NFPA 99C

Standard on Gas and Vacuum Systems

2005 Edition



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NFPA 99C

Standard on

Gas and Vacuum Systems

[Excerpted from NFPA 99, Standard for Health Care Facilities, 2005 edition]

2005 Edition

The text contained herein is a reprint of text from NFPA 99, *Standard for Health Care Facilities*, 2005 edition, covering requirements and recommendations for gas and vacuum systems.

The 2005 edition of NFPA 99, *Standard for Health Care Facilities*, was prepared by the Technical Committees on Administration, Electrical Equipment, Electrical Systems, Gas Delivery Equipment, Health Care Emergency Preparedness and Disaster Planning, Hyperbaric and Hypobaric Facilities, and Piping Systems, released by the Technical Correlating Committee on Health Care Facilities and acted on by NFPA at its November Association Technical Meeting held November 13–17, 2004, in Miami Beach, FL. It was issued by the Standards Council on January 14, 2005, with an effective date of February 7, 2005, and supersedes all previous editions.

The 2005 edition of NFPA 99 was approved as an American National Standard on February 7, 2005.

Readers are cautioned that NFPA 99 is structured so that the applicability of requirements in Chapters 4 through 12 are specified for the health care facilities listed in Chapters 13 through 18 and Chapter 21.

Origin and Development of NFPA 99C

The gas systems portion of NFPA 99C originated from NFPA 56F, *Standard for Nonflammable Medical Gas Systems*. This document was incorporated into NFPA 99 during the processing of the 1987 edition of NFPA 99.

The vacuum systems portion of NFPA 99C originated from NFPA 56K, *Recommended Practice for Medical Surgical Vacuum Systems*. The 1980 edition of NFPA 56K was simultaneously revised to a standard and incorporated into the 1984 edition of NFPA 99.

The 1999 edition reorganized the chapter configuration and added a new Chapter 20 on free-standing birthing centers.

The 2002 edition was revised to meet the requirements of the *Manual of Style*. Gas and vacuum piping systems were reorganized to be more user friendly.

The 2005 edition added new pipe joining methods to Chapter 5, and Chapter 12 on Health Care Emergency Management was modified to correlate with NFPA 1600, *Standard on Disaster/Emergency Management and Business Continuity Programs*.

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Committee Scope: This Committee shall have primary responsibility for documents that contain criteria for safeguarding patients and health care personnel in the delivery of health care services within health care facilities, as follows:

- (1) From fire, explosion, electrical, and related hazards resulting either from the use of anesthetic agents, medical gas equipment, electrical apparatus, and high frequency electricity, or from internal or external incidents that disrupt normal patient care(2) From fire and explosion hazards associated with laboratory practices
- (3) In connection with the use of hyperbaric and hypobaric facilities (NFPA 99B) for medical purposes
- (4) Through performance, maintenance, and testing criteria for electrical systems, both normal and essential
- (5) Through performance, maintenance and testing, and installation criteria, as follows:
 - (a) For vacuum systems for medical or surgical purposes
 - (b) For medical gas systems

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents or portions of documents covering the performance, maintenance, installation, and testing of medical and dental related gas piping systems and medical and dental related vacuum piping systems.

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Standard on

Gas and Vacuum Systems [Excerpted from NFPA 99, Standard for Health Care Facilities, 2005 edition]

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for mandatory extracts are given in Chapter 2 and those for nonmandatory extracts are given in Annex G. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications can be found in Chapter 2 and Annex G.

Further explanatory information on Chapters 1 through 20 can be found in Annex C.

Chapter 1 Administration

1.1 Scope.

1.1.1 The scope of this document is to establish criteria to minimize the hazards of fire, explosion, and electricity in health care facilities providing services to human beings.

1.1.2 Annex D of NFPA 99 covers principles of design and use of electrical and electronic appliances generating high-frequency currents for medical treatment in hospitals, clinics, ambulatory care facilities, and dental offices, whether fixed or mobile.

1.1.2.1 Areas Not Addressed. The following areas are not addressed:

- (1) Communication equipment, resuscitation equipment (e.g., defibrillators), or physiological stimulators (e.g., used for anesthesia, acupuncture)
- (2) Experimental or research apparatus built to order, or under development, provided such apparatus is used under qualified supervision and provided the builder demonstrates to the authority having jurisdiction that the apparatus has a degree of safety equivalent to that described in Annex D of NFPA 99

1.1.3 Annex E of NFPA 99 retains the established requirements that would be necessary for the safe use of flammable inhalation anesthetics should the use of this type of anesthetic be reinstituted.

1.1.4 Chapter 4, Electrical Systems, of NFPA 99 covers the performance, maintenance, and testing of electrical systems (both normal and essential) used within health care facilities.

1.1.4.1 Areas Not Addressed in Chapter 4 of NFPA 99. The following areas are not addressed in NFPA 99, but are addressed in other NFPA documents:

- (1) Specific requirements for wiring and installation on equipment are covered in NFPA 70, National Electrical Code.
- (2) Requirements for illumination and identification of means of egress in health care facilities are covered in NFPA 101, Life Safety Code.
- (3) Requirements for fire protection signaling systems.
- (4) Requirements for fire pumps are covered in NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection, except that the alternate source of power shall be permitted to be the essential electrical system.
- (5) Requirements for the installation of stationary engines and gas turbines are covered in NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.

1.1.5 Chapter 5, Gas and Vacuum Systems, covers the performance, maintenance, installation, and testing of the following:

- (1) Nonflammable medical gas systems with operating pressures below a gauge pressure of 2068 kPa (300 psi)
- Vacuum systems used within health care facilities (2)
- Waste anesthetic gas disposal (WAGD) systems, also re-(3)ferred to as scavenging
- Manufactured assemblies that are intended for connec-(4)tion to the medical gas, vacuum, or WAGD systems (also referred to as scavenging)

1.1.5.1 Areas Not Addressed in Chapter 5. Requirements for portable compressed gas systems are covered in Chapter 9, Gas Equipment.

1.1.6 Chapter 6, Environmental Systems, covers the performance, maintenance, and testing of the environmental systems used within health care facilities.

1.1.7 Chapter 7, Materials, of NFPA 99 covers the hazards associated with the use of flammable and combustible materials used within health care facilities.

1.1.8 Chapter 8, Electrical Equipment, of NFPA 99 covers the performance, maintenance, and testing of electrical equipment used within health care facilities.

1.1.9 Chapter 9, Gas Equipment, of NFPA 99 covers the performance, maintenance, and testing of gas equipment used within health care facilities.

1.1.10 Chapter 10, Manufacturer Requirements, of NFPA 99 covers the performance, maintenance, and testing, with regard to safety, required of manufacturers of equipment used within health care facilities.

1.1.11 Chapter 11, Laboratories, establishes criteria to minimize the hazards of fire and explosions in laboratories, as defined in Chapter 3.

1.1.11.1 Areas Not Addressed in Chapter 11. Subsection 1.1.11 is not intended to cover hazards resulting from any of the following:

- (1) Chemicals
- (2) Radioactive materials
- (3)*Biological materials that will not result in fires or explosions

1.1.12* Chapter 12, Health Care Emergency Management, of NFPA 99 establishes minimum criteria for health care facility emergency management in the development of a program for effective disaster preparedness, response, mitigation, and recovery.

1.1.13 Chapter 13, Hospital Requirements, addresses safety requirements of hospitals.

1.1.14 Chapter 14, Other Health Care Facilities, addresses safety requirements for facilities, or portions thereof, that provide diagnostic and treatment services to patients in health care facilities. Requirements for specific health care facilities are addressed in the following chapters:

- (1) Hospitals Chapter 13
- (2) Nursing homes Chapter 17
- (3) Limited care facilities Chapter 18

1.1.15 Reserved.

1.1.16 Reserved.

1.1.17 Chapter 17, Nursing Home Requirements, addresses safety requirements of nursing homes.

1.1.18 Chapter 18, Limited Care Facility Requirements, covers safety requirements of limited care facilities.

1.1.19 Chapter 19, Electrical and Gas Equipment for Home Care, of NFPA 99 addresses the requirements for the safe use of electrical and gas equipment used for home care medical treatment.

1.1.20* Chapter 20, Hyperbaric Facilities, covers the recognition of and protection against hazards of an electrical, explosive, or implosive nature, as well as fire hazards associated with hyperbaric chambers and associated facilities that are used, or intended to be used, for medical applications and experimental procedures at gauge pressures from 0 to 690 kPa (0 to 100 psi). Chapter 20 applies to both single- and multiple-occupancy hyperbaric chambers; to animal chambers, the size of which precludes human occupancy; and to those in which the chamber atmosphere contains an oxygen partial pressure greater than an absolute pressure of 21.3 kPa (3.09 psi) (0.21 atmospheres).

1.1.21 Chapter 21, Freestanding Birthing Centers, addresses the requirements for the safe use of electrical and gas equipment, and for electrical, gas, and vacuum systems used for the delivery and care of infants in freestanding birthing centers.

1.2 Purpose.

1.2.1 The purpose of this standard is to provide minimum requirements for the performance, maintenance, testing, and safe practices for facilities, material, equipment, and appliances, including other hazards associated with the primary hazards.

1.3 Application.

1.3.1 This document shall apply to all health care facilities.

1.3.2 Construction and equipment requirements shall be applied only to new construction and new equipment, except as modified in individual chapters. Only the altered, renovated, or modernized portion of an existing system or individual component shall be required to meet the installation and equipment requirements stated in this standard. If the alteration, renovation, or modernization adversely impacts existing performance requirements of a system or component, additional upgrading shall be required.

1.3.3 Chapters 13 through 19 of NFPA 99 specify the conditions under which the requirements of Chapters 4 through 12 of NFPA 99 shall apply in Chapters 13 through 19 of NFPA 99.

1.3.4 This document is intended for use by those persons involved in the design, construction, inspection, and operation of health care facilities and in the design, manufacture, and testing of appliances and equipment used in patient care areas of health care facilities. Nonflammable piped medical gases covered by this document include, but are not limited to, oxygen, nitrogen, nitrous oxide, medical air, carbon dioxide, and helium.

1.4 Equivalency.

1.4.1 The authority having jurisdiction for the enforcement of this document shall be permitted to grant exceptions to its requirements.

1.4.2 Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety to those prescribed by this standard. Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency. The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

1.5 Units and Formulas.

1.5.1* Primary units will be trade units, secondary will be the conversion. Although it is common practice for medical appliances to have metric units on their dials, gauges, and controls, many components of systems within the scope of this document, which are manufactured and used in the United States, employ nonmetric dimensions. Since these dimensions (such as nominal pipe sizes) are not established by the National Fire Protection Association, the Technical Correlating Committee on Health Care Facilities cannot independently change them. Accordingly, this document uses dimensions that are presently in common use by the building trades in the United States.

1.6 Standard Adoption Requirements.

1.6.1 The effective date of application of any provision of this document is not determined by the National Fire Protection Association. All questions related to applicability shall be directed to the authority having jurisdiction.

1.6.2 Enforcement. This standard shall be administered and enforced by the authority having jurisdiction designated by the governing authority. (See Annex F for a sample wording for enabling legislation.)

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 10, Standard for Portable Fire Extinguishers, 2002 edition. NFPA 13, Standard for the Installation of Sprinkler Systems, 2002 edition.

NFPA 30, Flammable and Combustible Liquids Code, 2003 edition.

NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, 2002 edition.

NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals, 2004 edition.

NFPA 51, Standard for the Design and Installation of Oxygen-Fuel

Gas Systems for Welding, Cutting, and Allied Processes, 2002 edition. NFPA 54, National Fuel Gas Code, 2002 edition.

NFPA 58, Liquefied Petroleum Gas Code, 2004 edition.

NFPA 70, National Electrical Code[®], 2005 edition.

NFPA 72[®], National Fire Alarm Code[®], 2002 edition.

NFPA 99B, Standard for Hypobaric Facilities, 2005 edition.

NFPA 101[®], Life Safety Code[®], 2003 edition.

NFPA 110, Standard for Emergency and Standby Power Systems, 2005 edition.

NFPA 220, Standard on Types of Building Construction, 1999 edition.

NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials, 2000 edition.

NFPA 326, Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair, 1999 edition.

NFPA 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films, 2004 edition.

NFPA 704, Standard System for the Identification of the Hazards of Materials for Emergency Response, 2001 edition.

NFPA 1600, Standard on Disaster/Emergency Management and Business Continuity Programs, 2004 edition.

2.3 Other Publications.

2.3.1 ANSI Publications. American National Standards Institute, Inc., 22 West 43rd Street, 4th floor, New York, NY 10036.

ANSI/ASSE Series 6000, Professional Qualifications Standard for Medical Gas Systems Installers, Inspectors, and Verifiers, 2001.

ANSI B16.22, Wrought Copper and Copper Alloy Solder -Joint Pressure Fittings, 2001.

ANSI B57.1 (See CGAV-1.)

ANSI C84.1, Electric Power Systems and Equipment — Voltage Ratings, 1995.

ANSI C-4 (See CGA C-4.)

ANSI G-7.1 (See CGA G-7.1.)

2.3.2 ASME Publications. American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

ANSI/ASME PVHO-1-1990, Safety Standard for Pressure Vessels for Human Occupancy.

ASME Boiler and Pressure Vessel Code, 2001.

2.3.3 ASTM Publications. American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM A 53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless, 1994.

ASTM B 32, Standard Specification for Solder Metal, 1996.

ASTM B 88, Standard Specification for Seamless Copper Water Tube, 2002.

ASTM B 280, Standard Specification for Seamless Copper Tubing for Air Conditioning and Refrigeration Field Service, 2002.

ASTM B 819, Standard Specification for Seamless Copper Tube for Medical Gas Systems, 2000. ASTM B 828, Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings, 2002.

ASTM D 5, Standard Test Method for Penetration of Bituminous Materials, 1997.

ASTM D 2863, Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-like Combustion of Plastics (Oxygen Index) (ANSI D2863), 1997.

ASTM E 136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C, 1998.

2.3.4 AWS Publications. American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

ANSI/AWS A5.8, Specification for Filler Metals for Brazing and Braze Welding, 1992.

AWS B2.2, Standard for Brazing Procedure and Performance Qualification, 1991.

2.3.5 CDA Publication. Copper Development Association Inc., 260 Madison Avenue, New York, NY 10016, www.copper.org. *Copper Tube Handbook.*

2.3.6 CGA Publications. Compressed Gas Association, 4221

Walney Road, 5th Floor, Chantilly, VA 20151-2923.

GCA C-7, Guide to the Preparation of Precautionary Labeling and Marking of Compressed Gas Containers, 2004.

CGA G-4, Oxygen, 1996.

CGA G-4.1, Cleaning Equipment for Oxygen Service, 2004.

CGA G-8.1, Standard for Nitrous Oxide Systems at Consumer Sites, 1990.

CGA P-2.5, Transfilling of High Pressure Gaseous Oxygen to be Used for Respiration, 2000.

CGA P-2.6, Transfilling of Liquid Oxygen to be Used for Respiration, 1995.

CGA P-2.7, Guide for the Safe Storage, Handling, and Use of Portable Liquid Oxygen Systems in Healthcare Facilities, 2000.

CGAV-1, Compressed Gas Association Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections (ANSI B57.1), 2003.

CGAV-5, Diameter-Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications), 2000.

2.3.7 ISA Publications. The Instrumentation, Systems, and Automation Society (ISA), 67 Alexander Drive, Research Triangle Park, NC 27709.

RP 12.6, Installation of Intrinsically Safe Systems in Hazardous Locations, 1995.

2.3.8 MSS Publications. Manufacturer's Standardization Society of the Valve and Fittings Industry, Inc., 127 Park Street NE, Vienna, VA 22180.

SP-58, Pipe Hangers and Supports — Materials, Design, and Manufacture, 2002.

SP-69, Pipe Hangers and Supports — Selection and Application, 2002.

2.3.9 NCCLS Publication. National Committee for Clinical Laboratory Standards, 940 West Valley Road, Suite 1400, Wayne, PA 19087-1898.

NCCLS ASI-5, Power Requirements for Clinical Laboratory Instruments and for Laboratory Power Sources.