm. and noninvas. spec. proc. ¹⁵	—	—	6	—	—	—	75
Physical Rx							
Hydrotherapy	In	—	6	—	—	—	75
Treatment room	—	—	6	—	—	—	70-75
Soiled utility	In	—	10	No	Yes	—	—
Clean utility	—	—	4	—	—	—	—
Autopsy room	In	—	12	No	Yes	—	—
Darkroom	In	—	10	No	Yes	—	—
Nonrefrigerated body-holding room ¹²	In	—	10	Yes	Yes	—	70
Toilet room	In	—	10	Yes	Yes	—	—
Bedpan room	In	—	10	Yes	Yes	—	—

¹ This table covers ventilation for comfort, as well as for asepsis and odor control in areas of acute care hospitals that directly affect patient care. Areas where specific standards are not given shall be ventilated in accordance with ASHRAE Standard 62-1981, "Ventilation for Acceptable Indoor Air Quality Including Requirements for Outside Air." Specialized patient care areas including organ transplant units, burn units, specialty procedure rooms, etc., shall have additional ventilation provisions for air quality control as may be appropriate. OSHA standards and/or NIOSH criteria require special ventilation requirements for employee health and safety within health care facilities.

² Design of the ventilation system shall, insofar as possible, provide that air movement is from "clean to less clean" areas. However, continuous compliance may be impractical with full utilization of some forms of variable air volume and load shedding systems which may be used for energy conservation. Areas which do require positive and continuous control are noted with "out" or "in" to indicate the required direction of air movement in relation to the space named (this designation was previously described as "positive" or "negative" pressure). Rate of air movement may, of course, be varied as needed within the limits required for positive control. Where indication of air movement direction is enclosed in parentheses, continuous directional control is required only when the tool is in use or where room use may otherwise compromise the intent of movement from clean to less clean. Air movement for rooms with dashes and nonpatient areas may vary as necessary to satisfy the requirements. Additional adjustments may be needed when space is unused or unoccupied and air systems are shut down or reduced.

³ To satisfy exhaust needs, replacement air from outside is necessary. Table 3 does not attempt to describe specific amounts of outside air to be supplied to individual spaces except for certain areas such as those listed. Distribution of the outside air, added to the system to balance required exhaust, shall be as required by good engineering practice.

⁴ Because of cleaning difficulty and potential for buildup of contamination, recirculating room units shall not be used in areas marked "No." Isolation and intensive care unit rooms may be ventilated by reheat induction units in which only the primary air supplied from a central system passes through the reheat unit. Gravity-type heating or cooling units such as radiators or convectors shall not be used in operating rooms and other special care areas.

⁵ Air from areas with contamination and/or odor problems shall be exhausted to the outside and not recirculated to other areas. Note that individual circumstances may require special consideration for air exhaust to outside, e.g., an intensive care unit in which patients with pulmonary infection are treated, and rooms for burn patients.

⁶ The ranges listed are the minimum and maximum limits where control is specifically needed.

⁷ Dual temperature indications (such as 70-75) are for an upper and lower variable range at which the room temperature must be controlled. A single figure indicates a heating or cooling capacity of at least the indicated temperature. This is usually applicable when patients may be undressed and require a warmer environment. Nothing in this document shall be construed as precluding the use of temperatures lower than those noted when the patients' comfort and medical conditions make lower temperatures desirable. Unoccupied areas such as storage, etc., shall have temperatures appropriate for the function intended.

⁸ Number of air changes may be reduced when the room is unoccupied if provisions are made to insure that the number of air changes indicated is reestablished any time the space is being utilized. Adjustments shall include provisions so that the direction of air movement shall remain the same when the number of air changes is reduced. Areas not indicated as having continuous directional control may have ventilation systems shut down when space is unoccupied and ventilation is not otherwise needed.

Table 3 (Continued)
Ventilation Requirements for Areas Affecting Patient Care in Hospitals, Skilled Nursing, Outpatient, and Rehabilitation Facilities¹

Area designation	Air movement relationship to adjacent area ²	Minimum air changes outside air per hour ³	Minimum total air changes per hour ⁴	Recirculated by means of room units ⁴	All air exhausted directly outdoors ⁵	Relative humidity (%) ⁶	Design temperature (degrees) ⁷
Bathroom	---	---	10	---	---	---	75
Janitors closet	In	---	10	No	Yes	---	---
Sterilizer equipment room ¹³	In	---	10	---	Yes	---	---
ETO-sterilizer room ¹³	In	---	10	No	Yes	---	75
Soiled linen and trash rooms	In	---	10	No	Yes	---	---
Laboratory							
General ¹⁴	---	---	6	---	---	---	---
Nuclear medicine ¹⁵	In	---	6	No	Yes	---	---
Pathology	In	---	6	No	Yes	---	---
Cytology	In	---	6	No	Yes	---	---
Biochemistry ¹⁶	Out	---	6	No	---	---	---
Histology	In	---	6	No	Yes	---	---
Microbiology ¹⁶	In	---	6	No	Yes	---	---
Serology	Out	---	6	No	---	---	---
Glass washing	In	---	10	---	Yes	---	---
Sterilizing	In	---	10	---	Yes	---	---
Food preparation center ¹¹	---	---	10	No	---	---	---
Ware washing	In	---	10	No	Yes	---	---
Dietary day storage	In	---	2	---	---	---	---
Laundry, general	---	---	10	---	Yes	---	---
Soiled linen (sorting and storage)	In	---	10	No	Yes	---	---
Clean linen	---	---	2	---	---	---	---
Anesthesia gas storage ¹⁴	---	---	8	---	Yes	---	---
Central supply							
Soiled room	In	---	6	No	Yes	---	---
Clean workroom and sterile storage	Out	---	4	No	---	(max) 70	75

⁹The term *trauma room* as used here is the operating room space in the emergency department, or other trauma reception area that is used for emergency surgery. The first aid room and/or "emergency room" used for initial treatment of accident victims may be ventilated as noted for the "treatment room."

¹⁰The isolation rooms described in these standards are those that might be utilized in the average community hospital. The assumption is made that most isolation procedures will be for infectious patients and that the room should also be suitable for normal private patient use when not needed for isolation. This compromise obviously does not provide for ideal isolation. The design should consider types and numbers of patients that might need this separation within the facility. When need is indicated by the program, it may be desirable to provide more complete control with a separate anteroom as an air lock to minimize potential for airborne particulates from the patients' area reaching adjacent areas. Certain types of patients such as those with organ transplants, burns, etc., may require special consideration, including reverse isolation for which the air movement relationship to adjacent areas would be "out" rather than "in." Where these requirements are reflected in the anticipated patient load, ventilation shall be modified as necessary. *Variable exhaust that allows maximum room space flexibility with reversible air flow direction would be useful only if appropriate adjustments can be assured for different types of isolation procedures.*

¹¹Food preparation centers shall have ventilation systems that have an excess of air supply for "out" air movements when hoods are not in operation. The number of air changes may be reduced or varied to any extent required for odor control when the space is not in use. See section 7.31D(1)(p) of this document for designation of hoods.

¹²A nonrefrigerated body-holding room would be applicable only for health care facilities in which autopsies are not performed on-site, or the space is used only for holding bodies for short periods prior to transferring.

¹³Specific OSHA regulations regarding ethylene oxide (ETO) use have been promulgated. 29 CFR Part 1910.1047 includes specific ventilation requirements including local exhaust of the ETO sterilizer area. Also, see section 7.31D(1)(r) of this document.

¹⁴National Institute of Occupational Safety and Health (NIOSH) Criteria Documents regarding Occupational Exposure to Waste Anesthetic Gases and Vapors, and Control of Occupational Exposure to Nitrous Oxide indicate a need for both local exhaust (scavenging) systems and general ventilation of the areas in which the respective gases are utilized.

¹⁵Large hospitals may have separate departments for diagnostic and therapeutic radiology and nuclear medicine. For specific information on radiation precautions and handling of nuclear materials, refer to appropriate publication of National Radiation Safety Council and Nuclear Regulatory Commission. Special requirements are imposed by the U.S. Nuclear Regulatory Commission (Regulatory Guide 10.8-1980) regarding use of Xenon-133 gas.

¹⁶When required, appropriate hoods and exhaust devices for the removal of noxious gases shall be provided (see section 7.31D(1)(o) and NFPA 99).

placement of contaminated filters. Filters shall be as close to the hood as practical to minimize duct contamination. Hoods that process radioactive materials shall meet the requirements of the Nuclear Regulatory Commission.

p. Exhaust hoods in food preparation centers shall comply with NFPA 96. All hoods over cooking ranges shall be equipped with grease filters, fire extinguishing systems, and heat-actuated fan controls. Cleanout openings shall be provided every 20 feet (6.10 meters) in the horizontal exhaust duct systems serving these hoods. (Horizontal runs of ducts serving range hoods should be kept to a minimum.)

q. The ventilation system for anesthesia storage rooms shall conform to the requirements of NFPA 99, including the gravity option. Mechanically operated air systems are optional in this room.

r. The space that houses ethylene oxide (ETO) sterilizers should be designed to:

- i. Provide a dedicated local exhaust system with adequate capture velocity (i.e., with a minimum capture of 200 feet per minute [1.01 meters per second]) to allow for the most effective installation of an air handling system, i.e., exhaust over sterilizer door, atmospheric exhaust vent for safety valve, exhaust at sterilizer, drain and exhaust for the aerator, and multiple load station.
- ii. Provide exhaust in ETO source areas such as service/aeration areas.
- iii. Ensure that general airflow is away from sterilizer operator(s).
- iv. Provide a dedicated exhaust duct system for ETO. The exhaust outlet to the atmosphere should be at least 25 feet (7.60 meters) away from any air intake.
- s. Boiler rooms shall be provided with sufficient outdoor air to maintain equipment combustion rates and to limit work station temperatures.
- t. Gravity exhaust may be used, where conditions permit, for nonpatient areas such as boiler rooms, central storage, etc.
- u. The energy-saving potential of variable air volume systems is recognized and these standards herein are intended to maximize appropriate use of that system. Any system utilized for occupied areas

shall include provisions to avoid air stagnation in interior spaces where thermostat demands are met by temperatures of surrounding areas (see appendix).

v. Special consideration shall be given to the type of heating and cooling units, ventilation outlets, and appurtenances installed in patient-occupied areas of psychiatric units. The following shall apply:

- i. All air grilles and diffusers shall be of a type that prohibits the insertion of foreign objects.
- ii. All convector or HVAC enclosures exposed in the room shall be constructed with rounded corners and shall have enclosures fastened with tamper-proof screws.
- iii. HVAC equipment shall be of a type that minimizes the need for maintenance within the room.

E. Plumbing and Other Piping Systems.

Unless otherwise specified herein, all plumbing systems shall be designed and installed in accordance with *National Standard Plumbing Code*, chapter 14, Medical Care Facility Plumbing Equipment.

1. The following standards shall apply to plumbing fixtures:

- a. The material used for plumbing fixtures shall be nonabsorptive and acid-resistant.
- b. Water spouts used in lavatories and sinks shall have clearances adequate to avoid contaminating utensils and the contents of carafes, etc.
- c. All fixtures used by medical and nursing staff and all lavatories used by patients and food handlers shall be trimmed with valves that can be operated without hands (single-lever devices may be used). Blade handles used for this purpose shall not exceed 4½ inches (11.4 centimeters) in length. Handles on scrub sinks and clinical sinks shall be at least 6 inches (15.2 centimeters) long.
- d. Clinical sinks shall have an integral trap wherein the upper portion of the water trap provides a visible seal.
- e. Showers and tubs shall have nonslip surfaces.

2. The following standards shall apply to potable water supply systems:

- a. Systems shall be designed to supply water at sufficient pressure to operate all fixtures and equipment during maximum demand. Supply capacity for hot- and cold-water piping shall be determined on the basis of fixture units, using recognized engineering standards. When the ratio of plumbing fixtures to occupants is proportionally more than required by the building occupancy and is in excess of 1,000 plumbing fixture units, a diversity factor is permitted.

Table 4
Hot Water Use

	Clinical	Dietary ¹	Laundry
Liters per second per bed*	.0033	.0020	.0021
Gallons per hour per bed*	3	2	2
Temperature (°C)**	43	49	71**
Temperature (°F)**	110	120	160**

¹ Provisions shall be made to provide 180°F (82°C) rinse water at warewasher. (May be by separate booster.)

*Quantities indicated for design demand of hot water are for general reference minimums and shall not substitute for accepted engineering design procedures using actual number and types of fixtures to be installed. Design will also be affected by temperatures of cold water used for mixing, length of run and insulation relative to heat loss, etc. As an example, total quantity of hot water needed will be less when temperature available at the outlet is very nearly that of the source tank and the cold water used for tempering is relatively warm.

**Provisions shall be made to provide 160°F (71°C) hot water at the laundry equipment when needed. (This may be by steam jet or separate booster heater.) However, it is emphasized that this does not imply that all water used would be at this temperature. Water temperatures required for acceptable laundry results will vary according to type of cycle, time of operation, and formula of soap and bleach as well as type and degree of soil. Lower temperatures may be adequate for most procedures in many facilities but the higher 160°F (71°C) should be available when needed for special conditions.

b. Each water service main, branch main, riser, and branch to a group of fixtures shall have valves. Stop valves shall be provided for each fixture. Appropriate panels for access shall be provided at all valves where required.

c. Backflow preventers (vacuum breakers) shall be installed on hose bibbs and supply nozzles used for connection of hoses or tubing in laboratories, janitors sinks, bedpan-flushing attachments, and autopsy tables, etc.

d. Bedpan-flushing devices (may be cold water) shall be provided in each inpatient toilet room; however, installation is optional in psychiatric and alcohol-abuse units where patients are ambulatory.

e. Potable water storage vessels (hot and cold) not intended for constant use shall not be installed.

3. The following standards shall apply to hot water systems:

a. The water-heating system shall have sufficient supply capacity at the temperatures and amounts indicated in table 4. Water temperature is measured at the point of use or inlet to the equipment.

b. Hot-water distribution systems serving patient care areas shall be under constant recircula-

tion to provide continuous hot water at each hot water outlet. The temperature of hot water for showers and bathing shall be appropriate for comfortable use but shall not exceed 120°F (49°C) (see table 4).

4. The following standards shall apply to drainage systems:

a. Drain lines from sinks used for acid waste disposal shall be made of acid-resistant material.

b. Drain lines serving some types of automatic blood-cell counters must be of carefully selected material that will eliminate potential for undesirable chemical reactions (and/or explosions) between sodium azide wastes and copper, lead, brass, and solder, etc.

c. Insofar as possible, drainage piping shall not be installed within the ceiling or exposed in operating and delivery rooms, nurseries, food preparation centers, food serving facilities, food storage areas, central services, electronic data processing areas, electric closets, and other sensitive areas. Where exposed, overhead drain piping in these areas is unavoidable, special provisions shall be made to protect the space below from leakage, condensation, or dust particles.

d. Floor drains shall not be installed in operating, delivery, and cystoscopic rooms.

e. Drain systems for autopsy tables shall be designed to positively avoid splatter or overflow onto floors or back syphonage and for easy cleaning and trap flushing.

f. Building sewers shall discharge into community sewerage. Where such a system is not available, the facility shall treat its sewage in accordance with local and state regulations.

g. Kitchen grease traps shall be located and arranged to permit easy access without the need to enter food preparation or storage areas.

h. Where plaster traps are used, provisions shall be made for appropriate access and cleaning.

5. The installation of nonflammable medical gas and air systems shall comply with the requirements of NFPA 99. (See table 5 for rooms requiring station outlets.) When any piping or supply of medical gases is installed, altered, or augmented, the altered zone shall be tested and certified as required by NFPA 99.

6. Clinical vacuum system installations shall be in accordance with NFPA 99. (See table 5 for rooms which require station outlets.)

Note: Cautionary comments of NFPA 99 may be especially applicable when a vacuum system is being

Table 5
Station Outlets for Oxygen, Vacuum (Suction), and Medical Air Systems

Location	Oxygen	Vacuum	Medical air
Patient rooms for medical/surgical, obstetrics and pediatrics	A	A	— ⁴
Examination/treatment for nursing units	A	A	—
Intensive care (all)	C	C	A
Nursery ¹	A	A	A
General operating rooms	E	F ⁵	E
Cytoscopic and invasive special procedures	D	F ⁵	E
Recovery	B	B	A
Delivery and LDR rooms ²	E	F ⁵	D
Labor rooms	B	A	A
First aid and emergency treatment ³	B	B ⁵	B
Autopsy	—	G	G
Anesthesia workroom	G	—	G

Key. A = one outlet accessible to each bed (one outlet may serve two beds). B = separate outlet for each bed. C = two outlets for each bed (or one outlet with Y fitting). D = one outlet per room (assumes one patient at any one time). E = two outlets per room (assumes one patient at any one time). F = three outlets per room (assumes one patient at any one time). G = one outlet per work station.

¹Includes pediatric nursery.

²Includes obstetric recovery.

³Emergency trauma rooms used for surgical procedures shall be classified as general operating rooms.

⁴One outlet for air (A) is required for pediatric units only.

⁵Vacuum outlets required are in addition to any that might be used as part of a scavenging system for removal of anesthetizing gases (see also NFPA 99).

considered for scavenging of anesthetizing gases.
 7. All piping, except control-line tubing, shall be identified. All valves shall be tagged, and a valve schedule shall be provided to the facility owner for permanent record and reference.

7.32 Electrical Standards

A. General

1. All material and equipment, including conductors, controls, and signaling devices, shall be installed in compliance with applicable sections of NFPA 70 and NFPA 99. All materials shall be listed as complying with approved established standards.

2. The electrical installations, including alarm, nurses call and communication systems, shall be tested to demonstrate that equipment installation and operation is appropriate and functional. A written record of performance tests on special electrical systems and equipment shall show compliance with applicable codes and standards. Grounding continuity shall be tested as described in NFPA 99.

3. Isolation transformers, voltage regulators, or other safeguards shall be provided as required where spikes or electrical current interruptions may affect data processing and/or automated laboratory equipment.

4. Design of the electrical systems shall include provisions for avoiding power-factor deviations below established norms.

B. Switchboards and Power Panels

Switchboards and power panels shall comply with NFPA 70. The main switchboard shall be located in an area separate from plumbing and mechanical equipment and shall be accessible to authorized persons only. The switchboards shall be convenient for use, readily accessible for maintenance, away from traffic lanes, and located in a dry, ventilated space free of corrosive or explosive fumes, gases, or any flammable material. Overload protection devices shall operate properly at ambient room temperatures.

C. Panelboards

Panelboards serving normal lighting and appliance circuits shall be located on the same floor as the circuits they serve. Panelboards for emergency circuits shall be located on each floor that has major users (operating rooms, delivery suite, intensive care, etc.) Panels for emergency circuits may also serve floors above and/or below for secondary users (general patient areas, administration, laboratory, X-ray, etc.).

D. Lighting

1. The Illuminating Engineering Society of North America (IES) has developed recommended lighting budget figures for footcandle levels and watts per square foot for hospital areas. See appendix.

Three types of interior lighting systems are available and should be maximized when designing light-

ing. They are direct, indirect, and task lighting. Site lighting, a specialty, requires design skill to create an efficient system. In general, the use of light colors and reflective surfaces can affect lighting efficiency.

a. Direct lighting has been the standard design for years and will remain so for some time. Its performance has been dramatically increased in recent years through the improvement of luminaries and the use of more efficient light sources.

b. Indirect lighting utilizes the reflectance characteristics of the ceiling and walls to disperse the light, resulting in less glare and higher visual comfort. Calculations are best accomplished by computers. The most popular sources for indirect lighting are metal halide and high-pressure sodium.

c. Task lighting reduces general area lighting needs by applying light to a specific task. This system of lighting results in the greatest energy savings by focusing light only in required spaces. Emphasis should be given to task lighting design that is independently controlled for use on an as-needed basis.

d. Site lighting should be high- and/or low-pressure sodium or metal halides. Calculations of footcandles and layouts are best accomplished by computer for maximization of light efficiency.

2. Approaches to buildings and parking lots, and all occupied spaces within buildings shall have fixtures for lighting.

3. Patient rooms shall have general lighting and night lighting. A reading light shall be provided for each patient. Flexible light arms, if used, shall be mechanically controlled to prevent the bulb from contacting the bed linen. At least one night light fixture in each patient room shall be controlled at the room entrance. All light controls in patient areas shall be quiet-operating. Lighting for intensive care bed areas shall permit staff observation of the patient but minimize glare.

4. Operating and delivery rooms shall have general lighting in addition to special lighting units provided at surgical and obstetrical tables. Each fixed special lighting unit at the table shall be connected to an independent circuit. Portable units may share circuits.

5. Nursing unit corridors shall have general illumination with provisions for reducing light levels at night.

6. Light intensity for staff and patient needs shall comply with guidelines set forth in *Lighting for Health Care Facilities*, by the IES. An infinite number of procedures are available to satisfy requirements, but the design should consider light quality as well as quantity for effectiveness and efficiency.

Note: While light levels in the IES publication are referenced herein, that publication does include

other useful guidance and recommendations which the designer is encouraged to follow.

Consideration shall be given to:

a. Conserving energy with high-efficiency fixtures, lamps, and ballasts, task lights, natural lighting, dimming and switching, and heat disposition.

b. Minimizing glare that may be wasteful, unpleasant, or harmful to the retina of certain patients.

c. Using colors and reflectance of surface finishes to enhance efficiency of light values.

d. Eliminating excessive contrast in light levels that make effective sight adaptation difficult.

e. Installing reading lamps in multibed rooms that will be unobtrusive to other room occupants.

f. Providing dimmers and/or shielding for overhead primary light sources in bed areas where patients may have difficulty moving.

7. Light intensity of required emergency lighting shall comply with standards in the IES publication, *Lighting for Health Care Facilities*.

E. Receptacles (Convenience Outlets)

1. Receptacles for pediatric and psychiatric units shall be of the safety type or protected by 5-milliamperes ground-fault-interrupters.

2. Each operating room and delivery room shall have at least six receptacles at anesthetizing locations. Where mobile X-ray equipment requiring special electrical considerations is used, additional receptacles distinctively marked for X-ray use shall be provided. (See NFPA 70, article 517 for receptacle requirements when capacitive discharge or battery-operated, mobile X-ray units are used.)

3. Each patient room shall have duplex-grounded receptacles. There shall be one at each side of the head of each bed; one for television, if used; and one on every other wall.

Receptacles may be omitted from exterior walls where construction makes installation impractical. Nurseries shall have at least two duplex-grounded receptacles for each bassinet. Critical care areas, as defined in NFPA 70, article 517, including pediatric intensive care, shall have at least four duplex outlets at the head of each bed, crib, or bassinet. Additional outlets (which may be shared) shall be available so that each bed for critical care will have access to at least seven duplex outlets.

4. Duplex-grounded receptacles for general use shall be installed approximately 50 feet (15.24 meters) apart in all corridors and within 25 feet (7.62

meters) of corridor ends. Receptacles in pediatric unit corridors shall be of the safety type or protected by 5 milliamperere ground-fault-interrupters. Single-polarized receptacles marked for use of X-ray only shall be installed in corridors of patient areas so that mobile equipment may be used anywhere within a patient room using a cord length of 50 feet (15.24 meters) or less. If the same mobile X-ray unit is used in operating rooms and in nursing areas, receptacles for X-ray use shall permit the use of one plug in all locations. *Where capacitive discharge or battery-powered X-ray units are used, separate polarized receptacles are not required.*

5. Electrical receptacle coverplates or electrical receptacles supplied from the emergency system shall be distinctively colored or marked for identification. If color is used for identification purposes, the same color should be used throughout the facility.

F. Equipment Installation in Special Areas

1. At inhalation anesthetizing locations, all electrical equipment and devices, receptacles, and wiring shall comply with applicable sections of NFPA 99 and NFPA 70.

2. Fixed and mobile X-ray equipment installations shall conform to articles 517 and 660 of NFPA 70.

3. The X-ray film illuminator unit or units for displaying at least two films simultaneously shall be installed in each operating room, emergency treatment room, and X-ray viewing room of the radiology department. All illuminator units within one space or room shall have lighting of uniform intensity and color value.

4. Ground-fault-interrupters shall comply with NFPA 70. *When ground-fault-interrupters are used in critical areas, provisions shall be made to insure that other essential equipment is not affected by activation of one interrupter.*

5. In areas such as intensive care units and special nurseries where a patient may be treated with an internal probe or catheter connected to the heart, the ground system shall comply with applicable sections of NFPA 99 and NFPA 70.

G. Nurses Calling System

1. In patient areas, each patient room shall be served by at least one calling station for two-way voice communication. Each bed shall be provided with a call device. Two call devices serving adjacent beds may be served by one calling station. Calls shall activate a visible signal in the corridor at the patient's door, in the clean workroom, in the soiled workroom, and at the nursing station of the nursing unit. In multicorridor nursing units, additional visible signals shall be installed at corridor intersections. In rooms containing two or more calling stations, indicating lights shall be provided at each

station. Nurses calling systems at each calling station shall be equipped with an indicating light which remains lighted as long as the voice circuit is operating.

2. A nurses emergency call system shall be provided at each inpatient toilet, bath, sitz bath, and shower room. This system shall be accessible to a collapsed patient lying on the floor. Inclusion of a pull cord will satisfy this standard.

The emergency call system shall be designed so that a signal activated at a patient's calling station will initiate a visible and audible signal distinct from the regular nurse calling system that can be turned off only at the patient calling station. The signal shall activate an enumerator panel at the nurse station, a visible signal in the corridor at the patient's door, and at other areas defined by the functional program. Provisions for emergency calls will also be needed in outpatient and treatment areas where patients may be subject to incapacitation.

3. In areas such as intensive care where patients are under constant visual surveillance, the nurses call system may be limited to a bedside button or station that activates a signal readily seen at the control station.

4. A calling station for nurses to summon assistance from other areas shall be provided in each operating, delivery, recovery, emergency examination and/or treatment area, and in intensive care units, nurseries, special procedure rooms, stress-test areas, and supervised nursing units for mental patients.

H. Emergency Electric Service

1. An emergency electrical source shall be provided and connected to certain circuits to provide lighting and power during an interruption of the normal electric supply. Where stored fuel is required, storage capacity shall permit continuous operation for at least 24 hours. Fuel storage for electricity generation shall be separate from heating fuels. If the use of heating fuel for diesel engines is considered after the required 24-hour supply has been exhausted, positive valving and filtration shall be provided to avoid entry of water and/or contaminants. In areas where the electrical service is found to be unreliable, consideration should be given to the use of dual-fuel generator units.

2. The source(s) of this emergency electric service shall be:

a. An emergency generating set for facilities whose normal service is supplied by one or more central station transmission lines.

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b. An emergency generating set or a central station transmission line for facilities whose normal electrical supply is generated on the premises.

3. The required emergency generating set, including the prime mover and generator, shall be located on the premises and shall conform to NFPA 99 and NFPA 110.

4. As required in NFPA 99 and NFPA 70, emergency electricity shall be provided to all services that must continue to function during any failure of the normal power source including the fire pump, if installed. As a minimum, each patient bed and treatment space shall have access to a receptacle on the critical branch of the emergency power system.

Where access is by extension cords, length required shall not exceed 50 feet (15.2 meters). See NFPA 99 for special care areas.

5. Local codes and regulations may have additional requirements.

6. Exhaust systems (including locations, mufflers, and vibration isolators) for internal combustion engines shall be designed and installed to minimize objectionable noise. Where a generator is routinely used to reduce peak loads, protection of patient areas from excessive noise may become a critical issue.

7. Emergency generator sets shall have adequate clearances for access and maintenance and shall be provided with appropriate ventilation for cooling and elimination of fumes. Mechanisms for intake air shall be arranged to resist entry of rain and/or snow.

I. Fire Alarm System

The fire alarm and detector system shall be in compliance with NFPA 101, NFPA 72A, and NFPA 72E.

8.1 General Considerations

A. Applicability

This section (formerly Long-Term Care Facilities) covers skilled nursing facilities that may be part of a general acute-care hospital or a separate facility. Standards listed may also be suitable for intermediate and other extended care facilities. However, each of these other facility types may have additional, unique programmatic needs. Judgment must be used to insure that all program needs are met without unnecessary restrictions.

B. Ancillary Services

When the skilled nursing care unit is part of, or contractually linked with, another facility, services such as dietary, storage, pharmacy, and laundry may be shared insofar as practical. In some cases, all ancillary service requirements will be met by the principal facility and the only modifications necessary will be within the nursing unit. In other cases, programmatic concerns and requirements may dictate separate services.

C. Swing Beds

See section 7.1F of this document for description of swing beds, which may be part of an acute-care hospital.

D. Special Needs

While there are many similarities in the spatial arrangement of hospitals and skilled nursing facilities, the service requirements of long-term care patients will require additional special design considerations. When a section of an acute-care facility is converted, it may be necessary to reduce the number of beds to provide space for long-term care services. Design shall maximize opportunities for ambulation and self-care, and minimize the negative aspects of institutionalization.

E. Provisions for Handicapped

The facility shall assure accessibility by handicapped patients, staff, and visitors. Attention shall be given to the needs of patients who may need assistance in learning to use toilets, lavatories, etc. Insofar as possible, corners shall be rounded and projections eliminated or minimized to reduce potential for injury (see section 1.3 of this document).

F. Parking

In the absence of a formal parking study, the facility shall at least provide one space for each employee normally present during one week-day morning shift plus one space for every five beds. This ratio may be reduced when justified by the availability of convenient public transportation and public parking.

G. Program of Functions

The sponsor for each project shall provide a functional program for the facility (see section 1.1F of this document).

H. Services

Each skilled nursing care facility shall, as a minimum, contain the elements described herein. However, when the project calls for the sharing or purchase of services, appropriate modifications or deletions in space requirements shall be made.

8.2 Nursing Unit

Each nursing unit shall comply with the following:

A. Number of Beds

The number of beds in a nursing unit should not exceed 60. At least 5 percent of the total beds should be located in single-bed rooms, each with a private bathing facility and toilet.

B. Patient Rooms

Each patient room shall meet the following requirements (see section 1.2 of this document for discussion of existing units in which absolute compliance with these standards may be impractical):

1. Maximum room occupancy shall be four patients.
2. In new constructions, major renovations or conversions, minimum room areas (exclusive of toilets, closets, lockers, wardrobes, alcoves, or vestibules) shall be 120 square feet (11.1 square meters) in single-bed rooms and 100 square feet (9.3 square meters) per bed in multiple-bed rooms. In multiple-bed rooms, clearance shall allow for the movement of beds and equipment without disturbing patients. The dimensions and arrangement of rooms should be such that there is a minimum of 3 feet (.9 meters) between the sides and foot of the bed and any wall, other fixed obstruction, or other bed. *If function is not impaired*, minor encroachments such as columns, lavatories, and door swings may be ignored in determining space requirements.
3. Each room shall have a window (see section 8.9A(5) of this document).
4. A nurses calling system shall be provided in accordance with standards contained in section 7.30 of this document.
5. Handwashing facilities shall be provided in each patient room. They may be omitted from single-bed or two-bed rooms when such is located in an adjoining toilet room serving that room only.
6. Each patient shall have access to a toilet room without having to enter the corridor area. One toilet room shall serve no more than four beds and no

more than two single-bed patient rooms. The toilet room shall contain a water closet, a lavatory, and the door should swing outward and be double acting. The lavatory may be omitted from a toilet room if each patient room served by that toilet contains a lavatory for handwashing.

7. Each patient bedroom shall have a wardrobe, locker, or closet with minimum clear dimensions of 1 foot 10 inches (56 centimeters) by 1 foot 8 inches (51.8 centimeters); and a shelf and clothes rod to permit a vertically clear hanging space of 5 feet (1.52 meters) for full length garments. (The shelf may be omitted if the unit provides at least two drawers and capacity for storing extra blankets, pillows, etc.)

8. Visual privacy shall be provided for each patient in multiple-bed rooms. Design for privacy shall not restrict patient access to the toilet, lavatory, or room entrance.

9. Beds shall be no more than two deep from windows in new construction and three deep from windows in renovated construction.

10. Provision should be made for wheelchairs within the room.

C. Service Areas

The size and features of each service area will depend upon the number and types of patients served. Although identifiable spaces are required for each indicated function, consideration will be given to multiple-use design solutions that provide equal, though unspecified, areas. Service areas may be arranged and located to serve more than one nursing unit, but at least one such service area shall be provided on each nursing floor unless noted otherwise. Except where the words *room* or *office* are used, service may be provided in a multipurpose area. The following service areas shall be located in or be readily accessible to each nursing unit:

1. Nurse or control station. This shall have space for charting, storage, and administrative activities and be convenient to handwashing facilities.
2. Toilet room(s) for staff (may be unisex).
3. Lockable closets, drawers, or compartments in or near the nurses station. These shall be provided for safekeeping of staff personal effects such as handbags, etc.
4. Staff lounge (may be shared by more than one nursing unit).
5. Room(s) for examination and treatment of patients. This may be omitted if all patient rooms are single-bed rooms. It shall have a minimum floor area of 100 square feet (9.3 square meters), excluding space for vestibule, toilet, and closet. It shall

contain a lavatory or sink equipped for handwashing, a work counter, storage facilities, and a desk, counter, or shelf for writing. Centrally located examination and treatment room(s) may serve more than one floor and/or nursing unit.

6. Clean workroom or clean holding room. If the room is used for work, it shall contain a counter and handwashing facilities. When the room is used only for storage of clean and sterile supply materials, the work counter and handwashing facilities may be omitted.

7. Soiled workroom or soiled holding room. This shall contain a clinical sink or equivalent flushing rim fixture, handwashing facilities, work counter, waste receptacle, and soiled linen receptacle. When the room is used only for temporary holding of soiled materials, the work counter may be omitted.

8. Drug distribution station. Provision shall be made for 24-hour distribution of medications. A medicine preparation room, a self-contained medicine dispensing unit, or other system may be used for this purpose. The medicine preparation room, if used, shall be visually controlled from the nurses station. It shall contain a work counter, sink, refrigerator, and locked storage for controlled drugs. It shall have a minimum area of 50 square feet (4.7 square meters). A self-contained medicine dispensing unit, if used, may be located at the nurses station, in the clean workroom, in an alcove, or in other space convenient for staff control. (Standard "cup" sinks provided in many self-contained units are not adequate for handwashing.)

9. Clean linen storage. A separate closet or designated area within the clean work room shall be provided. If a closed-cart system is used, storage may be in an alcove away from traffic where staff control can be assured.

10. Nourishment station. This should contain a work counter, refrigerator, storage cabinets, and a sink for serving nourishments between meals. Ice for patients' consumption shall be provided by icemaker-dispenser units. The nourishment station shall include space for trays and dishes used for nonscheduled meal service. Handwashing facilities shall be in or immediately accessible from the nourishment station.

11. Storage space for stretchers and wheelchairs. This shall be located away from normal traffic.

12. Patient bathing facilities. A minimum of one bathtub or shower shall be provided for every 12 beds (or a major fraction thereof) not otherwise served by bathing facilities in patient rooms. Patients shall have access to at least one bathtub in each nursing unit. Each tub or shower shall be in an individual room or enclosure with space for private use of the bathing fixture, for drying and dressing, and for a wheelchair and attendant. At least one shower in each central bathing facility shall be at

least 4 feet (1.22 meters) square without curbs and be designed for use by a wheelchair patient.

13. Bedpan cleaning and sanitizing facilities. These shall be provided on each nursing floor in addition to those in the patients toilet room. Such facilities may be located in the soiled work or holding room and be designed to minimize acoustical disturbance to patients.

D. Patient Toilet Facilities

1. The minimum dimensions of a room containing only a water closet shall comply with UFAS and ANSI A117.1.

2. At least one toilet on each nursing floor shall be appropriate for training. A clearance of 3 feet (91 centimeters) shall be provided at the front and at each side of the water closet. This room shall also contain a lavatory.

3. A separate toilet room shall be provided that is directly accessible to each multifixture central bathing area without requiring entry into the general corridor. This also may serve as the required toilet-training facility.

8.3 Patient Support Areas

A. Area Need

The total area set aside for dining and recreation shall be at least 30 square feet (2.8 square meters) per bed with a minimum total area of at least 225 square feet (20.9 square meters). For facilities with more than 100 beds, the minimum area may be reduced to 25 square feet (2.3 square meters) per bed. Additional space shall be provided for outpatient day care programs as needed. At least 14 square feet (1.3 square meters) per bed shall be dedicated for dining.

B. Storage

Storage space(s) for equipment and supplies shall be provided at or near the recreation area. A minimum of 50 cubic feet (1.4 cubic meters) of secure storage shall be provided for each patient. This area shall be onsite but not necessarily in the same building as the patient, provided access is convenient.

8.4 Rehabilitation Therapy

Each skilled nursing facility shall include physical and occupational therapy provisions for rehabilitat-

ing long-term care patients. Areas and equipment shall conform to program intent. Where the skilled nursing facility is part of a general hospital or other patient facility, services may be shared as appropriate.

A. Physical and Occupational Therapy Provisions for Inpatients

As a minimum, the following shall be located onsite convenient for use to the nursing unit:

1. Space for files, records, and administrative activities.
2. Waiting area with provision for wheelchair patients.
3. Storage for supplies and equipment.
4. Separate storage rooms for clean and soiled linen.
5. Handwashing facilities within the therapy unit.
6. Space and equipment for carrying out each of the types of therapy that may be prescribed.
7. Provisions for patient privacy.
8. Janitor closets, in or near unit.
9. Patient toilet room(s), usable by wheelchair patients.
10. Locked cabinets or other provisions for storing personal effects.
11. Convenient access to conference rooms for patient/staff education and training. Rooms may be on separate floor shared with other activities.
12. Convenient access to toilet facilities.

B. Physical and Occupational Therapy for Outpatients

If the program includes outpatient treatment, additional provisions shall include:

1. Convenient facility access usable by the handicapped.
2. Lockers for storing patients clothing and personal effects.
3. Outpatient facilities for dressing.
4. Shower(s) for patients' use.

8.5 Personal Care Unit

Facilities and equipment for patient hair care and grooming shall be provided outside the patient rooms. These may be part of another area, such as the daily activity room, provided that location and scheduling preserve patient dignity.

8.6 Pharmacy Unit

Provisions shall be made for the procurement, storage, distribution, and recording of drugs and other

pharmacy products. This unit may be located in an offsite facility but must provide 24-hour emergency service to the skilled nursing facility.

8.7 General Services

The following services shall be provided as required by the functional program and as described in section 7 for "General Hospital." When the skilled nursing facility is part of a general hospital or other facility, appropriate services should be shared (see also, section 8.2 of this document, which describes services essential to each nursing unit).

A. Dietary Facilities

B. Administration and Public Areas

Note: A separate medical library is not required for the skilled nursing facility.

C. Clerical Files and Staff Office Space

D. Linen Services

E. Employee Facilities

F. Janitors Closets

G. Engineering Service and Equipment Areas

H. General Store

These areas shall have at least 5 square feet (.47 square meters) per skilled nursing bed. Additional space is required for other types of beds. General storage space may be provided in a separate building on the premises offering convenient daily access.

When additional services such as radiology, laboratory, etc., are provided in a separate skilled nursing facility, these services shall comply with section 7, "General Hospital." Services shall be modified in accordance with the functional program.

8.8 Waste Processing Services

Skilled nursing facilities that are part of an acute-care hospital may share waste processing. Free-standing facilities shall comply with the requirements of section 7.27, with the exception that

incineration may be performed on- or offsite by a small unit capable of handling type I waste in the limited quantities expected. (The incinerator used by the skilled nursing facility is normally used only for small quantities of contaminated waste, which should create minimal pollution problems. Pathological incinerators would not usually be needed for nursing facilities.)

8.9 Special Provisions and Standards for Details and Finishes

Skilled nursing facilities require features that encourage ambulation of long-term patients. Potential hazards to the infirm, such as sharp corners, highly polished floors, and loose carpets, should be avoided.

Details and finishes for new constructions, including those used in a retained existing facility, shall conform to section 8.9A and B. If correction is impractical, waivers and/or exceptions for existing areas shall be considered on a case-by-case basis. *Alterations shall not diminish the level of compliance with these standards below that which existed prior to the alteration. However, features in excess of those for new constructions are not required to be maintained.*

A. Details

1. The placement of drinking fountains, telephone booths, and vending machines shall not restrict corridor traffic or reduce the corridor width below the minimum stipulated in NFPA 101. Provisions shall be made to store portable equipment out of the path of traffic.
2. Doors to all rooms containing bathtubs, sitz baths, showers, and water closets for inpatient use shall be equipped with privacy hardware that permits emergency access from outside without keys. When such rooms have only one entrance or are small, the doors shall open outward to avoid pressing against an occupant who may have collapsed within the room.
3. Each room for use by wheelchair-confined patients, staff, or employees, including all patient toilets and bathing facilities, shall have one door in compliance with UFAS or ANSI A117.1. Patient room doors, exit doors, etc., shall comply with NFPA 101. Door width is defined as the width of the door leaf.
4. Windows and outer doors that may be frequently left open shall have insect screens.
5. Patient rooms or suites in new constructions intended for 24-hour occupancy shall have operable

windows or vents that open from the inside to vent noxious fumes and smoke and bring in fresh air in emergencies. Operation of such windows shall be restricted to inhibit possible patient escape or suicide. Where the operation of windows or vents requires the use of tools or keys, these shall be located on the same floor at a prominent staff-controlled location. Windows in buildings designed with approved engineered-smoke-control systems may be of fixed construction.

6. Doors, sidelights, borrowed lights, and windows glazed to within 18 inches (46 centimeters) of the floor shall be constructed of safety glass, wire glass, or plastic glazing material that resists breaking and creates no dangerous cutting edges when broken. Similar materials shall be used in wall openings in activity areas (such as recreation rooms and exercise rooms) unless fire safety codes require otherwise. Glazing for shower doors and tub enclosures shall be safety glass or plastic.

7. Thresholds and expansion joint covers shall be flush with the floor to facilitate use of wheelchairs and carts and to prevent tripping. Expansion and seismic joints shall be constructed to restrict the passage of fire and/or smoke.

8. Grab bars shall be installed in all patient toilets, showers, tubs, and sitz baths at a 1½-inch (3.8-centimeter) clearance from walls. Bars, including those which are part of fixtures such as soap dishes, shall have the strength to sustain a concentrated load of 250 pounds (113.4 kilograms).

9. Handrails shall be provided on both sides of all corridors normally used by patients. A clearance of 1½ inches (3.8 centimeters) shall be provided between the handrail and the wall. Rail ends shall be finished to minimize potential for personal injury.

10. Handwashing facilities shall be constructed with sufficient clearance for blade-type operating handles and for use by wheelchair patients.

11. Lavatories and handwashing facilities shall be securely anchored.

12. Each handwashing facility shall have a mirror except as noted otherwise. Mirror placement shall allow for convenient use by both wheelchair occupants and/or ambulatory persons. Tops and bottoms may be at levels usable by individuals either sitting or standing, or additional mirrors may be provided for wheelchair occupants. One separate full-length mirror may serve for wheelchair occupants.

13. Provisions for hand drying shall be included at all handwashing facilities. These shall be paper or cloth towels enclosed to protect against dust or soil and to insure single-unit dispensing.

14. The minimum ceiling height shall be 7 feet 10 inches (2.38 meters) with the following exceptions:

a. Boiler rooms shall have ceiling clearances of at least 2 feet 6 inches (76 centimeters) above the main boiler header and connecting pipe.

b. Rooms containing ceiling-mounted equipment shall have the required ceiling height to ensure proper functioning of that equipment.

c. Ceilings in corridors, storage rooms, and toilet rooms shall be at least 7 feet 8 inches (2.34 meters). Ceilings in normally unoccupied spaces may be reduced to 7 feet (2.1 meters).

d. Building components and suspended tracks, rails, and pipes located along the path of normal traffic shall be not less than 7 feet (2.1 meters) above the floor.

e. Where existing conditions make the above impractical, clearances shall be sufficient to avoid injury to individuals up to 6 feet 4 inches (1.95 meters) tall.

15. Rooms containing heat-producing equipment (such as boiler rooms, heater rooms, and laundries) shall be insulated and ventilated to prevent the floors of occupied areas overhead and the adjacent walls from exceeding a temperature 10°F (6°C) above the ambient room temperature of such occupied areas.

B. Finishes

1. Interior finishes on walls, ceilings and floors shall meet the standards of section 7.28B of this document as applicable.

2. Cubicles, curtains, and draperies shall be non-combustible or flame-resistant as prescribed in both the large- and small-scale tests in NFPA 701.

3. Insofar as possible, use of materials for finishes and furnishings, including mattresses and upholstery that produce objectionable quantities of toxic gases and/or smoke shall be avoided.

4. Floor materials shall be readily cleanable and appropriate for the location. Floors in areas used for food preparation and assembly shall be water-resistant. Floor surfaces, including tile joints, shall be resistant to food acids. In all areas subject to frequent wet-cleaning methods, floor materials shall not be physically affected by germicidal cleaning solutions. Floors subject to traffic while wet (such as shower and bath areas, kitchens, and similar work areas) shall have a nonslip surface. Carpet and padding in patient areas shall be stretched taut and free of loose edges or wrinkles that might create hazards or interfere with the operation of wheelchairs, walkers, wheeled carts, etc.

5. Wall bases in areas subject to routine wet cleaning shall be coved, integrated with the floor, and tightly sealed.

6. Wall finishes shall be washable and, if near plumbing fixtures, shall be smooth and moisture-re-

sistant. Finish, trim, walls, and floor constructions in dietary and food storage areas shall be free from rodent- and insect-harboring spaces.

7. Floor and wall openings for pipes, ducts, and conduits shall be tightly sealed to resist fire and smoke and to minimize entry of pests. Joints of structural elements shall be similarly sealed.

8. The finishes of all exposed ceilings and ceiling structures in patient rooms and staff work areas shall be readily cleanable with routine housekeeping equipment. Finished ceilings shall be provided in dietary and other areas where dust fallout might create a problem.

8.10 Construction Features

All parts of the skilled nursing facility shall be designed and constructed to sustain dead and live loads in accordance with local and national building codes and accepted engineering practices and standards. Construction shall also comply with section 7 of this document, "General Hospital," including requirements for seismic forces and applicable sections of NFPA 101.

8.11 Elevators

A. General

All buildings having patient use areas on more than one floor shall have electric or hydraulic elevator(s).

1. In the absence of an engineered traffic study the following guidelines for number of elevators shall apply (these standards may be inadequate for moving large numbers of people in a short time; adjustments should be made as appropriate):

a. At least one hospital-type elevator shall be installed where patient beds are located on any floor other than the main entrance floor.

b. When 60 to 200 patient beds are located on floors other than the main entrance floor, at least two elevators, one of which shall be of the hospital-type, shall be installed.

c. When 201 to 350 patient beds are located on floors other than main entrance floor, at least three elevators, one of which shall be of the hospital-type, shall be installed.

d. For facilities with more than 350 patient beds above the main entrance floor, the number of elevators shall be determined from a facility plan

study and from the estimated vertical transportation requirements.

e. When the skilled nursing unit is part of a general hospital, elevators may be shared and the standards of section 7.30 of this document shall apply.

2. Cars of hospital-type elevators shall have inside dimensions that accommodate a patient bed with attendants. Cars shall be at least 5 feet (1.52 meters) wide by 7 feet 6 inches (2.29 meters) deep. The car door shall have a clear opening of not less than 3 feet 8 inches (1.12 meters). Other elevators required for passenger service shall be constructed to accommodate wheelchairs.

3. Elevators shall be equipped with an automatic two-way leveling device with an accuracy of $\frac{1}{4}$ inch (0.7 centimeters).

4. The controls, alarm buttons, and telephones in elevators shall be accessible to wheelchair patients.

5. Elevator call buttons shall not be activated by heat or smoke. If employed, light beam door activators shall be used in combination with door-edge safety devices and shall be connected to a system of smoke detectors. This is so that the light control feature will disengage or be overridden if it encounters smoke at any landing.

B. Field Inspection and Tests

Inspections and tests shall be made and the owner shall be furnished with written certification stating that the installation meets the standards set forth in this section as well as all applicable safety regulations and codes. Installation shall comply with UFAS or ANSI A117.1.

8.12 Mechanical Standards

A. General

1. The mechanical system should be subject to general review for overall efficiency and life-cycle cost. Details for cost-effective implementation of design features are interrelated and too numerous (as well as too basic) to list individually. Recognized engineering procedures shall be followed for the most economical and effective results. A well-designed system can generally achieve energy efficiency with minimal additional cost and simultaneously provide improved patient comfort. Different geographic areas may have climatic and use conditions that favor one system over another in terms of overall cost and efficiency. For instance, adiabatic cooling and dead-load controls may be common designs for certain western states but relatively unknown elsewhere. In no case shall patient care or safety be sacrificed for conservation.

2. Remodeling and work in existing facilities may

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

3. Facility design considerations shall include site, building mass, orientation, configuration, fenestration, and other features relative to passive and active energy systems.

4. Insofar as practical, the facility shall include provisions for recovery of waste cooling and heating energy (ventilation, exhaust, water and steam discharge, cooling towers, incinerators, etc.).

5. Facility design shall include consideration of recognized energy-saving mechanisms such as variable-air-volume systems, load shedding, programmed controls for unoccupied periods (nights and weekends, etc.) and use of natural ventilation where site and climatic conditions permit, etc. Systems with excessive installation and/or maintenance costs that would negate long-range energy savings should be avoided.

6. As appropriate, controls for air-handling systems shall be designed with an economizer cycle to use outside air for cooling and/or heating. (Use of mechanically circulated outside air does not reduce need for filtration.) It may be practical in many areas to reduce or shut down mechanical ventilation during appropriate climatic and patient-care conditions and to use open windows for ventilation.

7. Major changes have been made to previous ventilation standards to permit maximum use of simplified systems, such as the variable-air-volume supply. However, care must be taken in design to avoid possibility of large temperature differentials, high-velocity supply, excessive noise, air stagnation, etc. Air supply and exhaust in rooms for which no minimum total air change rate is noted may vary down to zero in response to room load. For areas listed in table 3, where variable-air-volume systems are permitted, minimum total air change shall be within limits noted. Temperature control shall also comply with these standards. To maintain asepsis control, airflow supply and exhaust should generally be controlled to insure movement of air from "clean" to "less clean" areas.

8. Prior to acceptance of the facility, all mechanical systems shall be tested, balanced, and operated to demonstrate to the design engineer or his representative that the installation and performance of these systems conform to design intent. Test results shall be documented for maintenance files.

9. Upon completion of the equipment-installation contract, the owner shall be furnished with a complete set of manufacturers' operating, maintenance, and preventive maintenance instructions, a parts lists, and complete procurement information including equipment numbers and descriptions. Operating staff persons shall also be provided with instructions for properly operating systems and equipment. Required information shall include energy ratings as needed for future conservation calculations.

B. Thermal and Acoustical Insulation

1. Insulation within the building shall be provided to conserve energy, protect personnel, prevent vapor condensation, and reduce noise and vibration for the following:

- a. Boilers, smoke breeching, and stacks.
- b. Steam supply and condensate return piping.
- c. Heating, hot water supply, and return piping.
- d. Chilled water, refrigerant, and other process piping and equipment operating with fluid temperatures below the ambient dew point.
- e. Cold water supply and drainage piping on which condensation may occur.
- f. Domestic hot water piping, water heaters, tanks, generators and converters.
- g. Heating, ventilating, air conditioning, and air-handling duct systems (including ducts, plenums, and casings) with surface temperatures above or below the ambient dry-bulb or dew-point temperatures.
- h. Other piping, ducts, and equipment where applicable.

2. Insulation on cold surfaces shall include an exterior vapor barrier. (Material that will not absorb or transmit moisture will not require a separate vapor barrier.)

3. Insulation, including finishes and adhesives on the exterior surfaces of ducts and equipment, shall have a flame-spread rating of 25 or less and a smoke-developed rating of 50 or less as determined by an independent testing laboratory in accordance with NFPA 255. The smoke-development rating for pipe insulation shall not exceed 150. This includes mechanical refrigeration and distribution equipment and hot water distribution equipment such as valves, pumps, chillers, etc.

4. Use of duct linings is generally discouraged as they increase energy costs by increasing system-pressure drops. Moreover, remodeling of lined duct systems destroys the integrity of the liner sealant. However, if linings are used in nonsensitive areas, they shall meet the erosion test method described in Underwriters' Laboratories, Inc., publication no. 181. These linings (including coatings, adhesives, and exterior surface insulation of pipes and ducts in

spaces used as air supply plenums) shall have a flame-spread rating of 25 or less and a smoke-developed rating of 50 or less, as determined by an independent testing laboratory in accordance with NFPA 255.

5. Asbestos insulation shall not be used in health facilities.

6. Existing accessible insulation within areas of facilities to be modernized shall be inspected, repaired, and/or replaced as appropriate.

C. Steam and Hot Water Systems

1. Boilers shall have the capacity, based upon the net ratings published by the Hydronics Institute or another acceptable national standard, to supply not less than 70 percent of the normal requirements of all systems and equipment. Their number and arrangement shall accommodate facility needs despite the breakdown or routine maintenance of any one boiler. The capacity of the remaining boiler(s) shall be sufficient to provide hot water service for clinical, dietary, and patient use; steam for dietary purposes; and heating for general patient rooms. However, reserve capacity for facility space heating is not required in geographic areas where a design dry-bulb temperature of 25°F (-4°C) or more represents not less than 99 percent of the total hours in any one heating month as noted in ASHRAE's *Handbook of Fundamentals*, under the "Table for Climatic Conditions for the United States."

2. Boiler accessories including feed pumps, heat-circulating pumps, condensate return pumps, fuel oil pumps, and waste heat boilers shall be connected and installed to provide both normal and standby service.

3. Supply and return mains and risers for cooling, heating, and steam systems shall be equipped with valves to isolate the various sections of each system. Each piece of equipment shall have valves at the supply and return ends, except for vacuum condensate returns, which do not require valves at each piece of equipment.

D. Air Conditioning, Heating, and Ventilation Systems

1. The ventilation rates shown in table 3 shall be used only as model standards; they do not preclude the use of higher, more appropriate rates. All rooms and areas in the facility shall have provision for positive ventilation. Though natural window ventilation may be utilized where weather permits, use of mechanical ventilation should be considered for interior areas and during periods of temperature extremes. Fans serving exhaust systems shall be located at

the discharge end and shall be readily serviceable. Exhaust systems may be combined to enhance the efficiency of recovery devices required for energy conservation.

a. To reduce utility costs, facility design should utilize energy-conserving mechanisms including recovery devices, variable air volume, load shedding, and systems to shut down or reduce ventilation of unoccupied areas, insofar as patient care is not compromised. When appropriate, mechanical ventilation should employ an economizer cycle that uses outside air to reduce heating- and cooling-system loads. Filtering requirements shall be met when outside air is used as part of the mechanical ventilation system. Innovative design that provides for additional energy conservation while meeting the intent of these standards for acceptable patient care should be considered (see appendix).

b. Fresh air intakes shall be located at least 25 feet (7.62 meters) from exhaust outlets of ventilating systems, combustion equipment stacks, medical-surgical vacuum systems, plumbing vents, or areas that may collect vehicular exhaust or other noxious fumes. (Prevailing winds and/or proximity to other structures may require greater clearances.) Plumbing and vacuum vents that terminate above the level of the top of the air intake may be located as close as 10 feet (3.05 meters). The bottom of outdoor air intakes serving central systems shall be as high as practical, but at least 6 feet (1.83 meters) above ground level, or, if installed above roof, 3 feet (91 centimeters) above roof level. Exhaust outlets from areas that may be contaminated shall be above roof level and arranged to minimize recirculation of exhaust air into the building.

c. The ventilation systems shall be designed and balanced to provide directional flow as shown in table 3. (See also note 8 of table 3 for reductions and shutdown of ventilation systems during room vacancy.)

d. All central ventilation or air conditioning systems shall be equipped with filters with efficiencies equal to, or greater than, those specified in table 6. Filter efficiencies, tested in accordance with ASHRAE 52-76, shall be average. Filter frames shall be durable and proportioned to provide an airtight fit with the enclosing ductwork. All joints between filter segments and the enclosing ductwork shall have gaskets or seals to provide a positive seal against air leakage. A manometer shall be installed across each filter bed having a required efficiency of 75 percent or more.

e. Air-handling duct systems shall meet the requirements of NFPA 90A and those contained herein.

f. Fire and smoke dampers shall be constructed, located, and installed in accordance with the requirements of NFPA 101 and 90A. Fans,

Table 6

Filter Efficiencies for Central Ventilation and Air Conditioning Systems in Skilled Nursing Facilities

	Minimum no. filter beds	Filter efficiencies (%)
All areas for inpatient care, treatment, and/or diagnosis, and those areas providing direct service or clean supplies	1	80
Administrative, bulk storage, soiled holding, food preparation, laundries	1	25

Notes. Additional roughing or prefilters should be considered to reduce maintenance required for the main filters. Ratings shall be based on ASHRAE 52-76.

dampers, and detectors shall be interconnected so that damper activation will not damage ducts. Maintenance access shall be provided at all dampers. All damper locations should be shown on drawings. Dampers should be activated by fire or smoke sensor, not by fan cutoff alone.

Switching systems for restarting fans may be installed for fire department use in evacuating smoke after a fire has been controlled. However, provisions should be made to avoid possible damage to the system because of closed dampers.

When smoke partitions are required, heating, ventilating, and air conditioning zones shall be coordinated with compartmentation insofar as practical to minimize the need to penetrate fire and smoke partitions.

E. Plumbing

1. All plumbing, piping, drains, and fixtures shall comply with section 7.31 of this document for the acute-care hospital except as described otherwise herein.

2. Bedpan-flushing-and-sanitizing equipment shall be provided on each nursing floor in addition to the bedpan-flushing devices used in toilet rooms.

3. Medical gases and suction system(s), if installed, shall be in accordance with NFPA 99 and section 7.31 of this document. Station outlets shall be provided for patient rooms as required by the functional program.

9. OUTPATIENT FACILITIES

8.13 Electrical Standards

A. General

1. All material and equipment, including conductors, controls, and signaling devices, shall be installed to provide a complete electrical system in accordance with NFPA 70 and NFPA 99.
2. All electrical installations and systems shall be tested to verify that the equipment has been installed and that it operates as designed.
3. Electrical systems for skilled nursing facilities shall comply with applicable sections of NFPA 70 and section 7.32 of this document, except as described otherwise herein.
4. Lighting shall conform to standards set forth in table 1 of the Illuminating Engineering Society of North America's publication CP29, *Lighting for Health Care Facilities*, and to section 7.32 of this document.
5. When the skilled nursing facility is part of an acute-care hospital, it may use the hospital's emergency generator system for required emergency lighting and power, if such sharing does not reduce hospital services. Life support systems and their respective areas shall be subject to applicable standards of section 7.32. As a minimum, skilled nursing facilities or sections thereof shall have emergency electrical systems as described in NFPA 101 and NFPA 76A.
6. A nurses call system shall be provided for patient care areas as described for the acute-care general hospital in section 7.32.
7. Fire alarm and detection systems shall be provided in compliance with NFPA 101, NFPA 72A, and NFPA 72E.

9.1 General

A. Section Applicability

This section applies to the outpatient unit, which may be a separate freestanding facility within a non-medical facility or part of a health maintenance organization (HMO) or other health service. This section does not apply to the offices of private-practice physicians in commercial office space and should not be applied to such offices in ancillary outpatient facilities. Specifically described are:

1. Primary Care Outpatient Center (section 9.3).
2. The Small Primary (Neighborhood) Outpatient Facility (section 9.4).
3. The Outpatient Surgical Facility (section 9.5).
4. The Freestanding Emergency Facility (section 9.6).

The general standards set forth in sections 9.1 and 9.2 apply to each of the above. Additions and/or modifications shall be made as described for the specific facility type. (See section 7 for emergency and outpatient services that are part of the general hospital.)

Specialty facilities such as those for renal dialysis, cancer treatment, mental health, rehabilitation etc., have needs that are not addressed here. They must satisfy additional conditions to meet respective programs standards.

B. Outpatient Facility Classification

Except for the emergency unit, the outpatient facilities described herein used primarily by patients capable of traveling into, around, and out of the facility unassisted. This includes the handicapped confined to wheelchairs. Occasional facility use by stretcher patients should not be used as a basis for more restrictive institutional occupancy classifications.

Facilities shall comply with the "Ambulatory Health Care Centers" section of NFPA 101, in addition to details herein, where patients incapable of self-preservation or those receiving inhalation anesthesia are treated. The "Business Occupancy" section of NFPA 101 applies to other types of outpatient facilities. Outpatient units that are part of another facility may be subject to the additional requirements of the other occupancy.

References are made to section 7, "General Hospital," for certain service spaces such as the operating rooms of the outpatient surgical unit. Those references are intended only for the specific areas indicated.

C. Facility Access

Where the outpatient unit is part of another facility, separation and access shall be maintained as described in NFPA 101. Building entrances used to reach the outpatient services shall be at grade level, clearly marked, and located so that patients need not go through other activity areas. (Lobbies of multioccupancy buildings may be shared.) Design shall preclude unrelated traffic within the unit.

D. Functional Program Provision

Each project sponsor shall provide a functional program for the facility. (See section 1.1F of this document.)

E. Shared/Purchased Services

When services are shared or purchased, space and equipment should be modified or eliminated to avoid unnecessary duplication.

F. Location

Community outpatient units shall be conveniently accessible to patients and staff via available public transportation.

G. Parking

In the absence of a formal parking study, parking for outpatient facilities shall be provided at the rate noted for each type of unit. On-street parking, if available, may satisfy part of this requirement unless described otherwise. If the facility is located in a densely populated area where a large percentage of patients arrive as pedestrians; or if adequate public parking is available nearby; or if the facility is conveniently accessible via public transportation, adjustments to this standard may be made with approval of the appropriate authorities.

H. Access for Handicapped

All outpatient facilities shall be accessible to and usable by handicapped employees, staff, visitors, and patients. (See section 1.3 of this document.)

I. Privacy for Patients

Each facility design shall ensure patient privacy and dignity during interviews, examinations, and treatment.

9.2 Common Elements for Outpatient Facilities

The following shall apply to each outpatient facility described herein with additions and/or modifications as noted for each specific type. Special consideration shall be given to needs of children for pediatric services.

A. Administration and Public Areas

1. Entrance. Located at grade level and able to accommodate wheelchairs.
2. Public services shall include:
 - a. Conveniently accessible wheelchair storage.
 - b. A reception and information counter or desk.
 - c. Waiting space(s). Where an organized pediatric service is part of the outpatient facility, provisions shall be made for separating pediatric and adult patients.
 - d. Conveniently accessible public toilets.
 - e. Conveniently accessible public telephone(s).
 - f. Conveniently accessible drinking fountain(s).
3. Interview space(s) for private interviews related to social service, credit, etc., shall be provided.
4. General or individual office(s) for business transactions, records, administrative, and professional staffs shall be provided.
5. Clerical space or rooms for typing, clerical work, and filing, separated from public areas for confidentiality, shall be provided.
6. Multipurpose room(s) equipped for visual aids shall be provided for conferences, meetings, and health education purposes.
7. Special storage for staff personal effects with locking drawers or cabinets (may be individual desks or cabinets) shall be provided. Such storage shall be near individual work stations and staff controlled.
8. General storage facilities for supplies and equipment shall be provided as needed for continuing operation.

B. Clinical Facilities

As needed, the following elements shall be provided for clinical services to satisfy the functional program:

1. General purpose examination room(s). For medical, obstetrical, and similar examinations, rooms shall have a minimum floor area of 80 square feet (7.43 square meters), excluding vestibules, toilets, and closets. Room arrangement should permit at least 2 feet 8 inches (81.3 centimeters) clearance at each side and at the foot of the examination table. A lavatory or sink for handwashing and a counter or shelf space for writing shall be provided.
2. Special purpose examination rooms. Rooms for special clinics such as eye, ear, nose, and throat examinations, if provided, shall be designed and out-

fitted to accommodate procedures and equipment used. A lavatory or sink for handwashing and a counter or shelf space for writing shall be provided.

3. Treatment room(s). Rooms for minor surgical and cast procedures (if provided) shall have a minimum floor area of 120 square feet (11.15 square meters), excluding vestibule, toilet, and closets. The minimum room dimension shall be 10 feet (3.05 meters). A lavatory or sink for handwashing and a counter or shelf for writing shall be provided.

4. Observation room(s). Observation rooms for the isolation of suspect or disturbed patients shall have a minimum floor area of 80 square feet (7.43 square meters) and shall be convenient to a nurse or control station. This is to permit close observation of patients and to minimize possibilities of patients' hiding, escape, injury, or suicide. An examination room may be modified to accommodate this function. A toilet room with lavatory should be immediately accessible.

5. Nurses station(s). A work counter, communication system, space for supplies, and provisions for charting shall be provided.

6. Drug distribution station. This may be a part of the nurses station and shall include a work counter, sink, refrigerator, and locked storage for biologicals and drugs.

7. Clean storage. A separate room or closet for storing clean and sterile supplies shall be provided. This storage shall be in addition to that of cabinets and shelves.

8. Soiled holding. Provisions shall be made for separate collection, storage, and disposal of soiled materials.

9. Sterilizing facilities. A system for sterilizing equipment and supplies shall be provided. Sterilizing procedures may be done on- or offsite, or disposables may be used to satisfy functional needs.

10. Wheelchair storage space. Such storage shall be out of the direct line of traffic.

C. Radiology

Basic diagnostic procedures (these may be part of the outpatient service, offsite, shared, by contract, or by referral) shall be provided, including the following:

1. Radiographic room(s). See section 7.10 of this document for special requirements.
2. Film processing facilities.
3. Viewing and administrative areas(s).
4. Storage facilities for exposed film.
5. Toilet rooms with handwashing facilities accessible to fluoroscopy room(s), if fluoroscopic procedures are part of the program.

6. Dressing rooms or booths, as required by services provided, with convenient toilet access.

D. Laboratory

Facilities shall be provided within the outpatient department, or through an effective contract arrangement with a nearby hospital or laboratory service, for hematology, clinical chemistry, urinalysis, cytology, pathology, and bacteriology. If these services are provided on contract, the following laboratory facilities shall also be provided in (or be immediately accessible to) the outpatient facility:

1. Laboratory work counter(s), with sink, vacuum, gas, and electric services.
2. Lavatory(ies) or counter sink(s) equipped for handwashing.
3. Storage cabinet(s) or closet(s).
4. Specimen collection facilities with a water closet and lavatory. Blood collection facilities shall have seating space, a work counter, and handwashing facilities.

E. Janitors Closet(s)

At least one janitors closet per floor shall be provided. It shall contain a service sink and storage for housekeeping supplies and equipment.

F. Staff Facilities

Staff locker rooms and toilets shall be provided.

G. Engineering Service and Equipment Areas

The following shall be provided (these may be shared with other services provided capacity is appropriate for overall use):

1. Equipment room(s) for boilers, mechanical equipment, and electrical equipment.
2. Storage room(s) for supplies and equipment.
3. Waste processing services:
 - a. Space and facilities shall be provided for the sanitary storage and disposal of waste.
 - b. If incinerators and/or trash chutes are used, they shall comply with NFPA 82.
 - c. Incinerators, if used, shall also conform to the standards prescribed by area air pollution regulations.

H. Details and Finishes

1. Details shall comply with the following standards:

- a. Minimum public corridor width shall be 5 feet (1.52 meters). Work corridors less than 6 feet (1.82 meters) long may be 4 feet (1.22 meters) wide.
- b. Each building shall have at least two exits that are remote from each other. Other details relating to exits and fire safety shall comply with NFPA 101 and the standards outlined herein.

c. Items such as drinking fountains, telephone booths, vending machines, etc., shall not restrict corridor traffic or reduce the corridor width below the required minimum. Out-of-traffic storage space for portable equipment shall be provided.

d. The minimum door width for patient use shall be 2 feet 10 inches (86 centimeters). If the outpatient facility services hospital inpatients, the minimum width of doors to rooms used by hospital inpatients transported in beds shall be 3 feet 8 inches (1.12 meters). All rooms subject to occupancy by staff, patients, or visitors shall comply with ANSI A117.1 or UFAS.

e. Doors, sidelights, borrowed lights, and windows glazed to within 18 inches (46 centimeters) of the floor shall be constructed of safety glass, wired glass, or plastic glazing material that resists breakage and creates no dangerous cutting edges when broken. Similar materials shall be used in wall openings of playrooms and exercise rooms unless otherwise required for fire safety. Glazing materials used for shower doors and bath enclosures shall be safety glass or plastic.

f. Threshold and expansion joint covers shall be flush with the floor surface to facilitate use of wheelchairs and carts.

g. Handwashing facilities shall be located and arranged to permit proper use and operation. Particular care shall be taken to provide the required clearance for blade-type handle operation.

h. Provisions for hand drying shall be included at all handwashing facilities except scrub sinks.

i. Radiation protection for X-ray and gamma ray installations shall comply with section 7.10 of this document.

j. The minimum ceiling height shall be 7 feet 10 inches (2.38 meters) with the following exceptions:

- i. Boiler rooms shall have ceiling clearances not less than 2 feet 6 inches (76 centimeters) above the main boiler header and connecting piping.
- ii. Radiographic and other rooms containing ceiling-mounted equipment shall have ceilings of sufficient height to accommodate the equipment and/or fixtures.
- iii. Ceilings in corridors, storage rooms, toilet rooms, and other minor rooms shall not be less than 7 feet 8 inches (2.34 meters).
- iv. Tracks, rails, and pipes suspended along the path of normal traffic shall be not less than 6 feet 8 inches (2.03 meters) above the floor.

k. Rooms containing heat-producing equipment (such as boiler or heater rooms) shall be insulated and ventilated to prevent occupied adjacent floor or wall surfaces from exceeding a temperature

10 degrees above the ambient room temperature.

2. Finishes shall comply with the following standards:

a. Cubicle curtains and draperies shall be noncombustible or flame-retardant and shall pass both the large- and small-scale tests required by NFPA 701.

b. The flame-spread and smoke-developed ratings of finishes shall comply with section 7.29 and table 7 of this document. Where possible, the use of materials known to produce large amounts of noxious gases shall be avoided.

c. Floor materials shall be readily cleanable and appropriately wear-resistant. In all areas subject to wet cleaning, floor materials shall not be physically affected by liquid germicidal and cleaning solutions. Floors subject to traffic while wet, including showers and bath areas, shall have a nonslip surface.

d. Wall finishes shall be washable and, in the proximity of plumbing fixtures, shall be smooth and moisture resistant.

e. Wall bases in areas that are frequently subject to wet cleaning shall be monolithic and coved with the floor; tightly sealed within the wall; and constructed without voids.

f. Floor and wall areas penetrated by pipes, ducts, and conduits shall be tightly sealed to minimize entry of rodents and insects. Joints of structural elements shall be similarly sealed.

I. Design and Construction, Including Fire-Resistive Standards

1. Construction and structural elements of free-standing outpatient facilities shall comply with recognized model-building-code requirements for offices and to the standards contained herein.

Outpatient facilities that are an integral part of the hospital or that share common areas and functions shall comply with the construction standards for general hospitals. See applicable sections of this document for additional details.

2. Interior finish materials shall have flame-spread and smoke-production limitations as described in NFPA 101. Wall finishes less than 4 mil thick applied over a noncombustible material are not subject to flame-spread rating requirements.

3. Building insulation materials, unless sealed on all sides and edges, shall have a flame-spread rating of 25 or less and a smoke-developed rating of 150 or less when tested in accordance with NFPA 255.

Table 7
Flame-Spread and Smoke-Production Limitations on Interior Finishes

	Flame-spread rating	Smoke-production rating
Walls and ceiling		
Exitways, storage rooms, and areas of unusual fire hazard	25 or less (ASTM E84)	450 or less* (NFPA 258)
All other areas	75 or less (ASTM E84)	450 or less (NFPA 258)
Floors**		
Corridors and means of egress	Minimum of .45 watts/cm ² (NFPA 253, Floor Radiant Panel Test)	

* Average of flaming and nonflaming values.

** See section 1.3 of this document for requirements relative to carpeting areas that may be subject to use by handicapped individuals. These areas include offices, waiting spaces, etc., as well as corridors that might be used by handicapped employees, visitors, or staff.

J. Provision for Disasters

Seismic-force resistance of new construction for outpatient facilities shall comply with section 1.4 of this document and shall be given an importance factor of one. Where the outpatient facility is part of an existing building, that facility shall comply with applicable local codes. Special design provisions shall be made for buildings in regions that have sustained loss of life or damage to buildings from hurricanes, tornados, floods, or other natural disasters.

K. Elevators

1. All buildings with patient or service areas on other than the grade-level main entrance floor shall have electric or hydraulic elevators. Installation and testing of elevators shall comply with UFAS or ANSI A117.1.

a. Cars shall have a minimum inside floor dimension of not less than 5 feet (1.52 meters).

b. Elevators shall be equipped with an automatic two-way leveling device with an accuracy of $\pm \frac{1}{2}$ inch (± 1.3 centimeters).

c. Elevator controls, alarm buttons, and telephones shall be accessible to wheelchair occupants and usable by the blind.

d. Heat-sensitive call buttons shall not be used. Where light beams are used to activate safety

stops, these shall be in addition to door-edge stops and shall be deactivated by smoke detectors located at each landing.

2. Elevator inspections and tests shall be made. The owner shall be furnished with written certification that the installation meets all applicable safety regulations and codes and the standards set forth in this section.

L. Mechanical Standards

The following requirements shall apply to outpatient facilities that are freestanding; or within a nonmedical facility; or part of a health maintenance organization or other health service; or physically attached to a general hospital but independent of hospital areas, services, or equipment.

Where general hospital areas, services, and/or equipment are shared with the outpatient facility, the mechanical standards of section 7.31 of this document shall apply only to the specific areas, services, and/or equipment being shared (i.e., operating room, recovery room, etc.).

1. General mechanical systems standards are as follows:

a. The mechanical system should be subject to general review for overall efficiency and life-cycle cost. Details for cost-effective implementation of design features are interrelated and too numerous (as well as too basic) to list individually. Recognized engineering procedures shall be followed for the

most economical and effective results. A well-designed system can generally achieve energy efficiency at minimal additional cost and simultaneously provide for improved patient comfort. Different geographic areas may have climatic variations and use conditions that favor one system over another in terms of overall cost and efficiency. For instance, adiabatic cooling and dead-load controls may be common designs for certain western states but relatively unknown elsewhere. In no case shall patient care or safety be sacrificed for conservation.

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

c. Facility design considerations shall include site, building mass, orientation, configuration, fenestration, and other features relative to passive and active energy systems.

d. Insofar as practical, the facility shall include provisions for recovery of waste cooling and heating energy (ventilation, exhaust, water and steam discharge, cooling towers, incinerators, etc.).

e. Facility design shall include consideration of recognized procedures such as variable-air-volume systems, load shedding, programmed controls for unoccupied periods (nights and weekends, etc.), and use of natural ventilation, site and climatic conditions permitting. Systems with excessive operational and/or maintenance costs that negate long-range energy savings should be avoided.

f. Controls for air-handling systems shall be designed with an economizer cycle to use outside air for cooling and/or heating. (Use of mechanically circulated outside air does not reduce need for filtration.) It may be practical in many areas to reduce or shut down mechanical ventilation during appropriate climatic and patient-care conditions and to use open windows for ventilation.

g. Ventilation standards permit maximum use of simplified systems including those for variable-air-volume (VAV) supply. However, care must be taken in design to avoid possibility of large temperature differentials, high-velocity supply, excessive noise, and air stagnation, etc. Air supply and exhaust in rooms for which no minimum air change rate is noted may vary down to zero in response to room load. Temperature control shall also comply with these standards. To maintain asepsis control, airflow supply and exhaust should generally be con-

trolled to insure movement of air from "clean" to "less clean" areas.

h. Prior to acceptance of the facility, all mechanical systems shall be tested, balanced, and operated to demonstrate to the design engineer or to his or her representative that the installation and performance of these systems conform to design intent. Test results shall be documented for maintenance files.

i. Upon completion of the equipment installation contract, the owner shall be furnished with a complete set of manufacturers' operating, maintenance, and preventive maintenance instructions, a parts lists, and complete procurement information including equipment numbers and descriptions. Operating staff persons shall also be provided with instructions for properly operating systems and equipment. Required information shall include energy ratings needed for future conservation calculations.

2. Thermal and acoustical insulation shall meet the following standards:

a. Insulation within the building shall be provided to conserve energy, protect personnel, prevent vapor condensation, and reduce noise and vibration for the following:

- i. Boilers, smoke breeching, and stacks.
- ii. Steam supply and condensate return piping.
- iii. Heating, hot water supply, and return piping.
- iv. Chilled water, refrigerant, and other process piping and equipment operating with fluid temperatures below ambient dew point.
- v. Cold water supply and drainage piping on which condensation may occur.
- vi. Domestic hot water piping, water heaters, tanks, generators, and converters.
- vii. Heating, ventilating, air conditioning, and air-handling duct systems (including ducts, plenums, and casings) with surface temperatures 9°F (5°C) above or below the ambient dry-bulb or dew-point temperatures.
- viii. Other piping, ducts, and equipment where applicable.

b. Insulation on cold surfaces shall include an exterior vapor barrier. (Material that will not absorb or transmit moisture need not have a separate vapor barrier.)

c. Insulation, including finishes and adhesives on the exterior surfaces of ducts and equipment, shall have a flame-spread rating of 25 or less and a smoke-developed rating of 50 or less as determined by an independent testing laboratory in accordance with NFPA 255. The smoke-development rating for pipe insulation shall not exceed 150. This includes mechanical refrigeration and distribution equipment

and hot water distribution equipment such as valves, pumps, chillers, etc.

d. Use of duct linings is generally discouraged as they increase energy costs by increasing system-pressure drops. Moreover, remodeling of lined duct systems destroys the integrity of the liner sealant. However, if linings are used in nonsensitive hospital areas, they shall meet the erosion test method described in Underwriters' Laboratories, Inc., publication no. 181. These linings (including coatings, adhesives, and exterior surface insulation on pipes and ducts in spaces used as air supply plenums) shall have a flame-spread rating of 25 or less and a smoke-developed rating of 50 or less as determined by an independent testing laboratory in accordance with NFPA 255.

e. Duct lining exposed to air movement shall not be used in ducts serving operating rooms, delivery rooms, LDR rooms, and intensive care units. Where its use cannot be avoided, terminal filters of at least 90 percent efficiency shall be installed downstream of all lining material. This requirement shall not apply to mixing boxes and acoustical traps that have special coverings over such linings.

f. Asbestos insulation shall not be used in health facilities.

g. Existing accessible insulation within areas of facilities to be modernized shall be inspected, repaired, and/or replaced, as appropriate.

3. Mechanical standards for steam and hot water systems (where used) are as follows:

a. Boilers shall have the capacity, based upon the net ratings published by the Hydronics Institute or another acceptable National Standard, to supply the normal heating, hot water, and steam requirements of all systems and equipment.

b. Boiler accessories including feed pumps/heating circulating pumps, condensate return pumps, fuel oil pumps, and waste heat boilers shall be connected and installed to provide both normal and standby service.

c. Supply and return mains and risers for cooling, heating, and steam systems shall be equipped with valves to isolate the various sections of each system. Each piece of the equipment shall have valves at the supply and return ends. However, vacuum condensate returns need not be valved at each piece of equipment.

4. Air conditioning, heating, and ventilating systems shall comply with the following standards:

a. The ventilation rates shown in table 3 shall be used only as model standards; they do not preclude the use of higher, more appropriate rates. All rooms and areas in the facility shall have provisions for ventilation. Though natural window ventilation for noncritical areas may be employed, weather permitting, mechanical ventilation should be considered for use in interior areas and during periods of tem-

perature extremes. Fans serving exhaust systems shall be located at the discharge end and shall be readily serviceable. Exhaust systems may be combined to enhance the efficiency of recovery devices required for energy conservation.

i. Facility design should utilize energy conserving mechanisms including recovery devices, variable air volume, load shedding, and systems to shut down or reduce ventilation of unoccupied areas, insofar as patient care is not compromised. When appropriate, mechanical ventilation should employ an economizer cycle that uses outside air to reduce heating- and cooling-system loads. Filtering requirements shall be met when outside air is used as part of the mechanical ventilation system. Innovative design that provides for additional energy conservation while meeting the intent of these standards for acceptable patient care should be considered (see appendix).

ii. Fresh air intakes shall be located at least 25 feet (7.62 meters) from exhaust outlets of ventilating systems, combustion equipment stacks, medical-surgical vacuum systems, plumbing vents, or areas that may collect vehicular exhaust or other noxious fumes. (Prevailing winds and/or proximity to other structures may require greater clearances.) Plumbing and vacuum vents that terminate at a level above the top of the air intake may be located as close as 10 feet (3.05 meters). The bottom of outdoor air intakes serving central systems shall be as high as practical, but at least 6 feet (1.83 meters) above ground level, or, if installed above the roof, 3 feet (91 centimeters) above the roof level. Exhaust outlets from areas that may be contaminated shall be above roof level and arranged to minimize recirculation of exhaust air into the building.

iii. The ventilation systems shall be designed and balanced to provide directional flow as shown in table 3. (See also note 8 of table 3 for reductions and shutdown of ventilation systems during room vacancy.)

iv. Operating room air supply shall be from ceiling outlets near the center of the work area for effective air movement control. Return air shall be from the floor level. Each operating room shall have at least two return air inlets located as remotely

- from each other as practical. (Design should consider turbulence and other factors of air movement to minimize fall of particulates onto sterile surfaces.)
- v. Each space routinely used for administering inhalation anesthesia shall be equipped with a scavenging system to vent waste gases. If a vacuum system is used, the gas-collecting system shall be arranged so that it does not disturb patients' respiratory systems. Gases from the scavenging system shall be exhausted directly to the outside. The anesthesia gas scavenging exhausts directly to the outside and is not part of the recirculation system. Separate scavenging systems are not required for areas where gases are used only occasionally, such as the emergency room, and offices for routine dental work, etc. Acceptable concentration of anesthetizing agents are unknown at this time. The absence of specific data makes it difficult to set specific standards. However, any scavenging system should be designed to remove as much of the gas as possible from the room environment. While not within the scope of this document, it is assumed that anesthetizing equipment will be selected and maintained to minimize leakage and contamination of room air.
 - vi. The bottoms of ventilation (supply/return) openings shall be at least 3 inches (7.6 centimeters) above the floor.
 - vii. All central ventilation or air conditioning systems shall be equipped with filters having efficiencies equal to, or greater than, those specified in table 8. Where two filter beds are used, filter bed no. 1 shall be located upstream of the air conditioning equipment and filter bed no. 2 shall be downstream of any fan or blower. Where only one filter bed is required, it shall be located upstream of the air conditioning equipment, unless an additional prefilter is used. In this case, the prefilter shall be upstream of the equipment and the main filter may be located further downstream. Filter efficiencies, tested in accordance with ASHRAE 52-76, shall be average, except as noted otherwise. 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. A manometer shall be installed across each filter bed having a required efficiency of 75 percent or more, including hoods requiring HEPA filters. Reservoir-type sprays shall not be used.
 - viii. Air-handling duct systems shall meet the requirements of NFPA 90A and those contained herein.
 - ix. Ducts that penetrate construction intended for X-ray or other ray protection shall not impair the effectiveness of the protection.
 - x. Fire and smoke dampers shall be constructed, located, and installed in accordance with the requirements of NFPA 101 and 90A. Fans, dampers, and detectors shall be interconnected so that damper activation will not damage the ducts. Maintenance access shall be provided at all dampers. All damper locations shall be shown on drawings. Dampers should be activated by fire or smoke sensors, not by fan cutoff alone. Switching systems for restarting fans may be installed for fire department use in venting smoke after a fire has been controlled. However, provisions should be made to avoid possible damage to the system due to closed dampers. When smoke partitions are required, heating, ventilating, and air conditioning zones shall be coordinated with compartmentation insofar as practical to minimize need to penetrate fire smoke partitions.
 - xi. If air change standards in table 3 do not provide sufficient air for use by hoods and safety cabinets, makeup air shall be provided to maintain the required airflow direction and to avoid dependence upon infiltration from outdoor or contaminated areas.
 - xii. Laboratory hoods shall have an average face-velocity of at least 75 feet per minute (0.38 meters per second). They shall be connected to an outside-vented exhaust system separate from the building exhaust system and have an exhaust fan located at the discharge end. In addition, they shall have an exhaust duct system made of non-combustible corrosion-resistant material designed to accommodate the planned usage of the hood.
 - xiii. Laboratory hoods used to process infectious or radioactive materials shall meet special standards. In new construction and major renovation work, each hood used to process infectious or radioactive materials shall have a minimum face-velocity of 150

Table 8
**Filter Efficiencies for Central Ventilation and Air Conditioning Systems
 in Outpatient Facilities**

Area designation	No. filter beds	Filter efficiencies (%)	
		Filter bed no. 1	Filter bed no. 2
Critical areas*	2	25	90
All noncritical areas for patient care, treatment, and/or diagnosis, and those areas providing direct or support services such as clean supplies, laboratories, sterile and clean processing, bulk storage, soiled holding areas, administrative	1	25	—

Notes. Additional roughing or prefilters should be considered to reduce maintenance required for main filters. Ratings shall be based on ASHRAE 52-76.

* Operating rooms.

feet per minute with suitable static-pressure-operated dampers and alarms to alert staff of fan shutdown. Each shall also have filters with a 99.97 percent efficiency (based on the DOP, dioctyl-phthalate test method) in the exhaust stream, and be designed and equipped to permit the safe removal, disposal, and replacement of contaminated filters. Filters shall be as close to the hood as practical to minimize duct contamination. Hoods that process radioactive materials shall meet requirements of the Nuclear Regulatory Commission.

(*Note:* Radioactive isotopes used for injections, etc., without probability of airborne particulates or gases might be processed in a clean workbench-type hood in keeping with standards acceptable to the Nuclear Regulatory Commission.) Ducts serving hoods for radioactive material shall be constructed of acid-resistant stainless steel overall and have a minimum number of joints. Duct systems serving hoods in which strong oxidizing agents (e.g., perchloric acid) are used shall be constructed of acid-resistant stainless steel for at least 10 feet (3.05 meters) from the hood and shall be equipped with washdown facilities. Provisions shall be made for safe removal of filters during washdown operations.

- xiv.* The ventilation system for anesthesia storage rooms shall conform to the requirements of NFPA 99.

- xv.* Where ethylene oxide is used for sterilization, provisions shall be made for complete exhaust of gases to the exterior. Provisions shall be made to insure that when the sterilizer door is open, gases are pulled away from the operator. Provisions shall also be made for appropriate aeration of supplies. Aeration cabinets shall be vented to the outside. Where aeration cabinets are not used in ethylene oxide processing, an isolated area for mechanically venting gases to the outside shall be provided.
- xvi.* Boiler rooms shall be provided with sufficient outdoor airflow to maintain equipment combustion rates and to limit workstation temperatures.
- xvii.* Gravity exhaust may be used, conditions permitting, for nonpatient areas such as boiler rooms, central storage, etc.
- xviii.* The energy-saving potential of variable-air-volume systems is recognized, and the standards herein are intended to maximize appropriate use of such systems. Any ventilation system used for occupied areas must include provisions to avoid air stagnation in interior spaces where thermostat demands are met by temperatures of surrounding areas.

M. Plumbing and Other Piping Systems

All plumbing systems shall be designed and installed in accordance with the *National Standard Plumbing Code*, chapter 14, "Medical Care Facility Plumbing Equipment."

1. The following standards shall apply to plumbing fixtures:

a. The material used for plumbing fixtures shall be nonabsorptive and acid-resistant.

b. Handwashing facilities for staff in patient care areas shall be trimmed with valves that can be operated without hands (single-lever devices may be used, subject to above). Where blade handles are used, they shall not exceed 4½ inches (11.4 centimeters) in length, except that handles on clinical sinks shall be not less than 6 inches (15.2 centimeters) long.

2. The following standards shall apply to water systems:

a. Systems shall be designed to supply water at sufficient pressure to operate all fixtures and equipment during maximum demand.

b. Each water service main, branch main, riser, and branch to a group of fixtures shall have valves. Stop valves shall be provided at each fixture.

c. Backflow preventers (vacuum breakers) shall be installed on fixtures to which hoses or tubing can be attached.

3. The following standards shall apply to drainage systems: Building sewers shall discharge into a community sewage system. Where such a system is not available, sewage treatment must conform to applicable local and state regulations.

4. All piping in the HVAC and service-water systems shall be color coded or otherwise marked for easy identification.

N. Electrical Standards

1. All material and equipment, including conductors, controls, and signaling devices, shall be installed to provide a complete electrical system with the necessary characteristics and capacity to supply the electrical systems as indicated on plans and in the functional program. All materials shall be listed as complying with available standards of Underwriters' Laboratories, Inc., or other similar established standards. All electrical installations and systems shall be tested to show that the equipment operates in accordance with design intent. Installation shall be in accordance with applicable sections of NFPA 70.

2. Circuit breakers or fused switches that provide electrical disconnection and overcurrent protection for switchboard and panelboard conductors shall be enclosed or guarded to provide a dead-front assembly. The main switchboard shall be readily accessible for use and maintenance, set apart from traffic lanes, and located in a dry, ventilated space, free of

corrosive fumes or gases. Overload protective devices shall operate properly in ambient temperature conditions.

3. Panelboards serving lighting and appliance circuits shall be on the same floor and in the same facility area as the circuits they serve.

4. The following standards for lighting shall apply:

a. All spaces occupied by people, machinery, or equipment within buildings, approaches to buildings, and parking lots shall have lighting.

b. A portable or fixed examination light shall be provided for examination, treatment, and trauma rooms.

5. Duplex grounded-type receptacles (convenience outlets) shall be installed in all areas in sufficient quantities for tasks to be performed as needed. Each examination and work table shall have access to a minimum of two duplex receptacles.

6. Automatic emergency lighting shall be provided for safe egress from the building in the event of power failure in accordance with NFPA 99.

7. A manually operated, electrically supervised fire alarm system shall be installed in each facility that has a total floor area of more than 6,000 square feet (557 square meters). The fire alarm system shall be as described in NFPA 101.

9.3 Primary Care Outpatient Centers**A. General**

The primary care center provides comprehensive community outpatient medical services. The number and type of diagnostic, clinical, and administrative areas shall be sufficient to support the services and estimated patient load described in the program. All standards set forth in sections 9.1 and 9.2 of this document shall be met for primary care outpatient centers, with additions and modifications described herein. (See section 9.4 for smaller care centers.)

B. Parking

Parking spaces for patients and family shall be provided at the rate of not less than two parking spaces for each examination and each treatment room. In addition, one space for each of the maximum number of staff persons on duty at any one shift will be provided. Adjustments, as described in 9.1, should be made where public parking, public transportation, etc., reduce the need for onsite parking. Parking shall be provided for the handicapped in accordance with UFAS or ANSI A117.1.

C. Administrative Services

Each outpatient facility shall make provisions to support administrative activities, filing, and clerical work as appropriate. See also 9.2A. Service areas shall include:

1. Office(s), separate and enclosed, with provisions for privacy.
2. Clerical space or rooms for typing and clerical work separated from public areas to insure confidentiality.
3. Filing cabinets and storage for the safe and secure storage of patient records with provisions for ready retrieval.
4. Office supply storage (closets or cabinets) within or convenient to administrative services.
5. A staff toilet and lounge in addition to and separate from public and patient facilities.
6. Multiuse rooms for conferences, meetings, and health education. One room may be primarily for staff use but also available for public access as needed. In smaller facilities the room may also serve for consultation, etc.

D. Public Areas

Public areas shall be situated for convenient access and designed to promote prompt accommodation of patient needs, with consideration for personal dignity.

1. Entrances shall be well marked and at grade level. Where entrance lobby and/or elevators are shared with other tenants, travel to the outpatient unit shall be direct and accessible to the handicapped. Except for passage through common doors, lobbies, or elevator stations, patients shall not be required to go through other occupied areas or outpatient service areas. Entrance shall be convenient to parking and available via public transportation (see UFAS or ANSI A117.1).
2. A reception and information counter or desk shall be located to provide visual control of the entrance to the outpatient unit, and shall be immediately apparent from that entrance.
3. The waiting area for patients and escorts shall be under staff control. The seating area shall contain not less than two spaces for each examination and/or treatment room. Where the outpatient unit has a formal pediatrics service, a separate, controlled area for pediatric patients shall be provided. Wheelchairs within the waiting area will be accommodated.
4. Toilet(s) for public use shall be immediately accessible from the waiting area. In smaller units the toilet may be unisex and also serve for specimen collection.

5. Drinking fountains shall be available for waiting patients. In shared facilities, drinking fountains may be outside the outpatient area if convenient for use.

6. A control counter (may be part of the reception, information, and waiting room control) shall have access to patient files and records for scheduling of services.

E. Diagnostic

Provisions shall be made for X-ray and laboratory procedures as described in sections 9.2C and D of this document. Services may be shared or provided by contract offsite. Each outpatient unit shall have appropriate facilities for storage and refrigeration of blood, urine, and other specimens.

F. Clinical Facilities

Examination rooms and services as described in section 9.2B shall be provided. In addition, offices and consultation rooms shall be provided as required for practitioner use.

9.4 Small Primary (Neighborhood) Outpatient Facility

A. General

Facilities covered under this section are often contained within existing commercial or residential buildings as "store front" units, but they may also be a small, freestanding, new, or converted structure. The size of these units limits occupancy, thereby minimizing hazards and allowing for less stringent standards. Needed community services can therefore be provided at an affordable cost. The term *small structure* shall be defined as space and equipment serving four or fewer workers at any one time. Meeting all provisions of section 9.2 for general outpatient facilities is desirable, but limited size and resources may preclude satisfying any but the basic minimums described. This section does not apply to outpatient facilities that are within a hospital, nor is it intended for the larger, more sophisticated units.

B. Location

The small neighborhood center is expected to be especially responsive to communities with limited income. It is essential that it be located for maximum accessibility and convenience. In densely populated areas, many of the patients might walk to services. Where a substantial number of patients rely on public transportation, facility location shall permit convenient access requiring a minimum of transfers.

C. Parking

Not less than one convenient parking space for each staff member on duty at any one time and not less than four spaces for patients shall be provided. Parking requirements may be satisfied with street parking, or by a nearby public parking lot or garage. Where the facility is within a shopping center or similar area, customer spaces may meet parking needs.

D. Administration and Public Areas

1. Public areas shall include:
 - a. A reception and information center or desk.
 - b. Waiting space, including provisions for wheelchairs.
 - c. Patient toilet facilities.
2. An office area for business transactions, records, and other administrative functions, separate from public and patient areas, shall be provided.
3. General storage facilities for office supplies, equipment, sterile supplies, and pharmaceutical supplies shall be provided.
4. Locked storage (cabinets or secure drawers) convenient to work stations shall be provided for staff valuables.

E. Clinical Facilities

1. At least one examination room shall be available for each provider who may be on duty at any one time. Rooms may serve both as examination and treatment spaces (see section 9.2B(1)).
2. A clean work area with a counter, a sink equipped for handwashing, and storage for clean supplies, shall be provided. This may be a separate room or an isolated area.
3. A soiled holding room shall be provided (see section 9.2B(8)).
4. Sterile equipment and supplies shall be provided to supply functional and storage requirements. Sterile supplies may be prepackaged disposables or processed offsite.
5. Locked storage for biologicals and drugs shall be provided.
6. A toilet room containing a lavatory for handwashing shall be accessible from all examination and treatment rooms. Where a facility contains no more than three examination and/or treatment rooms, the patient toilet may also serve waiting areas.

F. Diagnostic Facilities

1. The functional program shall describe where and how diagnostic services will be made available to the outpatient if these are not offered within the facility. When provided within the facility, these services shall meet the standards of section 9.2 of this document.

2. Laboratory services and/or facilities shall meet the following standards:

- a. Urine collection rooms shall be equipped with a water closet and lavatory. Blood collection facilities shall have space for a chair and work counter. (The toilet room provided within the examination and treatment room may be used for specimen collection.)
- b. Services shall be available within the facility or through a formal agreement or contract with a hospital or other laboratory for hematology, clinical chemistry, urinalysis, cytology, pathology, and bacteriology.

G. Details and Finishes

See section 9.2H of this document.

H. Design and Construction

1. Every building and every portion thereof shall be designed and constructed to sustain all dead and live loads in accordance with accepted engineering practices and standards. If existing buildings are converted for use, consideration shall be given to the structural requirements for concentrated floor loadings, including X-ray equipment, storage files, and similar heavy equipment that may be added.
2. Construction and finishes may be of any type permitted for business occupancies as described in NFPA 101 and as specified herein.

I. Mechanical Standards

The following shall apply for the small outpatient facility of this section in lieu of sections 9.2L and 9.2M of this document:

1. Prior to completion and acceptance of the facility, all mechanical systems shall be tested and operated to demonstrate to the owner that the installation and performance of these systems conform to the functional and operational design intent.
2. Manuals shall be provided for all new equipment. These shall include manufacturers' operating and maintenance instructions and a complete parts list.
3. Heating and ventilation systems shall meet the following standards:
 - a. A minimum indoor winter-design-capacity temperature of 75°F (24°C) shall be set for all patient areas. Controls shall be provided for adjusting temperature as appropriate for patient activities and comfort.
 - b. All occupied areas shall be ventilated by natural or mechanical means.
 - c. Air-handling duct systems shall meet the requirements of NFPA 90A.

4. Plumbing and other piping systems shall meet the following standards:

- a. Systems shall comply with applicable codes, be free of leaks, and be designed to supply water at sufficient pressure to operate all fixtures and equipment during maximum demand.
- b. Backflow preventer (vacuum breakers) shall be installed on all water supply outlets to which hoses or tubing can be attached.
- c. Water temperature at lavatories shall not exceed 120°F (49°C).
- d. All piping registering temperatures above 120°F (49°C) shall be covered with thermal insulation.

J. Electrical Standards

The following shall apply to the small outpatient facility of this section in lieu of section 9.2N:

1. Prior to completion and acceptance of the facility, all electrical systems shall be tested and operated to demonstrate that installation and performance conform to applicable codes and functional needs.
2. Lighting shall be provided in all facility spaces occupied by people, machinery, and/or equipment, and in outside entryways. An examination light shall be provided for each examination and treatment room.
3. Sufficient duplex grounded-type receptacles shall be available for necessary task performance. Each examination and work table area shall be served by at least one duplex receptacle.
4. X-ray equipment installations, when provided, shall conform to NFPA 70.
5. Automatic emergency lighting shall be provided in every facility that has a total floor area of more than 1,000 square feet (92.9 square meters), and in every facility requiring stairway exit.

9.5 Outpatient Surgical Facility

A. General

Outpatient surgery is performed without anticipation of overnight patient care. The functional program shall describe in detail staffing, patient types, hours of operation, function and space relationships, transfer provisions, and availability of offsite services, etc.

If the outpatient surgical facility is part of an acute-care hospital or other medical facility, service may be shared to minimize duplication as appropriate. Where outpatient surgical services are provided within the same area or suite as inpatient surgery, additional space shall be provided as needed. If inpatient and outpatient procedures are performed in

the same room(s), the functional program shall describe in detail scheduling and techniques used to separate inpatients and outpatients.

The outpatient surgical facility shall be arranged to preclude movement of unrelated traffic through the operating room suite.

B. Size

The extent (number and types) of the diagnostic, clinical, and administrative facilities to be provided will be determined by the services contemplated and the estimated patient load as described in the narrative program.

C. Provision for the Handicapped

See section 1.3 of this document.

D. Parking

Four spaces for each room routinely used for surgical procedures plus one space for each staff member shall be provided. Additional parking spaces convenient to the entrance for pickup of patients after recovery shall be provided.

E. Administration and Public Areas

The following shall be provided:

1. A covered entrance for pickup of patients after surgery.
2. A lobby area (see section 9.2A(2) of this document).
3. Interview space(s) for private interviews relating to social services, credit, and admission.
4. General and individual office(s) for business transactions, records, and administrative and professional staff. These shall be separate from public and patient areas with provisions for confidentiality of records. Enclosed office spaces for administration and consultation shall be provided.
5. Multipurpose room(s).
6. A medical records room equipped for dictating, recording, and retrieval.
7. Special storage, including locking drawers and/or cabinets, for staff personal effects.
8. General storage facilities.

F. Sterilizing Facilities

A system for sterilizing equipment and supplies shall be provided. This may be offsite, provided that adequate sterile supplies are on hand to meet the maximum demand of one day's case load.

G. Clinical Facilities

1. At least one room shall be provided for examination and testing of patients prior to surgery. This

may be an examination room or treatment room as described in 9.2B(1) or (3) of this document.

2. Each operating room shall have a minimum clear area of 250 square feet (23.2 square meters), exclusive of cabinets and shelves. An additional clear area may be justified in the functional program to accommodate specific functions. An emergency communication system connected with the surgical suite control station shall be provided. There shall be at least one X-ray film illuminator in each room. Closed storage space for splints and traction equipment shall be provided for orthopedic surgery rooms. If the outpatient surgery service is to be integrated with hospital inpatient surgery service, at least one room shall be specifically designated for outpatient surgery. When the same operating rooms are used for inpatients, the functional program shall describe how scheduling conflicts will be avoided.

3. Room(s) for postanesthesia recovery of outpatient surgical patients shall be provided. At least 3 feet (91.4 centimeters) shall be provided at each side and at the foot of each bed as needed for work and/or circulation. If pediatric surgery is part of the program, separation from the adult section and space for parents shall be provided. Bedpans and bedpan-cleaning services shall be supplied.

4. A designated supervised recovery lounge shall be provided for patients who do not require postanesthesia recovery but need additional time for their vital signs to stabilize before safely leaving the facility. This lounge shall contain a control station, space for family members, and provisions for privacy. It shall have convenient patient access to toilets large enough to accommodate a patient and an assistant.

5. The following services shall be provided in surgical service areas:

a. A control station located to permit visual surveillance of all traffic entering the operating suite.

b. A drug distribution station. Provision shall be made for storage and preparation of medications administered to patients.

c. Scrub facilities. Station(s) shall be provided near the entrance to each operating room. Scrub facilities shall be arranged to minimize incidental splatter on nearby personnel or supply carts.

d. Soiled workroom. The soiled workroom shall contain a clinical sink or equivalent flushing-type fixture, a work counter, a sink for handwashing, and waste receptacle(s).

e. Fluid waste disposal facilities. These shall be convenient to the general operating rooms. A clinical sink or equivalent equipment in a soiled workroom shall meet this standard.

f. A clean workroom or a clean supply room. A clean workroom is required when clean materials are assembled within the facility prior to use; it

shall contain a work counter, sink equipped for handwashing, and space for clean and sterile supplies. A clean supply room may be provided when the narrative program defines a system for the storage and distribution of clean and sterile supplies that does not require the use of a clean workroom.

g. Anesthesia storage facilities shall be in accordance with the standards detailed in section 7.7C(9) for general hospitals.

h. Anesthesia workroom for cleaning, testing, and storing anesthesia equipment. It shall contain a work counter and sink.

i. Medical gas supply and storage with space for reserve nitrous oxide and oxygen cylinders.

j. Equipment storage room(s) for equipment and supplies used in the surgical suite.

k. Staff clothing change areas. Appropriate change areas shall be provided for staff working within the surgical suite. The areas shall contain lockers, showers, toilets, lavatories for handwashing, and space for donning scrub attire.

l. Outpatient surgery change areas. A separate area shall be provided for outpatients to change from street clothing into hospital gowns and to prepare for surgery. This area shall include waiting room(s), lockers, toilets, clothing change or gowning area(s), and space for administering medications. Provisions shall be made for securing patients' personal effects.

m. Stretcher storage area. This area shall be convenient for use and out of the direct line of traffic.

n. Lounge and toilet facilities for surgical staff. These shall be provided in facilities having three or more operating rooms. A nurses toilet room shall be provided near the recovery room(s).

o. Janitors closet. Space containing a floor receptor or service sink and storage space for house-keeping supplies and equipment shall be provided exclusively for the surgical suite.

p. Space for temporary storage of wheelchairs.

q. Provisions for convenient access to and use of emergency crash carts at both the surgical and recovery areas.

H. Diagnostic Facilities

Diagnostic services shall be provided on- or offsite for preadmission tests as required by the functional program.

I. Details and Finishes

All details and finishes shall meet the standards in section 9.2 of this document and those herein.

1. Details shall conform to the following guidelines:

a. Minimum public corridor width shall be 6 feet (1.83 meters), except that corridors in the operating room section, where patients are transported on stretchers or beds, shall be 8 feet (2.44 meters) wide.

b. The separate facility or section shall comply with the "New Ambulatory Health Care Centers" section of NFPA 101 and as described herein. Where the outpatient surgical unit is part of another facility that does not comply with, or exceeds, the fire safety requirements of NFPA 101, there shall be not less than one-hour separation between the outpatient surgical unit and other sections. The outpatient surgical facility shall have not less than two exits to the exterior. Exits, finishes, separation for hazardous areas, and smoke separation shall conform to NFPA 101.

c. Toilet rooms in surgery and recovery areas for patient use shall be equipped with doors and hardware that permit access from the outside in emergencies. When such rooms have only one opening or are small, the doors shall open outward or be otherwise designed to open without pressing against a patient who may have collapsed within the room.

d. Flammable anesthetics shall not be used in outpatient surgical facilities.

2. Finishes shall conform to the following guidelines:

a. All ceilings and walls shall be cleanable. Those in sensitive areas such as surgical rooms shall be readily washable and free of crevices that can retain dirt particles. These sensitive areas shall have a finished ceiling that covers all overhead ductwork and piping. Finished ceilings may be omitted in mechanical and equipment spaces, shops, general storage areas, and similar spaces, unless required for fire-resistive purposes (see NFPA 99 and NFPA 70).

J. Plumbing

See section 9.2M of this document.

K. Electrical

See section 9.2N of this document.

L. Fire Alarm System

A manually operated, electrically supervised fire alarm system shall be installed in each facility as described in NFPA 101.

M. Mechanical

Heating, ventilation, and air conditioning should be described for similar areas in section 9.2L and table 3, except that the recovery lounge need not be considered a sensitive area and outpatient operating rooms may meet the standards for emergency

trauma rooms. See table 8 for filter efficiency standards.

9.6 Freestanding Emergency Facility

A. General

This section applies to the emergency facility that is separate from the acute-care hospital and that therefore requires special transportation planning to accommodate transfer of patients and essential services. The separate emergency facility provides expeditious emergency care where travel time to appropriate hospital units may be excessive. It may include provisions for temporary observation of patients until release or transfer. It is not, however, for routine inpatient care.

Where hours of operation are limited, provisions shall be made in directional signs, notices, and designations to minimize potential for mistakes and loss of time by emergency patients seeking care during nonoperating hours.

Facility size, type, and design shall satisfy the functional program. In addition to standards in sections 9.1 and 9.2 of this document, the following guidelines shall be met:

B. Location

The emergency facility shall be conveniently accessible to the population served and shall provide patient transfer to appropriate hospitals. In selecting location, consideration shall be given to factors affecting source and quantity of patient load, including highway systems, industrial plants, and recreational areas. Though most emergency patients will arrive by private cars, consideration should also be given to availability of public transportation.

C. Parking

Not less than one parking space for each staff member on duty at any one time and not less than two spaces for each examination and each treatment room shall be provided. Additional spaces shall be provided for emergency vehicles. Street, public, and shared lot spaces, if included as part of this standard, shall be exclusively for the use of the emergency facility. All required parking spaces shall be convenient to the emergency entrance. Parking for the handicapped shall be in accordance with UFAS or ANSI A117.1.

D. Administrative and Public Areas

Administrative and public areas shall conform to the standards in section 9.2A with the following additions.

1. Entrances shall be covered to permit protected transfer of patients from ambulance and/or automobiles. If a platform is provided for ambulance use, a ramp for wheelchairs and stretchers shall be provided in addition to steps. Door(s) to emergency services shall be not less than 4 feet (1.22 meters) wide to allow the passage of a stretcher and assistants. The emergency entrance shall have vision panels to minimize conflict between incoming and outgoing traffic and to allow for observation of the unloading area from the control station.

2. Lobby and waiting areas shall satisfy the following requirements:

a. Convenient access to wheelchairs and stretchers shall be provided at the emergency entrance.

b. Reception and information function may be combined or separate. These shall provide direct visual control of the emergency entrance, and access to the treatment area and the lobby. Control stations will normally include triage function and shall be in direct communication with medical staff. Emergency entrance control functions shall include observation of arriving vehicles.

c. The emergency waiting area shall include provisions for wheelchairs and be separate from the area provided for scheduled outpatient service.

3. Initial interviews may be conducted at the reception/control area. Facilities for conducting detailed interviews on payments, social services, and personal data shall include provisions for acoustical privacy. These facilities may be separate from the reception area but must be convenient to the emergency service waiting area.

4. For standards concerning general and individual offices, see section 9.2A(4) of this document.

5. For standards concerning clerical space, see section 9.2A(5).

6. Multipurpose room(s) shall be provided for staff conferences. This room may also serve for consultation.

7. For standards concerning special storage, see section 9.2A(7).

8. For standards concerning general storage, see section 9.2A(8).

E. Clinical Facilities

See section 9.2B of this document and, in addition, provide:

1. A trauma room for surgical procedures as described in section 9.5G(2) in the outpatient surgery unit. The trauma room may be set up to accommodate more than one patient. Where the emergency trauma room is set up for multipatient use, there

shall be not less than 180 square feet per patient area, and there shall be utilities and services for each patient. Provisions shall be included for patient privacy.

2. In addition to wheelchair storage, a holding area for stretchers within the clinical area, away from traffic and under staff control.

3. A poison control service with immediately accessible antidotes and a file of common poisons. Communication links with regional and/or national poison centers shall be provided. This service may be part of the nurses control and work station.

4. A nurses work and control station. This shall accommodate charting, files, and staff consultation activities. It shall be located to permit visual control of clinical area and its access. Communication links with the examination/treatment area, trauma room, reception control, laboratory, radiology, and on-call staff shall be provided.

5. A cardiac pulmonary resuscitation (CPR) emergency cart, away from traffic but immediately available to all areas including entrance and receiving areas.

6. Scrub stations at each trauma room. Water and soap controls shall not require use of hands.

7. At least two examination rooms and one trauma room (treatment room may also be utilized for examination).

F. Radiology

Standards stipulated in section 9.2C of this document shall be met during all hours of operation. Radiographic equipment shall be adequate for any part of the body including, but not limited to, fractures. Separate dressing rooms are not required for unit(s) used only for emergency procedures.

G. Laboratory

See section 9.2D of this document for applicable standards. In addition, immediate access to blood for transfusions and provisions for cross-match capabilities shall be provided.

H. Employee Facilities

See section 9.2F of this document for applicable standards. In addition, facilities for on-call medical staff shall be provided.

I. Observation

Facilities shall be provided for holding emergency patients until they can be discharged or transferred to an appropriate hospital. Size, type, and equipment shall be as required for anticipated patient

10. REHABILITATION FACILITIES

load and lengths of stay. (An emergency facility within a one-hour drive of a receiving hospital may keep a patient long enough for stabilization only, but a remote rural facility may be required to provide several days' care before transfer can be safely made.) One or more examination/treatment rooms may be utilized for this purpose. Each observation bed shall permit:

1. Direct visual observation of each patient from the nurses duty station, except where examination/treatment rooms are used for patient holding. View from the duty station may be limited to the door.
2. Patient privacy.
3. Access to patient toilets.
4. Secure storage of patients' valuables and clothing.
5. Dispensing of medication.
6. Bedpan storage and cleaning.
7. Provision of nourishment (see section 7.2B(15) of this document). In addition, meal provisions shall be made for patients held for more than four hours during daylight.

J. Mechanical

See section 9.2L of this document for applicable mechanical standards.

K. Plumbing

See section 9.2M of this document for applicable plumbing standards.

L. Electrical

See section 9.2N of this document for applicable electrical standards.

10.1 General Considerations

Rehabilitation facilities may be organized under hospitals (organized departments of rehabilitation), outpatient clinics, rehabilitation centers, and other facilities designed to serve either single- or multiple-disability categories.

A. Provisions for Handicapped

Facilities shall be available and accessible to the physically handicapped (see ANSI A117.1 or UFAS).

B. Functional Units and Service Areas

Functional units and service areas shall include:

1. Required units. Each rehabilitation facility shall contain a medical evaluation unit and one or more of the following units:

- a. Psychological services unit.
- b. Social services unit.
- c. Vocational services.

2. Required service areas. Each rehabilitation facility shall provide the following service areas, if they are not otherwise conveniently accessible to the facility and appropriate to program functions:

- a. Patient dining, recreation, and day spaces.
- b. Dietary unit.
- c. Personal care facilities.
- d. Unit for teaching activities of daily living.
- e. Administration department.
- f. Engineering service and equipment areas.
- g. Linen service.
- h. Janitors closet.
- i. Employees facilities.
- j. Nursing unit.

3. Optional units. The following special services areas, if required by the functional program, shall be provided as outlined in these sections. The sizes of the various departments will depend upon the requirements of the service to be provided:

- a. Sterilizing facilities.
- b. Physical therapy unit.
- c. Occupational therapy unit.
- d. Prosthetics and orthotics unit.
- e. Speech and hearing unit.
- f. Dental unit.
- g. Radiology unit.
- h. Pharmacy unit.
- i. Laboratory facilities.

10.2 Evaluation Unit

A. Office(s) for Personnel

B. Examination Room(s)

Examination rooms shall have a minimum floor area of 120 square feet (11.15 square meters), excluding such spaces as the vestibule, toilet, closet, and work counter (whether fixed or movable). The minimum room dimension shall be 10 feet (3.05 meters). The room shall contain a lavatory or sink equipped for handwashing, a work counter, and storage facilities, and a desk, counter, or shelf space for writing.

C. Evaluation Room(s)

Evaluation room areas shall be arranged to permit appropriate evaluation of patient needs and progress and to determine specific programs of rehabilitation. Rooms shall include a desk and work area for the evaluators; writing and workspace for patients; and storage for supplies. Where the facility is small and workload light, evaluation may be done in the examination room(s).

D. Laboratory Facilities

Facilities shall be provided within the rehabilitation department or through contract arrangement with a nearby hospital or laboratory service for hematology, clinical chemistry, urinalysis, cytology, pathology, and bacteriology. If these facilities are provided through contract, the following minimum laboratory services shall be provided in the rehabilitation facility:

1. Laboratory work counter(s) with a sink, and gas and electric service.
2. Handwashing facilities.
3. Storage cabinet(s) or closet(s).
4. Specimen collection facilities. Urine collection rooms shall be equipped with a water closet and lavatory. Blood collection facilities shall have space for a chair and work counter.

E. Electromyographic Room

If required by the functional program, the electromyographic room and equipment shall be provided in a multidisability facility.

10.3 Psychological Services Unit

This shall include office(s) and workspace for testing, evaluation, and counseling.

10.4 Social Service Unit

This shall include office space(s) for private interviewing and counseling.

10.5 Vocational Services Unit

Office(s) and workspace for vocational training, counseling, and placement shall be provided.

10.6 Patient Dining, Recreation, and Day Spaces

The following standards shall be met for patient dining, recreation, and day spaces (areas may be in separate or adjoining spaces):

A. Inpatients and Residents

A total of 30 square feet (2.79 square meters) per bed for the first 100 beds and 27 square feet (2.51 square meters) per bed for all beds in excess of 100 shall be provided.

B. Outpatients

If dining is part of the day care program, a total of 20 square feet (1.86 square meters) per person shall be provided. If dining is not part of the program, at least 10 square feet (0.93 square meters) per person for recreation and day spaces shall be provided.

C. Storage

Storage spaces shall be provided for recreational equipment and supplies.

10.7 Dietary Department**A. General**

Construction, equipment, and installation of food service facilities shall meet the requirements of the functional program. Services may consist of an onsite conventional food preparation system, a convenience food service system, or an appropriate combination thereof.

The following facilities shall be provided as required to implement the food service selected:

1. A control station for receiving food supplies.
2. Storage facilities for four days' food supply, including cold storage items.
3. Food preparation facilities. Conventional food preparation systems require space and equipment for preparing, cooking, and baking. Convenience

food service systems such as frozen prepared meals, bulk packaged entrees, individually packaged portions, and contractual commissary services require space and equipment for thawing, portioning, cooking, and/or baking.

4. Handwashing facility(ies) located in the food preparation area.
5. Patients meal service facilities for tray assembly and distribution.
6. Dining space for ambulatory patients, staff, and visitors.
7. Warewashing space. This shall be located in a room or an alcove separate from food preparation and serving area. Commercial dishwashing equipment shall be provided. Space shall also be provided for receiving, scraping, sorting, and stacking soiled tableware and for transferring clean tableware to the using areas. A lavatory shall be conveniently available.
8. Potwashing facilities.
9. Storage areas for cans, carts, and mobile tray conveyors.
10. Waste storage facilities. These shall be located in a separate room easily accessible to the outside for direct waste pickup or disposal.
11. Office(s) or desk spaces for dietitian(s) or the dietary service manager.
12. Toilets for dietary staff. Handwashing facilities shall be immediately available.
13. Janitors closet. This shall be located within the dietary department and shall contain a floor receptor or service sink and storage space for housekeeping equipment and supplies.
14. Self-dispensing icemaking facilities. This may be in an area or room separate from the food preparation area but must be easily cleanable and convenient to dietary facilities.

10.8 Personal Care Unit for Inpatients

A separate room with appropriate fixtures and utilities shall be provided for patient grooming.

10.9 Activities for Daily Living Unit

A unit for daily living teaching activities shall be provided. It shall include a bedroom, bath, kitchen, and space for training stairs.

10.10 Administration and Public Areas

A. Entrance

A grade-level entrance, sheltered from the weather and able to accommodate wheelchairs, shall be provided.

B. Lobby

The lobby shall include:

1. Wheelchair storage space(s).
2. A reception and information counter or desk.
3. Waiting space(s).
4. Public toilet facilities.
5. Public telephone(s).
6. Drinking fountain(s).

C. Interview Space(s)

Space for private interviews relating to social service, credit, and admissions shall be provided.

D. General or Individual Office(s)

General or individual offices for business transactions, records, and administrative and professional staffs shall be provided.

E. Multipurpose Room(s)

Multipurpose rooms for conferences, meetings, health education, and library services shall be provided.

F. Special Storage

This shall be provided for storing employees' personal effects.

G. General Storage

Separate space for office supplies, sterile supplies, pharmaceutical supplies, splints and other orthopedic supplies, and housekeeping supplies and equipment shall be provided.

10.11 Engineering Service and Equipment Areas

A. Equipment Rooms

Rooms for boilers, mechanical equipment, and electrical equipment shall be provided.

B. Storage Room(s)

Storage rooms for building maintenance supplies and yard equipment shall be provided.

C. Waste Processing Services

1. Space and facilities shall be provided for the sanitary storage and disposal of waste.
2. If provided, design and construction of inciner-

ators and trash chutes shall be in accordance with NFPA 82 and shall also conform to the requirements prescribed by environment regulations.

10.12 Linen Services

A. Onsite Processing

If linen is to be processed on the site, the following shall be provided:

1. Laundry processing room with commercial equipment that can process seven days' laundry within a regularly scheduled workweek. Handwashing facilities shall be provided.
2. Soiled linen receiving, holding, and sorting room with handwashing and cart-washing facilities.
3. Storage for laundry supplies.
4. Clean linen storage, issuing, and holding room or area.
5. Janitors closet containing a floor receptor or service sink and storage space for housekeeping equipment and supplies.

B. Offsite Processing

If linen is processed off the rehabilitation facility site, the following shall be provided:

1. Soiled linen holding room.
2. Clean linen receiving, holding, inspection, and storage room(s).

10.13 Janitors Closet(s)

In addition to the janitors closets called for in certain departments, janitors closets shall be provided throughout the facility as required to maintain a clean and sanitary environment. Each shall contain a floor receptor or service sink and storage space for housekeeping supplies and equipment.

10.14 Employee Facilities

In addition to the employee facilities such as locker rooms, lounges, toilets, or showers called for in certain departments, a sufficient number of such facilities to accommodate the needs of all personnel and volunteers shall be provided.

10.15 Nursing Unit (for Inpatients)

Where inpatients are a part of the facility, each nursing unit shall provide the following:

A. Patient Rooms

Each patient room shall meet the following requirements:

1. Maximum room occupancy shall be four patients. Larger units may be provided if justified by the functional program. At least two single-bed rooms with private toilet rooms shall be provided for each nursing unit.
2. Minimum room areas exclusive of toilet rooms, closets, lockers, wardrobes, alcoves, or vestibules shall be 125 square feet (11.61 square meters) in single-bed rooms and 100 square feet (9.29 square meters) per bed in multibed rooms. In multibed rooms, a clearance of 3 feet 8 inches (1.12 meters) shall be maintained at the foot of each bed to permit the passage of equipment and beds.
3. Each patient sleeping room shall have a window in accordance with section 7.28A(11) of this document.
4. A nurses calling system shall be provided.
5. In new construction, handwashing facilities shall be provided in each patient room. In renovations and modernization, the lavatory may be omitted from the bedroom where a water closet and lavatory are provided in a toilet room designed to serve one single-bed room, or one two-bed room.
6. Each patient shall have access to a toilet room without having to enter the general corridor area. One toilet room shall serve no more than four beds and no more than two patient rooms. The toilet room shall contain a water closet and a lavatory. The lavatory may be omitted from a toilet room that serves single-bed and two-bed rooms if each such patient's room contains a lavatory.
7. Each patient shall have a wardrobe, closet, or locker with minimum clear dimensions of 1 foot 10 inches (55.9 centimeters) by 1 foot 8 inches (50.8 centimeters), suitable for hanging full-length garments. A clothes rod and adjustable shelf shall be provided.
8. Visual privacy shall be provided for each patient in multibed rooms.

B. Service Areas

The service areas noted below shall be in or readily available to each nursing unit. The size and disposition of each service area will depend upon the number and types of disabilities for which care will be provided. Although identifiable spaces are required for each indicated function, consideration will be given to alternative designs that accommodate some functions without designating specific areas or rooms. Such proposals shall be submitted for prior

approval. Each service area may be arranged and located to serve more than one nursing unit, but at least one such service area shall be provided on each nursing floor. The following service areas shall be provided:

1. Administrative center or nurses station.
2. Nurses office.
3. Storage for administrative supplies.
4. Handwashing facilities located near the nurses station and the drug distribution station. One lavatory may serve both areas.
5. Charting facilities for nurses and doctors.
6. Lounge and toilet room(s) for staff.
7. Individual closets or compartments for safe-keeping personal effects of nursing personnel, located convenient to the duty station or in a central location.
8. Room for examination and treatment of patients. This room may be omitted if all patient rooms are single-bed rooms. It shall have a minimum floor area of 120 square feet (11.15 square meters), excluding space for vestibules, toilet, closets, and work counters (whether fixed or movable). The minimum room dimension shall be 10 feet (3.05 meters). The room shall contain a lavatory or sink equipped for handwashing, work counter, storage facilities, and a desk, counter, or shelf space for writing. The examination room in the evaluation unit may be used if it is conveniently located.
9. Clean workroom or clean holding room.
10. Soiled workroom or soiled holding room.
11. Drug distribution station. Provisions shall be made for convenient and prompt 24-hour distribution of medicine to patients. Distribution may be from a medicine preparation room, a self-contained medicine dispensing unit, or through another approved system. If used, a medicine preparation room shall be under the nursing staff's visual control and contain a work counter, refrigerator, and locked storage for biologicals and drugs. A medicine dispensing unit may be located at a nurses station, in the clean workroom, or in an alcove or other space under direct control of nursing or pharmacy staff.
12. Clean linen storage. A separate closet or an area within the clean workroom shall be provided for this purpose. If a closed-cart system is used, storage may be in an alcove.
13. Nourishment station. This shall contain a sink for handwashing, equipment for serving nourishment between scheduled meals, a refrigerator, storage cabinets, and icemaker-dispenser units to provide for patient service and treatment.
14. Equipment storage room. This shall be for equipment such as I.V. stands, inhalators, air mattresses, and walkers.
15. Parking for stretchers and wheelchairs. This shall be located out of the path of normal traffic.

C. Patient Bathing Facilities

Bathtubs or showers shall be provided at a ratio of one bathing facility for each eight beds not otherwise served by bathing facilities within patient rooms. At least one island-type bathtub shall be provided in each nursing unit. Each tub or shower shall be in an individual room or privacy enclosure that provides space for the private use of bathing fixtures, for drying and dressing, and for a wheelchair and an assistant. Showers in central bathing facilities shall be at least 4 feet (1.22 meters) square, curb-free, and designed for use by a wheelchair patient.

D. Patient Toilet Facilities

1. The minimum dimensions of a room containing only a water closet shall be 3 feet (91.4 centimeters) by 6 feet (1.83 meters); additional space shall be provided if a lavatory is located within the same room. Water closets must be usable by wheelchair patients.
2. At least one room on each floor containing a nursing unit(s) shall be provided for toilet training. It shall be accessible from the nursing corridor. A minimum clearance of 3 feet (91.4 centimeters) shall be provided at the front and at each side of the water closet. This room shall also contain a lavatory.
3. A toilet room that does not require travel through the general corridor shall be accessible to each central bathing area.
4. Doors to toilet rooms shall have a minimum width of 2 feet 10 inches (86.4 centimeters) to admit a wheelchair. The doors shall permit access from the outside in case of an emergency.
5. A handwashing facility shall be provided for each water closet in each multifixture toilet room.

10.16 Sterilizing Facilities

Where required by the functional program, a system for sterilizing equipment and supplies shall be provided.

10.17 Physical Therapy Unit

The following elements shall be provided:

- A. Office Space
- B. Waiting Space

C. Treatment Area(s)

For thermotherapy, diathermy, ultrasonics, hydrotherapy, etc., cubicle curtains around each individual treatment area shall be provided. Handwashing facility(ies) shall also be provided. One lavatory or sink may serve more than one cubicle. Facilities for collection of wet and soiled linen and other material shall be provided.

D. An Exercise Area**E. Storage for Clean Linen, Supplies, and Equipment****F. Patients Dressing Areas, Showers, Lockers, and Toilet Rooms****G. Wheelchair and Stretcher Storage**

(Items A, B, E, F, and G may be planned and arranged for shared use by occupational therapy patients and staff if the functional program reflects this sharing concept.)

10.18 Occupational Therapy Unit

The following elements shall be provided:

A. Office Space**B. Waiting Space****C. Activity Areas**

Provisions shall be made for a sink or lavatory and for the collection of waste products prior to disposal.

D. Storage for Supplies and Equipment**E. Patients Dressing Areas, Showers, Lockers, and Toilet Rooms**

(Items A, B, D, and E may be planned and arranged for shared use by physical therapy patients and staff if the functional program reflects this sharing concept.)

10.19 Prosthetics and Orthotics Unit

The following elements shall be provided:

A. Workspace for Technician(s)**B. Space for Evaluation and Fitting**

This shall include provision for privacy.

C. Space for Equipment, Supplies, and Storage**10.20 Speech and Hearing Unit**

This shall include:

A. Office(s) for Therapists**B. Space for Evaluation and Treatment****C. Space for Equipment and Storage****10.21 Dental Unit**

The following elements shall be provided:

A. Operatory

This shall contain a lavatory.

B. Laboratory and Film Processing Facilities**10.22 Radiology Unit**

This unit shall contain the following elements:

A. Radiographic Room(s)

See section 7.10 of this document for special requirements.

B. Film Processing Facilities**C. Viewing and Administration Area(s)****D. Film Storage Facilities****E. A Toilet Room**

This shall be equipped with a handwashing facility. It shall be directly accessible from each fluoroscopy room and shall not require entry through the general corridor area.

F. Dressing Area(s)

These shall be conveniently accessible to toilets.

G. A Waiting Room or Alcove

These shall serve ambulatory patients.

H. A Holding Area for Stretcher Patients

This shall be out of the direct line of normal traffic.

10.23 Pharmacy Unit

The size and type of services to be provided in the pharmacy will depend upon the drug distribution system chosen and whether the facility proposes to provide, purchase, or share pharmacy services. This shall be explained in the narrative program. Provisions shall be made for the following functional areas:

- A. A Dispensing Area with a Handwashing Facility**
- B. An Editing or Order Review Area**
- C. An Area for Compounding**
- D. Administrative Areas**
- E. Storage Areas**
- F. A Drug Information Area**
- G. A Packaging Area**
- H. A Quality-Control Area**

10.24 Details and Finishes

Patients in a rehabilitation facility will be disabled to differing degrees. Therefore, high standards of safety for the occupants shall be provided to minimize accidents. All details and finishes for modernization projects as well as for new construction shall comply with the following requirements insofar as they affect patient services:

A. Details

1. Compartmentation, exits, automatic extinguishing systems, and other details relating to fire prevention and fire protection in inpatient rehabilitation facilities shall comply with requirements listed in NFPA 101. In freestanding outpatient rehabilitation

facilities, details relating to exits and fire safety shall comply with the appropriate business occupancy chapter of NFPA 101 and the requirements outlined herein.

2. Items such as drinking fountains, telephone booths, vending machines, and portable equipment shall not restrict corridor traffic or reduce the corridor width below the required minimum.

3. Rooms containing bathtubs, sitz baths, showers, and water closets, subject to patient use shall be equipped with doors and hardware that will permit access from the outside in an emergency. When such rooms have only one opening or are small, the doors shall open outward or be otherwise designed to open without pressing against a patient who may have collapsed within the room.

4. Minimum width of all doors to rooms needing access for beds shall be 3 feet 8 inches (1.2 meters). Doors to rooms requiring access for stretchers and doors to patient toilet rooms and other rooms needing access for wheelchairs shall have a minimum width of 2 feet 10 inches (86.4 centimeters). Where the functional program states that the sleeping facility will be for residential use (and therefore not subject to in-bed patient transport), patient room doors may be 3 feet (91 centimeters) wide, if approved by the local authority having jurisdiction.

5. Doors between corridors and rooms or those leading into spaces subject to occupancy, except elevator doors, shall be swing-type. Openings to showers, baths, patient toilets, and other small, wet-type areas not subject to fire hazard are exempt from this requirement.

6. Doors, except those to spaces such as small closets not subject to occupancy, shall not swing into corridors in a manner that obstructs traffic flow or reduces the required corridor width.

7. Windows shall be designed to prevent accidental falls when open, or shall be provided with security screens where deemed necessary by the functional program.

8. Windows and outer doors that may be frequently left open shall be provided with insect screens.

9. Patient rooms intended for 24-hour occupancy shall have windows that operate without the use of tools and shall have sills not more than 3 feet (91 centimeters) above the floor.

10. Doors, sidelights, borrowed lights, and windows glazed to within 18 inches (46 centimeters) of the floor shall be constructed of safety glass, wired glass, or plastic glazing material that resists breaking or creates no dangerous cutting edges when broken. Similar materials shall be used in wall openings of playrooms and exercise rooms. Safety glass or plastic glazing material shall be used for shower doors and bath enclosures.

11. Linen and refuse chutes shall comply with NFPA 101.

12. Thresholds and expansion joint covers shall be flush with the floor surface to facilitate use of wheelchairs and carts in new facilities.

13. Grab bars shall be provided at all patient toilets, bathtubs, showers, and sitz baths. The bars shall have 1½ inches (3.8 centimeters) clearance to walls and shall be sufficiently anchored to sustain a concentrated load of 250 pounds (113.4 kilograms). Special consideration shall be given to shower curtain rods which may be momentarily used for support.

14. Recessed soap dishes shall be provided in showers and bathrooms.

15. Handrails shall be provided on both sides of corridors used by patients. A clear distance of 1½ inches (3.8 centimeters) shall be provided between the handrail and the wall, and the top of the rail shall be about 32 inches (81 centimeters) above the floor, except for special care areas such as those serving children.

16. Ends of handrails and grab bars shall be constructed to prevent snagging the clothes of patients.

17. Location and arrangement of handwashing facilities shall permit proper use and operation. Particular care should be given to clearance required for blade-type operating handles. Lavatories intended for use by handicapped patients shall be installed to permit wheelchairs to slide under them.

18. Mirrors shall be arranged for convenient use by wheelchair patients as well as by patients in a standing position.

19. Provisions for hand drying shall be included at all handwashing facilities.

20. Lavatories and handwashing facilities shall be securely anchored to withstand an applied vertical load of not less than 250 pounds (113.4 kilograms) on the front of the fixture.

21. Radiation protection requirements of X-ray and gamma ray installations shall conform to necessary state and local laws. Provisions shall be made for testing the completed installation before use. All defects must be corrected before acceptance.

22. The minimum ceiling height shall be 7 feet 10 inches (2.44 meters) with the following exceptions:

a. Boiler rooms shall have a ceiling clearance not less than 2 feet 6 inches (76 centimeters) above the main boiler header and connecting piping.

b. Ceilings of radiographic and other rooms containing ceiling-mounted equipment, including those with ceiling-mounted surgical light fixtures, shall have sufficient height to accommodate the equipment and/or fixtures.

c. Ceilings in corridors, storage rooms, toilet rooms, and other minor rooms may be not less than 7 feet 8 inches (2.34 meters).

d. Suspended tracks, rails, and pipes located

in the path of normal traffic shall be not less than 6 feet 8 inches (2.03 meters) above the floor.

23. Recreation rooms, exercise rooms, and similar spaces where impact noises may be generated shall not be located directly over patient bed areas unless special provisions are made to minimize such noise.

24. Rooms containing heat-producing equipment (such as boiler or heater rooms and laundries) shall be insulated and ventilated to prevent any floor surface above from exceeding a temperature 10°F (6°C) above the ambient room temperature.

25. Noise reduction criteria shown in table 1 shall apply to partition, floor, and ceiling construction in patient areas.

B. Finishes

1. Cubicle curtains and draperies shall be noncombustible or rendered flame retardant and shall pass both the large and small scale tests in NFPA 701.

2. Floor materials shall be readily cleanable and appropriately wear-resistant for the location. Floors in food preparation or assembly areas shall be water-resistant. Joints in tile and similar material in such areas shall also be resistant to food acids. In all areas frequently subject to wet cleaning methods, floor materials shall not be physically affected by germicidal and cleaning solutions. Floors subject to traffic while wet, such as shower and bath areas, kitchens, and similar work areas, shall have a non-slip surface.

3. Wall bases in kitchens, soiled workrooms and other areas that are frequently subject to wet cleaning methods shall be monolithic and coved with the floor, tightly sealed within the wall, and constructed without voids that can harbor insects.

4. Wall finishes shall be washable and, in the proximity of plumbing fixtures, shall be smooth and moisture-resistant. Finish, trim, and floor and wall construction in dietary and food preparation areas shall be free from spaces that can harbor pests.

5. Floor and wall areas penetrated by pipes, ducts, and conduits shall be tightly sealed to minimize entry of pests. Joints of structural elements shall be similarly sealed.

6. Ceilings throughout shall be readily cleanable. All overhead piping and ductwork in the dietary and food preparation area shall be concealed behind a finished ceiling. Finished ceilings may be omitted in mechanical and equipment spaces, shops, general storage areas, and similar spaces, unless required for fire-resistive purposes.

7. Acoustical ceilings shall be provided for corridors in patient areas, nurses stations, dayrooms, recreational rooms, dining areas, and waiting areas.

10.25 Design and Construction, Including Fire-Resistive Standards

A. Design

Except as noted below, construction of freestanding outpatient rehabilitation facilities shall adhere to recognized national model building codes and/or to NFPA 101 and the minimum requirements contained herein. Rehabilitation facilities that accommodate inpatients shall comply with the construction requirements for general hospitals as indicated in section 7 of this document.

B. Interior Finishes

Interior finish materials for inpatient facilities shall comply with the flame-spread limitations and the smoke-production limitations set forth in NFPA 101.

C. Insulation Materials

Building insulation materials, unless sealed on all sides and edges, shall have a flame-spread rating of 25 or less and a smoke-developed rating of 150 or less when tested in accordance with NFPA 255-1984.

D. Provisions for Natural Disasters

For design and construction standards relating to hurricanes, tornadoes, and floods, see section 7.29F of this document.

10.26 Elevators

A. General

All buildings having patient facilities (such as bedrooms, dining rooms, or recreation areas) or critical services (such as diagnostic or therapy) located on other than the main entrance floor shall have electric or hydraulic elevators. Installation and testing of elevators shall comply with ANSI A17.1, ANSI A117.1, or UFAS.

1. The number of elevators required shall be determined from a study of the facility plan and of the estimated vertical transportation requirements.

2. Cars of hospital-type elevators shall have inside dimensions that will accommodate a patient bed and attendants. They shall be at least 5 feet (1.52 meters) wide by 7 feet 6 inches (2.29 meters) deep. Car doors shall have a clear opening of not less than 3 feet 8 inches (1.12 meters). Cars of all other required elevators shall have a minimum inside floor dimension of not less than 5 feet (1.52 meters). Car doors shall have a clear opening of not less than 3 feet (91 centimeters).

10.27 Mechanical Standards

Refer to applicable parts of sections 7.31 and 9.2L and M of this document for these standards.

10.28 Electrical Standards

Refer to applicable parts of sections 7.32 and 9.2N of this document for these standards.

1. APPENDIX

Energy Conservation Considerations

1.1 General

Hospital energy consumption ranges from 200,000–800,000 Btu per square foot per year and can be approximately three times that used in large office buildings. For the average hospital, energy costs are between 3 and 8 percent of its total budget. Hospitals are unique in terms of occupant demands and needs: many areas of hospitals are occupied 24 hours a day, 7 days a week; they provide services which may require energy-consuming technology; and they must provide services in an environment controlled for patient health and safety. Effective energy management requires close, consistent control of all energy-consuming systems and components.

Providing for an acceptable environment for appropriate patient care is a major part of energy consumption by a hospital. Heating, cooling, domestic hot water, and lighting systems for occupant needs are generally responsible for approximately 80 percent of energy consumed. Support functions, such as food service, and equipment account for the remaining 20 percent.

The quality of hospital environment is supportive of patients. When energy resources were plentiful and inexpensive compared to present day costs, hospitals, like all other buildings, were designed and constructed for maximum comfort without careful consideration of the impact on operating costs. As energy resources become more expensive and the future supply of fossil fuel uncertain, energy conservation and life-cycle cost considerations become increasingly important to designers and administrators. However, opportunities for conserving energy resources and dollars must be carefully weighed against the benefits of energy use, i.e., patient health and safety. Functional requirements may outweigh the need to conserve energy. Maintaining this consideration as a first priority, individuals responsible for energy management have found that through the installation of various new equipment, e.g., heat recovery systems, new lighting, energy efficient chillers, and boiler modifications, substantial savings have been obtained.

The intent is to promote energy conservation without reducing indoor environmental quality below acceptable levels. For the last few years, a common belief has developed that energy conservation implies a degradation of environmental quality. Sufficient evidence now exists to indicate that degradation is not a necessary effect of energy conservation, but that it can easily occur if care is not taken in the selection and implementation of appropriate

measures. Conversely, hospitals as well as other buildings can be designed and managed so that improved environmental quality can be achieved at reduced energy consumption.

Recommendations for design, construction, and operation which are intended to decrease energy consumption and minimize life-cycle costs without decreasing environmental quality below initial conditions are discussed.

1.2 Life-Cycle Cost Analysis of Energy Conservation Investments

The construction and operation of hospitals requires the commitment of a great many dollars—not only in the initial planning, design, and construction of facilities, but also throughout their lives.

Once occupied, a facility must be heated, cooled, cleaned, and secured; its environmental control systems demand not only energy to fuel them but also people to watch over and maintain them; building surfaces must be cleaned, resealed, repainted, and refinished; grounds must be cared for; and, from time to time, individual elements within the building must be renewed or replaced. If money was borrowed to finance the initial investment, its repayment also becomes a continuing cost.

Design plays a key role in determining both initial and continuing costs. Furthermore, these costs may often be traded off against each other: extra initial investment in a more efficient HVAC system, or in finishes which do not have to be frequently replaced, or in facade design which makes windows easier to clean, or in lobby design which minimizes the need for security personnel. All may reap dividends that can keep paying off—year after year.

Life-cycle cost (LCC) analysis provides architects, consultants, and their clients with a straightforward and usable technique to assist in determining these trade-offs, and in making them when they count, during the planning and early design phases. The technique allows, and in fact encourages, the architect to consider all of the relevant economic consequences of design decisions, both in terms of the dollars to be spent today and the dollars required tomorrow.

LCC analysis is a method of economic evaluation of alternatives which considers all relevant costs and benefits associated with each alternative activity or project over its life. As applied to energy conservation projects in buildings, LCC analysis provides an evaluation of the net effect, over time, of reducing fuel costs by purchasing, installing, maintaining, operating, repairing, and replacing energy-conserving features. The use of LCC analysis has become widespread and almost essential in the evaluation of alternative energy conservation measures applicable to both new buildings in design and to existing buildings where retrofit for energy efficiency is under consideration.

LCC analysis is primarily suited for the economic comparison of alternatives. Its emphasis is on determining how to allocate a given budget among competing projects so as to maximize the overall net return from that budget. The LCC method is used to select energy conservation projects for which budget estimates must be made; however, the LCC cost estimates are not appropriate as budget estimates, because they are expressed in constant dollars (excluding inflation) and all dollar cash flows are converted to a common point in time. Hence, LCC estimates are not necessarily equivalent to the obligated amounts required in the funding years.

The results of LCC analyses are usually expressed in either present value dollars, uniform annual value dollars, as a ratio of present or annual value dollar savings to present or annual value dollar costs (referred to here as the savings-to-investment ratio or SIR), or as a percentage rate of return on the investment.

Although it is not in a strict sense an LCC measure, the time until the initial investment is recouped (payback) is another form that is sometimes used to report the results of an LCC analysis. A simple payback period of 3–5 years is generally considered to be cost effective. To derive any of these measures, it is important to adjust for differences in the timing of expenditures and cost savings. This time adjustment can be accomplished by a technique called "discounting."

The major steps for performing an LCC analysis of energy conservation investments are the following:

- A.** Identify the alternative approaches to achieve the objective of reducing consumption of nonrenewable energy, as well as any constraints that must be imposed, such as the level of thermal comfort required.
- B.** Establish a common time basis for expressing LCC values, a study period for the analysis, and the economic lives of major assets.

- C.** Identify and estimate the cost (and benefit) parameters to be considered in the analysis.
- D.** Convert costs and savings occurring at different times to a common time.
- E.** Compare the investment alternatives in terms of their relative economic efficiencies in order to select the energy conservation projects that will result in the largest savings of nonrenewable energy costs possible for a given budget and constraints.
- F.** Analyze the results for sensitivity to the initial assumptions.

LCC is the best method for evaluating the economics of alternative capital investments. Other methods are still in common use but sometimes give erroneous results. The payback method is probably the most popular, but it has the following disadvantages: it does not allow for the difference in length of life for various investments, it does not adequately consider the effects of uneven cash flows from one year to the next, and finally, it does not account for any expenses or revenues that may occur after the end of the payback period when the investment may still be in operation.

1.3 Energy Conservation Measures

Opportunities for energy conservation exist in all aspects of hospital design, construction, and operation—from initial site selection and landscaping to equipment selection. This section provides guidelines for building orientation and building envelope construction in the interest of energy conservation as well as HVAC systems requirements for effective utilization of energy.

A. Architectural Design Considerations

1. Land Planning

Planning of the site should take advantage of existing natural resources such as: existing ground water formation and rain water collection for use as heat sinks, prevailing wind direction and air quality for natural ventilation, vegetation and land forms which may be used as wind breaks in colder climates, the location and type of vegetation to provide summer shading, and the use of slopes for subterranean building opportunities. Careful evaluation of the site should also include adjacent public transportation routes. The microclimate of the site should be analyzed to take advantage or protect against the impacts of prevailing winds, secondary currents, and weather movement.

2. Civil/Site Engineering

a. **Building orientation.** In climates which primarily require cooling, the building should be oriented with major glass portions to the north. Where possible, minimum glazing or solar shading should be used on southern exposures. In climates which primarily require heating, a southern orientation would reduce the heating load. Proper shading devices should be used on south-facing glazing during appropriate seasons. Natural wind breaks, existing adjacent structures, or locating the primary building axis into the prevailing wind direction may be used to reduce the wind load and cooling effect on the facility.

b. **Partially buried building.** Partially buried buildings may be considered for nonpatient sleeping areas of hospitals. This approach should consider the additional cost related to structure, excavation, and water protection.

c. **Underground energy sources.** A system of piping buried in the ground for ground-to-water (or air) transfer of energy from the ground to the building for heating by means of a heat pump can be advantageous. The application must consider the availability of land, cost effectiveness, and potential building expansion. Where feasible, consideration should also be given to the utilization of underground hot springs for heating and underground water for cooling or heating by means of a heat pump.

3. Landscape Design

a. **General landscaping.** To reduce the reflected radiation on the ground surface by such materials as concrete, asphalt, water, gravel, metal, and sand, the ground surfaces surrounding the building within the reflective zone of the sun should be designed with less reflective materials such as trees, shrubs, grass, ground cover, or mulch.

b. **Vegetation.** In cold climates plants can manage snow accumulation and serve as windblocks for buildings. In mild and hot climates, plants can be used to shade the building to reduce solar heat gain, and at the same time, permit air circulation.

4. Building Architecture

a. **Orientation**

i. **Daylighting.** Natural lighting and ventilation should be considered. Windows can be used for both ventilation and lighting to reduce heat gain. Energy consumption for lighting can be reduced by developing a building configuration and envelope which maximizes the natural light available to the interior spaces. For example, the exterior surface exposed to light may be increased by use of atriums. The space could be used as a thermal buffer, unoccupied and unconditioned, by using skylights and interior glass walls.

Lightwells and atriums, in conjunction with sidelighting from the windows, raise the overall level of natural light. The use of natural lighting can also reduce energy consumption for cooling, in some cases, due to lower internal heat gains from reduced use of artificial lighting. An increase in energy consumption for heating may also result and should be considered in the analysis.

ii. **Solar shading.** Solar shading to reduce undesirable heat gain may be accomplished by use of site conditions such as trees, adjacent structures, or other materials. Additionally, solar shading may be achieved by using solar shading devices at each window requiring shade.

iii. **Massing.** Building systems which provide mass to delay heat transfer into the facility may be used to reduce peak cooling loads during the peak cooling season. The system may also reduce night perimeter heating during heating seasons.

iv. **Interior transportation.** Interior transportation systems for people and materials are typically required in hospitals. The electrical energy consumption for interior transportation is a small portion of the total consumption of the building, but savings can be realized in this area.

Energy consumption for transportation can be minimized by arranging the spaces to reduce the need for moving people and materials, vertically, if possible, and by maximizing the efficiency of the system through controls. Additionally, the type of drive system can affect consumption.

aa. **Architectural considerations.** Reducing the number of floors or arranging the spaces to encourage the use of stairs by the staff and reducing the floor elevation of material storage areas or other material handling requirements will reduce the need for vertical transportation systems.

bb. **Optimize cab type and number.** Traffic patterns should be analyzed and the system designed to provide the heaviest loadings. Reduction of the number of stops per elevator, as with various skip-stop schemes, reduces starting and stopping energy requirements to the elevator system. Design should provide the required unoccupied period capacity using the minimum practicable number of cabs.

cc. **Optimizing controls.** Optimizing controls ensure that transportation tasks are achieved with minimum elevator travel. The controls respond to any particular demand situation by dispatching the cab that is already loaded

Table A-1
Maximum Wall, Roof, Floor, and Overall Transmission Factors for Hospital Facilities¹

Heating degree days ²	Gross wall ^{3,4} (U_O)	Walls ⁵ (U_W)	Ceiling/roof ⁶ (U_R)	Floor ⁷ (U_F)	Floor ⁸ (U_F)
Less than 1,000	0.38	0.15	0.05	0.10	0.29
1,000-2,000	0.38	0.15	0.05	0.08	0.24
2,001-3,000	0.36	0.10	0.04	0.07	0.21
3,001-4,000	0.36	0.10	0.03	0.07	0.18
4,001-6,000	0.31	0.08	0.03	0.05	0.14
6,001-8,000	0.28	0.07	0.03	0.05	0.12
Over 8,001	0.28	0.07	0.03	0.05	0.10

Notes. Value of U for wall, roof, and floor should not be greater than the following values corresponding to 97.5 percent (99 percent for sensitive areas)⁹ winter ambient design temperatures (i.e., use the lowest of the two values obtained, one based on degree day criteria and the other on winter ambient design criteria):

Temperature (°F)	Walls	Floor
-40 to -10	.07	.05
-9 to +10	.10	.07
+11 to +50	.15	.10

¹ Heat transmission values are expressed in Btu/hr/ft²/°F.

² Degree days value from the latest edition of ASHRAE System Manual shall be used.

³ Gross wall value includes all doors and windows, window frames, metal ties through walls, structural steel members that protrude through all insulation to the exterior or adjacent to the exterior and continuous concrete or masonry walls or floors that extend from inside heated spaces through the building envelope to the exterior, e.g., fire walls that extend above the roof and concrete floor slabs that extend beyond the exterior wall to form a balcony or terrace.

⁴ Maximum U_O value will put a limitation on the allowable percentage of glass to gross wall area in a building. Insulating glass on the building will allow higher percentage of glass in comparison with single glass.

⁵ Wall U_W value is the thermal transmittance of all elements of the opaque wall area. U_W values are to be used for upgrade of existing facilities where the alteration of walls and resizing of window glazing to meet gross wall is not cost-effective.

⁶ Ceiling/roof U_R values are for ceiling/roof areas where adequate space exists for insulation to be applied above ceiling and/or below roof structure. Built-up roof assemblies and ceiling assemblies in which the finished interior surface is essentially the underside of the roof deck shall have a maximum U_R value of 0.05 for a heating degree day area. On existing buildings, use the maximum U_R value practical to accommodate the existing roof conditions where the life-cycle cost analysis indicates a higher life-cycle cost to implement U_R values required by table A-1. The values are as follows: (a) cost of providing additional structural support to accommodate additional dead loads of new insulation and roofing system, and additional live loads from greater accumulations of snow (snow will melt slower due to increased insulation); (b) cost of raising roof curbs; (c) cost of raising cap flashings; (d) cost of raising roof drains.

⁷ Floor U_F values are for floors of heated space over unheated areas such as garages, crawl spaces, and basements without a positive heat supply to maintain a minimum of 50°F.

⁸ Floor U_F values are for slab-on-grade insulation around the perimeter of the floor.

⁹ Sensitive areas are defined as operating rooms, obstetrical delivery rooms, nurseries, recovery rooms, emergency operating and treatment rooms, central sterile supply rooms, ICU and CCU units, neopsychiatric seclusion units, allergy suite and those technical equipment areas, e.g., automatic data processing, radiology, and nuclear magnetic resonance, where accurate temperature and humidity control is vital to the function of the equipment or the success of medical procedure performed. Related working areas, lounges, locker rooms, etc., should not be designed on the 99 percent criteria.

while preventing an unloaded cab from responding. In addition to avoiding unnecessary travel by unoccupied cabs, the improved response allows the elevator demand to be met with a reduced number of cabs, over a system with simple demand controls. An elevator system utilizing group supervisory operation can be preprogrammed to react to all levels of elevator demand: heavy up, heavy down, heavy balanced, off hours, etc. In addition, the system can be programmed to selectively turn off elevators as demand lessens. Energy savings of up to 45 percent can be realized

using this type of system. A survey of elevator demand and use after occupancy should be part of a contract.

- b. Exterior envelope (walls, floor, glass, and roof)
 - i. Exterior envelope—heating and cooling. The exterior shell of a building should be designed to minimize winter heat loss and summer heat gain. The selection of heat transmission factor "U" (Btu/hour/square foot/°F) is made by comparing heating and cooling criteria requirements and selecting the most restrictive value, i.e., the lower value of the two.

- aa. Heating design criteria. The heat transmission factors for walls, roof, and floors should not exceed the values suggested in table 1. (No interpolation for intermediate degree days values should be used.) Glass selection for all buildings should be based on economics, but in no case should the overall heat transfer coefficient value (U_0) shown in table 1 be exceeded when used in conjunction with the following equation:

$$U_0 A_0 = U_W \times A_W + U_G \times A_G + U_D \times A_D$$

$$U_0 = \frac{U_W \times A_W + U_G \times A_G + U_D \times A_D}{A_0}$$

where U_0 = the average thermal transmittance of the gross wall area; A_0 = a unit area of gross wall; U_W = thermal transmittance of opaque (net) wall area; A_W = ratio of opaque (net) wall area to gross wall area; U_G = thermal transmittance of window or glass; A_G = ratio of window area to gross wall area; U_D = thermal transmittance of door; and A_D = ratio of door area to gross wall area.

- bb. Perimeter insulation. Where heated spaces are adjacent to exterior walls in slab-on-grade construction, perimeter insulation should be installed on the interior of foundation walls as follows: 1 inch thick when annual heating degree days aggregate from 3,500 to 4,500 and 2 inches thick when the annual heating degree days are 4,500 and over. Installation of the insulation should be in accordance with the ASHRAE Guide.
- cc. Condensation control—heating. The design of the building envelope should be designed to provide protection against cold weather water-vapor condensation on or in roofs, attics, walls, windows, doors, and floors. For opaque areas of ceilings, roofs, floors, and walls contained for thermal insulation, a continuous vapor barrier having a water vapor permeance not exceeding 0.5 perm [grains/hr ft² (in.-Hg.)] is recommended on the wintertime warm side of the insulation. Slab-on-grade floors should have vapor barrier with lapped joints under the slab not exceeding 0.1 perm. A vapor barrier not exceeding 0.1 perm should cover the ground area of a crawl space beneath floors. There should be thermal breaks to prevent excessive heat transmission through framing members of windows, ceiling, roof, floor, and wall construction. Overall heat transfer

coefficient for windows in sensitive areas requiring winter humidity control should be sufficient to avoid condensation when the outdoor dry-bulb temperature is at or above the minimum temperature for 97.5 percent of the hours occurring in any one heating month as noted in the ASHRAE *Handbook of Fundamentals*.

- dd. Cooling design criteria. Wall (net area) and roof heat gain should not exceed 2.0 Btuh per square foot at design conditions. All glass, except north glass, should have a shading device (e.g. shades, venetian blinds, draperies, awnings, eyebrow reveals, or vertical/horizontal fins), and maximum instantaneous transmission and solar gain through glass should not exceed 70 Btu's per square foot as an average for the entire building (i.e., block load figure). This average of maximum instantaneous solar and transmission factors includes shading factor. Thermal storage effect due to mass of building must be accounted for to produce the properly sized system, capable of balancing the actual loads. For buildings that are cooled, only the overall thermal transmittance U_0 for the gross wall should not exceed 0.38.
- c. Vestibules. Vestibules and/or windshields should be used at entries to provide protection against prevailing winds.
- d. Textures and materials. Exterior materials, colors, and textures should be selected for the effect on the solar heat gains and reflective lighting.

5. Structural Engineering

- a. Roofs and walls. Where active solar system might be installed in the future, the design of roof and wall systems should include increased loading to carry active solar equipment such as solar panels to ensure that the increased dead load, penetrations, and maintenance are provided.
- b. Subterranean building. The effects of hydrostatic pressure on the floor and exterior walls should be considered in the design of subterranean and "berm" structures.

B. Mechanical Design Considerations

1. General

- a. Even though much of the energy use of a hospital is determined by the architectural design and internal building activity, the achievement of energy efficiency within a health facility will depend largely

upon the design and operation of the mechanical systems. The design process should include comparative analysis of appropriate systems, equipment, and control strategies for energy use characteristics, including thermal and mechanical efficiencies, and consideration of the interface between mechanical and electrical loads.

b. Pursuit of maximum efficiency in mechanical system design should be exercised to a degree that does not impair health care operations and cost objectives.

2. Heating, Ventilating and Air Conditioning (HVAC)

a. General. Three types of HVAC systems are commonly applied to health facilities: all-air, air and water, and unitary air conditioning equipment.

b. All-air systems

i. In all-air systems the air supplied to the spaces served provide the cooling, and possibly heating, capacity necessary to produce the desired temperature and humidity levels for comfort or process control.

ii. The fan energy required for the distribution of the air can be quite significant and is dependent upon (a) the quantity of the air, (b) pressure resistance of the conditioning equipment and duct work, (c) fan and drive efficiencies, and (d) hours of operation.

iii. Although ventilation for reduction of contaminants may govern, the quantity of air is usually determined by and is proportional to the space-sensible cooling or heating load and inversely proportional to the difference between room and supply air temperatures. Consequently, reduction in space cooling load through prudent design of the building envelope and lighting will produce a reduction in the required fan energy. The air quantity and fan energy can be further minimized by designing with as high a room supply air temperature difference as considerations of refrigeration design, duct heat gain, and room air distribution will permit.

iv. Air system resistance

aa. Fan energy is proportional to the conditioning equipment and duct resistance and, therefore, can be minimized by thoughtful selection of components and duct design.

bb. Air-handling equipment including intake and exhaust louvers, filters, and heating and cooling coils can be optimized by selection at a conservative face velocity. Since the pressure drop of these components generally varies as the square of the face velocity, selection at 300 to 400 feet per minute, in-

stead of the customary 500 feet per minute can often be justified by life-cycle cost analysis, especially for continuously operating systems.

cc. Filter life may be improved by reducing face velocity, permitting an economically justifiable lower final pressure drop (before replacement).

dd. Lower cooling coil face velocities may reduce the required depth (number of rows) in the coil bank giving an additional pressure drop improvement.

ee. Where return air and outdoor air are both conditioned by the air handling unit, the effectiveness of the blending of the two air streams can have impact upon both actual operating pressure losses and the stability of the supply air temperature control.

ff. Where desirable to have the supply (or other fans) discharge into a plenum, the fan discharge transition should be gradual for proper fan performance and minimal fan energy use.

gg. Simpler, shorter duct systems designed with conservatively low duct velocities are likely to be consistent with energy efficiency objectives. High loss fittings, such as mitered elbows, abrupt transitions and take-offs; and internal obstructions, such as damper frames, should be avoided. Long duct runs, if necessary, should be designed with special consideration of pressure loss since the maximum loss for any run will be imposed upon the entire fan system.

hh. Sound attenuators should be selected for low velocities pressure losses. High-velocity selection may, in addition to incurring undesirable pressure loss, result in internally generated noise.

ii. Terminals, such as mixing boxes, variable-air-volume devices, should be selected for low pressure loss.

v. Leakage of air from supply ducts robs system capacity and wastes energy. Sealing seams and joints of supply ducts will minimize this loss.

vi. Fan type and size and its motor drive should be selected for good mechanical efficiency. (See section 1.3C(5) of this appendix for high-efficiency motors.) Special design investigation of existing conditions may be necessary in renovation projects.

vii. Supply and exhaust air systems should serve spaces saving similar operating characteristics. Spaces with different periods of occupancy or substantially different ventilation requirements, generally should not be combined on the same system.

viii. Dedicating air systems to specific medical departments can often provide proper grouping of

spaces with similar occupancy characteristics and environmental performance requirements and simplify the duct distribution systems. Supplying perimeter and interior building spaces (because of differing load characteristics) from separate systems will permit use of energy-saving control strategies.

ix. Humidification. During the heating season, humidification systems vaporize water into the dry ventilating air to increase moisture and achieve the desired humidity within the building. The volume of moisture required to maintain a desired level of relative humidity is proportional to the amount of outdoor air entering the building, its dryness, and the natural moisture contributed by occupants.

Humidification systems are often designed not only to maintain the comfort and health of occupants, but to preserve materials, furnishings, and equipment.

Over-humidification can be avoided by: (1) high limit control of air supply stream, (2) proper sizing of humidifier, (3) selecting humidifiers for stepped capacity and sequence control, (4) avoid placing objects (e.g., filters) downstream of steam humidifiers, (5) providing positive shut off of steam humidifiers including jacket when air supply is off and when seasonably not required, and (6) providing concealed adjustment for room humidistats. Humidifiers should be shut off during unoccupied periods. No additional humidification should be provided in unoccupied spaces unless it is justified to be critical, such as to avoid static electricity for electronic components or computer rooms.

x. Variable air volume. Variable-air-volume (VAV) systems offer opportunities for savings and can be used in health care facilities if environmental requirements (including minimum outdoor air ventilation) of the space being served are continually met during occupancy. VAV control should not be used for areas which require outward air movement to control contamination and odors (table 3 of this document), nor should VAV control be used for areas which require inward air movement unless an acceptable alternate source of makeup air is provided for exhaust to maintain the minimum number of total air changes (table 3). Although it may be possible to design a VAV system which satisfies air quality requirements for these spaces, complexities of controls could make such a system unreliable and difficult to maintain. VAV systems for areas which require positive air movement should be used only after careful consideration that the control reliability is adequate to justify the achievable energy savings.

Modified variable-air-volume systems designed to provide not less than a preset minimum total air change rate required to insure continuous control of air flow direction may be used in critical care areas (i.e., surgery, nurseries, recovery, and intensive care). In addition, outdoor air and total air change rates, including that of sensitive areas, may be reduced when space is unoccupied or unused. Care should be taken to insure that control of air flow direction created by use of exhaust fans in adjacent areas does not cause undesired movement of air from soiled areas to clean areas.

xi. Room air distribution. The room air-distribution system must be responsive to the thermal loads in the space, the indoor air quality requirements, and the acoustic room criteria. To meet all of these criteria, simultaneously, care is required in the selection and placement of the supply and return air terminals.

- aa. To provide thermally acceptable conditions in the functional areas, the supply air diffusers should be sized and located within the rooms according to the air diffusion performance index (ADPI) procedure described in chapter 32 of the ASHRAE *Handbook of Fundamentals*. It should be noted that this procedure does not specify the amount of supply air to be delivered to the room, but only how that air should be distributed within the room.
- bb. To provide acoustically acceptable conditions in the functional areas, the supply and return air terminal devices should be selected to meet the appropriate noise criteria (NC) or room criteria (RC) described in chapter 7 of the ASHRAE *Handbook of Fundamentals*. These noise criteria should be complied with in addition to the ADPI requirements.
- cc. To provide acceptable indoor air quality in the functional areas, the location of the return air terminal devices should be carefully considered. The common practice of locating both supply and return air devices in the ceiling, or on opposing high sidewalls can materially reduce the effectiveness of the ventilation and the heating/cooling capability by short circuiting the supply air directly to the return device. The air-distribution pattern within an occupied space is at least as important as the amount of ventilation air supplied to the room. In areas where variable-volume systems are installed, special care is needed to assure that sufficient room ventilation air reaches the occupants. For example, high-occupancy density and a moderate lighting load in a perimeter zone

may offset the heat loss through the walls and windows of a space during the heating season. Thus, with a variable-air-volume system the room thermostat may be satisfied, resulting in minimum supply air to the space at the time when the ventilation requirements may be at a maximum. To compensate for this type of problem, it may be necessary to provide a separate ventilation system or to use a reset control strategy on the mixed-air control system.

c. Air and water systems

i. Air and water systems are those where air and water distributed to the spaces served provide the cooling, and commonly heating, capacity necessary to produce the desired temperature and humidity level. Less than half the air is generally circulated to the spaces compared to all-air systems. Water can transfer energy more efficiently than air systems. Consequently, distribution energy use is less a factor. However, design guidelines for the all-air systems are also appropriate to the air side of air and water systems.

ii. Water distribution piping should be sized to minimize heat loss following ASHRAE recommendations (*Handbook of Fundamentals*).

iii. Air and water systems are categorized as two-pipe, three-pipe, and four-pipe systems. Two-pipe systems derive their name from the water-distribution system which consists of one supply pipe and one return pipe. Three-pipe systems have a cold water supply, warm water supply, and a common return. Four-pipe systems connect a chilled water supply, chilled water return, warm water supply, and warm water return to each terminal unit. Controls for room terminals connected to four-pipe distribution systems should be sequenced to avoid simultaneous heating and cooling with provisions for an adjustable dead band between cooling and heating modes. Systems pressures for all these systems should be limited by design, or controlled to avoid pressure differentials across terminal control valves that would prevent them from closing.

iv. Pumps dedicated to cooling or heating should be automatically controlled to shut off when their function is unnecessary.

v. Piping systems should be zoned by exposure, where such zoning will avoid over-cooling or over-heating of spaces served that could occur if supplied with water at a common temperature.

d. Unitary equipment

i. Unitary air conditioning equipment within, or in the proximity of, the spaces served for the

purpose of environmental control should be evaluated for their seasonal energy efficiency and energy cost effectiveness. The energy use of such systems may be more or less than central air conditioning systems depending upon application factors and component performance characteristics. Unitary systems and central systems should be compared in terms of energy efficiency, cost effectiveness and compliance with applicable state codes.

ii. Both air and water source heat pumps require compressor operation during the heating mode. Emergency power will be necessary to maintain the minimum heating capability in the event of interruption to the normal electrical power supply.

3. Refrigeration

a. Because refrigerating equipment serving HVAC system can be selected over a varying range of full- and partial-load operating efficiencies (coefficient of performance), purchasing decisions of such equipment should be based upon life-cycle cost evaluation.

b. Partial-load performance of water chillers, as well as reliability, will be improved by selecting multiple refrigeration units arranged to operate in series or parallel, whichever is best suited to the performance objectives of the chilled water system.

c. In some climates "free cooling" of chilled water can be obtained with reduced energy use during cool weather by utilizing the cooling capability of the cooling tower. Evaluation of the feasibility of this technique including possible contamination of the cooled water is suggested for central refrigeration plants.

d. The feasibility of employing heat rejected by the refrigeration plant for service hot water preheating, air conditioning reheat, or other cooling season uses should be considered. Year-round cooling loads can be converted by the refrigeration equipment or a dedicated elevated temperature heat pump for process or building heating.

e. Separate refrigeration should be considered for laboratories and surgical suites and other spaces where space temperature control is essential. This provision will permit mechanical cooling of critical spaces independent of the central refrigeration plant serving the total hospital.

4. Economizer Cycles Air (See glossary for definition)

Air-economizer cycles which use filtered outside air for cooling may be used when the energy to be exhausted may not be usefully recaptured for heating or cooling the incoming air, or another use, such as hot water heating.

5. Heat-Generating Plants

a. Hot water and steam boilers should be selected

for both full- and partial-load thermal efficiency.

b. Efficient part-load performance can be obtained through modulating burner controls and sequence firing of multiple boilers. This is of special significance where the boilers of medical facilities must be oversized for standby and future growth considerations.

c. Reduced summer loads frequently can be provided most economically by a small heat generator sized for the load or individual generators at the points of use.

d. The versatility of having boilers capable of burning different fuels (oil, gas, coal, combustible waste) often can prove cost effective as the comparative costs and availability of fuels change.

e. Heat exchangers for the recovery of heat from the flue gas for feed water or combustion air preheating should be evaluated for boiler efficiency improvement especially in larger, high pressure boilers.

f. Analysis of boiler and stack performance for automatic adjustment of fuel-air proportions can be of positive value in obtaining optimum efficiency performance.

g. Recovery of heat from boiler blowdown can be both cost effective and reduce the temperature of waste water to a more acceptable level prior to discharge to the sewerage system.

6. Heat Distribution Systems

a. Energy losses from steam and hot water distribution networks can be substantial. Life-cycle cost evaluation should be used to determine the type and thickness of insulation.

b. Unnecessarily high steam pressures or hot water temperatures in the distribution piping will aggravate energy losses and should be avoided where practical.

c. Flash steam resulting from high-pressure steam condensate should be collected for supply to low-pressure steam mains.

d. Steam traps should be selected for their intended use. Selection should be based upon the maximum design load plus an allowance for warm-up and the estimated inlet and outlet pressures.

e. Heating elements in building heating systems should be parallel connected and controlled sequentially with the cooling system supply with provision for adjustable dead band to avoid simultaneous heating and cooling.

f. The hot water temperature of building heating systems should be automatically or manually adjustable for reset of heating capacity to match changes in load.

7. Service Hot Water Systems

a. The temperature of the hot water supply should be limited to maximum system requirements.

b. Recirculation of hot water should be minimal.

c. Decentralized generation or booster heating of hot water should be considered for remote fixtures and for those requiring high temperatures, such as dishwashing, laundry, etc.

8. Heat Reclamation

Heat reclamation is the recovery and utilization of heat energy that is otherwise rejected as waste. Sources of this waste heat include lights, equipment, and people. Heat-reclamation systems recover waste heat to satisfy part of the heat energy needs for heating, cooling, and domestic hot water systems. Heat recovery conserves energy, reduces operating costs, and reduces peak loads.

The performance of any heat recovery system depends upon the following factors: temperature difference between the heat source and heat sink; latent heat difference (where applicable) between the heat source and sink; mass flow multiplied by specific heat of each source and sink; efficiency of the heat-transfer device; extra energy input required to operate the heat recovery device; and fan or pump energy absorbed as heat by the heat transfer device, which can enhance or detract from the performance.

a. Methods. The basic principles of heat recovery can be implemented by various methods using different devices applicable to different systems or situations. Heat-recovery devices reduce the peak heating and cooling loads when used with outdoor air systems. Other devices reduce or completely eliminate the requirements for heating and/or cooling equipment in major building expansions. Consideration of cross contamination should be exercised in the application of heat-recovery methods. The following are some of the most frequently used methods for heat recovery:

i. Thermal wheels. A thermal or heat wheel is a rotating heat exchanger driven by an electric motor with a high-thermal inertia core. Such wheels are capable of transferring energy from one air stream to another and, in very large boiler plants, from flue gas to air. The hot and cold air streams must be immediately adjacent and parallel to permit installation of the heat wheel. Duct modifications may be necessary. Two types of thermal wheels are available. The first type transfers sensible heat only and the second transfers both sensible and latent heat.

ii. Run-around system. This system is comprised of two or more extended surface fin coils installed in air ducts and interconnected by piping.

The heat-exchanger fluid, consisting of ethylene glycol and water, is circulated through the system by a pump, removing heat from the hot air stream and rejecting it into the cold air stream. A run-around-coil system may be used in winter to recover heat from warm exhaust air for use in pre-heating cold outdoor air, and in summer to cool hot outdoor air by rejecting heat into cooler exhaust air.

iii. Heat pipe systems. Heat pipe systems are comprised of extended surface finned tubes extending between adjacent air ducts. The tubes are continuous from one duct to the other on the same horizontal plane. Each tube contains liquid refrigerant which evaporates at the warm end, absorbing heat from the water air stream, and migrates as a gas to the cold end where it condenses and releases heat into the cold air stream. The condensed liquid then runs back to the hot end of the tube to complete the cycle.

iv. Air-to-air heat exchangers. Air-to-air heat exchangers transfer heat directly from one air stream to another through direct contact on either side of a metal heat-transfer surface. This surface may be either convoluted plate (more common for low-temperature use in an HVAC system) or tube (more common for boiler flue gas-heat transfer).

v. Heat pump as heat exchanger. Heat pumps are actually heat-transfer devices and, unlike those previously described, upgrade the temperature by as much as a factor of 3 to 1. This feature makes them particularly attractive for use with low-temperature heat sources. They also have the capacity to transfer latent heat as well as sensible heat.

vi. Shell and tube heat exchangers. Shell and tube heat exchangers consists of tubular shell with a flange, in which a tube bundle of "U" bend construction is inserted. This device transfers heat between two physically separated fluids, one circulating through the tubes while the other passes through the shell.

vii. Waste incineration. Incinerators burning solid waste, which generally has a heating value of 6,000 Btu/lb, can be designed to produce significant steam. Special heat-recovery incinerators are now available with exit gas temperature as low as approximately 450°F (232°C), which can be used in a heat exchanger as a source of high- and low-temperature heat.

viii. Heat-of-light system. The major advantage of a "heat-of-light" system lies in its reduction of heating, cooling, and HVAC system and distribution loads, rather than in savings in electrical energy for lighting. However, slightly higher lamp efficiencies will result as the cooling effect on the lamps increases their output. The two types of heat-of-light systems, "dry" and "wet," provide the following three advantages: Excess heat from interior areas of the building can be collected and distributed to

perimeter areas; the sensible room heat component of the cooling load is decreased, permitting a reduction in the quantity of air required for cooling (thus saving fan horsepower); and in the case of wet heat-of-light systems, the cooling load is reduced and less power is required for the refrigeration units.

ix. Thermal storage. Thermal-storage system is any storage vessel in which water, ice, or water and ice are stored (charged) and made available to produce the desired heating or cooling effect when the demand occurs. Storage is accomplished by circulating water from storage tanks to heat-reclaim or double-bundle heat-recovery machines. The storage tanks may be utilized in several different ways, such as: (1) to store chilled water, or combination of ice and water to minimize peak demand; (2) installing an electric resistance heater to provide supplementary heat after the tanks are depleted; (3) charging the tanks at night using low-cost electrical energy; and (4) with sufficiently high storage temperatures, the tanks can supply building heat directly, thereby reducing the operating time of the booster heater. To optimize tank size for capacity and size, the tank should be located so that it receives the hottest water from the heating circuit and the coldest water from the chilled-water circuit. This same location will also be desirable from the hydraulic standpoint, since it will minimize pressure in the storage system. In multiple-tank installations, series piping of the tanks will decrease balancing problems.

x. Cogeneration. Broadly defined, cogeneration is the simultaneous production of electrical or mechanical energy in conjunction with useful thermal energy, typically in the form of hot gases or fluids. This concept was particularly popular with industry around the turn of the century. However, with the advent of low-cost, reliable electricity, the interest in such systems began to decline significantly, from a peak in 1940 to less than 10 percent of U.S. industrial energy in 1976. Because of the dramatic increases in the cost of fuel and electricity, the idea of cogeneration is once again receiving serious consideration as a means of reducing costs and assuring a reliable supply of energy.

Cogeneration systems applicable to a hospital setting would consist of a generator fueled by steam, natural gas, or diesel. It could be sized to produce electricity for baseload purposes or for peak shaving. The onsite production of electricity alone is usually not cost-effective but with the recovery of the waste heat for useful purposes, the system efficiency may exceed 75 percent and be-

come cost effective. The recovered heat may be used to augment building heating or hot water heating, or to fire an absorption chiller for building cooling.

Hospitals have a special opportunity for cogeneration that does not exist in many other types of buildings because hospitals are usually equipped with emergency generators. The opportunity exists to use these generators for other than emergency situations. It is possible that when electricity is generated and the waste heat is recovered for useful purposes that the overall cost of on-site electricity will be lower than purchased electricity from the utility. This can be particularly attractive if the generator is used for peak-shaving purposes—to reduce the extent of electrical demand during peak conditions. In these situations, the hospital can save not only electrical consumption charges but also electrical demand charges. By extracting more utility from equipment that is required to meet power outages, the economics of cogeneration can be very beneficial.

b. Applications

i. Transfer energy between exhaust and outdoor air ducts when there is more than 4,000 cfm being exhausted.

When there are more than 3,500 heating degree days and or more than 8,000 cooling degree hours above 78°F (26°C), dry-bulb temperature, consider thermal wheels, heat pipes, and other devices. Where supply and exhaust ducts are remote from each other and cannot be brought together, consider systems other than heat pipes and thermal wheels.

Install a thermal wheel or heat pump to recover both sensible and latent heat in locations with more than 12,000 wet-bulb degree hours above 66°F (19°C), wbt.

When justified for the heating mode only, install an air-to-water-air heat pump to transfer energy from the exhaust air stream to the fresh air stream.

Utilize exhaust-air heat energy to temper make-up air and preheat combustion air, or use this system for space heating via heat pumps.

ii. Recover waste heat from the boiler flue gases whenever the stack temperature is greater than 350°F (177°C).

Install a heat pipe or an air-to-air exchanger to transfer energy from the hot flue gas to temper ventilation air, pre-heat domestic hot water, heat space, or pre-heat combustion air.

Take into account the corrosive effect of flue gas when selecting materials.

Allow for change-of draft conditions caused by a heat exchanger.

Provide an alternative source of combustion air when heat exchanger dampers are closed for cleaning.

iii. Recover heat from laundry and/or kitchen waste water:

When more than 30,000 gal/week of water at temperatures above 120°F (49°C) is discharged to waste, use it as a heat source for heat pump or other HVAC system requirements. Use of water discharged at lower temperatures would not be as economical.

Consideration must be given to the characteristics of the waste water, particularly the soap/detergent content of laundry waste water and the grease content of kitchen waste water. Piping and/or material modifications may be necessary to enable the heat exchanger to handle water with high concentrations of these impurities. In addition, a holding tank may be required to maintain a steady flow rate through the heat exchanger when water is being sporadically discharged.

Waste heat thus recovered may be used by any system requiring hot water, such as domestic hot water and heating systems.

iv. Recover heat from engine or combustion turbine exhaust and cooling systems:

On engines larger than 50 hp. Exhaust gas heat recovery is restricted by the practical limitations of the heat exchanger plus the prevention of flue gas condensation. The recommended minimum exhaust temperature is approximately 250°F (121°C). Depending on the initial exhaust temperature, 50 percent to 60 percent of the available exhaust heat can be removed.

v. Recover heat from incinerators if the quantity of solid waste exceeds 1,000 lbs/day.

vi. Recover heat from condensate-return systems when district heat steam condensate is discharged to waste, or when steam condensate from equipment supplied by onsite boilers is at temperature of 180°F (82°C) or greater.

vii. Recover heat from refrigeration-system hot gas where there is a steady and concurrent demand for refrigeration and waste heat, and where the refrigeration systems operate 1,000 hours or more per year.

Do not reduce superheat to the point where liquid slugging occurs.

The heat exchanger must be located after the hot gas bypass or other unloading devices. If located outdoors, drains must be provided to prevent freezing.

viii. Recover heat from condenser water systems:

Install a heat exchanger or heat pipe in the hot condenser water line to temper outdoor air, pre-

heat domestic hot water, or modify the piping in air handling units to utilize hot condenser water to heat air.

Install a coil to extract heat from the hot condenser water line to heat intake air in an air-cycle heat pump which can then transfer its condenser heat to the space requiring it. (Generally, it is not economical to replace existing condensers by double-bundle condensers; however, in the event that replacement is being contemplated due to age or the installation of new refrigeration equipment, give consideration to a double-bundle condenser.)

ix. Utilize heat from internal spaces to charge thermal storage tanks:

Install thermal storage tanks to store hot condenser water from daytime cooling for nighttime heating. This water can be used either directly for space heating or as a heat source for a heat pump system.

C. Lighting and Electrical Design Considerations

The following design considerations have been identified and recommended as areas of design opportunity for minimizing or conserving energy consumption in new hospitals. Special applications are left to the discretion of designer.

1. Lighting Equipment and Systems

a. General. Lighting design for hospitals should focus on equipment (including lamp source and luminaire) and on system design. Efficiency can be maximized by incorporating the high-efficiency lighting products available with design that will best utilize the equipment. Additionally, consideration should be given to the use of natural light when designing systems (see section 1.3 A(4)). Attention should be paid to both lighting levels and power consumption on a per square-foot basis.

b. Light sources. There are several light sources available to the designer. They are: incandescent, mercury vapor, fluorescent, metal halide, high and low pressure sodium.

i. Incandescent and mercury vapor should be avoided as light sources unless specifically required. Lamp efficacy is poorest with these sources, and lamp life is very short for incandescent.

ii. Fluorescent lamps are available in many sizes, wattages and color characteristics. Their efficacy and life are very good and they can be used in almost any indoor application. Energy-saving lamps are available as well as matching ballasts that can provide a highly efficient system.

iii. Metal halide lamps provide good color rendering and higher efficacy than mercury vapor and about the same as fluorescents. A major drawback

to metal halide is their short lamp life relative to the other sources.

iv. High-pressure sodium lamps are about the most efficient source available and typically have a longer life. Their efficacy is the highest available except low-pressure sodium but the color rendition is poor. This fact will limit its use indoors to nonexamination areas such as corridors and waiting rooms. High-pressure sodium lamps should be considered for exterior building and site lighting.

v. Low-pressure sodium lamps have the highest efficacy available but the poorest color rendition. As a source, low-pressure sodium should be limited to outdoor use.

c. Luminaires. Luminaire design can greatly affect the efficacy of a lighting system. The efficiency of the luminaire is a measure of how well the system delivers light to the space. Units should be chosen with highest coefficient of utilization factor possible. Additionally, the following areas should be considered:

i. Ballasts should be chosen with high power factor, energy-efficient features, and core and coil protection against heating. Energy-saving ballasts should be matched with energy-saving lamps to maximize efficiency. Consideration should be given to use of electronic ballasts. The designer should include as part of the contract, document requirements for the installation of the special ballasts and lamps.

ii. Light loss factor takes into account temperature, voltage variations and dirt accumulation on luminaire and room surfaces, lamp depreciation, maintenance procedures and atmospheric conditions. This factor is influenced by the level of maintenance performed to keep the space and luminaire surfaces clean and by replacement of lamps and ballasts when their output drops to poor levels. The specification of low-maintenance equipment will allow the designer to use a higher value in his calculations so fewer fixtures will be required.

iii. Heat can greatly affect lamp and ballast energy consumption, so the luminaire must be able to dissipate heat readily. The maximum efficiency for a fluorescent lamp occurs at a bulb wall temperature of 100°F (38°C). The luminaire should be able to pass air through it. This air should be at a relatively consistent temperature because shifts in bulk temperature will cause varying lamp color and brightness. To maximize air flow through the fixture, evenly spaced slots or vents near the lamp should be supplied rather than a single hole. Materials

Comparison Summary of Solid-State versus Motor Generators for Elevator Drives

	Solid state	Motor generator (M-G) set
Efficiency	High	Moderate
Motor life	Good	Longer than solid state
Line pollution	High	None
Maintenance	Low	Moderate
Overload capability	Poor	High
Reliability	High	Good
Space and weight	50% of M-G set	Relatively large
First cost	Approximately equal, maybe slightly less for solid state	

should also be considered because polished and diffuse anodized aluminum dissipates heat into the space better than white enamel, which absorbs and traps heat.

iv. Refraction and reflection produce the major amount of visible light or flux emitted from a luminaire. Therefore, the luminous efficiency of a light fixture can be directly measured against its effectiveness in this regard. Some of the refraction and reflection characteristics of luminaires are the angles of incidence and spectral characteristics of the incident flux as affected by moisture condensation or dust in the atmosphere, surface characteristic of the luminaire, and the source component characteristics.

d. Lighting controls. Lighting controls can be very simple or complex. A timeclock or individual photocell is about the simplest control scheme. Separate switching schemes should be used in areas with large amounts of daylight, such as on the perimeter. Lighting contactors can be added to control large groups of lights. Dimming of light sources should be considered. Motion detectors can be used for control of small-area lighting. A step-up in sophistication is a programmable controller that is hard-wired or that utilizes a carrier signal on the existing power system and receivers at the point of control.

2. Transportation Control

a. Solid-state drives. Solid-state drives can be used in lieu of the motor-generator (M-G) sets found in most elevator systems. Solid-state units rectify the incoming alternating current waveforms and directly control the output of the elevator drive motor. Use of these drives allows instantaneous on-off control, whereas the M-G set would remain rotating as standby for elevator service. The ac-

companying chart summarizes a comparison of solid-state versus motor generators for elevator drives. The major problem with solid-state is the creation of harmonic levels on the power lines that can affect sensitive equipment. Special filtering should be included.

b. Timed shutdown controls. If motor-generator set drives are chosen or required for elevators, timed shutdown after last call should be specified. The timer should be set such that the M-G set is shut off no more than 5 minutes after the last elevator call. It takes 10-20 seconds for M-G sets to resume operating speed.

3. Power Distribution Systems

a. General. The losses incurred in a distribution system are a function of the current flowing in it. Two methods to reduce the current are to use the highest distribution voltage feasible and to correct low power factor.

b. Distribution voltage. If a hospital complex is large and spread out, a higher voltage such as 4,160 volts should be considered. A total analysis will include higher equipment costs and transformation losses.

c. Power factor. Low lagging power factor is caused by inductive loads. A power meter only measures actual power and not apparent power, but a greater current is required to supply the apparent power load. This increase in current causes increased losses in the distribution conductors as well as the load conductors, i.e., motor windings. The lagging power factor can be corrected by adding capacitance to the system or at the load, thus reducing the current. A better approach is to use power-factor-corrected ballasts and to match motors to their loads so that the power factor is as close to one as possible.

4. Transformers

a. General. Regardless of the type of core fill, there are basically two types of losses associated with transformers: core or no-load losses and load losses. The no-load losses occur when there is little or no load on the transformer, and the load losses are a result of the load current supplied. In general, the higher the temperature rise rating of the transformer, the lower the no-load losses and the higher the load losses incurred.

b. Transformer fill. Presently, there are four classic transformer fills available: oil, silicone, dry-type, and cast resin. There is diversity in initial cost and

losses among the four types. All four types are available in building distribution systems.

i. Oil and silicone have very similar energy-loss characteristics for both 55°C and 65°C rise ratings. The no-load losses are the lowest available and their load losses are only greater than cast-resin type. Oil-fill transformers are the least expensive available except for dry type. The indoor installation costs for oil-filled transformers is higher than the other types.

ii. Dry-type transformers are widely used and are available in three temperature-rise ratings: 176°F (80°C), 239°F (115°C), and 302°F (150°C). Dry-type transformers have the lowest initial costs but the highest energy costs. The 302°F (150°C) rise unit will have the lowest no-load losses but the highest load losses while 176°F (80°C) rise transformers have the highest no-load losses and the lowest load losses and the higher cost. The break-even point for total losses is at about a 25 percent loading factor. The 302°F (150°C) rise rating allows no overload capability whereas the 176°F (80°C) rise rating will allow a temporary overload of 25 percent theoretically.

iii. Cast resin-core transformers provide the lowest load losses but have similar no-load losses to dry-type transformers. Their price is considerably higher than the other types available.

c. Total analysis. When choosing a transformer, the most important energy consideration is the load profile. A comparison of complete costs of owning should be generated for all types of fill and temperature-rise ratings for the transformer load. A hospital runs 8,760 hours per year, so the loading will tend to be high. Additionally, all costs of installation, maintenance, and equipment should be included in the analysis.

5. Motors and Drives

a. General. Motors comprise a large portion of building load and are usually part of the mechanical systems of the building. Because of this, motors are generally specified in the mechanical documents (such as V. B. in this document) and consideration is not always given to the options available. High efficiency motors generally have paybacks of 2 years or less and variable speed drives usually are the same depending on the variability of the driven load.

b. High-efficiency motors. Standard efficiency motors are available in T-frame and U-frame. The T-frame motor has the poorest efficiency and the U-frame is usually 2-3 percent more efficient. The high-efficiency motors are usually of T-frame construction and are about 6-7 percent more efficient than standard T-frame motors. To maximize the savings of a high-efficiency motor, the motor needs to be matched to the specific load. Motors reach their maximum efficiency at 80 percent loading, so

they should be chosen to operate at that point for the bulk of their operating time. When evaluating high-efficiency motors, the designer should be careful when reviewing manufacturers' efficiency claims. The nominal efficiency is developed from a bell-shape distribution curve of the testing of a large batch of motors. The motor received may be near the nominal efficiency or well above or below that rating. A minimum efficiency should be specified for best results.

c. Two-speed motors. Two-speed motors have applications where a fan or pump has basically two levels of operation, such as day or night operating parameters. Two-speed motors come in two varieties: single winding and two winding. For most pump and fan applications, a variable torque, one-half speed motor is used. The horsepower delivered at one-half speed is two-thirds of that delivered at full speed.

d. Variable-speed drives. Several types of variable-speed drives are available. There are mechanical, fluid, and variable frequency/voltage units available. The variable frequency/voltage drives vary the output for a standard A-C motor by varying the input frequency and/or voltage to the motor. Where required, special filtering should be included. These type of drives provide the highest energy savings. Applications are basically for fans or pumps with throttling devices that vary output according to needs.

It is critical to develop a load profile to accurately determine savings. Technology has been changing rapidly and has caused prices to drop, making paybacks more attractive. Vendors should be contacted for assistance in estimating energy and cost savings.

6. Emergency Generators

a. General. Hospitals require emergency backup power and this is usually provided by generator sets. This equipment constitutes a large capital investment that is utilized very infrequently. Planning during original design plus a small additional cost will allow these generators to provide a return on their investment by using them for peak shaving. Emergency generators used for peak shaving must comply with standards set forth in NFPA 70.

b. Peak shaving. Peak shaving differs from cogeneration in that its primary goal is the reduction of the electrical demand peak. The generators are operated only above a designated kilowatt level. The demand charge part of a utility bill is usually a

large portion of the cost. The specific rate structure, the designated peak, and the building load profile will determine the number of annual operating hours. The additional costs to be incurred are for extra transfer switches or utility paralleling equipment. Increased maintenance costs and premium costs for a continuous duty generator set should be included in the economic analysis (see also 1.3C(9) of this appendix).

7. Demand Controls (see also 1.3D of this appendix)

a. General. Controlling or shaving the level of the peak electrical demand will result in a savings on the demand charge. This technique does not reduce the building consumption but does reduce the utility costs. Demand control should be used for noncritical areas, allowing them to be shed off-line intermittently while not affecting the process. Control of the on and off times in sequence or by priority prevents simultaneous operation of these loads.

b. Packaged controllers. The controllers are microprocessor-based devices that continuously monitor the total demand and prevent a predetermined peak from being exceeded. One method of control is to shut down the designated loads that can be shed either on a priority or sequential basis. Another control method is time-of-day-load cycling such as for water heaters and refrigeration equipment that can be shut down and allowed to coast during the peak cycle. Larger motors should be sequenced on and not allowed to start during the same demand interval.

8. Process/Appliance Efficiency

a. General. Efficiency of energy-consuming processes such as laundry or food preparation may be improved by altering the process or by the installation of high-efficiency equipment. Scheduling or sequencing of the process can affect the demand charge part of the utility costs.

b. High-efficiency appliances. Examples of high-efficiency appliances that should be specified are: dishwashers that allow air drying rather than using the electric element; refrigeration equipment with additional condenser surfaces, thus reducing fan horsepower; and pilotless ignitors for boilers, water heaters, furnaces, and ranges.

9. Utility Rate Analysis

a. General. Usually, the rate schedule that the building will be billed on is dictated by the utility companies providing service. Rate schedules vary greatly from utility to utility, but most have options to save on utility costs. Riders have specific requirements to be adhered to, but if met, can mean a significant savings. Some utilities give customers a reduction in costs based on the voltage delivered to

the site. If customer use is large enough, a rate can be negotiated.

b. Demand charges. The demand-charge part of a utility bill is based on the average peak kilowatt level interval supplied to the customer. This is not an *energy* charge but is the power company's method of charging customers for having generating capacity available. In some instances, the demand charge almost equals the energy of kilowatt hour charge. Different methods exist for basing this charge, but the trend is toward time-of-day and season usage. It can be very beneficial to limit demand during the utilities' "on-peak" times when the rates are highest. Some form of peak shaving or scheduling rearrangement can accomplish this.

D. Energy Management, Monitoring and Control Systems

One objective of an energy-management control system, and/or equipment is to cost-effectively reduce energy consumption and demand. Such systems can manage energy consumption or demand or both. Four options are generally available to hospitals for managing energy: manual controls; individual control devices, such as timeclocks or thermostats connected to equipment; stand-alone computer-based systems; and computer-integrated energy-management systems that also combine administrative capabilities with communication functions (see table 2 for a comparison of types of systems).

Generally, hospitals are using energy-management systems that use variations of basic energy-savings strategies: time-of-day shutdown, individual load (or duty cycling) and peak load shedding. The first turns equipment on/off at a particular time of day and therefore limits energy use to where and when it is needed. The second controls loads by shutting down equipment intermittently during operation or according to a predetermined schedule. During periods of peak electric demand, noncritical loads such as water heaters or refrigeration can be shut down periodically, allowing their associated systems to "coast" until the peak load is reduced and the noncritical loads can be turned on again. Equipment normally unused during breaks or lunch hours can also be shut down. A staggered sequence for large induction motors can be incorporated as part of a time of day load cycling strategy. Cycling may also include a shutdown schedule with optimal start/stop. In those cases where shutting down and starting up

Table A-2
Energy Management Control Systems

Type	Description	Advantages	Disadvantages
Thermostat	Random cycling based on setpoint temperature.	Controls energy consumption.	High level of inaccuracy. Does not control demand.
Time clock	Turn equipment on/off at predetermined times.		Limited number of controllable loads. Difficult to coordinate more than a few clocks. No planned cycling to reduce electric demand.
Demand limiters	Turn electric equipment off when preset level of electrical usage is reached.		Does not consider environmental conditions.
Microprocessors	Utilize computerized memory to schedule and cycle electrical loads. Each load is entered individually. System usually connected to indoor and outdoor thermostat and programmed to modify its scheduling and cycling based on this feedback.	Flexibility of scheduling and cycling.	Keypad entry is time-consuming and complicated. Input subject to human error. Correction of mistakes is complicated. Computer codes used in programming must be memorized. Outdoor air thermostat feedback control is proven to malfunction. Downtime memories affected by dust and static electricity. Errors or malfunctions may go undetected. Need trained operators.
Computer-integrated systems	Combines administrative capabilities with communications functions.	Able to perform sophisticated scheduling and cycling of electrical equipment.	Energy management only a small part of its function. Expensive. Need full-time operator. Keypad entry. Downtime.
Positive control solid state system	Use solid state logic devices for scheduling and cycling.	Easier to operate than microprocessors. Easier to program than microprocessors. Ideal for small builders.	Save approximately 80-85% of potential energy savings. Not as technologically advanced as microprocessors.
Direct digital control (DDC) systems	On/off control based on occupant input and/or time-of-day cycling.	Allows for both discrete and continuous feedback loop control. Allows proportional, integral, and derivative (PID) control. High reliability and accuracy. Flexibility in interfacing.	
Distributed processing control	Uses stand-alone intelligent Field Interface Device (FIDs) as sensor inputs.	Equipment control is not interrupted when central station goes down. FIDs can be reset or reprogrammed by central station.	

Source: Time Energy Systems, Inc., *Technical Manual*, Houston, Texas, 1981.

large horsepower supply fans is anticipated within an eight-hour cycle, necessary inspection and correction maintenance should be completed prior to implementation of such fan cycling schedule. Starting and stopping large horsepower supply fans two or three times within an hour can lead to more frequent belt failure than is normally anticipated. Cycling of air handlers should only be considered when compliance with positive air flow and air changes requirements can be assured.

The third strategy controls or shaves the level of peak demand. Demand control can be used for non-critical loads, allowing them to be shed off-line intermittently while not affecting the process. Control of the on and off times in sequence or by priority prevents simultaneous operation of these loads with the critical process loads. Examples of loads that can be shed during periods of peak demand are: storeroom lighting, water heaters, space heating, and refrigeration equipment. Some systems employ additional strategies, such as enthalpy control (see table 3 for a description of strategies).

Determining which control strategy and type of equipment is cost effective to a particular facility requires an analysis of needs, capabilities, and resources available prior to the acquisition of any system. This front-end analysis should include: initial energy audit; estimate of savings potential; and payback-analysis study of financing alternatives (i.e., summary of all benefits and costs arising from the project, and a reasonable time period over which those benefits and costs are expected to occur).

Selection of a system or subsystem should include qualitative as well as quantitative benefits of the investment. Some qualitative considerations are installation, expandability, ease of operation, system capabilities, understandability of displays, and service.

E. Postdesign Activities

The conservation of energy in hospitals is the responsibility of the administrative staff as well as the designer, architect, and engineer. A project manager or management team overseeing a construction or modernization/renovation project should perform specific activities in the interest of energy conservation. These activities include:

1. In the bid and award phase:

Review and evaluate proposed alternatives and prior approvals where required for architectural, mechanical, and electrical/lighting system to confirm compliance with energy-related design concepts.

2. In the construction phase:

Obtain operation and maintenance manuals, as-built drawings, and air-balance reports and participate in the start-up, check-out, and operating test of mechanical and electrical/lighting systems.

3. After initial occupancy:

Conduct postoccupancy survey to determine if mechanical and electrical/lighting systems function according to energy-conservation design objectives.

F. Operating Management

Hospitals can substantially reduce their energy consumption and energy cost through an aggressive energy-management program which does not disrupt the environments required for health care delivery nor decrease comfort, security, or safety. An energy-management approach which has proven to be successful is *Total Energy Management* (TEM) developed by the Department of Health and Human Services [U.S. Department of Health, Education and Welfare, Public Health Service, Health Resources Administration, Bureau of Health Facilities, Division of Energy Policy and Program. *Total Energy Management*. DHEW Pub. No. (HRA)80-14516.]. This is not the only approach being utilized. Applications of TEM and other programs have demonstrated that certain components are essential for effective implementation. These components include: developing data on historical and ongoing patterns of energy use, conducting an audit or facility survey to identify problems, and developing methods for energy conservation, maintaining records, obtaining cooperation of all hospital personnel, and good management, monitoring, and followup.

A key to managing energy and energy costs is the maintenance of meaningful and reliable data, i.e., energy accounting. To be useful, the data must be systematically organized and easily accessible. Energy-accounting systems currently used by hospitals include those developed by the American Hospital Association, the Veterans Administration, and Blue Cross/Blue Shield of Greater New York.

There are numerous operations and maintenance methods for conserving energy in hospitals, some requiring minimal or no costs. The following guidelines represent the types of low-cost, short-payback conservation measures that can be applied to hospitals. They do not represent an exhaustive list of everything that can be done.

1. Heating, Ventilation, and Air Conditioning

Provisions of table 3, "Ventilation Requirements for

Table A-3
Typical EMS Software Strategies

Type	Description	Results
Start/stop control (S/S)	Multiple S/S, 24-hour programs should be provided for digital points. This program will start and stop equipment at the designed times. Provisions for holiday scheduling should be provided.	Turns fans, air conditioners, boilers, lights, etc., on and off at the proper times.
Optimized start/stop	This S/S program shall determine the proper time to start the environmental control system to provide comfort during occupancy hours. It will also determine the correct time to turn off equipment prior to the end of the occupancy period, allowing the building to "coast."	Energy savings result from starting the equipment on a variable requirement schedule as opposed to a fixed schedule. Additional savings result from letting the building coast at night.
Duty cycling	This program will turn off selected loads for percentage of time during a preset period. Both the on and off times must be adjustable. If indoor air temperature exceeds preset upper or lower limits, the software should be able to adjust the cycling times to compensate.	Since many systems are oversized, turning them off for a short period of time will not adversely affect comfort conditions. Certain loads, such as compressors, must have cycle time set carefully to avoid possible damage to the equipment. Duty cycling can also lower overall electric demand if the off times are staggered.
Demand limiting	A signal from the utility meter(s) is used to calculate KW demand. This number is used for usage reporting and is compared to a peak demand stored in memory. If actual demand is going to exceed peak demand, selected loads are turned off according to a priority schedule. Again, a provision should be made to compensate for when the program would cause indoor air to exceed preset temperature limitations.	Since demand charges can represent 40% or more of an electrical bill, demand limiting can result in substantial savings. Care must be exercised because very often, maximum cooling can be required in a commercial building at the same time load shedding is most desirable. The more sophisticated programs use duty cycling.
Enthalpy control	Dry-bulb and dew-point temperatures are used to calculate the heat content of indoor and outside air (enthalpy). If the outside air enthalpy is less than the indoor air enthalpy, the outside air dampers are opened.	Enthalpy calculation allows the use of cool, dry outside air to replace a certain amount of mechanical air conditioning. It results in reduced energy consumption compared to use of outside air based only on dry-bulb temperatures.

Areas Affecting Patient Care in Hospital, Skilled Nursing, and Rehabilitation Areas," of *Guidelines for Construction and Equipment of Hospital and Medical Facilities* should be satisfied when implementing these measures.

- a. In noncritical areas, stop air conditioning and fans prior to occupants' leaving.
- b. Consider partial shutdowns of air-circulating equipment during unoccupied periods.
- c. Shut dampers when air-handling unit zone is unoccupied.
- d. Turn fans off when area is unoccupied.
- e. Reduce outside-air intake to minimum code requirements.
- f. Repair air damper mechanism.
- g. Shut exhaust when not required.
- h. Repair air duct leakage and insulation.

- i. Clean filters and coil units.
- j. Install timeclocks on air-handling units.
- k. Shut off unneeded circulating pumps.
- l. Cycle fans and pumps.
- m. Reduce pumping flow.
- n. Reset heating and chilled water temperatures.
- o. Insulate heat pumping.
- p. Reduce heat circulation by installing summer/winter controls.
- q. Reduce room day temperature to minimum code requirements.
- r. Set night thermostats back where possible (e.g., administration areas.)
- s. Shut off or reduce stairwell heating.

Table A-3 (continued)

Typical EMS Software Strategies

Type	Description	Results
Chilled water reset, hot water reset, hot or cold dec reset	These strategies are similar. The temperature is measured and adjusted based on a variable that reflects the load on the system. The variable may be outside air temperature, average space temperatures, or any other measure of load.	Varying heating and cooling equipment temperature setpoints reduces the energy used to meet given HVAC loads.
User-generated programs	This capability is necessary for the development of custom programs that the vendor cannot anticipate in standard software offerings. The following commands should be available to the user: <ul style="list-style-type: none"> • logic operators: and, or, not • analog operators: greater than, less than, equal, plus, times, divided by, minus • controlled outputs: on, off, decrease, increase with or without time delay 	User-generated programs are used for such purposes as: <ul style="list-style-type: none"> • boiler operation by outside temperature • night setback of temperature savings calculators • customizing standard vendor software offering "no energy zone" controls • precooling the building with outside air
Utilities	<ul style="list-style-type: none"> • adjustable limit setpoints for analog points • user-generated print programs with selectable contents and initiators • error detection and printout routines for sensors, data-gathering panels, phone lines, and the computer itself • power outage and restart routines • operator check of status of equipment 	
Chiller optimization	Program to operate the correct number of chillers in multiple chiller central plants based on the loads exhibited.	Energy consumption is reduced when the right combination of equipment operates for maximum efficiency.

Source: George R. Owens, "Specifying Your System. How to Get More than a Glorified Timeclock," *Energy Management*, March 1983, p. 31.

Note. Use of any of these strategies should comply with table 3 of this document.

- t. Reduce humidification to minimum requirements.
- u. Reduce condenser water temperature.
- v. Shed loads during peak electrical use periods.
- w. Use outside air for free cooling whenever possible.
- x. Reduce reheating of cooled air.
- y. Recover heating or cooling with energy-recovery units.
- z. Reduce chilled water circulated during light cooling loads.
- aa. Install minimum-sized motor to meet loads.
- bb. Replace hand valves with automatic controls.
- cc. Utilize summer heaters for laundry and central sterile supply.

2. Lighting

- a. Enforce turning off lights when not needed.
- b. Revise cleaning schedules to minimize lighting other than during full-occupancy hours.
- c. Install high-voltage transformers to receive power at a primary rate.
- d. Reduce wattages where practical. For example, reduce wattage in parking areas, loading docks, storerooms, and exit stairways.
- e. Investigate substitution of high-intensity mercury fixtures for high-wattage lamps.
- f. Reduce wattage of bulbs in lamps.
- g. Maintain a program of bulb replacement to gain the most efficient usage.
- h. Reexamine the need for all outside signs and parking areas lights to be on.
- i. Use color-coded light switches to avoid nones-

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sential lights being turned on during unoccupied hours. Designate those needed for cleaning and security.

3. Building Envelope

- a. Redesign high heat-loss areas, including loading docks, vestibules, and entrances.
- b. Add insulation to roofs and major wall areas.
- c. Install dock enclosures and dock door seals at receiving and shipping points.
- d. Reduce infiltration by caulking and weatherstripping.
- e. Install storm windows or double-pane windows.
- f. Repair doors and windows.
- g. Keep windows and doors closed.
- h. Use window shading.
- i. Seal roof and wall openings.
- j. Install vestibules at main entrances in cold climates.

4. Electrical Equipment

- a. Initiate maintenance program to maintain electric equipment in the best running condition for minimum power needs.
- b. Investigate relay or computer controls over power supply and schedule.
- c. Combine electrical circuits of various buildings to effect metered billing rate.
- d. Investigate the low power factor condition associated with new light sources.
- e. Reduce the number and assortment of appliances running full time.
- f. Shut off elevators whenever possible.
- g. Shut off pneumatic tube system whenever possible.
- h. Use emergency generator to reduce peak demand.

5. Boiler Plant

- a. Reduce boiler pressure and hours of operation.
- b. Clean or repair boiler annually.
- c. Operate and maintain burners at most efficient levels. Clean heat exchangers regularly, inspect, maintain, and repair steam traps and steam lines.
- d. Shut off steam to laundry when not in use.
- e. Provide boiler water treatment.

6. Plumbing

- a. Reduce domestic hot water temperature to minimum code requirements.
- b. Repair and maintain hot water and steam piping insulation.
- c. Install flow restrictors.
- d. Install faucets which automatically shut off water flow.

Acceptable air quality: Air in which there are no known contaminants at harmful concentrations and with which a substantial majority (usually 80 percent) of the people exposed do not express dissatisfaction (ASHRAE 62).

Active system: A system that uses mechanical means to satisfy load demand as opposed to passive systems.

Air changes (AC or AC/HR): A way to express ventilation rates, which are the number of times that the air volume of a given space will be replaced in a one-hour period, assuming that the air distribution within the space is uniformly mixed.

Air conditioning: The process of treating air to meet the requirements of a conditioned space by controlling its temperature, humidity, cleanliness, and distribution (ASHRAE 62).

Air contaminant: An unwanted airborne constituent that may reduce acceptability of the air (ASHRAE 62).

Air pollutant: An airborne constituent that may adversely affect health.

Building envelope: The exterior enclosure of a building through which thermal energy may be transferred to or from the interior.

Constant volume system: A type of air handling system which provides precise air supply at a consistent volume.

Degree day, heating: A unit, based upon the difference between 65° and the outdoor mean daily temperature. The mean daily temperature is the average of the maximum and minimum outdoor temperature during the 24 hours of a given day.

Degree day, cooling: When the mean daily temperature is greater than 65°F there are as many cooling degree days as degrees Fahrenheit difference between the mean and 65°F.

Demand: The amount of energy per unit of time required to satisfy the utility loads averaged over any given time.

Economizer cycle, air: A method of operating an air conditioning system to reduce conditioning load. Whenever the outdoor air conditions are more favorable (lower or higher heat content) than return air conditions, outdoor air quantity is increased.

Economizer cycle, water: A method of restricting the amounts of domestic hot and cold water that flows from fixtures. This is accomplished with flow restrictors and pressure reducing valves and spring activated faucets.

Efficiency: The ratio of the useful energy (at the point of use) to the thermal energy input.

Energy management control system: Manual and/or automatic control and supervision of the operation of active and passive systems.

Heat gain: The amount of heat gained by a space from all sources, internal and external, including persons, lights, machines, sunshine, and so forth.

Heat loss: Heat flow from a building mass to the outside when the outdoor temperature is lower than desired indoor temperature.

Heat, latent: The quantity of heat required to effect a change in state, such as from water to steam.

Heat, sensible: Heat that results in a temperature change but no change in state.

Heat pump: A refrigeration machine possessing the capability of reversing the flow so that its output can be either heating or cooling. When used for heating, it extracts heat from a low temperature source and raises it to the point at which it can be used.

Infiltration: The uncontrolled inward air leakage through cracks and spaces and around windows and doors in any building element.

Insolation: The amount of solar energy that strikes a surface area. This is affected by orientation and configuration.

Life-cycle cost (LCC) analysis: A process of accounting for the total cost of the building or system over its useful life. It includes capital, operating and maintenance costs.

Load: The demand for energy that is required at any given time to satisfy heating or cooling need(s).

Manual: Operated by personal intervention.

Nondepletable or renewable energy sources: Natural processes (e.g. solar radiation, wind, flowing water) which are organized in such a manner as to yield energy without depleting natural resources or disrupting natural processes.

Passive system: A system that uses nonmechanical means to provide cooling or heating, including energy stored in construction mass.

Power factor: The ratio between actual electric power consumption in watts and the theoretical power obtained by multiplying volts by amperes. The ideal situation is when the power factor is unity, $KV \times A = KW$.

Recovered energy: Energy reclaimed and utilized that would otherwise be wasted, such as hot water drawn from laundry equipment.

Reheat: The application of sensible heat to supply air that has been previously cooled below the temperature of the conditioned space by either mechanical refrigeration or the introduction of outdoor air to provide cooling.

Reset: Adjustment, automatically or manually, of the set point of a control instrument to a higher or lower value to conserve energy.

R factor: Thermal resistance: A measure of ability to retard heat flow. R is the numerical reciprocal of U (see below), thus $R=1/U$. R is used in combination with numerals to designate thermal resistance units: $R=11$ equals 11 resistance units. The higher the R, the higher the insulating factor. All insulation products having the same R, regardless of material and thickness, are equal in insulating value.

Thermal transmittance (UI): Coefficient of heat transmission expressed in units of Btu per hour per square foot per degree F. It is the time rate of heat flow. The total U value results from combinations of different materials used in series along the heat flow path that comprise a building section, including cavity air spaces. Overall (average) heat transmission (U_o) of a gross area of the exterior building envelope is expressed in units of Btu per hour per square foot per degree F.

Unitary air conditioning equipment: A unitary air conditioner consists of one or more factory-made assemblies which normally include an evaporator or cooling coil, an air moving device, a compressor and condenser combination, and may include a heating function as well.

Variable air volume: Provides in varied volumes heated or cooled air at a constant temperature to all zones served. VAV boxes located in each zone adjust the volume of air reaching each zone depending on the requirements.

Ventilation: The process of supplying and removing air by natural or mechanical means to and from any space. Such air may or may not be conditioned (ASHRAE 62).

Waste heat: Heat that is too hot, too cool or otherwise inappropriate for another purpose and is therefore discarded.

Zone: A space or group of spaces within a building with similar heating or cooling requirements that can be maintained throughout by a single controlling device system.