

NFPA 1852

Standard on Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA)

2002 Edition



NFPA, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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NFPA 1852

Standard on

Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA)

2002 Edition

This edition of NFPA 1852, *Standard on Selection, Care, and Maintenance of Open-Circuit Self-Contained Breathing Apparatus (SCBA)*, was prepared by the Technical Committee on Respiratory Protection and Personal Alarm Equipment, released by the Technical Correlating Committee on Fire and Emergency Services Protective Clothing and Equipment, and acted on by NFPA at its November Association Technical Meeting held November 10–14, 2001, in Dallas, TX. It was issued by the Standards Council on January 11, 2002, with an effective date of January 31, 2002.

This edition of NFPA 1852 was approved as an American National Standard on January 31, 2002.

Origin and Development of NFPA 1852

The Committee was assigned the responsibility of addressing selection, care, and maintenance issues for open-circuit self-contained breathing apparatus (SCBA). To address these issues, the Committee developed this new document, NFPA 1852, which is oriented to the users of such SCBA and their respective organizations.

This new document was developed for organizations that use SCBA for the respiratory protection of their personnel who engage in emergency operations with the goal of reducing the safety risks and potential health risks associated with poorly maintained, contaminated, or damaged SCBA.

This document was also developed to fulfill the SCBA selection, care, and maintenance portions of the overall respiratory protection program required by NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, and applies to all SCBA that are certified as compliant with the current and previous editions of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services*.

During the development of this document, committee member Deputy Chief Robert Kolenda of the Pittsburgh, Pennsylvania Bureau of Fire (PBF) worked tirelessly to develop meaningful requirements to assure the safety of fire and emergency services personnel who depend on SCBA for their respiratory protection and their lives. Chief Kolenda lost his son, Pittsburgh Fire Fighter Marc Kolenda, at a fire, due in part to inadequate protection provided by his SCBA.

The Committee wishes to honor the memories of the Pittsburgh fire fighters who died in the line of duty on 14 February 1995: Captain Thomas Brooks, who joined the PBF on 15 January 1982; Fire Fighter Patricia Conroy, who joined the PBF on 21 September 1987; and Fire Fighter Marc Kolenda, who joined the PBF on 8 November 1993.

The Committee also wishes to pay tribute to PBF members Deputy Chief Robert Kolenda (retired with 29 years' service) and Captain Michael Kreuger (retired with 31 years' service) for their commitment to make the fire service a safer occupation for all fire fighters. Both Chief Kolenda and Captain Kreuger worked on the development and finalization of NFPA 1852 past their retirements from the PBF and deserve considerable recognition for their efforts.

In Memoriam, September 11, 2001

We pay tribute to the 343 members of FDNY who gave their lives to save civilian victims on September 11, 2001, at the World Trade Center. They are true American heroes in death, but they were also American heroes in life. We will keep them in our memory and in our hearts. They are the embodiment of courage, bravery, and dedication. May they rest in peace.

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Committee Scope: This Committee shall have primary responsibility for documents on the design, performance, testing, and certification of protective clothing and protective equipment manufactured for fire and emergency services organizations and personnel, to protect against exposures encountered during emergency incident operations. This Committee shall also have the primary responsibility for documents on the selection, care, and maintenance of such protective clothing and protective equipment by fire and emergency services organizations and personnel.

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Committee Scope: This Committee shall have primary responsibility for documents on protective equipment that provides respiratory protection for fire fighters or other emergency services responders during incidents involving operations conducted in hazardous or oxygen deficient atmospheres. These operations include the activities of rescue, fire suppression, hazardous materials mitigation, and property conservation where exposures to an oxygen deficient atmosphere or an atmosphere contaminated with harmful particulate, fog, fume, mist, gas, smoke, spray, or vapor will or could occur.

This committee shall also have primary responsibility for documents on personal monitor/alarm/distress devices for responders operating in hazardous atmospheres or in hazard areas at incidents where entrapment, disorientation, or other responder personal emergency could occur.

Additionally, this committee shall have primary responsibility for documents on the selection, care, and maintenance of respiratory and personal alarm equipment by fire and emergency services organizations and personnel.

These lists represent the membership at the time the Committees were balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

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NFPA 1852**Standard on****Selection, Care, and Maintenance
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Breathing Apparatus (SCBA)****2002 Edition**

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

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

Chapter 1 Administration**1.1 Scope.**

1.1.1 This standard shall specify minimum requirements for the selection, care, and maintenance of open-circuit self-contained breathing apparatus (SCBA) and combination SCBA/SAR that are used for respiratory protection during fire fighting, rescue, and other hazardous operations.

1.1.2 This standard shall specify the requirements for SCBA models as detailed in Section 1.3.

1.1.3 This standard shall specify the requirements for SCBA that are equipped with SCBA-integrated Personal Alert Safety Systems (PASS), also certified as compliant with NFPA 1982, *Standard on Personal Alert Safety Systems (PASS)*, as applicable.

1.1.4 This standard shall specify the requirements for the SCBA selection, care, and maintenance component of the respiratory protection program required by NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*.

1.1.5 This standard shall not specify requirements for any closed-circuit SCBA.

1.1.6 This standard shall not specify requirements for other respiratory protection program components of the organization such as SCBA training, appropriate use of SCBA for operations, and breathing air quality as these program components are under the jurisdiction of other NFPA standards.

1.1.7 This standard shall not specify requirements for accessories attached to the SCBA unless specifically addressed herein.

1.1.8 Nothing herein shall restrict any jurisdiction from exceeding these minimum requirements.

1.2 Purpose.

1.2.1 The purpose of this standard shall be to establish procedures as part of a program to provide care and maintenance for open-circuit SCBA and combination SCBA/SAR in order to reduce the safety risks and potential health risks associated with poorly maintained, contaminated, or damaged SCBA.

1.2.2 This standard shall also establish basic criteria for the evaluation and selection process associated with purchasing open-circuit SCBA to assure only SCBA that meet the requirements of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for the Fire Service*; and, where SCBA are

equipped with SCBA-integrated PASS, also certified as compliant with NFPA 1982, *Standard on Personal Alert Safety Systems (PASS)*, as applicable, are acquired for use by fire and emergency services organizations.

1.3 Application.**1.3.1 New and Existing SCBA.**

1.3.1.1 For fire departments, this standard shall apply to the requirements for selection, care, and maintenance of the SCBA component of the fire department's respiratory protection program as required by Section 7.9 of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*.

1.3.1.2 This standard shall apply to the acquisition of new open-circuit SCBA and to the preparation of new SCBA to go into the "in service" status.

1.3.1.3 This standard shall apply to the organization's existing open-circuit SCBA, other than as constrained by 1.3.1.7 and 1.3.1.8, that are covered in the care and maintenance part of the respiratory protection program for open-circuit SCBA, and shall also apply to the selection process to acquire new open-circuit SCBA to augment or replace existing SCBA.

1.3.1.4 This standard shall apply to open-circuit SCBA that were confirmed by the SCBA manufacturer as meeting the requirements of the 1987 edition of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*.

1.3.1.5 This standard shall apply to open-circuit SCBA that were certified by an independent third-party certification organization as compliant with the 1992 edition of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*, and with the 1997 and later editions of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for the Fire Service*.

1.3.1.6 This standard shall also apply to open-circuit SCBA that were certified as compliant by an independent third-party certification organization and is equipped with SCBA-integrated PASS, also certified as compliant with the 1998 edition of NFPA 1982, *Standard on Personal Alert Safety Systems (PASS)*, as applicable.

1.3.1.7 Only the requirements of Section 4.3 shall apply to any open-circuit SCBA that were confirmed by the SCBA manufacturer as meeting the requirements of the 1981 edition of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*, or NFPA 19B, *Standard on Respiratory Protective Equipment for Firefighters*.

1.3.1.8 Only the requirements of Section 4.3 shall apply to any open-circuit SCBA that were never confirmed by the SCBA manufacturer or were never certified as meeting the requirements of any edition of NFPA 1981 or NFPA 19B, *Standard on Respiratory Protective Equipment for Firefighters*.

1.3.2 Implementation.

1.3.2.1 When this standard is adopted by an organization or by a jurisdiction, the authority having jurisdiction shall set a date or dates for achieving compliance with the requirements of this standard.

1.3.2.2 The organization or the jurisdiction shall be permitted to establish a phase-in schedule for compliance with specific requirements of this standard.

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, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 19B, *Standard on Respiratory Protective Equipment for Firefighters*, 1971 edition.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, 2002 edition.

NFPA 1901, *Standard for Automotive Fire Apparatus*, 1999 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*, 1981 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*, 1987 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*, 1992 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for the Fire Service*, 1997 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services*, 2002 edition.

NFPA 1982, *Standard on Personal Alert Safety Systems (PASS)*, 1998 edition.

2.3 Other Publications.

2.3.1 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

Title 29, *Code of Federal Regulations*, Part 1910.134, 23 April 1998 (29 CFR 1910.134).

Title 29, *Code of Federal Regulations*, Part 1910.156, 18 June 1998 (29 CFR 1910.156).

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not included, common usage of the terms shall apply.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). The organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure.

3.2.3 Shall. Indicates a mandatory requirement.

3.2.4 Should. Indicates a recommendation or that which is advised but not required.

3.2.5 Standard. A document, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

3.3.1 Atmosphere-Supplying Respirator. A respirator that supplies the respirator user with breathing air from a source

independent of the ambient atmosphere, which includes self-contained breathing apparatus (SCBA) and supplied air respirators (SAR). (See also 3.3.15, *Self-Contained Breathing Apparatus*, and 3.3.17, *Supplied Air Respirator*.)

3.3.2 Care. Procedures for cleaning, decontamination, and storage of protective clothing and equipment.

3.3.3* Combination SCBA/SAR. An atmosphere-supplying respirator that supplies a respirable atmosphere to the user from a combination of two breathing air sources both of which are independent of the ambient environment. [See also 3.3.1, *Atmosphere-Supplying Respirator*, 3.3.15, *Self-Contained Breathing Apparatus*, and 3.3.17, *Supplied Air Respirator (SAR)*.]

3.3.4 Component. Any material, part, or subassembly used in the construction of the compliant product.

3.3.5 Contamination/Contaminated. The process by which protective clothing or equipment has been exposed to hazardous materials or biological agents.

3.3.6 Cross Contamination. The transfer of contamination from one item to another or to the environment.

3.3.7 Fully Charged. An SCBA cylinder filled to the SCBA manufacturer’s specified pressure level.

3.3.8 In-Service. Ready for immediate use.

3.3.9 Maintenance. Procedures for inspection, repair, and removal from service of protective clothing and equipment.

3.3.10* Organization. The entity that provides the direct management and supervision for fire and emergency services response personnel.

3.3.11 Rebuild. To clean and examine compliant product thoroughly and make needed repairs and replace components as specified by the manufacturer.

3.3.12 SAR. An abbreviation for supplied air respirator. [See also 3.3.17, *Supplied Air Respirator (SAR)*.]

3.3.13 SCBA. An abbreviation for self-contained breathing apparatus. (See also 3.3.15, *Self-Contained Breathing Apparatus*.)

3.3.14 Selection. The process of determining what protective clothing and equipment (PCE) is necessary for protection of fire and emergency services response personnel from an anticipated specific hazard or other activity, the procurement of the appropriate PCE, and the choice of the proper PCE for a specific hazard or activity at an emergency incident.

3.3.15* Self-Contained Breathing Apparatus (SCBA). An atmosphere-supplying respirator that supplies a respirable atmosphere to the user from a breathing air source that is independent of the ambient environment and designed to be carried by the user. [See also 3.3.1, *Atmosphere-Supplying Respirator*, 3.3.3, *Combination SCBA/SAR*, and 3.3.17, *Supplied Air Respirator (SAR)*.]

3.3.16 Specified Service Life. Time, exposure event, or number of uses to which a compliant product or component is expected to remain functional.

3.3.17* Supplied Air Respirator (SAR). An atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user. Also known as an airline respirator. [See also 3.3.1, *Atmosphere-Supplying Respirator*, 3.3.3, *Combination SCBA/SAR*, and 3.3.15, *Self-Contained Breathing Apparatus (SCBA)*.]

3.3.18 Technician. An individual qualified and authorized by the compliant product manufacturer to provide specified care and maintenance to the product, and perform inspection, repair, and testing beyond the level classified as “user repair.”

Chapter 4 Program Component

4.1 General.

4.1.1 As part of the respiratory protection program specified by Section 7.9 of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, the organization shall develop, implement, and apply the program component for the selection, care, and maintenance of open-circuit SCBA used by the members of the organization in the performance of their assigned functions.

4.1.2 The program component shall have the following goals:

- (1) To provide SCBA that is suitable and appropriate for the intended use
- (2) To maintain SCBA in a safe, usable condition to provide the intended protection to the user
- (3) To remove from use any SCBA that could cause or contribute to user injury, illness, or death because of its condition
- (4) To recondition, repair, or retire such SCBA

4.1.3 The SCBA selection, care, and maintenance component of the organization’s respiratory protection program shall be in accordance with Section 4.2.

4.2 SCBA Selection, Care, and Maintenance Program Component.

4.2.1 The organization shall develop written standard operating procedures (SOP) that shall identify and define the various parts of the program component of the organization’s respiratory protection program and the various roles and responsibilities of the organization and the members.

4.2.2 As part of the program component, the organization shall develop SOPs for the handling and custody of SCBA that is removed from service due to the serious injury or fatality of the wearer.

4.2.3 As part of the program component, the organization shall develop SOPs for minimizing exposure to contaminated SCBA.

4.2.3.1 The organization shall define what criteria will determine when an SCBA is contaminated beyond the ability to remedy by cleaning and disinfecting in accordance with Section 6.1.

4.2.3.2 The SOPs shall detail methods for proper disposition of such contaminated SCBA in accordance with 4.6.2.

4.2.3.3 As a minimum, SCBA that are known to be contaminated or are suspected of being contaminated shall be tagged out-of-service and shall be segregated from other equipment, personnel, and civilians.

4.2.3.4 The organization shall develop procedures to minimize the public’s risk of exposure to soiled or contaminated SCBA.

4.2.4 The portion of the program component for selection of SCBA shall include the requirements specified in Chapter 5.

4.2.5 The portion of the program component for care of SCBA shall include the requirements specified in Chapter 6.

4.2.6 The portion of the program component for maintenance of SCBA shall include the requirements specified in Chapter 7.

4.2.6.1 As part of the program component for maintenance, the organization shall have written SCBA testing procedures utilizing a breathing machine that meets the requirements of 7.5.5 and 7.5.6.

4.2.6.2 As part of the program component for maintenance, testing procedures elements shall include but not be limited to the following:

- (1) Administration
- (2) Testing protocol
- (3) Training in use of the breathing machine
- (4) Calibration of the breathing machine
- (5) Test technician authorization
- (6) Record keeping
- (7) Test scheduling
- (8) Evaluation of the effectiveness of the program

4.2.6.3 As part of the program component for maintenance, the organization shall develop SOPs for the frequency of technician inspection and testing of SCBA.

4.2.6.3.1 In all cases, the frequency of technician inspection shall not be less than specified in the SCBA manufacturer’s instructions.

4.2.6.3.2 The organization shall also consider factors not limited to the following:

- (1) Specific manufacturer’s instructions related to breathing machine testing
- (2) Severity of environment in which SCBA is used
- (3) Number of uses for each SCBA
- (4) User reports of visual damage of SCBA
- (5) User complaints of improperly operating SCBA
- (6) Specific work-site issues
- (7)*Specific SCBA cylinder inspection

4.2.6.4 Where the part of the component that addresses the maintenance of SCBA includes SCBA technicians who are members of the organization, such technicians shall meet the requirements of Section 4.8.

4.2.7* The organization shall develop an SOP that requires that no member of the organization performs any alterations to the SCBA’s form, fit, or function that would cause the certification to the National Institute for Occupational Health and Safety (NIOSH) or to NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for the Fire Service*, to be invalid.

4.2.8 The organization shall require that all members who use SCBA or are responsible for any part of the organization’s respiratory protection program are informed and trained not to make any alterations or changes to any SCBA’s original condition that would cause the certifications to NIOSH or to NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*, to be invalid.

4.3 SCBA Compliance — Upgrades and Retirement.

4.3.1 SCBA that are currently in service shall be certified as compliant with either the 1992 edition of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*,

or with the 1997 edition of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for the Fire Service*.

4.3.2* Where currently-in-service SCBA do not meet the requirements of 4.3.1 and are covered by any of the following three categories, such SCBA shall be retired as specified in 4.3.5, or shall be upgraded as specified in 4.3.3:

- (1) Currently-in-service SCBA that did *not* meet the requirements of the 1987 edition of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*, when the SCBA was manufactured
- (2) Currently-in-service SCBA that were *not* certified as compliant with the 1992 edition of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*, when the SCBA was manufactured
- (3) Currently-in-service SCBA that were *not* certified as compliant with the 1997 edition of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for the Fire Service*, when the SCBA was manufactured

4.3.2.1 The provisions of 4.3.4 shall apply to SCBA that are not covered by any of the three categories specified in 4.3.2.

4.3.3* SCBA shall be permitted to be upgraded to be compliant with the upcoming 2002 edition of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services*, in accordance with the SCBA manufacturer's and certification organization's instructions.

4.3.4* Where currently-in-service SCBA do not meet the requirements of 4.3.1 and are covered by any of the following three categories, such SCBA shall be retired as specified in 4.3.5:

- (1) Currently-in-service SCBA that *only* met the requirements of the 1981 edition of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*, when the SCBA was manufactured
- (2) Currently-in-service SCBA that *only* met the requirements of NFPA 19B, *Standard on Respiratory Protective Equipment for Firefighters*, when the SCBA was manufactured
- (3) Currently-in-service SCBA that were purchased prior to 1 July 1987 and did not meet the requirements, when the SCBA was manufactured, of either the 1971 edition of NFPA 19B, *Standard on Respiratory Protective Equipment for Firefighters*, or the 1981 edition of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*

4.3.5 Retired SCBA shall be disposed of as specified in 4.6.1.

4.4 Records.

4.4.1* The organization shall create a written procedure to manage the record-keeping system.

4.4.2 The record-keeping system shall accommodate the documents listed in 4.4.8 and all additional documents that are needed after considering the following factors:

- (1) The need for the record, report, or document
- (2) How the record, report, or document will contribute to realizing the organization's goals within the selection, care, and maintenance program component
- (3) The number of copies needed
- (4) The person(s) responsible for producing the record, report, or document
- (5) The format and substance of the record, report, or document

(6) The person(s) who will receive, forward, review, process, and use the record, report, or document

(7)*The disposition of the record, report, or document after it has been completely developed

4.4.3* The organization shall consult with legal counsel concerning specific laws that determine the length of time records, reports, and documents shall be retained. Additionally, legal counsel shall advise the organization about the form, written or electronic, that is permitted and under what circumstances original or copied documents are needed for various purposes.

4.4.4 The organization shall determine how required records, reports, and documents will be created, processed, maintained, and stored. Regardless of the method selected, the organization shall take measures to prevent loss and damage.

4.4.5 The record-keeping system shall be managed by a person who is trained and qualified to ensure that information is obtained, collected, communicated, retrieved, used, and stored according to the plan. The record-keeping manager shall also consider how to reduce waste, redundancy, and cost in the system.

4.4.6 The manager of the record-keeping system shall educate and train personnel within the organization in completing, filing, and using various components of the record-keeping system. The manager shall be assisted by sufficient staff to fulfill the manager's duties.

4.4.7 The manager of the record-keeping system shall conduct an annual inventory and audit of records, reports, and documents. Following the inventory and audit, the manager shall recommend changes in the record-keeping system as needed.

4.4.8 The organization shall create, maintain, and disseminate the following as required:

- (1) Written instructions for care, maintenance, and repair that correspond to those provided by the manufacturer
- (2) Written instructions for checks while donning SCBA
- (3) Written instructions for inspection, including procedures to be followed if defects are found
- (4) Forms to document the findings during inspection
- (5) Forms to record and to report defects, found during inspection, and to track the SCBA or cylinder as it is repaired
- (6) Forms to document inspections, tests, and repairs by SCBA users and technicians that shall include the following:
 - (a) SCBA make, model, and serial number and other information to identify components.
 - (b) Documentation of the date, result of the inspection or test, and all actions taken as well as who acted.
- (7) Written instructions for filling and for testing cylinders
- (8) Written policy and procedure concerning training and authorization of SCBA technicians as well as documentation of that training and authorization
- (9) Written procedures for the inspection of cylinders by technicians
- (10) Written procedures for recording information about the inspection and repair of cylinders
- (11) Stickers, tags, or other similarly effective means to alert users and technicians to defects, to document inspections, and to certify that tests, repairs, and other actions have been completed

- (12) Written procedures for periodic tests and comprehensive inspections that comply with the SCBA manufacturer's instructions
- (13) Documentation of the tests to verify SCBA performance
- (14) Schedule for retention, disposition, and disposal of each report, record, and document
- (15) Methods of identifying all SCBAs, cylinders, parts, and components so that these can be identified and tracked from initial receipt by the organization until removed from the possession and control of the organization
- (16) Documentation when a defective or obsolete SCBA or component part is removed from service in accordance with the following:
 - (a) Until retirement and disposal of a defective or obsolete SCBA or component as specified in 4.6.3, a tag shall be conspicuously placed on the SCBA or component.
 - (b) The tag shall indicate the date and time the SCBA or component was removed from service, by whom, and for what reason.
 - (c) SCBA and components that are removed from service shall be stored separately from other SCBA and components and secured, as necessary.
 - (d) Access to tagged SCBA and components shall be limited, and only authorized persons shall remove tags after repair or service.
- (17) Records for maintenance of each individual SCBA regulator, reducer, harness, cylinder including valve assembly, and facepiece including the following information:
 - (a) The manufacturer's serial number or other unique identifier
 - (b) Date of manufacture, receipt, service, inspection, test, maintenance, and repair
 - (c) Inspections, service, repairs, and tests
 - (d) Who performed the work
 - (e) Other comments
- (18) Records of training provided to each user showing date(s) and subject(s) covered
- (19) Such other reports, records, and documents including forms, tags, stickers, and other means necessary to effectuate the purposes of record keeping and the intent of this standard.

4.5 Manufacturer's Instructions.

4.5.1 When issuing new SCBA, the organization shall provide users with the instructions provided by the manufacturer on the care, use, and maintenance of their SCBA, including any warnings provided by the manufacturer.

4.5.2 Where the manufacturer's instructions regarding the care, use, and maintenance of their SCBA differ from the requirements in this standard, the manufacturer's instructions shall be followed.

4.6 Retirement and Disposal.

4.6.1 Retired SCBA shall be destroyed, or altered in a manner assuring that they will not be used for respiratory protection and shall be rendered unable to hold pressure, or the ownership of the SCBA shall be transferred to the manufacturer or the manufacturer's agent.

4.6.2 Where SCBA or SCBA components are contaminated beyond the ability to decontaminate so the SCBA or components can be returned to service, such SCBA or component shall be disposed of.

4.6.2.1 Contaminated SCBA or components as identified according to 4.6.2 shall be segregated from other equipment and personnel, and disposed of in a manner consistent with the type of contamination and any governmental regulations governing contaminated items.

4.6.2.2 Prior to disposal, contaminated SCBA or components shall be altered in a manner assuring that they cannot be used for any purpose.

4.6.3 Defective or obsolete SCBA components or defective or obsolete SCBA that have been removed from service and cannot be repaired or upgraded shall be destroyed, or altered in a manner assuring that they will not be used in any fire-fighting or other emergency activities including training, or the ownership of the SCBA shall be transferred to the manufacturer or the manufacturer's agent.

4.6.4 SCBA elastomeric components, including but not limited to facepieces, O-rings, and hose, shall be destroyed or altered in a manner assuring that they cannot be used for any purpose when the component reaches the SCBA manufacturer's specified component service life.

4.6.5* SCBA composite cylinders shall be removed from service and retired when they reach the end of the service life specified by the SCBA manufacturer. Such composite cylinders shall be destroyed, or altered in a manner assuring that they will not be used for respiratory protection and shall be rendered unable to hold pressure, or the ownership of the composite cylinder shall be transferred to the manufacturer or the manufacturer's agent.

4.6.6 Any SCBA cylinders that are beyond repair or not allowed to be repaired shall be destroyed or altered in a manner assuring that they are marked and identified as "Condemned" and shall be rendered unable to hold pressure. Before destroying or rendering them unable to hold pressure, permission from the owner of the cylinder shall be obtained.

4.7 Quality Assurance.

4.7.1 The organization shall establish and maintain a quality assurance plan for selection, care, and maintenance of SCBA.

4.7.2 The quality assurance plan shall be designed to realize all of the following goals:

- (1) To assure effective and safe performance of SCBA provided to users
- (2) To substantiate compliance with this standard
- (3) To determine the organization's policies and procedures are being followed
- (4) To determine the effectiveness of those policies and procedures
- (5) To improve the organization's respiratory protection program component for selection, care, and maintenance of SCBA

4.8 Technical Authorization.

4.8.1 Where the portion of the respiratory protection program component that addresses the maintenance of SCBA, as specified in 4.2.6, includes SCBA technicians that are members of the organization, such technicians shall be qualified and authorized by the SCBA manufacturer to perform specified allowable maintenance.

4.8.1.1 Allowable maintenance shall include periodic inspection, repair, and overhaul of all SCBA components and assemblies.

4.8.1.2 Technicians shall also be qualified and authorized in the use of all special tools and equipment required to test and maintain the SCBA.

4.8.2 The program component shall establish policies and procedures for qualification and selection of personnel for SCBA technician training and authorization.

4.8.3 The organization shall maintain evidence that all SCBA technicians that are members of the organization have current authorization by the SCBA manufacturer and have maintained their level of competency.

Chapter 5 Selection

5.1 Selection for Purchase.

5.1.1 Prior to starting the procurement process of SCBA, a risk assessment shall be performed. The risk assessment shall include, but not be limited to, the expected hazards that can be encountered by users of SCBA based on the type of duties performed, frequency of use, the organization's experiences, and the organization's geographic location and climatic conditions.

5.1.2 The organization shall review the following standards as a minimum:

- (1) NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for the Fire Service*
- (2) NFPA 1982, *Standard on Personal Alert Safety Systems (PASS)*
- (3) NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*

5.1.2.1 Organizations in the United States shall also review 29 CFR 1910.134 and 29 CFR 1910.156.

5.1.2.2 Organizations outside the United States shall also review all applicable national, state/provincial, and local regulations.

5.1.3 The organization shall compile and evaluate information on comparative product strengths and weaknesses.

5.1.4 The organization shall ensure that the SCBA interfaces properly with other personal protective items already being used by the organization.

5.1.5 The organization shall also consider the following items during the selection process:

- (1) Cross contamination between users and ease of cleaning/decontamination
- (2) Legibility of remote pressure indicators in reduced visibility
- (3) Size
- (4) Weight
- (5) Rated service time
- (6) Breathing resistance
- (7) Environment
- (8) Ease of donning and doffing
- (9) Comfort
- (10) Fit range and available number of facepiece sizes
- (11) The number and complexity of steps involved in operation and maintenance of the SCBA
- (12) Design features that provide positive feedback to the user that required steps have been completed properly
- (13) Design features that prevent steps from being performed improperly

- (14) Operability by user wearing structural fire fighting gloves
- (15) Facepiece vision area
- (16) Cylinder fill station requirements
- (17)*Method for uniquely identifying the components of the SCBA
- (18)*Facepiece nose cup
- (19) Vision correction needs of their personnel
- (20) Characteristics of the end of service time indicators
- (21) Communication capability such as speech diaphragms, voice amplifiers, radio interface, etc.
- (22) Supplied air compatibility
- (23) Spare cylinders
- (24) Rapid cylinder filling options
- (25) Cylinder types

5.1.6 Where a field or laboratory evaluation is conducted, at least the following criteria shall be used for designing a systematic evaluation procedure:

- (1) The organization shall develop an evaluation plan including, but not limited to, testing according to 7.5.2 prior to and after field evaluations.
- (2) Participants for field evaluations shall be selected based on a cross section of personnel, willingness to participate, objectivity, and level of operational activity.
- (3) Participants shall perform a field evaluation on each different product model being considered from each manufacturer for a particular SCBA. Participants shall be fitted for and instructed in the use of each product model being evaluated from each manufacturer.
- (4) A product evaluation form shall be developed for each model.
- (5) The organization shall solicit periodic reports from participants in the field evaluation.
- (6) The organization shall conclude the evaluation process and analyze the results.

5.1.7 Purchase specifications shall require evidence that the SCBA to be purchased are certified as compliant with NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for the Fire Service*.

5.1.7.1 Where SCBA-integrated PASS are involved, the PASS portion of the SCBA-integrated PASS shall be certified as compliant with NFPA 1982, *Standard on Personal Alert Safety Systems (PASS)*.

5.1.7.2 For both NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for the Fire Service*, and NFPA 1982, *Standard on Personal Alert Safety Systems (PASS)*, the edition of the respective standard(s) that is the current edition at the time of purchase shall be the edition specified.

5.1.8 Where the organization develops purchase specifications, at least the following criteria shall be considered:

- (1) All requirements developed by the organization in its evaluations conducted as specified in 5.1.3 through 5.1.7
- (2)*Quantitative fit testing
- (3) User training
- (4) Maintenance training
- (5) Manufacturer assistance to develop SOPs for maintenance
- (6) SCBA testing on site prior to acceptance
- (7) Maintenance schedule
- (8) Complete parts list
- (9) SCBA user and service manuals

- (10) List of any specialized equipment or special tools needed for SCBA maintenance
- (11) List of authorized service centers
- (12) Warranty statement
- (13) Procedures for returning items found defective upon initial receipt

5.2 Acceptance.

5.2.1 Upon receipt, organizations shall inspect and test purchased SCBA in accordance with 7.1.2, and 7.5.2 through 7.5.6, respectively. Organizations shall also verify that the equipment received is as specified.

5.2.2 Procedures shall be established for returning unsatisfactory products if the organization's specifications are not met.

5.2.3 Organizations shall review information supplied with the products such as instructions, warranties, and technical data.

Chapter 6 Care

6.1 Cleaning and Disinfecting.

6.1.1 The external surfaces of the SCBA shall be cleaned and disinfected according to the manufacturer's instructions using only those agents indicated by the manufacturer.

6.1.2 The facepiece shall be thoroughly cleaned after each use and disinfected as needed. Facepiece cleaning and disinfecting shall be performed according to the manufacturer's instructions using only those agents indicated by the manufacturer.

6.1.2.1 The exhalation valve shall be cleaned and flushed.

6.1.2.2 The facepiece shall be dried, and drying shall not be done in direct sunlight or in high heat.

6.1.2.3 The exhalation valve shall be cycled to assure proper operation.

6.1.3 The second stage regulator shall be thoroughly cleaned and disinfected if the internal components have been exposed to bodily fluids, exhaled breath, dirt, or debris. The cleaning and disinfecting shall be performed according to the manufacturer's instructions using only those agents indicated by the manufacturer.

6.1.4 SCBA straps and harness assemblies shall be cleaned and disinfected when required according to manufacturer's instructions. Straps and harness assembly cleaning and disinfecting shall be performed according to the manufacturer's instructions using only those agents indicated by the manufacturer.

6.1.4.1 Under no circumstances shall a chlorine bleach ever be used to clean straps and harness assemblies.

6.1.4.2 The straps and harness assemblies shall be dried, and drying shall not be done in direct sunlight or in high heat.

6.1.5 SCBA cylinder valve assemblies shall be cleaned and disinfected according to the manufacturer's instructions using only those agents indicated by the manufacturer.

6.1.5.1 Care shall be taken to ensure that the valve is free of debris.

6.1.5.2 The burst disc outlet shall be inspected and, if debris is present, the cylinder shall be removed from service.

6.1.6* Caution shall be taken to prevent water or cleaning materials from entering the connection between the cylinder valve and the mating SCBA inlet connector.

6.1.7 Pneumatic component cleaning and disinfecting shall be performed according to the manufacturer's instructions using only those agents indicated by the manufacturer.

6.1.7.1 All pneumatic components shall be thoroughly dried after cleaning.

6.1.7.2 Drying of pneumatic components shall not be done in direct sunlight or in high heat.

6.1.8 All other SCBA components shall be thoroughly air-dried prior to storage in a compartment that does not allow for air circulation.

6.1.9 Appropriate inspections according to 7.1.2 shall be performed after cleaning.

6.2 Contamination and Decontamination.

6.2.1 Where SCBA is suspected of being contaminated, it shall be tagged out-of-service and segregated from other equipment and personnel. Tags shall include details of the incident including known and suspected contaminants.

6.2.2 The SCBA manufacturer shall be contacted to determine if any additional special procedures can be used to decontaminate the SCBA.

6.2.3 In all cases, decontamination shall be conducted in accordance with the SCBA manufacturer's instructions.

6.2.4 Where it is determined, in accordance with 4.2.3.1, that the SCBA is contaminated beyond the ability to decontaminate it and return it to service, the SCBA shall be disposed of in accordance with 4.6.3.

6.3 Storage.

6.3.1 SCBA shall be stored in their original carrying or storage cases, or in a wall or apparatus bracket/rack, designed for quick removal and for protection of the SCBA. Brackets/racks shall protect the SCBA and shall be adjusted so they do not cause physical damage to cylinders, hoses, regulators, or straps.

6.3.2 Fire apparatus with brackets for securing SCBA shall meet the requirements of Section 13.5 of NFPA 1901, *Standard for Automotive Fire Apparatus*.

6.3.3 SCBA shall be stored with the cylinder valves closed. Other valves or controls shall be positioned according to manufacturer's specifications.

6.3.4 The facepieces of all SCBA shall be positioned to avoid distortion of parts during storage.

6.3.5 All harness straps shall be adjusted to their maximum length during storage.

6.3.6 In all instances the SCBA shall be stored in a manner to control and minimize exposure to shock, vibration, sunlight, heat, extreme cold, excessive moisture, damaging chemicals, and environmental elements.

6.3.7* All in-service SCBA cylinders shall be stored fully charged.

6.3.7.1 Cylinders shall be filled when the pressure falls to 90 percent of the manufacturer's specified pressure level.

6.3.7.2 A positive pressure shall be maintained in depleted SCBA cylinders by keeping the valve closed until they are filled to keep external contamination and condensation out of the cylinder.

6.3.8 SCBA cylinders shall be stored in a manner that prevents damage to the valve and cylinder.

Chapter 7 Maintenance

7.1 User Maintenance.

7.1.1 Inspection Frequency.

7.1.1.1* Where SCBA is assigned to an individual user for a duty period, the inspection specified in 7.1.2 shall be performed by the individual user at the beginning of each duty period.

7.1.1.2 Where additional SCBA are available for use on response vehicles but not assigned to individual users, the inspection specified in 7.1.2 shall be performed on such additional SCBA at least once each duty period.

7.1.1.3 Where SCBA are not assigned to an individual user for a duty period, the inspection specified in 7.1.2 shall be performed at least once a week on all SCBA that are available for use.

7.1.1.4 In all cases, the interval between the inspections specified in 7.1.2 shall not exceed 1 week.

7.1.2 Inspection.

7.1.2.1 All of the following SCBA components shall be present:

- (1) Facepiece
- (2) Backframe and harness assembly
- (3) Cylinder
- (4) Hose
- (5) End-of-service-time indicator(s) (EOSTI)
- (6) Regulators
- (7) Accessories

7.1.2.2 Facepiece inspection shall include the following:

- (1) Checking the material for deterioration, dirt, cracks, tears, holes, pliability, and tackiness
- (2) Checking the head-harness buckles, strap, and webbing for breaks, loss of elasticity, or wear
- (3) Checking the lens for holes, cracks, scratches, heat-damaged areas, and a proper seal with the facepiece material
- (4) Checking the exhalation valve, where present, for valve seat, springs, and covers for proper operation and for cleanliness
- (5) Checking the regulator connection(s) for proper operation and damage
- (6) Checking the speaking diaphragm where present for damage

7.1.2.3 Backframe and harness assembly inspection shall include the following:

- (1) Checking the harness straps and backframe for cuts, tears, abrasion, indications of heat damage, and indications of chemical-related damage
- (2) Checking all buckles, fasteners, and adjustments for proper operation
- (3) Checking the cylinder retention system for damage and proper operation, and checking that the cylinder is securely attached to the backframe
- (4) Checking that the harness straps are fully extended

7.1.2.4 Cylinder assembly inspection shall include the following:

- (1) Checking that the hydrostatic test date on the cylinder is current
- (2) Checking the gauge for damage
- (3) Checking the cylinder body for cracks, dents, weakened areas, indications of heat damage, and indications of chemical damage (*See Annex B.*)
- (4) Checking the composite portion of the cylinder for cuts, gouges, loose composite materials, and the absence of resin (*See Annex B.*)
- (5) Checking the cylinder valve outlet sealing surface and threads for damage
- (6) Checking the valve hand wheel for damage, proper alignment, serviceability, and secure attachment
- (7) Checking the burst disc outlet area for debris
- (8) Checking that the cylinder is fully charged

7.1.2.5 Hose inspection shall include the following:

- (1) Checking for cuts, abrasions, bubbling, cracks, heat damage, and chemical damage
- (2) Checking external fittings for visual signs of damage
- (3) Checking for tight connections

7.1.2.6 EOSTI inspection shall include the following:

- (1) Checking the alarm and mounting hardware for damage, secure attachment, dirt, and debris
- (2) Checking the EOSTI for proper activation in accordance with the manufacturer's instructions

7.1.2.7 Regulator inspection shall include the following:

- (1) Checking regulator controls, where present, for damage and proper function
- (2) Checking pressure relief devices visually for damage
- (3) Checking housing and components for damage
- (4) Checking the regulator for any unusual sounds such as whistling, chattering, clicking, or rattling during operation
- (5) Checking the regulator and bypass for proper function when each is operated (Where this is accomplished by donning the facepiece and contamination between users is a possibility, the regulator, facepiece, or both shall be cleaned and disinfected.)

7.1.2.8 Pressure indicator inspection shall include the following:

- (1) Checking the pressure indicator for damage
- (2) Checking that the cylinder pressure gauge and the remote gauge read within 10 percent of each other

7.1.2.9 Where SCBA has an integrated PASS, the SCBA-integrated PASS inspection shall include the following:

- (1) Checking for wear and damage
- (2) Checking covers/compartments for secure attachment
- (3) Checking all operating modes for proper function
- (4) Checking for the low battery warning signal

7.1.2.10 Where other accessories are attached to the SCBA, such accessories shall be inspected for signs of wear, damage, secure attachment, and proper operation.

7.1.2.11 As the final inspection item, the entire SCBA shall be checked for pressure retention by closing all regulator valves, opening the cylinder valve thereby pressurizing the SCBA, and then closing the cylinder valve.

7.1.2.11.1 The SCBA shall hold system pressure in accordance with the manufacturer's specifications after the cylinder valve is closed.

7.1.2.11.2 Following the pressure check, the system pressure shall be released.

7.1.3 Repair.

7.1.3.1 Where user repair can be accomplished promptly and replacement items or remedial action are immediately available, the SCBA shall be permitted to be restored to proper condition and returned to in-service status.

7.1.3.2 Where user repair cannot be accomplished promptly or where replacement items or remedial action are not immediately available, the SCBA shall be tagged out-of-service and removed from the response vehicle or standby location until the user repair can be completed.

7.1.3.3 The organization's personnel shall follow the organization's SOPs and the manufacturer's written instructions for allowable user repairs and shall be trained on the specific repair procedures before performing them.

7.1.3.4 Users shall not perform work beyond the limits of the organization's SOPs and their training, and shall not exceed what is allowed by the manufacturer's written instructions.

7.1.3.5 All repairs shall be done with the proper tools, parts, and equipment as specified by the manufacturer.

7.1.3.6 After repairs are made, the user shall conduct the appropriate inspection as specified in 7.1.2 to verify proper function of the SCBA.

7.1.4 Removal from Service.

7.1.4.1* Where a condition exists that is beyond user repair in accordance with 7.1.3 or there is reason to suspect the SCBA is not in a safe condition, the SCBA shall be removed from service, tagged, and referred to personnel responsible for technical maintenance.

7.1.4.2 Where any cylinder condition specified in 7.1.2.4 is identified, the cylinder shall be immediately depressurized to a slight positive pressure, tagged, and taken out of service. The valve shall be closed to keep external contamination and condensation out of the cylinder.

7.1.4.3 Any SCBA or SCBA components that have been exposed or are suspected of having been exposed to a chemical, biological, or nuclear agent(s) shall be removed from service, tagged, and referred to personnel responsible for technical maintenance.

7.1.4.4 Any SCBA or SCBA components being taken out of service shall be tagged as specified in 4.4.8(16).

7.1.4.5 Where an SCBA cylinder is identified as having been filled with air that did not comply with 7.3.2, the cylinder shall be removed from service, tagged, and referred to personnel responsible for technical maintenance.

7.2 Technician Maintenance.

7.2.1 Inspection Frequency.

7.2.1.1 The technician shall perform the inspection specified in 7.1.2 upon receipt of any SCBA removed from service.

7.2.1.2 The technician shall perform the inspection specified in 7.1.2 and the testing specified in Section 7.5 prior to returning any SCBA to service.

7.2.1.3 The SCBA shall be tested on a breathing machine specified in 7.5.6 in accordance with the organization's SOPs or in accordance with the SCBA manufacturer's instructions, whichever is more frequent, but in all cases at least annually.

7.2.1.4 The frequency of technician inspection and testing of SCBA shall be conducted in accordance with the organization's SOPs developed as specified in 4.2.6.3.

7.2.1.5 The organization shall test all newly purchased SCBA as specified in Section 7.5 prior to putting the SCBA in service.

7.2.2 Inspection.

7.2.2.1 Technicians shall perform the level of inspection for which they have been trained and have been qualified to conduct by the SCBA manufacturer.

7.2.2.2 Where an SCBA is removed from service in accordance with 7.1.4, the technician shall verify the user-reported condition. Where the user-reported condition is verified by the technician, the technician then shall determine the appropriate action to be taken to repair, return to service, or retire the SCBA or SCBA component(s).

7.2.2.3 Where the user-reported condition cannot be substantiated, the technician shall perform a complete SCBA inspection in accordance with the manufacturer's instructions.

7.2.3 Repair and Rebuild.

7.2.3.1 Technicians shall perform the level of repair or rebuild for which they have been qualified and are authorized to conduct by the SCBA manufacturer.

7.2.3.2 The technician shall verify that all parts and tools used in the maintenance, repair, and rebuild of SCBA are specified by the SCBA manufacturer for the specific SCBA model being repaired.

7.2.3.3* Parts and tools not specified by the manufacturer shall not be used.

7.2.3.4 The technician shall ensure that all components and tools are kept clean and free from contamination during repair and rebuild.

7.2.3.5 The technician shall ensure components are not damaged during repair and rebuild.

7.2.3.6 Product labels shall not be removed or obscured during repair or rebuild. Damaged or missing labels shall be replaced during repair or rebuild.

7.2.3.7 After repair or rebuild, the SCBA or SCBA component shall be inspected and tested in accordance with manufacturer's instructions.

7.2.3.8 Cylinder repairs shall be limited to only those conditions specified by the SCBA manufacturer.

7.2.3.9* SCBA shall be periodically rebuilt to replace all components that are subject to wear and aging at a frequency specified by the manufacturer or by the organization, which-

ever is more frequent. Such frequency shall be based on the conditions of use of the SCBA as indicated in 4.4.8(17)(a) through (e).

7.2.4 Removal from Service and Disposition.

7.2.4.1 An SCBA cylinder identified as having been filled with air that did not comply with 7.3.2 shall be removed from service and an action taken based upon consideration of the reason for the air sample failure. The action taken shall ensure that if the cylinder is placed back in service, it will not pass contaminants back to the breathing air in future fillings.

7.2.4.2* Any SCBA or SCBA component that is damaged and cannot be repaired shall be removed from service and retired as specified in Section 4.6.

7.2.4.3* Any SCBA or SCBA components that have been exposed or are suspected of having been exposed to a chemical, biological, or nuclear agent(s), and where such exposure cannot be remedied by a decontamination process authorized by the SCBA manufacturer, such SCBA or component shall be retired as specified in Section 4.6.

7.2.4.4 Any SCBA cylinder that is beyond repair shall be removed from service and retired as specified in Section 4.6. (*See Annex C.*)

7.2.4.5* Composite cylinders shall be removed from service and retired as specified in Section 4.6 when they reach the end of the SCBA manufacturer's specified service life.

7.2.4.6* Any elastomeric component, including but not limited to facepieces, O-rings, and hose, shall be removed from service and retired as specified in Section 4.6, when they reach the end of the SCBA manufacturer's specified service life.

7.3 Cylinder Filling.

7.3.1 Prior to filling SCBA cylinders, the cylinder inspection specified in 7.1.2.4(1) through (8) shall be performed.

7.3.2 SCBA cylinders shall be filled as soon as possible after use. Breathing air shall meet the requirements stated in Section 7.10 of NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*.

7.3.3 The SCBA manufacturer's specified fill rate shall not be exceeded.

7.3.4* When filling SCBA cylinders during routine maintenance, all operators and personnel shall be protected from catastrophic failure of the cylinder.

7.3.5 SCBA cylinders shall be requalified as specified by the SCBA manufacturer.

7.4 Cylinder Requalification.

7.4.1 SCBA cylinders shall be periodically requalified for service as required by the U.S. Department of Transportation (DOT). (*See Annex C.*)

7.4.2 If an SCBA cylinder is found to not be currently qualified for service, it shall be removed from service, tagged, and submitted for requalification testing.

7.4.3 An SCBA cylinder that fails requalification shall be dealt with in accordance with 4.6.6.

7.5 Testing.

7.5.1 The organization responsible for the maintenance of the SCBA shall perform periodic testing in accordance with the part of the SCBA program component for maintenance as specified in 4.2.6. In all cases, SCBA shall be tested at least annually on a breathing machine that meets the requirements specified in 7.5.5 and 7.5.6.

7.5.2 SCBA shall be tested for the performance specified in Table 7.5.2 after being inspected as specified in 7.1.2.

Table 7.5.2 Performance Test Requirements

Performance Element	Acceptance Criteria
Facepiece leakage	In order to proceed with the tests specified in Table 7.5.2, a pressure of at least 0.20 mb (0.1 in.) H ₂ O gauge below atmospheric shall remain in the facepiece at the end of a testing interval equal to 10 seconds \pm 0.5 seconds.
Facepiece exhalation valve opening pressure	Facepiece exhalation valve opening pressure shall be within manufacturer's specifications.
Facepiece static pressure	Pressure shall be between 0 mb (0 in.) H ₂ O gauge and 3.7 mb (1½ in.) H ₂ O gauge above atmospheric or shall meet manufacturer's specifications, whichever are more stringent.
First stage regulator (pressure reducer) static pressure	First stage regulator (pressure reducer) static pressure shall be within manufacturer's specifications.
Minimum facepiece pressure during breathing resistance test (at 40 L/min, \pm 1 L/min)	Minimum facepiece pressure shall meet manufacturer's specifications.
Maximum facepiece pressure during breathing resistance test (at 85 L/min, \pm 1 L/min)	Maximum facepiece pressure shall be less than or equal to the manufacturer's specifications, but not more than 5.0 mb (2 in.) H ₂ O gauge above maximum static pressure
Facepiece pressure during breathing resistance test (at 103 L/min, \pm 3 L/min)	Pressure shall be between 0 mb (0 in.) H ₂ O gauge and 8.7 mb (3½ in.) H ₂ O gauge above atmospheric or shall meet manufacturer's specifications, whichever are more stringent.
First stage pressure during breathing resistance test (at 103 L/min, \pm 3 L/min)	First stage pressure (pressure reducer) shall be within manufacturer's specifications.
First stage pressure during breathing resistance test (at 40 L/min, \pm 1.0 L/min)	First stage pressure (pressure reducer) shall be within manufacturer's specifications.

Table 7.5.2 *Continued*

Performance Element	Acceptance Criteria
Remote pressure gauge accuracy at $\frac{3}{4}$ -, $\frac{1}{2}$ -, $\frac{1}{4}$ - rated cylinder pressure	Remote pressure gauge accuracy shall be within ± 10 percent of full scale.
End-of-Service-Time Indicator (EOSTI): Activation	The EOSTI shall activate within manufacturer's specifications. Where the SCBA includes a second EOSTI, the activation pressure of the second EOSTI shall meet manufacturer's specifications.
Bypass flow rate	Where bypass valves are provided on SCBA, the flow rate through the bypass system shall be within manufacturer's specifications.

7.5.2.1 The sound level of all audible EOSTI's shall be measured using a calibrated instrument following the SCBA manufacturer's instructions and specifications. All other EOSTI's shall be measured in accordance with the manufacturer's instructions and specifications at least annually.

7.5.2.2 SCBA EOSTI signaling device(s) activation and operation shall conform to the SCBA manufacturer's specifications.

7.5.3 SCBA that fail to meet any of the acceptance criteria provided in Table 7.5.2 shall be tagged out-of-service until that SCBA has been adjusted or repaired, retested, and shown to meet all the requirements of Table 7.5.2.

7.5.4 All equipment used to test SCBA shall be calibrated in accordance with the test equipment manufacturer's instructions for calibration.

7.5.4.1 Calibration shall be performed periodically in accordance with the test equipment manufacturer's instructions but shall be calibrated at least annually.

7.5.4.2 A label shall be affixed to each piece of test equipment stating the date of the latest calibration and the date of the next scheduled calibration.

7.5.4.3 Records of calibration results shall be kept on file at the maintenance facility.

7.5.5 The breathing machine shall be capable of performing the tests listed in Table 7.5.2.

7.5.6 The breathing machine and any associated equipment shall be capable of meeting the specifications in Table 7.5.6(a) and Table 7.5.6(b).

Table 7.5.6(a) Lung Breathing Waveforms for 103 L/min Volume Work Rate

Step Number	Time (seconds)	Inspire/Expire	Volume (L) ± 0.1 L	Volume Change (L) $\pm 5\%$
0	0.00	—	-1.7	-0.012
1	0.02	Inspire	-1.688	0.012
2	0.04	Inspire	-1.662	0.025
3	0.06	Inspire	-1.626	0.036
4	0.08	Inspire	-1.581	0.045
5	0.10	Inspire	-1.529	0.052
6	0.12	Inspire	-1.471	0.058
7	0.14	Inspire	-1.409	0.062
8	0.16	Inspire	-1.345	0.064

Table 7.5.6(a) Continued

Step Number	Time (seconds)	Inspire/Expire	Volume (L) ± 0.1 L	Volume Change (L) $\pm 5\%$
9	0.18	Inspire	-1.277	0.068
10	0.20	Inspire	-1.207	0.07
11	0.22	Inspire	-1.134	0.073
12	0.24	Inspire	-1.059	0.075
13	0.26	Inspire	-0.984	0.076
14	0.28	Inspire	-0.906	0.077
15	0.30	Inspire	-0.828	0.079
16	0.32	Inspire	-0.748	0.08
17	0.34	Inspire	-0.667	0.081
18	0.36	Inspire	-0.586	0.081
19	0.38	Inspire	-0.504	0.082
20	0.40	Inspire	-0.421	0.083
21	0.42	Inspire	-0.337	0.084
22	0.44	Inspire	-0.254	0.084
23	0.46	Inspire	-0.169	0.085
24	0.48	Inspire	-0.085	0.085
25	0.50	Inspire	0	0.085
26	0.52	Inspire	0.085	0.085
27	0.54	Inspire	0.169	0.085
28	0.56	Inspire	0.254	0.085
29	0.58	Inspire	0.337	0.084
30	0.60	Inspire	0.421	0.084
31	0.62	Inspire	0.504	0.083
32	0.64	Inspire	0.586	0.082
33	0.66	Inspire	0.667	0.081
34	0.68	Inspire	0.748	0.081
35	0.70	Inspire	0.828	0.08
36	0.72	Inspire	0.906	0.079
37	0.74	Inspire	0.984	0.077
38	0.76	Inspire	1.059	0.076
39	0.78	Inspire	1.134	0.075
40	0.80	Inspire	1.207	0.073
41	0.82	Inspire	1.277	0.07
42	0.84	Inspire	1.345	0.068
43	0.86	Inspire	1.409	0.064
44	0.88	Inspire	1.471	0.062
45	0.90	Inspire	1.529	0.058
46	0.92	Inspire	1.581	0.052
47	0.94	Inspire	1.626	0.045
48	0.96	Inspire	1.662	0.036
49	0.98	Inspire	1.688	0.025
50	1.00	—	1.7	0.012
51	1.02	Expire	1.688	-0.012

(continues)

Table 7.5.6(a) *Continued*

Step Number	Time (seconds)	Inspire/Expire	Volume (L) \pm 0.1 L	Volume Change (L) \pm 5%
52	1.04	Expire	1.662	-0.025
53	1.06	Expire	1.626	-0.036
54	1.08	Expire	1.581	-0.045
55	1.10	Expire	1.529	-0.052
56	1.12	Expire	1.471	-0.058
57	1.14	Expire	1.409	-0.062
58	1.16	Expire	1.345	-0.064
59	1.18	Expire	1.277	-0.068
60	1.20	Expire	1.207	-0.07
61	1.22	Expire	1.134	-0.073
62	1.24	Expire	1.059	-0.075
63	1.26	Expire	0.984	-0.076
64	1.28	Expire	0.906	-0.077
65	1.30	Expire	0.828	-0.079
66	1.32	Expire	0.748	-0.08
67	1.34	Expire	0.667	-0.081
68	1.36	Expire	0.586	-0.081
69	1.38	Expire	0.504	-0.082
70	1.40	Expire	0.421	-0.083
71	1.42	Expire	0.337	-0.084
72	1.44	Expire	0.254	-0.084
73	1.46	Expire	0.169	-0.085
74	1.48	Expire	0.085	-0.085
75	1.50	Expire	0	-0.085
76	1.52	Expire	-0.085	-0.085
77	1.54	Expire	-0.169	-0.085
78	1.56	Expire	-0.254	-0.085
79	1.58	Expire	-0.337	-0.084
80	1.60	Expire	-0.421	-0.084
81	1.62	Expire	-0.504	-0.083
82	1.64	Expire	-0.586	-0.082
83	1.66	Expire	-0.667	-0.081
84	1.68	Expire	-0.748	-0.081
85	1.70	Expire	-0.828	-0.08
86	1.72	Expire	-0.906	-0.079
87	1.74	Expire	-0.984	-0.077
88	1.76	Expire	-1.059	-0.076
89	1.78	Expire	-1.134	-0.075
90	1.80	Expire	-1.207	-0.073
91	1.82	Expire	-1.277	-0.07
92	1.84	Expire	-1.345	-0.068
93	1.86	Expire	-1.409	-0.064
94	1.88	Expire	-1.471	-0.062
95	1.90	Expire	-1.529	-0.058
96	1.92	Expire	-1.581	-0.052
97	1.94	Expire	-1.626	-0.045
98	1.96	Expire	-1.662	-0.036
99	1.98	Expire	-1.688	-0.025

Table 7.5.6(b) Lung Breathing Waveforms for 40 L/min Volume Work Rate

Step Number	Time (seconds)	Inspire/Expire	Volume (L) \pm 0.1 L	Volume Change (L) \pm 5%
0	0	—	-0.833	0.001
1	0.025	Inspire	-0.831	0.002
2	0.050	Inspire	-0.825	0.005
3	0.075	Inspire	-0.816	0.009
4	0.100	Inspire	-0.803	0.013
5	0.125	Inspire	-0.787	0.016
6	0.150	Inspire	-0.768	0.019
7	0.175	Inspire	-0.745	0.022
8	0.200	Inspire	-0.720	0.025
9	0.225	Inspire	-0.692	0.028
10	0.250	Inspire	-0.661	0.031
11	0.275	Inspire	-0.628	0.033
12	0.300	Inspire	-0.592	0.035
13	0.325	Inspire	-0.555	0.038
14	0.350	Inspire	-0.515	0.039
15	0.375	Inspire	-0.474	0.041
16	0.400	Inspire	-0.431	0.043
17	0.425	Inspire	-0.387	0.044
18	0.450	Inspire	-0.341	0.046
19	0.475	Inspire	-0.295	0.047
20	0.500	Inspire	-0.247	0.048
21	0.525	Inspire	-0.198	0.049
22	0.550	Inspire	-0.149	0.049
23	0.575	Inspire	-0.100	0.050
24	0.600	Inspire	-0.050	0.050
25	0.625	Inspire	0.000	0.050
26	0.650	Inspire	0.051	0.050
27	0.675	Inspire	0.100	0.050
28	0.700	Inspire	0.150	0.050
29	0.725	Inspire	0.199	0.049
30	0.750	Inspire	0.248	0.048
31	0.775	Inspire	0.295	0.048
32	0.800	Inspire	0.342	0.047
33	0.825	Inspire	0.388	0.046
34	0.850	Inspire	0.432	0.044
35	0.875	Inspire	0.475	0.043
36	0.900	Inspire	0.516	0.041
37	0.925	Inspire	0.555	0.039
38	0.950	Inspire	0.592	0.037
39	0.975	Inspire	0.628	0.035
40	1.000	Inspire	0.661	0.033
41	1.025	Inspire	0.691	0.031
42	1.050	Inspire	0.719	0.028
43	1.075	Inspire	0.744	0.025
44	1.100	Inspire	0.767	0.022
45	1.125	Inspire	0.786	0.019
46	1.150	Inspire	0.802	0.016
47	1.175	Inspire	0.814	0.013
48	1.200	Inspire	0.823	0.009
49	1.225	Inspire	0.829	0.005
50	1.250	—	0.833	0.004
51	1.275	Expire	0.831	-0.002
52	1.300	Expire	0.825	-0.005
53	1.325	Expire	0.816	-0.009
54	1.350	Expire	0.803	-0.013
55	1.375	Expire	0.787	-0.016
56	1.400	Expire	0.768	-0.019

Table 7.5.6(b) *Continued*

Step Number	Time (seconds)	Inspire/Expire	Volume (L) ± 0.1 L	Volume Change (L) $\pm 5\%$
57	1.425	Expire	0.745	-0.022
58	1.450	Expire	0.720	-0.025
59	1.475	Expire	0.692	-0.028
60	1.500	Expire	0.661	-0.031
61	1.525	Expire	0.628	-0.033
62	1.550	Expire	0.592	-0.035
63	1.575	Expire	0.555	-0.038
64	1.600	Expire	0.515	-0.039
65	1.625	Expire	0.474	-0.041
66	1.650	Expire	0.431	-0.043
67	1.675	Expire	0.387	-0.044
68	1.700	Expire	0.341	-0.046
69	1.725	Expire	0.295	-0.047
70	1.750	Expire	0.247	-0.048
71	1.775	Expire	0.198	-0.049
72	1.800	Expire	0.149	-0.049
73	1.825	Expire	0.100	-0.050
74	1.850	Expire	0.050	-0.050
75	1.875	Expire	0.000	-0.050
76	1.900	Expire	-0.051	-0.050
77	1.925	Expire	-0.100	-0.050
78	1.950	Expire	-0.150	-0.050
79	1.975	Expire	-0.199	-0.049
80	2.000	Expire	-0.248	-0.048
81	2.025	Expire	-0.295	-0.048
82	2.050	Expire	-0.342	-0.047
83	2.075	Expire	-0.388	-0.046
84	2.100	Expire	-0.432	-0.044
85	2.125	Expire	-0.475	-0.043
86	2.150	Expire	-0.516	-0.041
87	2.175	Expire	-0.555	-0.039
88	2.200	Expire	-0.592	-0.037
89	2.225	Expire	-0.628	-0.035
90	2.250	Expire	-0.661	-0.033
91	2.275	Expire	-0.691	-0.031
92	2.300	Expire	-0.719	-0.028
93	2.325	Expire	-0.744	-0.025
94	2.350	Expire	-0.767	-0.022
95	2.375	Expire	-0.786	-0.019
96	2.400	Expire	-0.802	-0.016
97	2.425	Expire	-0.814	-0.013
98	2.450	Expire	-0.823	-0.009
99	2.475	Expire	-0.829	-0.005

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of

such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase “authority having jurisdiction,” or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.3.3 Combination SCBA/SAR. Combination SCBA/SAR consist of the following:

- (1) An SCBA certified as compliant with NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for the Fire Service*, and having a minimum rated service life of 30 minutes.
- (2) A connection for the attachment of an air line that provides a continuous supply of breathing air that is independent of the SCBA breathing air supply.

The definition does not include SAR that are used in conjunction with escape self-contained breathing apparatus (ESCBAs) where ESCBA provide less than a minimum rated service life of 30 minutes. For the purposes of this standard, combination SCBA/SAR are encompassed by the terms “self-contained breathing apparatus” and “SCBA.”

A.3.3.10 Organization. Examples of such organizations include, but are not limited to, fire departments, police and other law enforcement departments, rescue squads, EMS providers, and hazardous materials response teams.

A.3.3.15 Self-Contained Breathing Apparatus (SCBA). For the purposes of this standard, the terms “self-contained breathing apparatus” and “SCBA” indicate only open-circuit SCBA. Where the term “SCBA” is used without any qualifier in this standard, it indicates only SCBA and combination SCBA/SAR. Combination SCBA/SAR are encompassed by the terms “self-contained breathing apparatus” and “SCBA.”

A.3.3.17 Supplied Air Respirator (SAR). For the purposes of this standard, combination SCBA/SAR are encompassed by the terms “self-contained breathing apparatus” and “SCBA.”

A.4.2.6.3.2(7) A responsible member of the organization should estimate the frequency of SCBA cylinder use. It is not necessary to record or maintain records on the frequency of each SCBA cylinder use. For the purposes of determining the needed frequency of technical inspections of the SCBA cylinder, an estimate of cylinder use is acceptable.

It is also recommended that a responsible member of the organization determine the severity of the environment that the SCBA cylinders are usually exposed to. Where a more severe environment (with regards to hazards such as chemical

exposure or physical damage) exists, the organization should contact the SCBA manufacturer for cylinder technical inspection frequency advice.

Where the SCBA manufacturer does not have any technical inspection frequency instructions for SCBA cylinders used with their model, then the following guidelines are recommended:

- (1) A routine technical inspection of SCBA cylinders should be performed every 2 or 2½ years when the cylinders are in normal service and are filled or used 5 times a week or less.
- (2) A routine technical inspection of SCBA cylinders should be performed every year (annually) when the SCBA cylinder is in hazardous service, or when they are estimated to be used or filled more than 5 times a week.

The frequency guidelines are not meant to prevent a non-routine or specially required technical inspection. If the user has determined that a cylinder condition exists that warrants a technical inspection (*see 7.1.2.4*) then an immediate technical inspection of the cylinder is required.

A.4.2.7 The SCBA manufacturer should be contacted prior to any after-purchase modifications of any sort to an SCBA. Unapproved modifications could affect the NIOSH certification or certification to NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for the Fire Service*.

A.4.3.2 The portion of the text in 4.3.2(1) that applies to the 1987 edition of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*, uses the phrase “did not meet the requirements of the 1987 edition” while the portion of the text in 4.3.2(2) that applies to the 1992 and later editions of NFPA 1981 uses the phrase “were not certified as compliant with the 1992 edition.” The difference is that third-party certification first became a requirement with the 1992 edition and the terms *certified* and *compliant* are defined as relating to certification. Prior to the 1992 edition of NFPA 1981, the SCBA manufacturers confirmed their product as “meeting the requirements” of the standard.

A.4.3.3 SCBA that were compliant with the 1981 edition of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*, could have been upgraded since purchase through the SCBA manufacturer’s upgrade program and now be compliant with the later edition of NFPA 1981.

SCBA that are compliant with the 1981 edition of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters*, and have not been upgraded through the SCBA manufacturer’s upgrade program since their purchase should already have been removed from service (in the United States) under OSHA regulations in 29 CFR 1910.156 that effectively removed these SCBA from service on 1 July 1983.

A.4.3.4 SCBA that were compliant with the 1971 edition of NFPA 19B, *Standard on Respiratory Protective Equipment for Firefighters*, cannot be upgraded and should have been removed from service and disposed of many years ago. In the United States, OSHA regulations in 29 CFR 1910.156 effectively removed these SCBA from service on 1 July 1983.

A.4.4.1 The purposes of record keeping are to document what the organization has done, to create a record that can be used for compliance with laws or standards, and to provide information for analysis, evaluation, quality control, and plan-

ning. The organization should create and maintain a system of record keeping that achieves these purposes.

Record keeping should be comprehensive and structured to meet the requirements of this standard and needs of the organization. Record keeping should create, process, maintain, and store information with a minimum of effort, time, and cost. Record keeping should provide sufficient data and findings to allow the organization to analyze and to evaluate the selection, care, and maintenance performed under this standard.

All records, reports, and documents should be accurate and clear. If the reader detects inaccuracy, then the veracity of the writer, as well as the value of the record, could be suspect. Details, without the inclusion of unnecessary information, are necessary. Duplication of information in other forms or reports should be avoided.

A.4.4.2(7) Items to be considered should include the part the record, report, or document plays in the record-keeping system and whether it will be used for checking compliance, tracking, measuring effectiveness, spotting trends, or planning.

A.4.4.3 Some records and reports can be created and stored electronically although other items that are completed by users — such as forms, notices, stickers, and tags — are only practical and effective if tangible.

A.4.6.5 No specific requalification procedures are outlined in 49 CFR for composite cylinders. Therefore, the DOT developed special certifications known as *exemptions*. DOT-authorized composite cylinders have a maximum service life indicated in the exemption. Most exemptions specify that composite cylinders have a maximum life of 15 years. The composite cylinder is prohibited from being refilled after 15 years from the original hydrostatic test date. All U.S. retest facilities performing requalifications on composite cylinders are required by DOT to have a current copy of the cylinder’s exemption available, and have to follow its instructions and conditions. DOT, which is the regulatory authority in the United States, specifies the cylinder requalification frequency of every 3 years for composite cylinders and the cylinder requalification frequency of every 5 years for all-metal cylinders. The organization/cylinder owner and retest facility are required by DOT to know how often to have the requalification performed. (*See also Annex C.*)

A.5.1.5(17) SCBA maintenance and repair record keeping should include labeling and tracking SCBA major component assemblies by a unique identification method. Such identification can help to identify and document problems that are specific to a particular component assembly as well as simplify efforts to take corrective action and implement upgrades.

A.5.1.5(18) SCBA that are certified by NIOSH include a rated service time based on laboratory tests required by NIOSH. The SCBA is tested using a specified breathing machine with a breathing rate of 40 L/min. NIOSH uses this 40 L/min rate because it represents a moderate work rate that an average user can sustain for a period of time. To attain a rated service time of 30 minutes during this 40 L/min test, the typical SCBA cylinder has to contain 1200 L or more of compressed breathable air. A 45-ft³ cylinder has a capacity of 1273.5 L, based on 28.3 L/ft³. Because actual work performed by a fire fighter often results in a ventilation rate that exceeds 40 L/min, fire fighters will frequently not attain the rated service time of 30

minutes. During extreme exertion, for example, actual service time can be reduced by 50 percent or more.

To ensure proper utilization of equipment in actual situations, after training and instruction, it is recommended that users gain confidence by actually using the SCBA in a series of tasks representing or approximating the physical demands likely to be encountered.

In addition to the degree of user exertion, other factors that can affect the service time of the SCBA include the following:

- (1) The physical condition of the user (*see also ANSI Z88.6, Respiratory Protection — Respirator Use — Physical Qualifications for Personnel*)
- (2) Emotional conditions, such as fear or excitement, which can increase the user's breathing rate
- (3) The degree of training or experience the user has had with such equipment
- (4) Whether or not the cylinder is fully charged at the beginning of use
- (5) The facepiece fit
- (6) Use in a pressurized tunnel or caisson [At two atmospheres of pressure (29.4 psig), the duration will be one-half the duration obtained at one atmosphere of pressure (14.7 psig); at three atmospheres of pressure (44.1 psig), the duration will be one-third the duration obtained at one atmosphere of pressure.]
- (7) The condition of the SCBA
- (8) The SCBA effective dead air space (Dead air space is a volume proportional to the CO₂ concentration in the inhaled breathing gas.)

During normal breathing without a facepiece, carbon dioxide, which is produced by the body's metabolism, is released to the environment with each breath. The facepiece of an SCBA reduces this environment to a small space around the face. On exhalation, a portion of the carbon dioxide-rich exhaled breath is trapped in this space. On inhalation, fresh air from the SCBA cylinder mixes with this carbon dioxide-rich air and then enters the lungs. The concentration of carbon dioxide is dependent on facepiece configuration, flow characteristics, and ventilation rate.

The full effect of increased dead air space has not been demonstrated. However, the scientific work done in this area shows that an increase of CO₂ in the inhalation air leads to increased ventilation and, consequently, shorter service time for a given air supply. Means to reduce CO₂ in the inhalation air by using, for example, a well-fitting nose cup have been demonstrated to give longer service time. Contact each manufacturer for specific data.

A.5.1.8(2) Quantitative facepiece fit testing measures the amount (quantity) of leakage around the facepiece-to-face seal. This is normally done, using specifically designed equipment, by measuring the concentration of a detector (challenge) gas or aerosol in the area surrounding a user who is wearing a facepiece and comparing this with the concentration of the challenge gas or aerosol inside the facepiece. Comparing these two concentrations results in a *protection factor* expressed as the following relationship:

Protection factor = $1 \div (\text{concentration in facepiece} / \text{concentration outside facepiece})$

A high protection factor indicates that a very small amount of the challenge gas or aerosol has passed to inside the facepiece, thus the facepiece provides a high degree of protection to the user being tested.

An alternative facepiece fit test method is the *qualitative fit test*. Qualitative fit testing is based on whether the wearer of a facepiece can detect the presence of the challenge gas or aerosol by sensing the odor of it. This is a highly subjective test where a particular wearer determines whether the quality of air in the facepiece is acceptable. Results of qualitative fit testing are not precise and can vary based on the wearer's senses and the concentration of the challenge gas or aerosol.

A.6.1.6 Cleaning materials or water in the connection between the cylinder valve and the SCBA inlet connector are forced into the regulator and other pneumatic assemblies and can adversely affect the SCBA's performance over time.

A.6.3.7 SCBA cylinder pressure relief devices, such as frangible discs, are designed to safely relieve the contents of a cylinder when the cylinder internal pressure exceeds 5/3 of the rated service pressure. One way a cylinder can become overpressurized is when a cylinder is exposed to fire. The frangible disc pressure relief device is designed to protect a fully charged cylinder. If the cylinder is only partially charged, the cylinder structure can catastrophically fail before the cylinder's internal pressure reaches the pressure at which the pressure relief device functions. The conclusion is that SCBA cylinders in storage should be fully charged rather than partially charged.

A.7.1.1.1 A duty period should include, but not be limited to, a single shift in a career department, a substitute person taking over a position for part or all of a shift, personnel assigned to station duty in a department where the station is not staffed on a 24-hour daily basis, and other similar situations.

A.7.1.4.1 See A.7.2.4.2.

A.7.2.3.3 Many components in an SCBA, while appearing the same as those commonly available at stores and through catalogue sales, are made of special materials or under specific controls that are necessary to meet the stringent performance requirements of NFPA and NIOSH standards. One of the best examples of this is the manufacturer's use of a particular O-ring material and hardness in conjunction with a certain lubricant. Using a different O-ring or lubricant commonly obtainable from a hardware or plumbing store instead of that supplied by the manufacturer could result in a critical failure of the apparatus under certain conditions, even though the apparatus could appear to perform perfectly well immediately after repair.

A.7.2.3.9 It is recommended that organizations request substantiation from the SCBA manufacturer for any SCBA with no prescribed overhaul period.

A.7.2.4.2 Defects that should cause an SCBA cylinder to be removed from service include, but are not limited to, cylinders under the following conditions:

- (1) Not well cared for and maintained
- (2) Dropped, fallen, struck, or crushed
- (3) Stored improperly
- (4) Degraded, deteriorated, or corroded
- (5) In contact with damaging chemicals or an extremely corrosive atmosphere or environment
- (6) Damaged, as evidenced by a dent, gouge, crack, scrape, cut, dig, tear, or abrasion
- (7) Distorted, discolored, or showing the effects of heat exposure including one or more of the following: charring, blistering, peeling paint or coating, melting, or loss of resin or loose fibers on composite cylinders