NFPA®

1986

Standard on Respiratory Protection Equipment for Tactical and Technical Operations

2017

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NFPA® 1986

Standard on

Respiratory Protection Equipment for Tactical and Technical Operations

2017 Edition

This edition of NFPA 1986, *Standard on Respiratory Protection Equipment for Tactical and Technical Operations*, was prepared by the Technical Committee on Tactical and Technical Operations Respiratory Protection Equipment (FAE-TTO) and released by the Correlating Committee on Fire and Emergency Services Protective Clothing and Equipment (FAA-AAC). It was issued by the Standards Council on November 11, 2016, with an effective date of December 1, 2016.

This edition of NFPA 1986 was approved as an American National Standard on December 1, 2016.

Origin and Development of NFPA 1986

In September 2012, the Standards Council responded to a new project request submitted by Daniel Rossos, Chair of the Technical Committee on Respiratory Protection Equipment. The request related to the use of respiratory protection equipment for emergency operations that did not involve structural fire fighting. After its review, the Standards Council determined that there is a well-established technical need and a demonstrated demand for a standard addressing design, use, testing, and certification of self-contained breathing apparatus (SCBA) not covered by the requirements of NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus (SCBA) for Emergency Services*.

The Standards Council also established a new Technical Committee on Tactical and Technical Operations Respiratory Protection Equipment and invited individuals to apply for membership, particularly from law enforcement, federal agencies, defense organizations, hazardous material incident responders, and related agencies to establish a balanced technical committee representing the needs and requirements of the end user community.

This edition of the standard specifies the minimum requirements for the design (Chapter 6), performance (Chapter 7), testing (Chapter 8), and certification (Chapter 4) of new compressed breathing open-circuit SCBA and supplied air respirators (SAR) and for replacement parts, components, and accessories for non-structural fire-fighting devices.

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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 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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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 on respiratory protection equipment and selection, care and maintenance of respiratory protection equipment for non-fire fighting emergency services operations including, but not limited to, tactical law enforcement, confined space, and hazardous materials operations, during incidents involving hazardous or oxygen-deficient atmospheres. This committee does not cover respiratory protection equipment for firefighting operations addressed by the Technical Committee on Respiratory Protection Equipment.

Contents

NFPA 1986

Standard on

Respiratory Protection Equipment for Tactical and Technical Operations

2017 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.

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 extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex C. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. 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 C.

Chapter 1 Administration

1.1 Scope.

1.1.1* This standard shall specify the minimum requirements for the design, performance, testing, and certification of (1) new compressed breathing air open-circuit self-contained breathing apparatus (SCBA) and compressed breathing air combination open-circuit self-contained breathing apparatus and supplied air respirators (SCBA/SARs); and (2) replacement parts, components, and accessories for those respirators.

1.1.2 Reserved.

1.1.3 This standard shall not specify requirements for respiratory protection equipment that is used for fire-fighting operations.

1.1.4 This standard shall not specify requirements for other types of SCBA.

1.1.5* This standard shall not specify requirements for any accessories that could be attached to the certified product that are not certified by the National Institute for Occupational Safety and Health (NIOSH).

1.1.6 This standard shall not establish criteria for SCBA for underwater operations.

1.1.7 This standard shall not establish criteria for protection from ionizing radiation.

1.1.8 This standard shall not be construed as addressing all the safety concerns associated with the use of compliant SCBA and combination SCBA/SARs. It shall be the responsibility of the persons and organizations that use compliant SCBA and combination SCBA/SARs to establish safety and health practices and to determine the applicability of regulatory limitations prior to use.

1.1.9 This standard shall not be construed as addressing all the safety concerns, if any, associated with the use of this standard by testing facilities. It shall be the responsibility of the persons and organizations that use this standard to conduct testing of SCBA and combination SCBA/SARs to establish safety and health practices and to determine the applicability of regulatory limitations prior to using this standard for any designing, manufacturing, and testing.

1.1.10 Nothing herein shall restrict any jurisdiction or manufacturer from exceeding these minimum requirements.

1.2 Purpose.

1.2.1 The purpose of this standard shall be to establish minimum levels of SCBA performance for respiratory protection of emergency services personnel in non-fire-fighting operations in atmospheres that are categorized as immediately dangerous to life or health (IDLH).

1.2.2* Controlled laboratory tests used to determine compliance with the performance requirements of this standard shall not be deemed as establishing performance levels for all respiratory protective situations and IDLH atmospheres to which personnel can be exposed.

1.2.3 This standard shall not be interpreted or used as a detailed manufacturing or purchase specification but shall be permitted to be referenced in purchase specifications as minimum requirements.

1.3 Application.

1.3.1 This standard shall apply to all open-circuit SCBA and combination SCBA/SARs used by emergency services organizations for respiratory protection of its personnel during but not limited to rescue, hazardous materials response, tactical law enforcement operations, confined space entry, terrorist incident response, and similar operations where oxygen deficiency, particulates, toxic products, products of combustion, or other IDLH atmospheres exist or could exist at the incident scene.

1.3.1.1* If the SCBA is equipped with an emergency breathing safety system (EBSS), the EBSS performance requirements set forth in this standard shall apply only to open-circuit SCBA and combination SCBA/SARs used by emergency services personnel for respiratory protection of its personnel during the applications listed in 1.3.1.

1.3.2 This standard shall apply to the design, manufacturing, testing, and certification of new open-circuit SCBA and combination SCBA/SARs.

1.3.3 This standard shall not apply to accessories that can be attached to an open-circuit SCBA and combination SCBA/SARs but are not certified by NIOSH for use with that specific SCBA or combination SCBA/SARs.

1.3.4 Reserved.

1.3.5 This standard shall not apply to closed-circuit SCBA.

1.3.6* This standard shall not apply to the use of SCBA and combination SCBA/SARs.

1.4 Units.

1.4.1 In this standard, values for measurement are followed by an equivalent in parentheses, but only the first stated value shall be regarded as the requirement.

1.4.2 Equivalent values in parentheses shall not be considered as the requirement because those values might be approximate.

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 1971, *Standard on Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting,* 2013 edition.

NFPA 1989, *Standard on Breathing Air Quality for Emergency Services Respiratory Protection,* 2013 edition.

NFPA 1994, *Standard on Protective Ensembles for First Responders to CBRN Terrorism Incidents,* 2012 edition.

2.3 Other Publications.

2.3.1 ANSI Publications. American National Standards Institute, Inc., 25 West 43rd Street, 4th floor, New York, NY 10036.

ANSI/ASA S3.2, *Method for Measuring the Intelligibility of Speech over Communication Systems,* 2009 (R2014).

2.3.2 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P. O. Box C700, West Conshohocken, PA 19428-2959.

ASTM B117, *Standard Test Method for Salt Spray (Fog) Testing*, 2003.

ASTM D1003, *Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics*, 2000.

2.3.3 EBU Publications. European Broadcasting Union, Department of Technology & Innovation, L'Ancienne-Route 17A, CH-1218 Grand-Saconnex, Geneva, Switzerland.

EBU Technical Recommendation R68, *Alignment level in digital audio production equipment and in digital audio recorders*, 2000.

2.3.4 EN Publications (CEN). European Committee for Standardization Central Secretariat, rue de Stassart 36, B 1050 Brussels, Belgium.

EN 136, *Respiratory protective devices — Full face masks — Requirements, testing, marking*, 1998.

2.3.5 IEC Publications. International Electrotechnical Commission, 3, rue de Varembé, P.O. Box 131, CH-1211 Geneva 20, Switzerland.

IEC 60268, *Sound System Equipment — Part 16: Objective Rating of Speech Intelligibility by Speech Transmission Index*, 2003.

2.3.6 ISO Publications. International Organization for Standardization, 1, rue de Varembé, Case postale 56, CH-1211 Genéve 20, Switzerland.

ISO Guide 27, *Guidelines for corrective action to be taken by a certification body in the event of misuse of its mark of conformity*, 1983.

ISO 9001, *Quality management systems — Requirements,* 2005.

ISO/IEC 17000, *Conformity assessment — Vocabulary and general principles*, 2004.

ISO/IEC 17011, *Conformity assessment — General requirements for accreditation bodies accrediting conformity assessment bodies*, 2004.

ISO/IEC 17021, *Conformity assessment — Requirements for bodies providing audit and certification of management systems*, 2011.

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*, 2005.

ISO/IEC 17065, *Conformity assessment — Requirements for bodies certifying products, processes and services*, 2012.

2.3.7 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

ANSI/UL 913, *Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1 Hazardous (Classified) Locations,* Sixth edition.

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

Statement of Standard for NIOSH CBRN SCBA Testing, 2002.

Title 42, Code of Federal Regulations, Part 84, "Approval of Respiratory Protective Devices," 1 October 2004.

2.3.9 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections. (Reserved)

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 defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary,* 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

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

3.2.7 Standard. An NFPA Standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase "standards development process" or "standards development activities," the term "standards" includes all NFPA Standards, including Codes, Standards, Recommended Guides, and Guides.

3.3 General Definitions.

3.3.1 Accessory. Any item that could be attached to a certified product but that is not necessary for the certified product to meet the requirements of the standard.

3.3.2 Accreditation. Third-party attestation related to a conformity assessment body conveying formal demonstration of its competence to carry out specific conformity assessment tasks. These tasks include sampling and testing, inspection, certification, and registration. [**ISO/IEC 17000**, 2004]

3.3.3 Atmosphere-Supplying Respirator. A respirator that supplies the user with breathing air from a source independent of the ambient atmosphere and includes a self-contained breathing apparatus (SCBA) and/or a supplied air respirator (SAR). *[See also 3.3.13, Combination SCBA/SAR; 3.3.56, Self-Contained Breathing Apparatus (SCBA); and 3.3.64, Supplied Air Respirator (SAR).]*

3.3.4 Audit. Systematic, independent, documented process for obtaining records, statements of fact or other relevant information and assessing them objectively to determine the extent to which specified requirements are fulfilled. [**ISO/IEC 17000**, 2004]

3.3.5 Breathing Air. See 3.3.17, Compressed Breathing Air.

3.3.6 Breathing Air Cylinder. The pressure vessel or vessels that are an integral part of the SCBA and that contain the breathing gas supply; can be configured as a single cylinder or other pressure vessel or as multiple cylinders or pressure vessels.

3.3.7 Breathing Air/Gas Container. See 3.3.6, Breathing Air Cylinder.

3.3.8 Certification. A system whereby a certification organization determines that a manufacturer has demonstrated the ability to produce a product that complies with the requirements of this standard, authorizes the manufacturer to use a label on listed products that comply with the requirements of this standard, and establishes a follow-up program conducted by the certification organization as a check on the methods the manufacturer uses to determine continued compliance of labeled and listed products with the requirements of this standard.

3.3.9 Certification Organization. An independent third-party organization that determines product compliance with the requirements of this standard with a labeling/listing/follow-up program.

3.3.10 Certified. The resultant condition of a product having undergone certification in accordance with the requirements of this standard. *(See also 3.3.43, NIOSH Certified.)*

3.3.11 Char. The formation of a brittle residue when material is exposed to thermal energy.

3.3.12 Closed-Circuit SCBA. A recirculation-type SCBA in which the wearer rebreathes exhaled gas after the carbon dioxide has been removed from the exhalation gas and the oxygen content within the system has been restored from sources such as compressed breathing air, chemical oxygen, liquid oxygen, or compressed gaseous oxygen.

3.3.13* Combination SCBA/SAR. An atmosphere-supplying respirator that supplies a respirable atmosphere to the user from a combination of two breathing air sources that both are independent of the ambient environment. *[See also 3.3.3, Atmosphere-Supplying Respirator; 3.3.56, Self-Contained Breathing Apparatus (SCBA); and 3.3.64, Supplied Air Respirator (SAR).]*

3.3.14 Compliance. The condition of meeting or exceeding all applicable requirements of this standard.

3.3.15 Compliant. Meeting or exceeding all applicable requirements of this standard.

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

3.3.17* Compressed Breathing Air. A respirable gas mixture derived from normal atmospheric air or from manufactured synthetic air, stored in a compressed state in storage cylinders and respirator breathing air cylinders, and supplied to the user in a gaseous form.

3.3.18 Cylinder. See 3.3.6, Breathing Air Cylinder.

3.3.19 Demand SCBA. See 3.3.42, Negative Pressure SCBA.

3.3.20 Drip. To run or fall in drops or blobs.

3.3.21 EBSS. Emergency breathing safety system.

3.3.22 Emergency Breathing Safety System (EBSS). A device on an SCBA that allows users to share their available air supply in an emergency situation.

3.3.23 End-of-Service-Time Indicator (EOSTI). A warning device on an SCBA that warns the user that the end of the breathing air supply is approaching.

3.3.24 EOSTI. End-of-service-time indicator.

3.3.25 Fabric Component. Natural or synthetic material of combination of materials that is pliable and made by weaving, felting, forming, or knitting.

3.3.26 Facepiece. The component of an SCBA that covers the wearer's nose, mouth, and eyes.

3.3.27 Follow-up Program. The sampling, inspections, tests, or other measures conducted by the certification organization on a periodic basis to determine the continued compliance of labeled and listed products that are being produced by the manufacturer to the requirements of this standard.

3.3.28 Gas. Matter in a gaseous state at standard temperature and pressure.

3.3.29 HATS. Head and torso simulator.

3.3.30 Haze. Light that is scattered as a result of passing through a transparent object.

3.3.31 Head and Torso Simulator (HATS). A mannequin with built-in ear and mouth simulators that provides a realistic reproduction of the acoustic properties of an average adult human head and torso.

3.3.32 Heads-Up Display (HUD). Visual display of information and system condition status visible to the wearer.

3.3.33 HUD. Heads-up display.

3.3.34 Identical SCBA. SCBA that are produced to the same engineering and manufacturing specifications.

3.3.35 Inspection. Examination of a product design, product, process or installation and determination of its conformity with specific requirements or, on the basis of professional judgment, with general requirements. [**ISO/IEC 17000**, 2004]

3.3.36 Manufacturer. The entity that directs and controls any of the following: compliant product design, compliant product manufacturing, or compliant product quality assurance; also, the entity that assumes liability for the compliant product or provides the warranty for a compliant product.

3.3.37 Melt. A response to heat by a material resulting in evidence of flowing or dripping.

3.3.38 Microphone Measurement Point (MMP). A point 1.5 m in front of and on the axis of the lip position of typical human mouth (or artificial mouth) and 1.5 m above the floor.

3.3.39 MMP. Microphone measurement point.

3.3.40 Mouth Reference Point (MRP). A point 50 mm in front of and on the axis of the lip position of a typical human mouth (or artificial mouth).

3.3.41 MRP. Mouth reference point.

3.3.42 Negative Pressure SCBA. An SCBA in which the pressure inside the facepiece, in relation to the pressure surrounding the outside of the facepiece, is negative during any part of the inhalation or exhalation cycle when tested by NIOSH in accordance with 42 CFR 84.

3.3.43* NIOSH Certified. Tested and certified by the National Institute for Occupational Safety and Health (NIOSH) of the U.S. Department of Health and Human Services in accordance with the requirements of 42 CFR 84, Subpart H.

3.3.44 Open-Circuit SCBA. An SCBA in which exhalation is vented to the atmosphere and not rebreathed.

3.3.45 Pink Noise. Noise that contains constant energy per octave band.

3.3.46 Positive Pressure SCBA. See 3.3.47, Pressure Demand SCBA.

3.3.47 Pressure Demand SCBA. An SCBA in which the pressure inside the facepiece, in relation to the pressure surrounding the outside of the facepiece, is positive during both inhalation and exhalation when tested by NIOSH in accordance with 42 CFR 84, Subpart H.

3.3.48* Product Label. A marking provided by the manufacturer for each compliant product containing compliance statements, certification statements, manufacturer and model information, or similar data.

3.3.49 Rapid Intervention Crew/Company Universal Air Connection (RIC UAC). A system that allows emergency replenishment of breathing air to the SCBA of disabled or entrapped fire or emergency services personnel.

3.3.50 Rated Service Time. The period of time, stated on an SCBA's NIOSH certification label, that the SCBA supplied air to the breathing machine when tested to 42 CFR 84, Subpart H.

3.3.51 RIC. Rapid intervention crew/company.

3.3.52 Sample. (1) Product, component, or accessory randomly selected from the manufacturer's production line, the manufacturer's inventory, or the open market. (2) Product, component, or accessory that is conditioned for testing. *(See also 3.3.60, Specimen.)*

3.3.53 SAR. Supplied air respirator.

3.3.54 SCBA. Self-contained breathing apparatus.

3.3.55 SCBA/SAR. Self-contained breathing apparatus/supplied air respirator. *[See also 3.3.13, Combination SCBA/SAR; 3.3.56, Self-Contained Breathing Apparatus (SCBA); and 3.3.64, Supplied Air Respirator (SAR).]*

3.3.56* Self-Contained Breathing Apparatus (SCBA). An atmosphere-supplying respirator the breathing air source of which is designed to be carried by the user.

3.3.57 Service Life. The period for which compliant product should be useful before retirement.

3.3.58 Service Time. See 3.3.50, Rated Service Time.

3.3.59 Sound Pressure Level (SPL). The local pressure deviation from the ambient (average, or equilibrium) atmospheric pressure caused by a sound wave.

3.3.60 Specimen. The conditioned product, component, or accessory that is tested. Specimens are taken from samples. (*See also 3.3.52, Sample.*)

3.3.61 Speech Transmission Index (STI). A measure of intelligibility of speech quality on a scale of intelligibility, the values of which vary from 0 (completely unintelligible) to 1 (perfect intelligibility).

3.3.62 SPL. Sound pressure level.

3.3.63 STI. Speech transmission index.

3.3.64* 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 3.3.3, Atmosphere-Supplying Respirator; 3.3.13, Combination SCBA/SAR; and 3.3.56, Self-Contained Breathing Apparatus (SCBA).]*

3.3.65 Synthetic Breathing Air. Manufactured breathing air produced by blending nitrogen and oxygen. *(See also 3.3.17, Compressed Breathing Air.)*

3.3.66 Testing. Determination of one or more characteristics of an object of conformity assessment, according to a procedure. Testing typically applies to materials, products or processes. [**ISO/IEC 17000**, 2004]

3.3.67 UAC. Universal air connection.

3.3.68 Universal Air Connection (UAC). The male fitting affixed to the SCBA and the female fitting affixed to the filling hose that allow emergency replenishment of breathing air to an SCBA breathing air cylinder. Also known as Rapid Intervention Crew/Company Universal Air Connection.

3.3.69 Variant. A grouping of subassemblies (i.e., components) having common functional and/or design characteristics, the assembly of multiple variants of which results in an SCBA model configuration.

Chapter 4 Certification

4.1 General.

4.1.1 The process for certification of SCBA as being compliant with NFPA 1986 shall meet the requirements of Section 4.1, General; Section 4.2, Certification Program; Section 4.3, Inspections and Testing; Section 4.4, Recertification; Section 4.5, Manufacturers' Quality Assurance Program; Section 4.6, Hazards Involving Compliant Product; Section 4.7, Manufacturers' Investigation of Complaints and Returns; and Section 4.8, Manufacturers' Safety Alert and Product Recall Systems.

4.1.2 Prior to certification of SCBA to the requirements of this standard, the SCBA shall be NIOSH certified.

4.1.2.1 SCBA shall have NIOSH certification as positive pressure.

4.1.2.2 SCBA that are NIOSH certified as positive pressure but that are capable of supplying air to the user in a negative pressure demand-type mode shall not be certified to this standard.

4.1.3 SCBA and accessories that are certified as compliant with NFPA 1986 shall also be certified by NIOSH as compliant with the *Statement of Standard for NIOSH CBRN SCBA Testing*.

4.1.4 All SCBA that are labeled as being compliant with this standard shall meet or exceed all applicable requirements specified in this standard and shall be certified. This certification shall be in addition to, and shall not be construed to be the same as, the NIOSH certification specifically defined in 3.3.43.

4.1.5 All certification shall be performed by a certification organization that meets at least the requirements specified in Section 4.2, Certification Program, and that is accredited for personal protective equipment in accordance with ISO/IEC 17065, *Conformity assessment — Requirements for bodies certifying products, processes and services*.

4.1.6 Manufacturers shall not claim compliance with a portion(s) or segment(s) of the requirements of this standard and shall not use the name or identification of this standard, NFPA 1986, in any statements about their respective product(s) unless the product(s) is certified as compliant with this standard.

4.1.7 All compliant SCBA shall be listed by the certification organization, and the listing shall uniquely identify the certified product by, at a minimum, style or model number.

4.1.8 All compliant SCBA shall have a product label that meets the requirements specified in Chapter 5.

4.1.9 The certification organization's label, symbol, or identifying mark shall be attached to the product label, shall be part of the product label, or shall be immediately adjacent to the product label.

4.1.10 Reserved.

4.1.11 Reserved.

4.1.12 Reserved.

4.2 Certification Program.

4.2.1* The certification organization shall not be owned or controlled by manufacturers or vendors of the product being certified.

4.2.2 The certification organization shall be primarily engaged in certification work and shall not have a monetary interest in the product's ultimate profitability.

4.2.3 The certification organization shall be accredited for personal protective equipment in accordance with ISO/IEC 17065, *Conformity assessment – Requirements for bodies certifying products, processes and services*, and the accreditation shall be issued by an accreditation body operating in accordance with ISO/IEC 17011, *Conformity assessment — General requirements for accreditation bodies accrediting conformity assessment bodies*.

4.2.4 The certification organization shall refuse to certify products to this standard that do not comply with all applicable requirements of this standard.

4.2.5* The contractual provisions between the certification organization and the manufacturer shall specify that certification is contingent on compliance with all applicable requirements of this standard.

4.2.5.1 The certification organization shall not offer or confer any conditional, temporary, or partial certifications.

4.2.5.2 Manufacturers shall not be authorized to use any label or reference to the certification organization on products that are not compliant with all applicable requirements of this standard.

4.2.6* The certification organization shall have laboratory facilities and equipment available for conducting proper tests to determine product compliance.

4.2.6.1 The certification organization laboratory facilities shall have a program in place and functioning for calibration of all instruments, and procedures shall be in use to ensure proper control of all testing.

4.2.6.2 The certification organization laboratory facilities shall follow good practice regarding the use of laboratory manuals, form data sheets, documented calibration and calibration routines, performance verification, proficiency testing, and staff qualification and training programs.

4.2.7 The certification organization shall require the manufacturer to establish and maintain a quality assurance program that meets the requirements of Section 4.5, Manufacturers' Quality Assurance Program.

4.2.7.1 The certification organization shall require the manufacturer to have a product recall system specified in Section 4.8, Manufacturers' Safety Alert and Product Recall Systems, as part of the manufacturer's quality assurance program.

4.2.7.2 The certification organization shall audit the manufacturer's quality assurance program to ensure that the quality assurance program provides continued product compliance with this standard.

4.2.8 The certification organization and the manufacturer shall evaluate any changes affecting the form, fit, or function of the compliant product to determine its continued certification to the 2017 edition of NFPA 1986.

4.2.8.1 Reserved.

4.2.8.2 Reserved.

4.2.9* The certification organization shall have a follow-up inspection program of the manufacturing facilities of the compliant product, with at least two random and unannounced visits per 12-month period to verify the product's continued compliance.

4.2.9.1 As part of the follow-up inspection program, the certification organization shall select sample product at random from the manufacturer's production line, the manufacturer's in-house stock, or the open market.

4.2.9.2 Sample product shall be evaluated by the certification organization to verify the product's continued compliance in order to ensure that the materials, components, and manufacturing quality assurance systems are consistent with the materials, components, and manufacturing quality assurance that were inspected and tested by the certification organization during initial certification and recertification.

4.2.9.3 The certification organization shall be permitted to conduct specific testing to verify the product's continued compliance.

4.2.9.4 For products, components, and materials for which prior testing, judgment, and experience of the certification organization have shown results to be in jeopardy of not complying with this standard, the certification organization shall conduct more frequent testing of sample product, components, and materials acquired in accordance with 4.2.9.1 against the applicable requirements of this standard.

4.2.10 The certification organization shall have in place a series of procedures, as specified in Section 4.6, Hazards Involving Compliant Product, that address report(s) of situation(s) in which a compliant product is subsequently found to be hazardous.

4.2.11 The certification organization's operating procedures shall provide a mechanism for the manufacturer to appeal decisions. The procedures shall include the presentation of information from both sides of a controversy to a designated appeals panel.

4.2.12 The certification organization shall be in a position to use legal means to protect the integrity of its name and label. The name and label shall be registered and legally defended.

4.3* Inspections and Testing.

4.3.1 For both certification and recertification of SCBA, the certification organization shall conduct both the inspection and the testing specified in this section.

4.3.2 All inspections, evaluations, conditioning, and testing for certification or recertification shall be conducted by a certification organization's testing laboratory that is accredited in accordance with the requirements of ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*.

4.3.2.1 The certification organization's testing laboratory's scope of accreditation to ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*, shall encompass testing of personal protective equipment.

4.3.2.2 The accreditation of a certification organization's testing laboratory shall be issued by an accreditation body operating in accordance with ISO/IEC 17011, *Conformity assessment — General requirements for accreditation bodies accrediting conformity assessment bodies*.

4.3.3 A certification organization shall be permitted to utilize conditioning and testing results conducted by a product or component manufacturer for certification or recertification provided the manufacturer's testing laboratory meets the requirements specified in 4.3.3.1 through 4.3.3.5.

4.3.3.1 The manufacturer's testing laboratory shall be accredited in accordance with the requirements of ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*.

4.3.3.2 The manufacturer's testing laboratory's scope of accreditation to ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*, shall encompass testing of personal protective equipment.

4.3.3.3 The accreditation of a manufacturer's testing laboratory shall be issued by an accreditation body operating in accordance with ISO/IEC 17011, *Conformity assessment — General requirements for accreditation bodies accrediting conformity assessment bodies*.

4.3.3.4 The certification organization shall approve the manufacturer's testing laboratory.

4.3.3.5 The certification organization shall determine the level of supervision and witnessing of the conditioning and testing for certification or recertification conducted at the manufacturer's testing laboratory.

4.3.4 Sampling levels for testing and inspection shall be established by the certification organization and the manufacturer to ensure a reasonable and acceptable reliability at a reasonable and acceptable confidence level that products certified to this standard are compliant, unless such sampling levels are specified herein.

4.3.5 Inspection by the certification organization shall include a review of all product labels to ensure that all required label attachments, compliance statements, certification statements, and other product information are at least as specified for the SCBA in Section 5.1, Product Label Requirements.

4.3.6 Inspection by the certification organization shall include an evaluation of any symbols and pictorial graphic representations used on product labels or in user information, as permitted in 5.1.5, to ensure that the symbols are clearly explained in the product's user information package.

4.3.7 Inspection by the certification organization shall include a review of the user information required by Section 5.2, User Information, to ensure that the information has been developed and is available.

4.3.8 Inspection and evaluation by the certification organization for determining compliance with the design requirements specified in Chapter 6, Design Requirements, shall be performed on whole or complete products.

4.3.9 SCBA and SCBA components shall be subjected to the tests specified in Table 4.3.9 for each series.

4.3.10 SCBA shall be initially tested for certification and shall meet the performance requirements of three separate test series of Categories A, B, C, D, and E, as specified in Table 4.3.9. All tests within Categories A, B, C, D, and E, which are designed as cumulative damage tests, shall be conducted in the order specified.

4.3.11 SCBA lens components shall be initially tested for certification and shall meet the performance requirements of one test series of Category F, as specified in Table 4.3.9. SCBA component testing in Category F shall be conducted on test specimens as specified in the respective test method.

4.3.12 After certification, compliant SCBA and components of compliant SCBA shall be tested annually within 12 months of previous tests and shall meet the performance requirements of one test series of Categories A, B, C, D, E, and F, as specified in Table 4.3.9.

Table 4.3.9 Test Series

Test Order	Category A (SCBA #1)	Category B (SCBA #2)	Category C (SCBA #3)	Category D (SCBA #4)	Category E (SCBA #5)	Category F (SCBA #6)
1	Airflow *(Section 8.1)*	Airflow *(Section 8.1)*	Airflow *(Section 8.1)*	Airflow *(Section 8.1)*	Low power capacity *(Section 8.22)*	Facepiece lens abrasion (*Section 8.6*)
2	Facepiece carbon dioxide content *(Section 8.9)*	Breathing air cylinder and valve assembly retention *(Section 8.18)*	EOSTI recognition *(Section 8.10)*	Flame *(Section 8.8)*	Immersion leakage *(Section 8.19)*	
3	Nonelectronic communications *(Section 8.7)*	Cylinder connections and accessibility *(Section 8.20)*	HUD visibility *(Section 8.13 through 8.15)*	—	—	—
4	Supplementary voice communications system *(Section 8.21)*	RIC UAC cylinder refill breathing *(Section 8.16)*	HUD low power source visual alert signal *(Section 8.12)*	—	—	—
5	Environmental temperature *(Section 8.2)*	RIC UAC system fill rate *(Section 8.17)*	HUD wiring connection strength *(Section 8.11)*	—	—	—
6	EBSS cold temperature* *(Section 8.23)*	EBSS cold temperature* *(Section 8.23)*	Vibration *(Section 8.3)*	—	—	—
7	Particulate *(Section 8.5)*	Accelerated corrosion *(Section 8.4)*	—	—	—	—

*To be tested together.

4.3.13 A minimum of five identical SCBA that are to be certified to this standard shall be selected from the manufacturer's production.

4.3.14 The first SCBA shall be subjected to the tests listed in Category A, the second SCBA shall be subjected to the tests listed in Category B, the third SCBA shall be subjected to the tests in Category C, the fourth SCBA shall be subjected to the tests in Category D, and the fifth SCBA shall be subjected to the tests in Category E, as shown in Table 4.3.9.

4.3.15 Components from SCBA that are to be certified to this standard shall be subjected to the tests specified in Category F of Table 4.3.9. SCBA component testing in Category F shall be conducted on test specimens as specified in each respective test method.

4.3.16 The requirement specified in 4.3.12 shall be waived every fifth year when the testing required by 4.3.17 is conducted.

4.3.17 Compliant SCBA shall be tested and shall meet the performance requirements of three separate test series of Categories A, B, C, D, and E, as specified in Table 4.3.9, every fifth year from the date of the initial certification testing specified in 4.3.10.

4.3.18 SCBA lens components shall be tested and shall meet the performance requirements of one test series of Category F, as specified in Table 4.3.9, every fifth year from the date of the initial certification testing specified in 4.3.10. SCBA component testing in Category F shall be conducted on test specimens as specified in each respective test method.

4.3.19 The certification organization shall not allow any modifications, pretreatment, conditioning, or other such special processes of the product or any product component prior to the product's submission for evaluation and testing by the certification organization.

4.3.19.1 The certification organization shall accept from the manufacturer for evaluation and testing for certification only product or product components that are the same in every respect to the actual final product or product component.

4.3.19.2 The certification organization shall not allow the substitution, repair, or modification, other than as specifically permitted herein, of any product or any product component during testing.

4.3.20 No adjustment, repair, or replacement of parts shall be permitted to any SCBA being tested in accordance with this standard; however, breathing air cylinders shall be permitted to be filled as required.

4.3.21 Where SCBA are provided with an accessory or accessories that are certified by NIOSH in accordance with 42 CFR 84 for that specific SCBA, the SCBA with accessories installed shall be tested to all of the performance requirements specified in Chapter 7, and the accessories shall not cause degradation of the performance of the SCBA. The accessories themselves shall not be required to pass the performance testing unless specifically specified herein.

4.3.22 After completion of these tests for a specific model SCBA or its variant, only those tests on other similar SCBA models or variants shall be required where, in the determination of the certification organization, the SCBA's test results can be affected by any components or NIOSH-certified accessories that are different from those on the original SCBA tested.

4.3.23 Any modifications made to an SCBA or to any NIOSH-certified accessories provided for an SCBA by the SCBA manufacturer after certification shall require retesting and the meeting of the performance requirements of all those individual tests that the certification organization determines could be affected by such changes. This retesting shall be conducted before the modified SCBA is certified as being compliant with this standard.

4.3.24 The manufacturer shall maintain all design and performance inspection and test data from the certification organization used in the certification of the manufacturer's compliant product. The manufacturer shall provide such data, upon request, to the purchaser or authority having jurisdiction.

4.4 Recertification.

4.4.1 All SCBA models that are labeled as being compliant with this standard shall undergo recertification on an annual basis.

4.4.2 Recertification shall include inspection and evaluation to all design requirements and testing to all performance requirements as required by 4.3.8 and 4.3.12 on all manufacturer models and components.

4.4.3 The manufacturer shall maintain all design and performance inspection and test data from the certification organization used in the recertification of manufacturer models and components and shall provide such data, upon request, to the purchaser or authority having jurisdiction.

4.4.4 It is permissible for product to be manufactured for the follow-up inspection program to ensure correct configuration is available at the request of the certification organization. These samples shall be selected at random from a product completed on the manufacturer's production line.

4.5 Manufacturers' Quality Assurance Programs

4.5.1 The manufacturer shall provide and operate a quality assurance program that meets the requirements of this section and that includes a product recall system as specified in 4.2.7.1 and Section 4.8, Manufacturers' Safety Alert and Product Recall Systems.

4.5.2 The operation of the quality assurance program shall evaluate and test compliant product production to the requirements of this standard to ensure that production remains in compliance.

4.5.3 The manufacturer shall be registered to ISO 9001, *Quality management systems — Requirements.*

4.5.3.1 Registration to the requirements of ISO 9001, *Quality management systems — Requirements,* shall be conducted by a registrar that is accredited for personal protective equipment.

4.5.3.2 Registrars specified in 4.5.3.1 shall be accredited for personal protective equipment in accordance with ISO/IEC 17021, *Conformity assessment — Requirements for bodies providing audit and certification of management systems.*

4.5.4* Any entity that does not manufacture or assemble the compliant product but meets the definition of *manufacturer* as specified in 3.3.36 and therefore is considered to be the

"manufacturer" shall meet the requirements specified in Section 4.5, Manufacturers' Quality Assurance Programs.

4.5.5* Where the manufacturer uses subcontractors in the construction or assembly of the compliant product, the locations and names of all subcontractor facilities shall be documented, and the documentation shall be provided to the manufacturer's ISO registrar and the certification organization.

4.6 Hazards Involving Compliant Product.

4.6.1* The certification organization shall establish procedures to be followed where situation(s) are reported in which a compliant product is subsequently found to be hazardous. These procedures shall comply with the provisions of ISO Guide 27, *Guidelines for corrective action to be taken by a certification body in the event of misuse of its mark of conformity*, and as modified herein.

4.6.2* Where a report of a hazard involved with a compliant product is received by the certification organization, the certification organization shall contact NIOSH National Personal Protective Technology Laboratory (NIOSH/NPPTL), and the validity of the report shall be investigated following the procedures established by NIOSH/NPPTL.

4.6.3 With respect to a compliant product, a hazard shall be a condition or create a situation that results in exposing life, limb, or property to an imminently dangerous or dangerous condition.

4.6.4 Where a specific hazard is identified, the determination of the appropriate action for the manufacturer to undertake shall take into consideration the severity of the hazard and its consequences to the safety and health of users.

4.6.5 Where it is established that a hazard is involved with a compliant product, the certification organization, in coordination with NIOSH/NPPTL, shall determine the scope of the hazard, including products, model numbers, serial numbers, factory production facilities, production runs, and quantities involved.

4.6.6 The investigation shall include but not be limited to the extent and scope of the problem as it might apply to other compliant product or compliant product components manufactured by other manufacturers or certified by other certification organizations.

4.6.7 The certification organization, in coordination with NIOSH/NPPTL, shall also investigate reports of a hazard where compliant product is gaining widespread use in applications not foreseen when the standard was written, such applications in turn being ones for which the product was not certified, and no specific scope of application has been provided in the standard, and no limiting scope of application was provided by the manufacturer in written material accompanying the compliant product at the point of sale.

4.6.8 The certification organization, in coordination with NIOSH/NPPTL, shall require the manufacturer of the compliant product or the manufacturer of the compliant product component, if applicable, to assist the certification organization and NIOSH/NPPTL in the investigation and to conduct its own investigation as specified in Section 4.7, Manufacturers' Investigation of Complaints and Returns.

4.6.9 Where the facts indicating a need for corrective action are conclusive and the manufacturer has exhausted all appeal rights, the certification organization, in coordination with NIOSH/NPPTL, shall initiate corrective action immediately, provided there is a manufacturer to be held responsible for such action.

4.6.10 Where the facts are conclusive and corrective action is indicated, but there is no manufacturer to be held responsible, such as when the manufacturer has gone out of business or is bankrupt, the certification organization, in coordination with NIOSH/NPPTL, shall immediately notify relevant governmental and regulatory agencies and issue a notice to the user community about the hazard.

4.6.11* Where the facts are conclusive and corrective action is indicated, the certification organization, in coordination with NIOSH/NPPTL, shall take one or more of the following corrective actions:

(1) Parties authorized and responsible for issuing a safety alert shall be notified when, in the opinion of the certification organization and NIOSH/NPPTL, such a safety alert is necessary to inform the users.
(2) Parties authorized and responsible for issuing a product recall shall be notified when, in the opinion of the certification organization and NIOSH/NPPTL, such a recall is necessary to protect the users.
(3) The mark of certification shall be removed from the product.
(4) Where a hazardous condition exists and it is not practical to implement 4.6.11(1), 4.6.11(2), or 4.6.11(3), or the responsible parties refuse to take corrective action, the certification organization, in coordination with NIOSH/NPPTL, shall notify relevant governmental and regulatory agencies and issue a notice to the user community about the hazard.

4.6.12 The certification organization, in coordination with NIOSH/NPPTL, shall provide a report to the organization or individual identifying the reported hazardous condition and notify that organization or individual of the corrective action indicated or that no corrective action is indicated.

4.7 Manufacturers' Investigations of Complaints and Returns.

4.7.1 Manufacturers shall provide corrective action in accordance with ISO 9001, *Quality management systems — Requirements*, for investigating written complaints and returned products.

4.7.2 Manufacturers' records of returns and complaints related to safety issues shall be retained for at least 5 years.

4.7.3 Where the manufacturer discovers, during the review of specific returns or complaints, that a compliant product or compliant product component can constitute a potential safety risk to end users and is possibly subject to a safety alert or product recall, the manufacturer shall immediately contact NIOSH/NPPTL and the certification organization and provide all information about its review to assist NIOSH/NPPTL and the certification organization with their investigation.

4.8 Manufacturers' Safety Alert and Product Recall Systems.

4.8.1 Manufacturers shall establish a written safety alert system and a written product recall system that describes the procedures to be used in the event that they decide or are directed by the certification organization or NIOSH/NPPTL to either issue a safety alert or conduct a product recall.

4.8.2 The manufacturers' safety alert and product recall systems shall provide the following:

(1) The establishment of a coordinator and responsibilities by the manufacturer for the handling of safety alerts and product recalls
(2) A method of notifying all dealers, distributors, purchasers, users, and the National Fire Protection Association (NFPA) about the safety alert or product recall that can be initiated within a 1-week period following the manufacturer's decision to issue a safety alert or conduct a product recall or after the manufacturer has been directed by NIOSH/NPPTL or the certification organization to issue a safety alert or conduct a product recall
(3) Techniques for communicating accurately and understandably the nature of the safety alert or product recall and, in particular, the specific hazard or safety issue found to exist
(4) Procedures for removing product that is recalled and for documenting the effectiveness of the product recall
(5) A plan for repairing, replacing, or compensating purchasers for returned product

Chapter 5 Labeling and Information

5.1 Product Label Requirements.

5.1.1 In addition to the NIOSH certification label, each SCBA shall have an SCBA product label, which shall be permanently and conspicuously attached to the SCBA.

5.1.2 Multiple label pieces shall be permitted in order to carry all statements and information required to be on the SCBA product label; however, all label pieces of the product label shall be located adjacent to each other.

5.1.3 The certification organization's label, symbol, or identifying mark shall be attached to both the NIOSH certification label and the SCBA product label or be part of the product labels and shall be placed in a conspicuous location. All letters shall be at least 2.5 mm ($\frac{3}{32}$ in.) in height, and the label, symbol, or identifying mark shall be at least 6 mm ($\frac{15}{64}$ in.) in height.

5.1.4 All worded portions of both required product labels shall be at least in English.

5.1.5 Symbols and other pictorial graphic representations shall be permitted to be used to supplement worded statements on the product label(s).

5.1.6 The SCBA product label shall bear the following compliance statement legibly printed, and all letters and numbers shall be at least 2 mm in height:

THIS SCBA MEETS THE REQUIREMENTS OF NFPA 1986, STANDARD ON RESPIRATORY PROTECTION EQUIPMENT FOR TACTICAL AND TECHNICAL OPERATIONS, 2017 EDITION.
DO NOT REMOVE THIS LABEL

5.1.7 SCBA components, as listed on the NIOSH certification labels, shall be marked where practicable directly on the component with the lot number, serial number, or year and month of manufacture.

5.2 User Information.

5.2.1 The SCBA manufacturer shall provide with each SCBA at least the information and training materials specified in Section 5.2, User Information.

5.2.2 Upon request at the time of purchase, the SCBA manufacturer shall provide to the purchaser an information sheet with each SCBA that documents at least the following:

(1) Manufacturer name and address
(2) Manufacturing performance tests conducted at time of manufacture and the results
(3) Date of manufacture
(4) Model number
(5) Serial number
(6) Lot number, if applicable
(7) Hydrostatic test dates and results, if applicable

5.2.3 Information or training materials regarding pre-use shall be provided at least on the following areas:

(1) Safety considerations
(2) Limitations of use
(3) Charging breathing air cylinders
(4) Breathing air quality in accordance with NFPA 1989
(5) Marking recommendations and restrictions
(6) Warranty information
(7) Recommended storage practices
(8) Mounting on/in vehicles

5.2.4 Information or training materials regarding periodic inspections shall be provided at least on inspection frequency and details.

5.2.5 Information or training materials regarding donning and doffing shall be provided at least on the following areas:

(1) Donning and doffing procedures
(2) Adjustment procedures
(3) Interface issues

5.2.6* Information or training materials regarding use shall be provided at least on the following areas:

(1) Pre-use checks
(2) Recharging breathing air cylinders
(3) Emergency procedures to be followed in the event of damage, malfunction, or failure of the breathing apparatus
(4) Emergency procedures to be followed in the event of an out-of-air situation

5.2.7* Information or training materials regarding periodic maintenance and cleaning shall be provided at least on the following areas:

(1) Cleaning instructions and precautions
(2) Disinfecting procedures
(3) Maintenance frequency and details
(4) Methods of repair, where applicable
(5) Low power source signals and power source replacement, where applicable
(6) Complete instructions for reporting to the manufacturer, certification organization, and NIOSH/NPPTL all returned equipment or complaints of damage, malfunction, or failure of the breathing apparatus that could present a hazard to the user

5.2.8 Information or training materials regarding retirement shall be provided at least on replacement/retirement considerations.

5.2.9 The SCBA manufacturer shall provide the manufacturer's specified component service life for composite breathing air cylinders and for all elastomeric components of the SCBA. This information shall be included at least in the maintenance information provided to the users.

Chapter 6 Design Requirements

6.1 General Design Requirements.

6.1.1 SCBA shall meet the applicable design requirements specified in this chapter where inspected and evaluated by the certification organization as specified in Section 4.3, Inspections and Testing.

6.1.2 Prior to certification of SCBA to the requirements of this standard, SCBA shall be NIOSH certified in accordance with 42 CFR 84.

6.1.2.1 SCBA shall have NIOSH pressure-demand certification.

6.1.2.2 SCBA that are NIOSH pressure-demand certified but capable of supplying air to the user in a negative pressure demand-type mode shall not be certified to this standard.

6.1.3 SCBA that are certified as compliant with NFPA 1986 shall also be certified by NIOSH as compliant with the *Statement of Standard for NIOSH CBRN SCBA Testing*.

6.1.4 SCBA shall consist of all the components necessary for NIOSH certification in accordance with 42 CFR 84 and any additional components necessary to meet the requirements of this standard.

6.1.5 In addition to the cylinder-mounted breathing air pressure gauge, all SCBA shall have another breathing air pressure gauge that shall be capable of being viewed by the wearer when the SCBA is worn in accordance with the SCBA manufacturer's instructions.

6.1.5.1 A heads-up display (HUD) shall not be the sole device used to meet the requirements of 6.1.5.

6.1.6 The pressure gauge provided as part of the SCBA manufacturer's breathing air cylinder and valve assembly shall be readable by a person other than the wearer of the SCBA when the SCBA is worn in accordance with the SCBA manufacturer's instructions and with the breathing air cylinder securely retained in the SCBA backframe/carrier.

6.1.7 All SCBA shall be equipped with a facepiece that covers, at a minimum, the wearer's eyes, nose, and mouth.

6.1.8 All electric circuits integral to an SCBA or to any SCBA accessories shall be certified to the requirements for Class I, Groups C and D; Class II, Groups E, F, and G, Division 1 hazardous locations specified in ANSI/UL 913, *Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1 Hazardous (Classified) Locations*.

6.1.9 All hardware, brackets, and snaps or other fasteners of SCBA or any NIOSH-certified accessories shall be free of rough spots, burrs, and sharp edges.

6.1.10 All SCBA shall have a voice communications capability that shall consist of a nonelectronic transmission system.

6.1.10.1 If the SCBA incorporates an optional electronic supplementary voice communications system, the supplementary voice communications system design shall incorporate an indication that the system has been activated.

6.1.10.2 The optional supplementary voice communications system's power source shall at a minimum provide upon activation an alert signal indicating low power capacity.

6.1.10.3 The optional supplementary voice communications system shall be designed to be switched on and off manually without the performance of the SCBA being affected.

6.1.10.4 Where the optional supplementary voice communications system is automatically activated, the operation of the on/off control shall override the auto activation of the supplementary voice communications system without affecting the performance of the SCBA.

6.2 End-of-Service-Time Indicator (EOSTI) Design Requirements.

6.2.1 All SCBA shall be equipped with a minimum of one EOSTI.

6.2.2 The EOSTI(s) shall be activated with no additional procedures than those required to activate the SCBA breathing system.

6.2.3 The EOSTI(s) shall meet the activation requirements of NIOSH certification as specified in 42 CFR 84.

6.2.4 Each EOSTI shall consist of at least the following:

(1) A sensing mechanism
(2) A signaling device

6.2.4.1 The sensing mechanism of the EOSTI(s) shall activate the signaling device(s).

6.2.4.2 The EOSTI(s) signaling devices shall provide notification to the SCBA user of the activation of the EOSTI by stimulating one or more human senses.

6.2.4.3 The EOSTI(s) shall be permitted to have more than one signaling device, and each signaling device shall be permitted to stimulate more than one human sense.

6.2.5 A failure mode and effects analysis shall be provided to the certification organization for the EOSTI(s).

6.2.5.1 The failure mode and effects analysis shall identify each potential failure mode for each component necessary for the EOSTI(s) to function.

6.2.5.2 For purposes of the failure mode and effects analysis, power sources other than the air from the SCBA breathing air cylinder shall be considered as part of the EOSTI(s).

6.2.6 The EOSTI alarm shall activate at 25 percent +4/–0 percent of full cylinder pressure.

6.3 Optional HUD Design Requirements.

6.3.1 The SCBA shall be permitted to be equipped with at least one heads-up display.

6.3.2 If the SCBA is equipped with a HUD, the HUD shall be activated with no additional procedures other than those required to activate the SCBA breathing system.

6.3.2.1 The HUD shall be permitted to be capable of being user controlled following activation.

6.3.2.1.1 User control function(s) shall include, but not be limited to, deactivation of the HUD visual pressure gauge display function.

6.3.2.2 If the HUD is used as the EOSTI, the EOSTI indication shall not be capable of being disabled.

6.3.2.3 The activation/deactivation of the HUD shall be performed external to the facepiece, and the user shall be able to operate the HUD without having to use special tools.

6.3.3 Each time the SCBA breathing system is activated with the breathing air cylinder pressure of 20 bar (290 psi) or greater, the HUD shall provide a visual indication of activation.

6.3.4 Where the HUD is provided with an external wiring disconnect, the wiring connector shall require two distinct actions for disconnection.

6.3.5 The HUD shall provide at least visual displays of alert signals and information.

6.3.6 All HUD visual displays shall be visible to the SCBA wearer with the SCBA and facepiece properly donned and regardless of the wearer's head movement.

6.3.7 The HUD shall not use color as the only means of differentiating between alert signal displays and informational displays.

6.3.8 Visual Alert Signals (when in the active mode).

6.3.8.1 The HUD shall display visual alert signals for breathing air cylinder content specified in 6.3.8.4.

6.3.8.2 In addition to the mandatory visual alert signals specified in 6.3.8.4, additional visual alert signals to indicate when other status or conditions have occurred shall be permitted.

6.3.8.3 Each visual alert signal shall be identifiable, by the SCBA wearer, from any other visual alert signals or other informational displays provided on the HUD or on the SCBA.

6.3.8.4 The HUD shall display a visual alert signal for breathing air cylinder content when the breathing air in the SCBA cylinder has been reduced to 50 percent of rated service content. This visual alert signal shall visibly flash at a frequency of not less than one per second for a minimum of 20 consecutive seconds.

6.3.9 Visual Informational Displays (when in the active mode).

6.3.9.1 The HUD shall display visual informational signals for at least breathing air cylinder content as specified in 6.3.9.5.

6.3.9.2 In addition to the mandatory visual informational signal specified in 6.3.9.5 additional visual informational signals to indicate when other status or conditions have occurred shall be permitted.

6.3.9.3 All visual displays of information shall be permitted to flash at a frequency of not less than one per second for a minimum of 10 consecutive seconds every 60 seconds.

6.3.9.4 Where the visual display is not constantly visible or is not visible for at least 10 consecutive seconds every 60 seconds, the HUD shall be provided with a manual activation of the display.

6.3.9.5 The HUD shall display a visual informational signal for breathing air cylinder content at 100 percent, 75 percent, 50 percent, and 25 percent of the cylinder's total rated service content.

6.3.9.5.1 The range of pressures under the EOSTI set point shall be visually obvious.

6.3.9.5.1.1 Where a gauge analog is used, the sub-EOSTI pressure range shall have a red background.

6.3.9.5.1.2 Where an electronic mode is used, the sub-EOSTI display of pressure shall flash at a frequency of not less than one per second for the remaining duration of the cylinder.

6.3.9.6 A display only in units of pressure shall not be permitted.

6.4* Optional Rapid Intervention Crew/Company Universal Air Connection (RIC UAC) Design Requirements.

6.4.1 The SCBA shall be permitted to be equipped with an RIC UAC male fitting to allow replenishment of breathing air to the SCBA breathing air cylinder.

6.4.2 If the SCBA is equipped with an RIC UAC, the RIC UAC male fitting shall meet the requirements specified in 6.4.4 and shall be located on each SCBA in a permanently fixed position.

6.4.2.1 The distance between the leading edge of the Compressed Gas Association (CGA) fitting at the outlet of the SCBA cylinder valve and the leading edge of the RIC UAC male fitting shall be a maximum of 100 mm (4 in.).

6.4.3 If the SCBA is equipped with an RIC UAC, a separate self-resetting relief valve shall be installed on the SCBA to protect the SCBA against overpressurization.

6.4.4 RIC UAC Male Fitting.

6.4.4.1 The RIC UAC male fitting shall be designed as specified in Figure 6.4.4.1.

6.4.4.2 The RIC UAC male fitting shall be capable of connecting to any RIC UAC female fitting.

6.4.4.3 The RIC UAC male fitting shall not interfere with any other operation of the SCBA.

6.4.4.4 RIC UAC male fittings shall be equipped with a dust cap or sealing plug to prevent dust, dirt, and debris from entering the fitting and to serve as a leakproof seal.

6.4.5 RIC UAC Female Fitting.

6.4.5.1 The RIC UAC female fitting shall be designed as specified in Figure 6.4.5.1.

6.4.5.2 The RIC UAC female fitting shall be capable of connecting to all RIC UAC male fittings.

6.4.5.3 RIC UAC female fittings shall be equipped with a dust cap or sealing plug to prevent dust, dirt, and debris from entering the fitting and to serve as a leakproof seal.

6.4.6 RIC UAC Filling Hose Assembly.

6.4.6.1 Each SCBA manufacturer shall make available an RIC UAC filling hose assembly that consists of a filling hose and an RIC UAC female fitting.

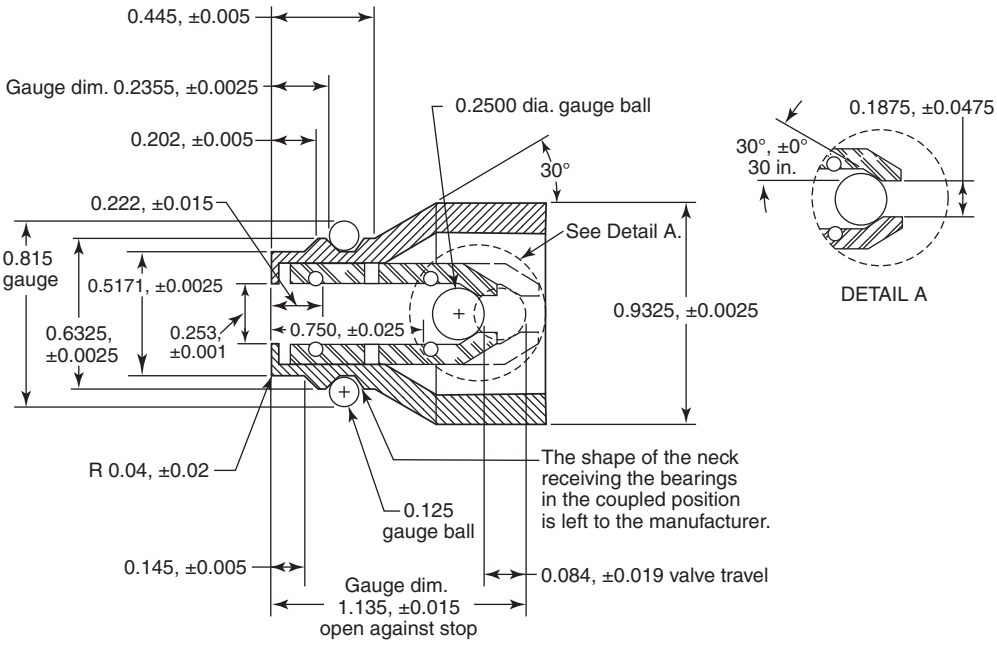


FIGURE 6.4.4.1 RIC UAC Male Fitting (all measurements in inches).

6.4.6.2 The RIC UAC filling hose assembly shall be, at a minimum, a high-pressure, 310 bar (4500 psi) assembly designed to replenish breathing air to an SCBA breathing air cylinder.

6.4.6.3 The filling hose shall have an RIC UAC female fitting that meets the requirements specified in 6.4.5 attached to the delivery end.

6.4.7 RIC UAC Coupling.

6.4.7.1 The complete RIC UAC male and female fittings shall constitute the RIC UAC coupling.

6.4.7.2 The RIC UAC coupling shall be capable of connection and disconnection with one hand while subjected to maximum operation pressure.

6.4.7.3 The RIC UAC coupling shall have an operating pressure of at least 310 bar (4500 psi).

6.5 Power Source Design Requirements.

6.5.1 Where the SCBA is equipped with a power source for electronics, it shall be either a single dedicated source for one device or a common power source for multiple devices.

6.5.2 Where all electronic devices that are part of the SCBA share a common power source, at least one low power source alert signal shall be provided.

6.5.3 Where multiple but not all electronic devices that are part of the SCBA share a common power source, a low power source alert signal shall be located on each of those electronic devices supplied by the common power source and positioned on each of those electronic devices where it will be detected upon device activation with the electronic device mounted in its permanent position on the SCBA.

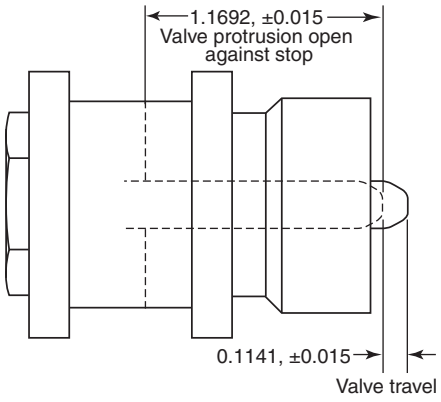


FIGURE 6.4.5.1 RIC UAC Female Fitting (all measurements in inches).

6.5.4 Where an electronic device uses a single, dedicated power source, the low power source alert signal shall be located on the electronic device and positioned where it will be detected upon device activation with the electronic device mounted in its permanent position on the SCBA.

6.5.5 Where a HUD display of low power source alert signal(s) specified in 6.5.2 is visual, the low power source alert signal(s) shall be positioned within the user's field of vision with the SCBA facepiece properly donned.

6.5.6 Where a power source is used for HUD to comply with the requirements of this standard, HUD shall provide an alert signal for low power source capacity when the remaining power source life will provide a minimum of 2 hours of operation of the HUD at maximum electrical draw.

6.5.6.1 Where the low power source alert signal is visual, it shall be independent from and physically distinguishable from the breathing air cylinder content visual alert signal display.

6.5.6.2 When the HUD is in the active mode and uses a low power source visual alert signal, the low power source visual alert signal shall be displayed at all times when the power source condition is below the level specified in 6.3.8.4 except as provided in 6.5.6.3.

6.5.6.3 Where the HUD is capable of being user controlled, the low power source capacity visual display function shall be permitted to be disabled upon indication of a low power source condition.

6.6 Optional Emergency Breathing Safety System (EBSS) Design Requirements.

6.6.1 If an SCBA is equipped with an EBSS, it shall meet the performance requirements of Sections 7.17 and 8.23.

6.6.2 Each EBSS shall operate off the pressure after the first stage pressure reducer of the SCBA.

6.6.3 The EBSS shall have an operating pressure of at least 5.5 bar (80 psi).

6.6.4 The EBSS shall have a male and female connection with a check valve feature to prevent inward contaminants.

6.6.5 The EBSS pressure hose assembly shall be a minimum of 20 in. long.

6.6.6 The EBSS shall be accessible by the wearer.

6.6.7 The EBSS shall require only one action for connection of the donor's fitting to the receiving SCBA's fitting.

6.6.8 The EBSS shall require two distinctive actions to disconnect the fitting between the donor SCBA and the receiving SCBA.

6.6.9 The EBSS fitting(s) shall be equipped with a dust cap or sealing plug to prevent dust, dirt, and debris from entering the fitting(s).

6.6.10 The connection of two EBSS shall be independent of the facepieces.

6.7 Accessories Design Requirements.

6.7.1 Items attached to or integrated with SCBA that are not required for the SCBA to meet the requirements of this standard shall be considered accessories.

6.7.2 All accessories attached to or integrated with SCBA shall be certified by NIOSH in accordance with 42 CFR 84 for use with that specific SCBA.

6.7.3 Any accessories attached to SCBA shall not interfere with the function of the SCBA or with the function of any of the SCBA's component parts.

6.7.4 Where an SCBA is provided with an accessory or accessories that are attached to or integrated with the SCBA, the SCBA, with accessories installed, shall meet all of the design and performance requirements of this standard.

6.7.5 In all cases, such accessories shall not degrade the performance of the SCBA.

Chapter 7 Performance Requirements

7.1* Airflow Performance.

7.1.1 SCBA shall be tested for airflow performance as specified in Section 8.1, Airflow Performance Test, and the SCBA facepiece pressure shall not be less than 0.0 mm (0.0 in.) water column and shall not be greater than 89 mm (3½ in.) water column above ambient pressure from the time the test begins until the time the test is concluded.

7.1.2 SCBA shall be tested for activation of EOSTI during the airflow performance testing specified in Section 8.1, Airflow Performance Test, and the EOSTI shall activate as specified in 6.2.2 and shall continue to operate throughout the remainder of the airflow performance test.

7.1.3 Where the SCBA is equipped with a HUD, the SCBA shall be tested for proper functioning of the HUD breathing air cylinder content informational display and visual alert signals during the airflow performance testing specified in Section 8.1, Airflow Performance Test, and the HUD shall display the visual information for the breathing air cylinder content as specified in 6.3.9.5 and shall display the visual alert signal as specified in 6.3.8.

7.2 Environmental Temperature Performance.

7.2.1 SCBA shall be tested for environmental temperature performance as specified in Section 8.2, Environmental Temperature Tests.

7.2.1.1 SCBA shall be tested for cold environment as specified in 8.2.5.5, and the SCBA facepiece pressure shall not be less than 0.0 mm (0.0 in.) water column and shall not be greater than 89 mm (3½ in.) water column above ambient pressure from the time the test begins until the time the test is concluded.

7.2.1.2 SCBA shall be tested for hot environment as specified in 8.2.5.6, and the SCBA facepiece pressure shall not be less than 0.0 mm (0.0 in.) water column and shall not be greater than 89 mm (3½ in.) water column above ambient pressure from the time the test begins until the time the test is concluded.

7.2.1.3 SCBA shall be tested for hot-to-cold environment as specified in 8.2.5.7, and the SCBA facepiece pressure shall not be less than 0.0 mm (0.0 in.) water column and shall not be greater than 89 mm (3½ in.) water column above ambient pressure from the time the test begins until the time the test is concluded.

7.2.1.4 SCBA shall be tested for cold-to-hot environment as specified in 8.2.5.8, and the SCBA facepiece pressure shall not be less than 0.0 mm (0.0 in.) water column and shall not be greater than 89 mm (3½ in.) water column above ambient pressure from the time the test begins until the time the test is concluded.

7.2.2 SCBA shall be tested for activation of EOSTI during the environmental temperature performance as specified in Section 8.2, Environmental Temperature Tests.

7.2.2.1 SCBA shall be tested for cold environment as specified in 8.2.5.5, and the EOSTI shall activate as specified in 6.2.2 and shall continue to operate throughout the remainder of the airflow performance test.

7.2.2.2 SCBA shall be tested for hot environment as specified in 8.2.5.6, and the EOSTI shall activate as specified in 6.2.2 and shall continue to operate throughout the remainder of the airflow performance test.

7.2.2.3 SCBA shall be tested for hot-to-cold environment as specified in 8.2.5.7, and the EOSTI shall activate as specified in 6.2.2 and shall continue to operate throughout the remainder of the airflow performance test.

7.2.2.4 SCBA shall be tested for cold-to-hot environment as specified in 8.2.5.8, and the EOSTI shall activate as specified in 6.2.2 and shall continue to operate throughout the remainder of the airflow performance test.

7.2.3 Where the SCBA is equipped with a HUD, the SCBA shall be tested for the proper functioning of the HUD breathing air cylinder content informational display and the visual alert signal during the environmental temperature performance as specified in Section 8.2, Environmental Temperature Tests.

7.2.3.1 SCBA shall be tested for cold environment as specified in 8.2.5.5, and the HUD shall display the visual information for the breathing air cylinder content as specified in 6.3.9.5 and shall display the visual alert signal as specified in 6.3.8.

7.2.3.2 SCBA shall be tested for hot environment as specified in 8.2.5.6, and the HUD shall display the visual information for the breathing air cylinder content as specified in 6.3.9.5 and shall display the visual alert signal as specified in 6.3.8.

7.2.3.3 SCBA shall be tested for hot-to-cold environment as specified in 8.2.5.7, and the HUD shall display the visual information for the breathing air cylinder content as specified in 6.3.9.5 and shall display the visual alert signal as specified in 6.3.8.

7.2.3.4 SCBA shall be tested for cold-to-hot environment as specified in 8.2.5.8, and the HUD shall display the visual information for the breathing air cylinder content as specified in 6.3.9.5 and shall display the visual alert signals as specified in 6.3.8.

7.3 Vibration Resistance Performance.

7.3.1 SCBA shall be tested for vibration resistance as specified in Section 8.3, Vibration Test, and the SCBA facepiece pressure shall not be less than 0.0 mm (0.0 in.) water column and shall not be greater than 89 mm (3½ in.) water column above ambient pressure from the time the test begins until the time the test is concluded and shall not have movement of the CGA fittings causing a break of any width in the line.

7.3.2 SCBA shall be tested for activation of EOSTI during the vibration testing specified in Section 8.3, Vibration Test, and the EOSTI shall activate as specified in 6.2.2 and shall continue to operate throughout the remainder of the airflow performance test.

7.3.3 Where the SCBA is equipped with a HUD, the SCBA shall be tested for proper functioning of the HUD breathing air cylinder content informational display and visual alert signals during the vibration testing specified in Section 8.3, Vibration Test, and the HUD shall display the visual information for the breathing air cylinder content as specified in 6.3.9.5 and shall display the visual alert signal as specified in 6.3.8.

7.4 Corrosion Resistance Performance.

7.4.1 SCBA shall be tested for corrosion resistance as specified in Section 8.4, Accelerated Corrosion Test, and any corrosion shall not prohibit the proper use and function, as specified in the manufacturer's instructions, of any control or operating feature of the SCBA.

7.4.2 SCBA shall be tested for corrosion resistance as specified in Section 8.4, Accelerated Corrosion Test, and the SCBA facepiece pressure shall not be less than 0.0 mm (0.0 in.) water column and shall not be greater than 89 mm (3½ in.) water column above ambient pressure from the time the test begins until the time the test is concluded.

7.4.3 SCBA shall be tested for activation of EOSTI during the corrosion resistance testing specified in Section 8.4, Accelerated Corrosion Test, and the EOSTI shall activate as specified in 6.2.2 and shall continue to operate throughout the remainder of the airflow performance test.

7.4.4 Where the SCBA is equipped with a HUD, the SCBA shall be tested for proper functioning of the HUD breathing air cylinder content informational display and visual alert signals during the corrosion resistance testing specified in Section 8.4, Accelerated Corrosion Test, and the HUD shall display the visual information for the breathing air cylinder content as specified in 6.3.9.5 and shall display the visual alert signal as specified in 6.3.8.

7.5 Particulate Resistance Performance.

7.5.1 SCBA shall be tested for particulate resistance as specified in Section 8.5, Particulate Test, and the SCBA facepiece pressure shall not be less than 0.0 mm (0.0 in.) water column and shall not be greater than 89 mm (3½ in.) water column above ambient pressure from the time the test begins until the time the test is concluded.

7.5.2 SCBA shall be tested for activation of EOSTI during the particulate resistance testing specified in Section 8.5, Particulate Test, and the EOSTI shall activate as specified in 6.2.2 and shall continue to operate throughout the remainder of the airflow performance test.

7.5.3 Where the SCBA is equipped with a HUD, the SCBA shall be tested for proper functioning of the HUD breathing air cylinder content informational display and visual alert signals during the particulate resistance testing specified in Section 8.5, Particulate Test, and the HUD shall display the visual information for the breathing air cylinder content as specified in 6.3.9.5 and shall display the visual alert signal as specified in 6.3.8.

7.6* Facepiece Lens Abrasion Resistance Performance. SCBA facepiece lenses shall be tested for abrasion resistance as specified in Section 8.6, Facepiece Lens Abrasion Test, and the average value of the tested specimens shall not exhibit a delta haze greater than 14 percent.

7.7 Nonelectronic Communications Performance Requirements. The SCBA voice communications system shall be tested for communications performance as specified in Section 8.7, Nonelectronic Communications Test, and shall have a speech transmission index (STI) average value of not less than 0.55.

7.8 Flame Resistance Performance.

7.8.1 SCBA shall be tested for flame resistance as specified in Section 8.8, Flame Test, and the SCBA facepiece pressure shall not be less than 0.0 mm (0.0 in.) water column and shall not be greater than 89 mm (3½ in.) water column above ambient pressure from the time the test begins until the time the test is concluded.

7.8.2 SCBA and SCBA accessories shall be tested for flame resistance as specified in Section 8.8, Flame Test, and no components of the SCBA and no accessories shall have an afterflame of more than 5 seconds.

7.8.3 SCBA shall be tested for flame resistance as specified in Section 8.8, Flame Test, and no component of the SCBA shall separate or fail in such a manner that would cause the SCBA to be worn and used in a position not specified by the manufacturer's instructions.

7.8.4 The SCBA facepiece shall be tested for flame resistance as specified in Section 8.8, Flame Test, and the facepiece lens shall not obscure vision below the 20/100 vision criterion.

7.8.5 SCBA shall be tested for activation of the EOSTI(s) during the flame resistance testing specified in Section 8.8, Flame Test, and the EOSTI shall activate as specified in 6.2.2 and shall continue to operate throughout the remainder of the airflow performance test.

7.8.6 Where the SCBA is equipped with a HUD, the SCBA shall be tested for functioning of the HUD breathing air cylinder content informational display and visual alert signals during the flame resistance testing specified in Section 8.8, Flame Test, and the HUD shall display the visual information for the breathing air cylinder content as specified in 6.3.9.5 and shall display the visual alert signal as specified in 6.3.8.

7.9 Carbon Dioxide (CO_2) Content Performance. SCBA facepieces shall be tested for CO_2 content as specified in Section 8.9, Facepiece Carbon Dioxide Content Test, and the CO_2 content in the inhalation air shall not be greater than 1.0 percent by volume.

7.10 EOSTI Alarm Recognition. Each EOSTI shall be tested for alarm recognition as specified in Section 8.10, EOSTI Recognition Test, and the EOSTI alarm signal shall be recognized in 10 seconds or less.

7.11 Additional SCBA HUD Performance. Where the SCBA is equipped with a HUD, the tests in 7.11.1 through 7.11.4 shall apply.

7.11.1 Where a HUD incorporates exposed wiring, the wire's entry into any associated components shall be tested for connection strength as specified in Section 8.11, HUD Wiring Connection Strength Test, and the HUD shall remain functional.

7.11.2 Where a power source is used for a HUD to comply with the requirements of this standard, the HUD shall be tested for proper functioning of alert signals and visual information displays as specified in Section 8.12, HUD Low Power Source Alert Signal Test, and the HUD shall continue to function at maximum current draw for a minimum of 2 hours following the activation of the low power source alert signal and shall display the alert signals specified in 6.3.8 and shall display the visual information for the breathing air cylinder content as specified in 6.3.9.5.

7.11.3 The HUD shall be tested for wearer visibility as specified in Section 8.13, HUD Visibility Test, and each informational display and visual alert signal shall be observable, distinct, and identifiable in both darkness and bright light.

7.11.4 The HUD shall be tested for disabling glare as specified in Section 8.15, HUD Disabling Glare Test, and the test subject shall be able to read at least 9 out of 10 selected letters when each visual alert signal is activated.

7.12 RIC UAC Performance Requirements.

7.12.1 If an SCBA is equipped with an RIC UAC, SCBA shall be tested for cylinder refill breathing performance as specified in Section 8.16, Cylinder Refill Breathing Performance Test, and the SCBA facepiece pressure shall not be less than 0.0 mm (0.0 in.) water column and shall not be greater than 89 mm (3½ in.) water column above ambient pressure from the time the test begins until the time the test is concluded.

7.12.2 If an SCBA is equipped with an RIC UAC, SCBA shall be tested for RIC UAC system fill rate performance as specified in Section 8.17, RIC UAC System Fill Rate Test, and the maximum allowable fill time shall be 3.0 minutes.

7.12.3 If an SCBA is equipped with an RIC UAC, the RIC UAC system connection shall be tested for accessibility as specified in Section 8.20, Cylinder Connections and Accessibility Test, and the RIC UAC shall be connected in a maximum of 15 seconds and shall disconnect in a maximum of 15 seconds.

7.13 Breathing Air Cylinder Performance Requirements. Where the SCBA is equipped with a rigid backframe/carrier, the SCBA and the cylinder retention device shall be tested for breathing air cylinder and valve assembly retention security as specified in Section 8.18, Breathing Air Cylinder and Valve Assembly Retention Test, and the cylinder and valve assembly shall not change position by more than 25 mm (1 in.).

7.14 Supplementary Voice Communications System Performance Requirements. Where the SCBA is equipped with a supplementary voice communications system as identified by the SCBA manufacturer, it shall be tested for communication performance as specified in Section 8.21, Supplementary Voice Communications System Performance Test, and shall have a speech transmission index (STI) average value of not less than 0.60.

7.15 Immersion Leakage Performance Requirements. SCBA electronics shall be tested for resistance to water ingress as specified in Section 8.19, Immersion Leakage Test, and the electronics shall function properly in accordance with the SCBA manufacturer's instructions for normal use, and all power source compartments or enclosures shall remain dry.

7.16 Low Power Capacity. Where power sources are used to comply with the requirements of this standard, electronic devices shall be tested for proper functioning during low power capacity as specified in Section 8.22, Low Power Capacity Test, and shall continue to properly function at maximum power consumption for a minimum of 2 hours following the activation of the low power source alert signal.

7.17 Emergency Breathing Safety System Cold Temperature Performance Requirements.

7.17.1 Where the SCBA is equipped with an EBSS, the donor SCBA and the receiving SCBA shall be tested independently for airflow performance as specified in Section 8.23, Emergency

Breathing Safety System Cold Temperature Performance Test, and the SCBA facepiece pressure shall not be less than 0.0 mm (0.0 in.) water column and shall not be greater than 89 mm (3½ in.) water column above ambient pressure from the time the test begins until the time the test is concluded.

7.17.2 Each SCBA shall be tested independently for activation of EOSTI during the airflow performance testing specified in Section 8.1, Airflow Performance Test, and EOSTI shall activate as specified in 6.2.2 and shall continue to operate throughout the remainder of the airflow performance test.

7.17.3 Where the SCBA is equipped with a HUD, the SCBA shall be tested independently for proper functioning of the HUD breathing air cylinder content informational display and HUD visual alert signals during the airflow performance testing specified in Section 8.1, Airflow Performance Test, and the HUD shall display the visual information for the breathing air cylinder content as specified in 6.3.9.5 and shall display the visual alert signal as specified in 6.3.8.

7.17.4 The SCBA classified as the donor shall start at full cylinder pressure, and the SCBA classified as the receiving SCBA shall have a pressure of 7 bar, +0.6 bar/–0 bar (100 psi, +10 psi/–0).

7.17.5 Both SCBA shall be connected through the EBSS and shall be tested for cold environment as specified in Section 8.23, Emergency Breathing Safety System Cold Temperature Performance Test, and the SCBA facepiece pressure shall not be less than 0.0 mm (0.0 in.) water column and shall not be greater than 89 mm (3½ in.) water column above ambient pressure from the time the test begins until the time the test is concluded.

7.17.6 The donor SCBA shall be tested for activation of EOSTI during the environmental temperature performance as specified in Section 8.23, Emergency Breathing System Cold Temperature Performance Test, and the EOSTI shall activate as specified in 6.2.2 and shall continue to operate throughout the remainder of the test.

7.17.7 Where the SCBA is equipped with a HUD, the donor SCBA shall be tested for the proper functioning of the HUD breathing air cylinder content informational display and the visual alert signal during the environmental temperature performance as specified in Section 8.23, Emergency Breathing System Cold Temperature Performance Test.

Chapter 8 Test Methods

8.1 Airflow Performance Test.

8.1.1 Application. This test method shall apply to complete SCBA.

8.1.2 Samples. Each sample shall be tested as specified in 4.3.9.

8.1.3 Specimen Preparation.

8.1.3.1 Specimens for conditioning shall be complete SCBA.

8.1.3.2 Prior to testing, specimens shall be conditioned for a minimum of 4 hours at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and relative humidity (RH) of 50 percent, ±25 percent.

8.1.3.3* The air used in the SCBA breathing air cylinders shall comply with the air quality requirements of NFPA 1989.

8.1.4 Apparatus.

8.1.4.1 A test headform as specified in Figure 8.1.4.1, or equivalent, shall be used.

8.1.4.2 A pressure probe shall be attached to the test headform to monitor facepiece pressure.

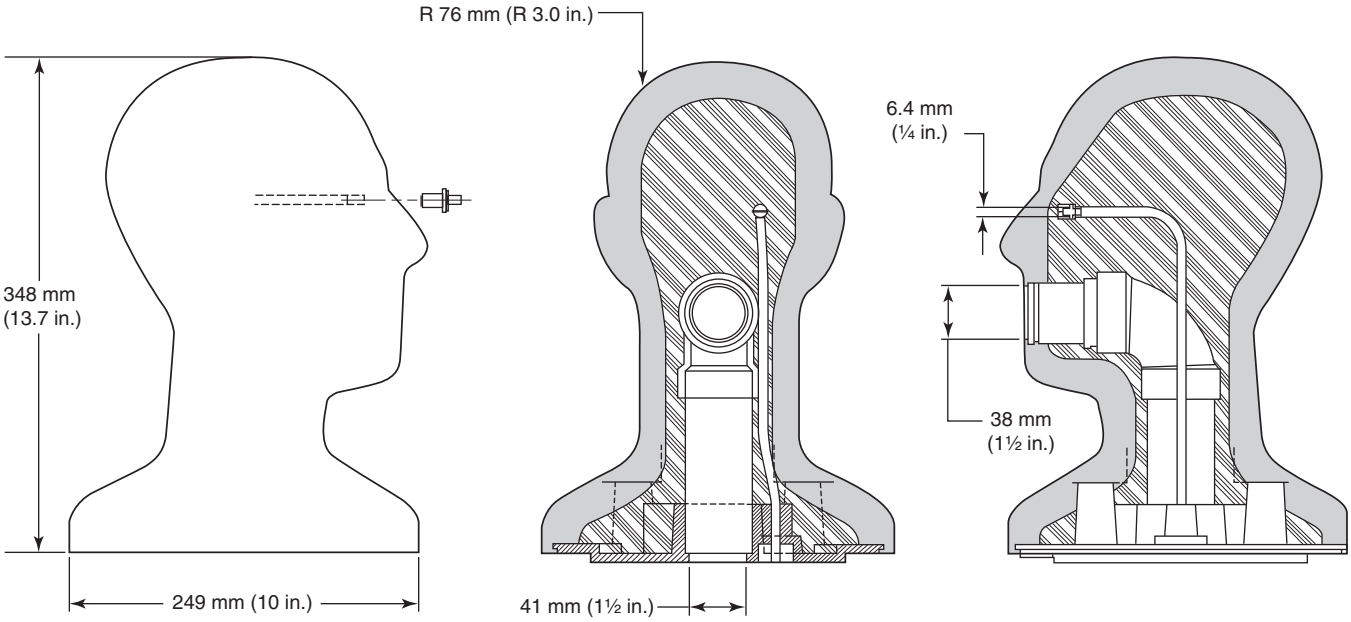


FIGURE 8.1.4.1 Test Headform.

8.1.4.2.1 The pressure probe shall be a 6.5 mm (¼ in.) O.D. with a 1.5 mm (1⁄16 in.) wall thickness metal tube having one open end and one closed end.

8.1.4.2.2 The closed end of the pressure probe shall have four equally spaced holes, each 1.5 mm, ±0.1 mm (1⁄16 in., ±0.0 in.), and each hole shall be positioned 6.5 mm, ±0.4 mm (¼ in., ±0.0 in.) from the end of the pressure probe.

8.1.4.2.3 The closed end of the pressure probe shall extend through the test headform, exiting out the center of the left eye.

8.1.4.2.4 The pressure probe shall extend 13 mm, +1.5 mm/−0 mm (½ in., + 1⁄16 in./−0 in.) outward from the surface of the center of the left eye.

8.1.4.3 A length of tubing, including connections, of a 1.5 m (5 ft) length with a nominal 5 mm (3⁄16 in.) I.D. flexible smooth-bore tubing with a nominal 1.5 mm (1⁄16 in.) wall thickness shall be permitted to be connected to the open end of the pressure probe and to the inlet of the pressure transducer.

8.1.4.4 A differential pressure transducer having the following characteristics shall be used:

(1) Range: 225 mm (8.9 in.) of water differential
(2) Linearity: ±0.5 percent full scale (FS) best straight line
(3) Line pressure effect: less than 1 percent FS zero shift/gauge pressure 1000 psi
(4) Output: ±2.5 Vdc for +FS
(5) Output ripple: 10 mV peak to peak
(6) Regulation: FS output shall not change more than ±0.1 percent for input voltage change from 22 to 35 Vdc
(7) Temperature, operating: −54°C to 121°C (−65°F to 250°F)
(8) Temperature, compensated: −18°C to 71°C (0°F to 160°F)
(9) Temperature effects: within 2 percent FS/55.6°C (100°F) error band

8.1.4.5 The differential pressure transducer shall be connected to a strip chart recorder having the following characteristics:

(1) Chart width of 250 mm
(2) Pen speed of at least 750 mm/sec
(3) Accuracy of ±0.25 percent FS
(4) Input voltage range of 1 V FS
(5) Span set at 25 mm (1 in.) of chart per 25.4 mm (1 in.) water column

8.1.4.6 The test headform shall be equipped with a breathing passage.

8.1.4.6.1 The breathing passage shall lead from the mouth of the test head to the lung.

8.1.4.6.2 The sum of the volumes of the lung, when fully extended to a 3.4 L tidal volume position, and the breathing passage shall not exceed 4.0 L.

8.1.4.6.3 The breathing passage shall be located on the centerline of the mouth and shall be flush with the test headform.

8.1.4.7 The breathing passage shall extend a minimum of 200 mm (8 in.) and a maximum of 450 mm (18 in.).

8.1.4.8 Where flexible smooth-bore tubing is used from the metal breathing tube to the inlet connection of the breathing machine, it shall have a maximum length of 1.2 m (4 ft) and a 19 mm (¾ in.) I.D. with a nominal 3 mm (⅛ in.) wall thickness.

8.1.4.8.1 When 8.2.5.5.2 of the environmental temperature test and 8.23.5.5 of the EBSS cold temperature performance test are performed, air exhaled through the headform shall be conditioned to an average temperature of 27°C, ±6°C (80°F, ±10°F) when measured at the breathing passage outlet at the mouth of the test headform *(see Figure 8.1.4.8.1)*.

8.1.4.9 The breathing machine shown in Figure 8.1.4.9 or equivalent shall be used.

8.1.4.9.1 The breathing machine shall consist of a flexible bellows material attached at one end to a fixed plate and at the other end to a free plate constrained to two degrees of freedom.

8.1.4.9.2 The free plate shall be connected to a rotating shaft by means of a connecting rod, vibration damper, and bellows crank mechanism.

8.1.4.9.3 The bellows crank mechanism shall have a center-to-center distance of 57 mm, ±0.005 mm (2¼ in., ±0.01 in.).

8.1.4.9.4 The connecting rod shall have a center-to-center free plate distance of 133 mm, ±0.005 mm (5¼ in., ±0.01 in.).

8.1.4.9.5 The vibration damper shall be a rubber-to-metal bonded antivibration mounting with a mounting flange hole spacing of 50 mm, ±5 mm (2 in., ± 3⁄16 in.) and an overall height of 20 mm, ±2 mm (3⁄16 in., ± 5⁄64 in.) and have a static force/displacement curve with a slope of 11.5 N/mm, ±0.5 N/mm.

8.1.4.10 The bellows material shall consist of neoprene-impregnated nylon fabric convoluted tubing.

8.1.4.10.1 The tubing shall have an I.D. of 200 mm, ±5 mm (8 in., ± 3⁄16 in.) and an O.D. of 250 mm, ±5 mm (10 in., ± 3⁄16 in.).

8.1.4.10.2 The nominal wall thickness of the tubing shall be 1.4 mm (1⁄32 in.).

8.1.4.10.3 The breathing machine shall have the capability to conduct breathing resistance testing at 40 L/min, ±1.0 L/min and 103 L/min, ±3.0 L/min.

8.1.4.10.4 The tidal volume of the lung shall determine the volume of air moved during each inhalation/exhalation cycle.

8.1.4.10.5 The airflow shall be determined by three factors:

(1) Number of inhalation/exhalation cycles per minute
(2) Tidal volume of the lung
(3) Breathing waveform

8.1.4.10.6 The breathing waveform shall be produced by reciprocal action of the shaft.

8.1.4.10.7 Inspired and expired volumes as a function of time shall be incorporated in accordance with the values given in Table 8.1.4.10.7(a) and Table 8.1.4.10.7(b), which list the linear displacement of the bellows free plate as a function of time for 103 L/min volume and 40 L/min volume work rates.

8.1.4.10.8 Switching between the two work rates shall be performed within 10 seconds.

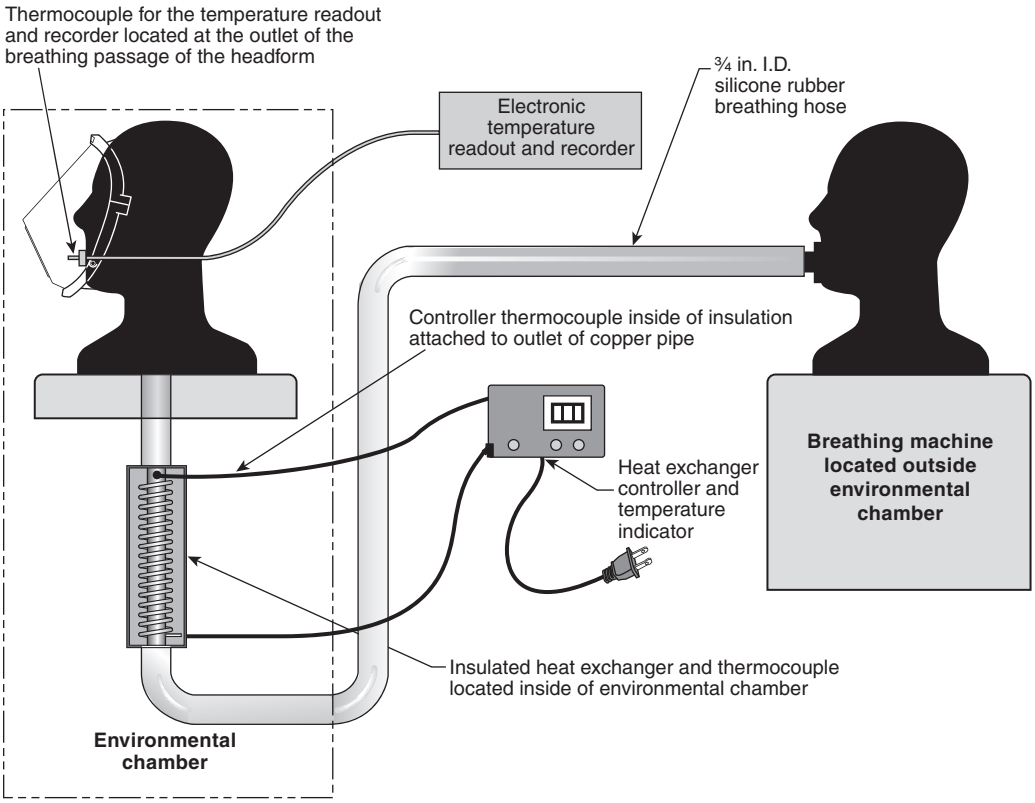


FIGURE 8.1.4.8.1 Cold Temperature Performance Test.

8.1.4.10.9 The construction of the breathing machine shall be such that the respiration rate, tidal volume, peak flow, and facepiece pressure measurement system accuracy are unaffected by temperature changes caused by the environmental airflow performance tests as specified in Section 8.2, Environmental Temperature Tests.

8.1.5 Procedure.

8.1.5.1* The test setup for conducting the airflow performance test shall be calibrated at least once each day before tests are conducted and shall be verified at least once each day after testing.

8.1.5.1.1 The calibration procedure utilized for the differential pressure transducer shall consist of confirmation of at least three different pressures between 0 mm and 125 mm (0 in. and 5 in.) water column.

8.1.5.1.2 The pressure shall be measured using an incline manometer or equivalent with a scale measuring in increments of ±0.5 mm (±0.02 in.) water column or less.

8.1.5.2 The SCBA being tested shall utilize a fully charged breathing air cylinder.

8.1.5.3 The facepiece of the SCBA being tested shall be secured to the test headform. The facepiece seal to the headform shall ensure that an initial pressure of 25 mm, ±2.5 mm (1 in., ±0.1 in.) water column below ambient shall not decay by more than 5 mm (0.2 in.) water column in 5 seconds.

8.1.5.4 The remaining components of the SCBA shall be mounted to simulate the proper wearing position as specified by the manufacturer's instructions.

8.1.5.5 SCBA shall be tested at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

8.1.5.6 The airflow performance test shall begin after five cycles of the breathing machine and shall continue to operate through at least 20 bar (290 psi) of cylinder inlet pressure.

8.1.5.7 The breathing machine shall be set at a rate of 103 L/min, ±3 L/min with a respiratory frequency of 30 breaths/min, ±1 breath/min.

8.1.6 Report.

8.1.6.1 The facepiece peak inhalation pressure and peak exhalation pressure shall be recorded and reported for each test.

8.1.6.2 The activation and operation of the EOSTI or the failure of the EOSTI to activate and operate shall be recorded and reported.

8.1.6.3 Where the SCBA is equipped with a HUD, the activation and identification of HUD visual alert signals shall be recorded and reported.

8.1.7 Interpretation.

8.1.7.1 The peak inhalation pressure and peak exhalation pressure shall be used to determine pass or fail performance.

8.1.7.2 One or more specimens failing this test shall constitute failing performance.

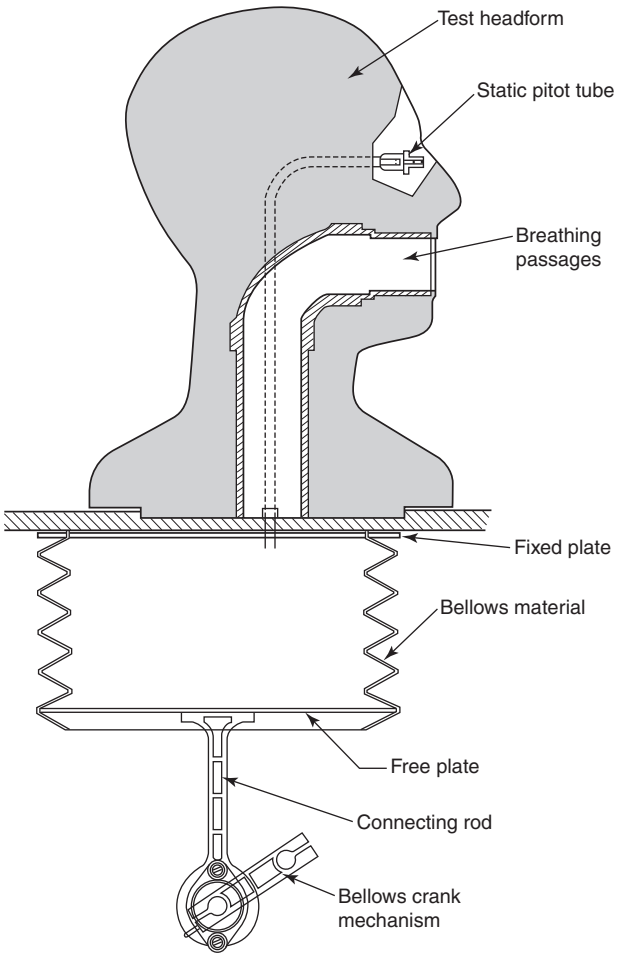


FIGURE 8.1.4.9 Breathing Machine.

8.1.7.3 Failure of any EOSTI alarm signal to activate and remain active during the test shall constitute failing performance.

8.1.7.4 Where the SCBA is equipped with a HUD, failure of the HUD to display the breathing air cylinder content or to display the visual alert signal during the test shall constitute failing performance.

8.2 Environmental Temperature Tests.

8.2.1 Application. This test method shall apply to complete SCBA.

8.2.2 Samples. Each sample to be tested shall be as specified in 4.3.9.

8.2.3 Specimen Preparation.

8.2.3.1 Specimens for conditioning shall be complete SCBA.

8.2.3.2 Prior to testing, the SCBA shall be placed in an ambient environment of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent for a minimum 12-hour dwell period.

Table 8.1.4.10.7(a) Lung Breathing Waveforms for 103 L/min Volume Work Rate

Step No.	Time (sec)	Inspire/ Expire	Volume (L, ±0.1 L)	Volume Change (L, ±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
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

(continues)

Table 8.1.4.10.7(a) *Continued*

Step No.	Time (sec)	Inspire/ Expire	Volume (L, ±0.1 L)	Volume Change (L, ±5%)
51	1.02	Expire	1.688	–0.012
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 8.1.4.10.7(b) Lung Breathing Waveforms for 40 L/min Volume Work Rate

Step No.	Time (sec)	Inspire/ Expire	Volume (L, ±0.1 L)	Volume Change (L, ±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

(continues)

Table 8.1.4.10.7(b) *Continued*

Step No.	Time (sec)	Inspire/ Expire	Volume (L, ±0.1 L)	Volume Change (L, ±5%)
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
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

8.2.4 Apparatus.

8.2.4.1 The SCBA shall be placed in an environmental chamber and positioned to simulate the normal wearing position of the SCBA on a person as specified by the manufacturer.

8.2.4.2 During the environmental exposures in 8.2.5.5, 8.2.5.6, 8.2.5.7, and 8.2.5.8, the SCBA facepiece shall be mounted on a Scott Aviation Model No. 803608-01 or 803608-02 test headform or equivalent.

8.2.4.3 The thermocouple or other temperature-sensing element used shall be mounted within the chamber in a manner in which it will be exposed directly to the chamber atmosphere.

8.2.4.4 The test headform shall be connected to the breathing machine specified in Section 8.1, Airflow Performance Test.

8.2.4.5 The breathing machine shall be permitted to be located either inside or outside the environmental chamber.

8.2.5 Procedure.

8.2.5.1 The variation in pressure extremes caused by the environmental test configuration shall be determined as follows:

(1) The airflow performance test as specified in Section 8.1, Airflow Performance Test, shall be carried out using the configuration specified in 8.2.4 at the 103 L/min, ±3 L/min ventilation rate.
(2) The difference in pressure between the two tests shall be calculated by subtracting the values obtained using the configuration defined in 8.2.4 from the values obtained using the configuration specified in Section 8.1, Airflow Performance Test.

8.2.5.2 The facepiece pressure during each entire test shall be read from the strip chart recorder and corrected by adding the value of the difference in pressure calculated in 8.2.5.1 to determine pass or fail as specified in 7.2.1.1 through 7.2.1.4.

8.2.5.3 These environmental temperature tests shall be permitted to be conducted in any sequence.

8.2.5.4 The dwell period between environmental temperature tests shall be used to refill the breathing air cylinder and to visually inspect the SCBA for any gross damage that could cause unsafe test conditions.

8.2.5.5 Test 1.

8.2.5.5.1 The SCBA shall be cold soaked at –32°C, ±1°C (–25°F, ±2°F) for a minimum of 12 hours.

8.2.5.5.2 The SCBA shall then be tested for airflow performance as specified in Section 8.1, Airflow Performance Test, at a chamber air temperature of –32°C, ±5°C (–25°F, ±10°F).

8.2.5.6 Test 2.

8.2.5.6.1 The SCBA shall be hot soaked at 71°C, ±1°C (160°F, ±2°F) for a minimum of 12 hours.

8.2.5.6.2 The SCBA shall then be tested for airflow performance as specified in Section 8.1, Airflow Performance Test, at a chamber air temperature of 71°C, ±5°C (160°F, ±10°F).

8.2.5.7 Test 3.

8.2.5.7.1 The SCBA shall be hot soaked at 71°C, ±1°C (160°F, ±2°F) for a minimum of 12 hours.

8.2.5.7.2 Immediately following the 12-hour hot soak, the SCBA shall be transferred to a chamber with an air temperature of –32°C, ±1°C (–25°F, ±2°F).

8.2.5.7.3 The SCBA shall then be tested for airflow performance as specified in Section 8.1, Airflow Performance Test, at a chamber air temperature of –32°C, ±5°C (–25°F, ±10°F).

8.2.5.7.4 The airflow performance test shall commence within 3 minutes after removal of the SCBA from the hot soak.

8.2.5.8 Test 4.

8.2.5.8.1 The SCBA shall be cold soaked at –32°C, ±1°C (–25°F, ±2°F) for a minimum of 12 hours.

8.2.5.8.2 Immediately following the 12-hour cold soak, the SCBA shall be transferred to a chamber with an air temperature of 71°C, ±1°C (160°F, ±2°F).

8.2.5.8.3 The SCBA shall then be tested for airflow performance as specified in Section 8.1, Airflow Performance Test, at a chamber air temperature of 71°C, ±5°C (160°F, ±10°F).

8.2.5.8.4 The airflow performance test shall commence within 3 minutes after removal of the SCBA from the cold soak.

8.2.6 Report.

8.2.6.1 The facepiece peak inhalation pressure and peak exhalation pressure shall be recorded and reported for each test condition.

8.2.6.2 The activation and operation of the EOSTI or the failure of the EOSTI to activate and operate shall be recorded and reported.

8.2.6.3 Where the SCBA is equipped with a HUD, the activation and identification of HUD visual alert signals shall be recorded and reported.

8.2.7 Interpretation.

8.2.7.1 The peak inhalation and peak exhalation shall be used to determine pass or fail performance for each test procedure.

8.2.7.2 One or more specimens failing any test procedure shall constitute failing performance.

8.2.7.3 Failure of any EOSTI alarm signal to activate and remain active during the test shall constitute failing performance.

8.2.7.4 Where the SCBA is equipped with a HUD, failure of the HUD to display the breathing air cylinder content or to display the visual alert signal during the test shall constitute failing performance.

8.3 Vibration Test.

8.3.1 Application. This test method shall apply to complete SCBA.

8.3.2 Samples. Each sample to be tested shall be as specified in 4.3.9.

8.3.3 Specimen Preparation.

8.3.3.1 Specimens for conditioning shall be complete SCBA.

8.3.3.2 Prior to testing, specimens shall be conditioned for a minimum of 4 hours and tested at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

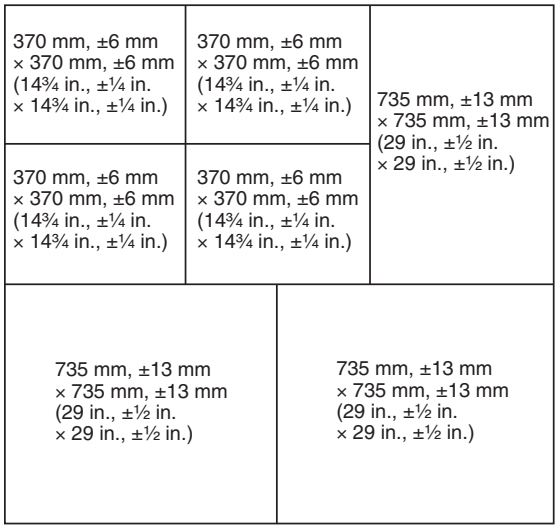


FIGURE 8.3.4.2(a) Vibration Table Compartments — Top View (Not to Scale).

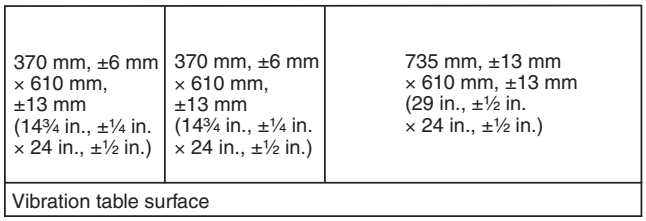


FIGURE 8.3.4.2(b) Vibration Table Compartments — Side View (Not to Scale).

8.3.4 Apparatus.

8.3.4.1 SCBA shall be tested on a typical package tester within the compartments specified in 8.3.4.2 through 8.3.4.4.

8.3.4.2 Compartments shall be set up as specified in Figure 8.3.4.2(a) and Figure 8.3.4.2(b).

8.3.4.2.1 The sides and base of the compartments shall be constructed of nominal 6 mm (¼ in.) stainless steel, and the top of the compartments shall remain open.

8.3.4.2.2 There shall be no burrs, sharp edges, surface discontinuities, or fasteners on the internal surfaces of the holding boxes.

8.3.4.2.3 If the SCBA does not fit the compartment as specified in Figure 8.3.4.2(a) and Figure 8.3.4.2(b), the compartment shall be designed to accommodate the size and shape of the SCBA, allowing a clearance of 150 mm, +150/–0 mm (6 in., +6/–0 in.) between the top to bottom length and the width of the SCBA.

8.3.4.3 The large compartments shall encase the complete SCBA.

8.3.4.3.1 SCBA regulators and hose shall remain attached to the complete SCBA.

8.3.4.3.2 Regulators shall be allowed to be placed in the regulator holder of the SCBA.

8.3.4.3.3 The SCBA facepiece and those components that attach directly to the facepiece, excluding regulators, shall not be included in the SCBA compartment.

8.3.4.4 The small compartments shall encase the facepiece and those components that attach directly to the facepiece, excluding the regulator and associated hose.

8.3.4.5* The breathing air cylinder of the SCBA shall be replaced by a surrogate cylinder.

8.3.4.6 The surrogate cylinder and cylinder valve shall be of identical design and construction as the breathing air cylinder and cylinder valve of the SCBA to be tested.

8.3.4.7 The mass of the breathing air of a fully pressurized breathing air cylinder shall be replaced in the surrogate cylinder with a substitute mass. The substitute mass shall consist of a brass rod and surrounding foam constructed as shown in Figure 8.3.4.7.

8.3.4.8 The surrogate cylinder and cylinder valve with the substitute mass shall have the same total mass ±5 percent as the fully pressurized breathing air cylinder and cylinder valve.

8.3.4.9 The attachment of the cylinder valve shall be tightened to a torque setting of 5 N-m, +0.5/–0.05 N-m (45 in. lb, +5/–0 in. lb) prior to the test. An opposing line no wider than 3 mm (⅛ in.) shall be placed on both the male and the female CGA fitting prior to the start of the test, to identify the relationship between the male and the female CGA fittings when tightened at the proper torque setting.

8.3.5 Procedure.

8.3.5.1 The test items shall be placed unrestrained in the compartments specified in 8.3.4.2, and all SCBA adjustment straps shall be fully extended.

8.3.5.2 No tie-downs shall be allowed to be made to the SCBA.

8.3.5.3 The basic movement of the bed of the test table shall be a 25 mm (1 in.) orbital path, such as can be obtained on a standard package tester operating in synchronous mode at 250 rpm, ±5 rpm.

8.3.5.4 The test duration shall be 3 hours.

8.3.5.5 After being subjected to the vibration test, the male and female CGA fittings shall be observed for movement.

8.3.5.6 After being subjected to the vibration test, the SCBA shall be reattached to the breathing air cylinder originally provided with the SCBA and shall then be tested as specified in Section 8.1, Airflow Performance Test.

8.3.6 Report.

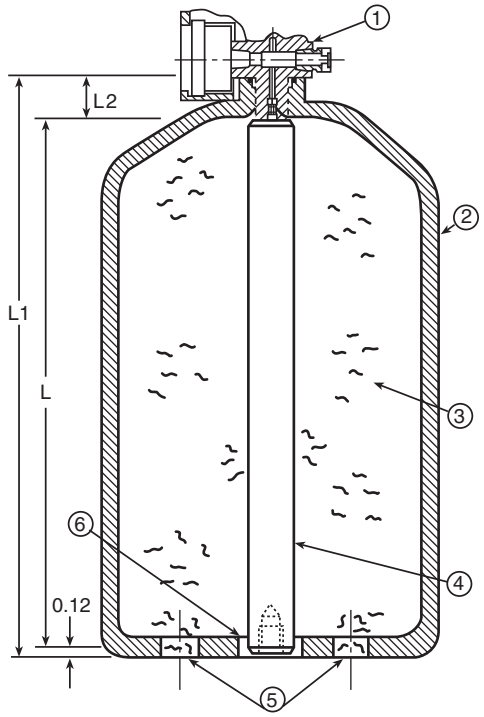
8.3.6.1 The observation of movement or no movement of the male and female CGA fittings shall be recorded and reported.

8.3.6.2 The facepiece peak inhalation pressure and peak exhalation pressure shall be recorded and reported for each test condition.

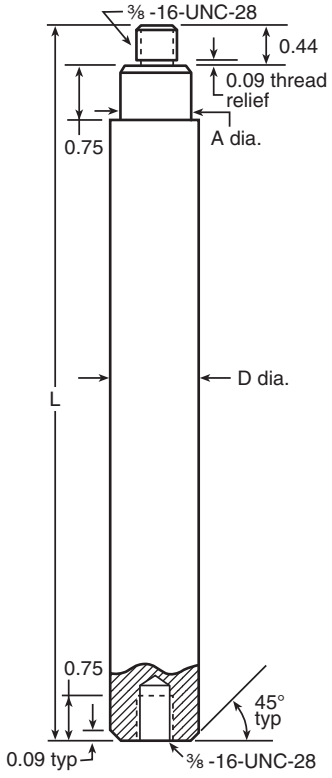
8.3.6.3 The activation and operation of the EOSTI or the failure of the EOSTI to activate and operate shall be recorded and reported.

Item	*Description*	*Quantity*
1	Cylinder valve assembly w/gauge and guards, etc.	1
2	SCBA air storage cylinder	1
3	Polyurethane foam	A/R
4	Ballast rod — ASTM B16 brass, ½ hard	A/R
5	Fill/vent holes ¾ – ⅞ in. diameter	2
6	Ballast rod installation hole — diameter A/R	1

Note: All dimensions are inches.



Complete Surrogate Cylinder



Ballast Rod Detail

FIGURE 8.3.4.7 Surrogate Cylinder.

8.3.6.4 Where the SCBA is equipped with a HUD, the activation and identification of HUD visual alert signals shall be recorded and reported.

8.3.7 Interpretation.

8.3.7.1 The movement of either the male or the female CGA fitting causing a break in the line of any width shall constitute a failure.

8.3.7.2 The peak inhalation and peak exhalation shall be used to determine pass or fail performance for each test procedure.

8.3.7.3 One or more specimens failing this test shall constitute failing performance.

8.3.7.4 Failure of any EOSTI alarm signal to activate and remain active during the test shall constitute failing performance.

8.3.7.5 Where the SCBA is equipped with a HUD, failure of the HUD to display the breathing air cylinder content or to display the visual alert signal during the test shall constitute failing performance.

8.4 Accelerated Corrosion Test.

8.4.1 Application. This test method shall apply to complete SCBA.

8.4.2 Samples. Each sample to be tested shall be as specified in 4.3.9.

8.4.3 Specimen Preparation.

8.4.3.1 Prior to testing, specimens shall be conditioned for a minimum of 4 hours and tested at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

8.4.3.2 Specimens for conditioning shall be complete SCBA.

8.4.4 Apparatus. A salt fog chamber shall be used for testing and shall meet the requirements of Section 4 of ASTM B117, *Standard Test Method for Salt Spray (Fog) Testing*.

8.4.5 Procedure.

8.4.5.1 The SCBA with a fully charged breathing air cylinder, with the breathing air cylinder valve fully closed, shall be placed in the test chamber attached to a mannequin to simulate its typical wearing position on a fire fighter as specified by the manufacturer.

8.4.5.2 SCBA shall not contact each other or the sides of the test chamber.

8.4.5.3 The SCBA shall be placed in the temperature-stabilized chamber for a minimum of 2 hours prior to introduction of the salt solution.

8.4.5.4 The SCBA shall then be exposed to the salt fog for 48 hours, +15 minutes/−0 minutes.

8.4.5.5 Specimen SCBA shall be subjected to a 5 percent, ±1 percent salt solution fog.

8.4.5.5.1 The salt solution shall be prepared by dissolving 5 parts, ±1 part by mass of sodium chloride in 95 parts of water.

8.4.5.5.2 The salt used shall be sodium chloride substantially free of nickel and copper and containing on the dry basis not more than 0.1 percent of sodium iodide and not more than 0.3 percent of total impurities.

8.4.5.5.3 The pH of the salt solution shall be in the range of 6.5 to 7.2.

8.4.5.6 The compressed air supply to the nozzle or nozzles for atomizing the salt solution shall be free of oil and dirt and maintained between 69 kPa/m and 172 kPa/m (10 psi and 25 psi).

8.4.5.7 The exposure temperature in the chamber shall be maintained at 35°C, ±1°C (95°F, ±2°F) for the duration of the test.

8.4.5.8 At least two clean fog collectors shall be placed within the exposure zone so that no drops of solution from the test specimens or any other source shall be collected in them.

8.4.5.8.1 The collectors shall be placed in the proximity of the test specimens, one nearest to any nozzle and the other farthest from all nozzles.

8.4.5.8.2 The fog shall be such that for each 80 cm^2 (12.4 $in.^2$) of horizontal collecting area from 1.0 mL to 2.0 mL of solution per hour will be collected in each collector.

8.4.5.9 After completion of the salt fog exposure, the SCBA shall be stored in an environment of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±5 percent for a minimum of 48 hours.

8.4.5.10 The SCBA shall then be tested as specified in Section 8.1, Airflow Performance Test, to determine pass or fail.

8.4.5.11 All controls or operating features of the SCBA shall operate in accordance with the SCBA manufacturer's instructions to determine pass or fail.

8.4.6 Report.

8.4.6.1 The facepiece pressure peak inhalation and peak exhalation shall be recorded and reported for each test condition.

8.4.6.2 The activation and operation of the EOSTI or the failure of any EOSTI to activate and operate shall be reported and recorded.

8.4.6.3 Where the SCBA is equipped with a HUD, the activation and identification of HUD visual alert signals shall be reported and recorded.

8.4.7 Interpretation.

8.4.7.1 The peak inhalation and peak exhalation shall be used to determine pass or fail performance.

8.4.7.2 One or more specimens failing this test shall constitute failing performance.

8.4.7.3 Failure of any EOSTI alarm signal to activate and remain active during the test shall constitute failing performance.

8.4.7.4 Where the SCBA is equipped with a HUD, failure of the HUD to display the breathing air cylinder content or to display the visual alert signal during the test shall constitute failing performance.

8.5 Particulate Test.

8.5.1 Application. This test method shall apply to complete SCBA.

8.5.2 Samples. Each sample to be tested shall be as specified in 4.3.9.

8.5.3 Specimen Preparation.

8.5.3.1 Prior to testing, specimens shall be conditioned for a minimum of 4 hours and tested at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

8.5.3.2 Specimens for conditioning shall be complete SCBA.

8.5.4 Apparatus.

8.5.4.1 A Scott Aviation model No. 803608-01 or 803608-02 test headform or equivalent shall be joined to a mannequin to simulate its typical wearing position, as specified by the manufacturer.

8.5.4.2 The test headform shall be connected, as specified in Section 8.1, Airflow Performance Test, to the breathing machine specified in 8.1.4.9 or other respiration simulator producing a 1-minute volume of 40 L, ±2 L at the ambient conditions specified in 8.1.3.2, with a minimum tidal volume of 1.6 L per breath at a minimum respiration of 10 breaths/min.

8.5.4.3 A test facility consisting of a chamber and accessories to control dust concentration, velocity, temperature, and humidity of dust-laden air shall be used.

8.5.4.4 To provide adequate circulation of the dust-laden air, no more than 50 percent of the cross-sectional area and no more than 30 percent of the volume of the test chamber shall be occupied by the test item(s).

8.5.4.5* The chamber shall be provided with a means of maintaining and verifying the dust circulation.

8.5.4.6 The dust-laden air shall be introduced into the test space in such a manner as to allow the air to become laminar in flow before it strikes the test item.

8.5.4.7* Dust shall be silica flour and shall contain 97 percent to 99 percent by weight silicon dioxide (SiO_2).

8.5.4.8 The following size distribution shall apply:

(1) 100 percent shall pass through a 100 mesh screen.
(2) 98 percent, ±2 percent shall pass through a 140 mesh screen.
(3) 90 percent, ±2 percent shall pass through a 200 mesh screen.
(4) 75 percent, ±2 percent shall pass through a 325 mesh screen.

8.5.5 Procedure.

8.5.5.1 A fully charged SCBA shall be secured to a test headform and mannequin as specified in 8.8.4.1.

8.5.5.2 The mannequin, including the test headform, shall be mounted upright and placed inside the test chamber.

8.5.5.3 The temperature of the test chamber shall be adjusted to 22°C, ±3°C (72°F, ±5°F) and the RH to less than 30 percent.

8.5.5.4 The air velocity shall be adjusted to 530 m/min, ±15 m/min (1750 ft/min, ±50 ft/min).

8.5.5.5 The dust concentration for the blowing dust shall be maintained at 10.6 g/m^3, ±7 g/m^3 (0.3 g/ft^3, ±0.2 g/ft^3).

8.5.5.6 The test duration shall be 1 hour, and the breathing machine shall be operating throughout the entire test.

8.5.5.6.1 The test shall be permitted to be interrupted to allow the SCBA breathing air cylinder to be changed.

8.5.5.6.2 Test item configuration and orientation shall be turned around its vertical axis 180 degrees midway through the test.

8.5.5.7 After the completion of the test, the SCBA shall be removed from the test compartment.

8.5.5.8 The SCBA shall be lightly shaken or brushed free of dust and then shall be tested as specified in Section 8.1, Airflow Performance Test, to determine pass or fail.

8.5.6 Report.

8.5.6.1 The facepiece pressure peak inhalation and peak exhalation shall be recorded and reported for each test condition.

8.5.6.2 The activation and operation of the EOSTI or the failure of any EOSTI to activate and operate shall be recorded and reported.

8.5.6.3 Where the SCBA is equipped with a HUD, the activation and identification of HUD visual alert signals shall be recorded and reported.

8.5.7 Interpretation.

8.5.7.1 The peak inhalation and peak exhalation shall be used to determine pass or fail performance.

8.5.7.2 One or more specimens failing this test shall constitute failing performance.

8.5.7.3 Failure of any EOSTI alarm signal to activate and remain active during the test shall constitute failing performance.

8.5.7.4 Where the SCBA is equipped with a HUD, failure of the HUD to display the breathing air cylinder content or display the visual alert signal during the test shall constitute failing performance.

8.6 Facepiece Lens Abrasion Test.

8.6.1 Application. This test method shall apply to facepiece lenses.

8.6.2 Samples. A minimum of four faceshield lenses shall be tested.

8.6.3 Specimen Preparation.

8.6.3.1 Seven specimens shall be chosen from a minimum of four facepiece lenses.

8.6.3.1.1 Four specimens shall be taken from the left viewing area, and three samples shall be taken from the right viewing area.

8.6.3.1.2 One of the four specimens taken from the left viewing area shall be the set-up specimen.

8.6.3.2 The left test specimens shall conform to all the following criteria:

(1) The specimen shall be a square measuring 50 mm × 50 mm (2 in. × 2 in.).
(2) Two edges of the square section shall be parallel within ±2 degrees of the axis of the cylinder or cone in the center of the specimen.

(3) At least 38 mm (1½ in.) of the 50 mm × 50 mm (2 in. × 2 in.) square shall be taken from the left side of the center line of the lens.
(4) The 50 mm × 50 mm (2 in. × 2 in.) square shall be cut at approximately eye level.

8.6.3.3 The right test specimens shall conform to all the following criteria:

(1) The specimen shall be a square measuring 50 mm × 50 mm (2 in. × 2 in.).
(2) Two edges of the square section shall be parallel within ±2 degrees of the axis of the cylinder or cone in the center of the specimen.
(3) At least 38 mm (1½ in.) of the 50 mm × 50 mm (2 in. × 2 in.) square shall be taken from the right side of the center line of the lens.
(4) The 50 mm × 50 mm (2 in. × 2 in.) square shall be cut at approximately eye level.

8.6.3.4 Each of the specimens shall be cleaned in the following manner:

(1) The specimen shall be rinsed with clean tap water.
(2) The specimen shall be washed with a solution of nonionic/low-phosphate detergent and water using a clean, soft gauze pad.
(3) The specimen shall be rinsed with de-ionized water.
(4) The specimen shall be blown dry with clean compressed air or nitrogen.

8.6.4 Apparatus. The test apparatus shall be constructed in accordance with Figure 8.6.4(a) and Figure 8.6.4(b).

8.6.5 Procedure.

8.6.5.1 The haze of the specimen shall be measured using a haze meter in accordance with ASTM D1003, *Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics,* and recorded with the following additions:

(1) The haze shall be measured in the middle of the specimen ±1.6 mm (± 1/16 in.).
(2) The specimen shall be repositioned to achieve the maximum haze value within the area defined in 8.6.5.1(1).
(3) The haze meter shall have a specified aperture of 22.4 mm (7/8 in.).
(4) The haze meter shall have a visual display showing 0.1 percent resolution.
(5) The haze meter shall be calibrated before and after each day's use following procedures specified in ASTM D1003, *Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics.*

8.6.5.2 The set-up specimen shall be placed cover side up in the test apparatus specimen holder.

8.6.5.3 The specimen holder shall be configured with a flat surface under the lens or with an inner radius support.

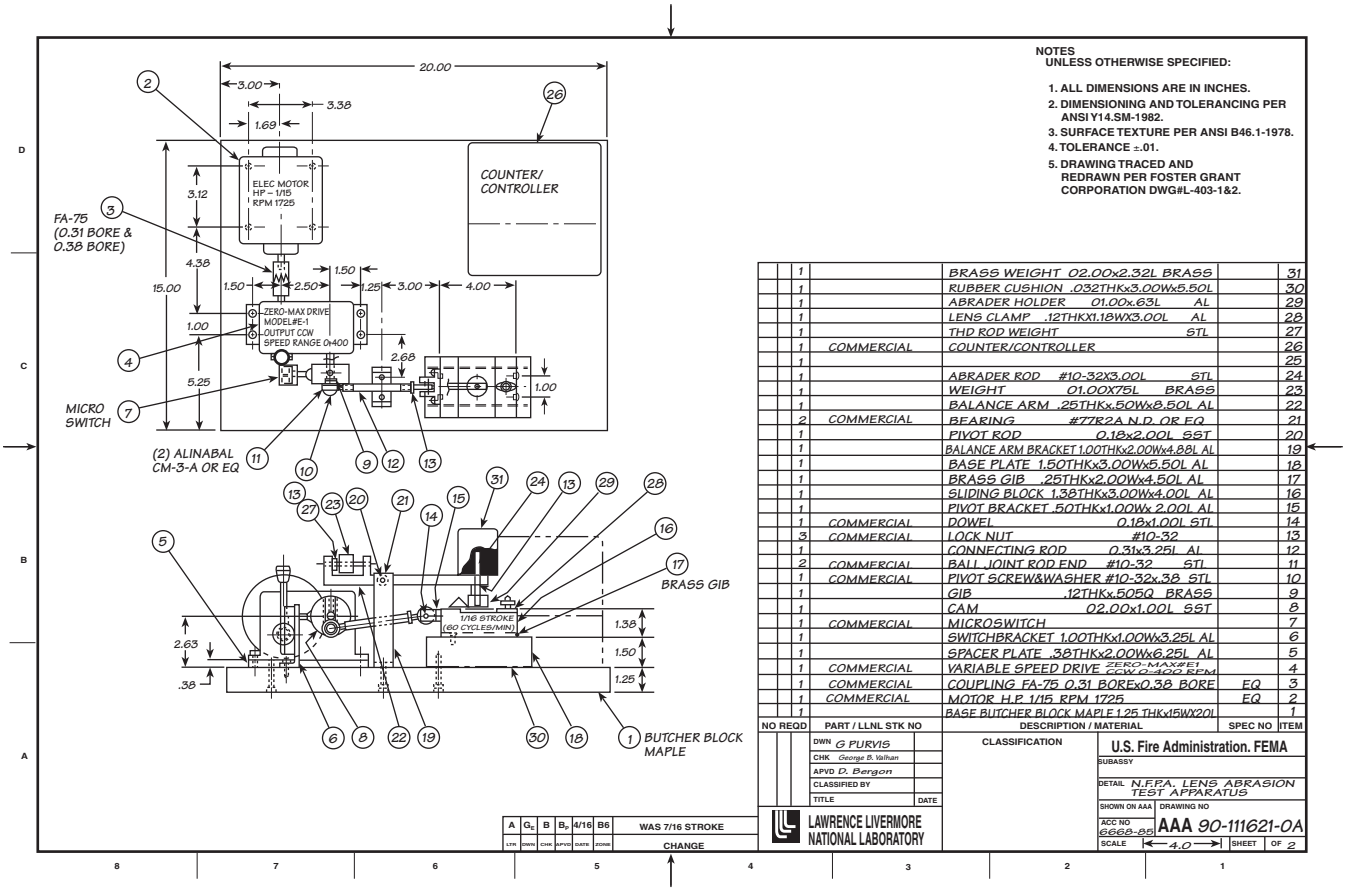


FIGURE 8.6.4(a) Lens Abrasion Tester.

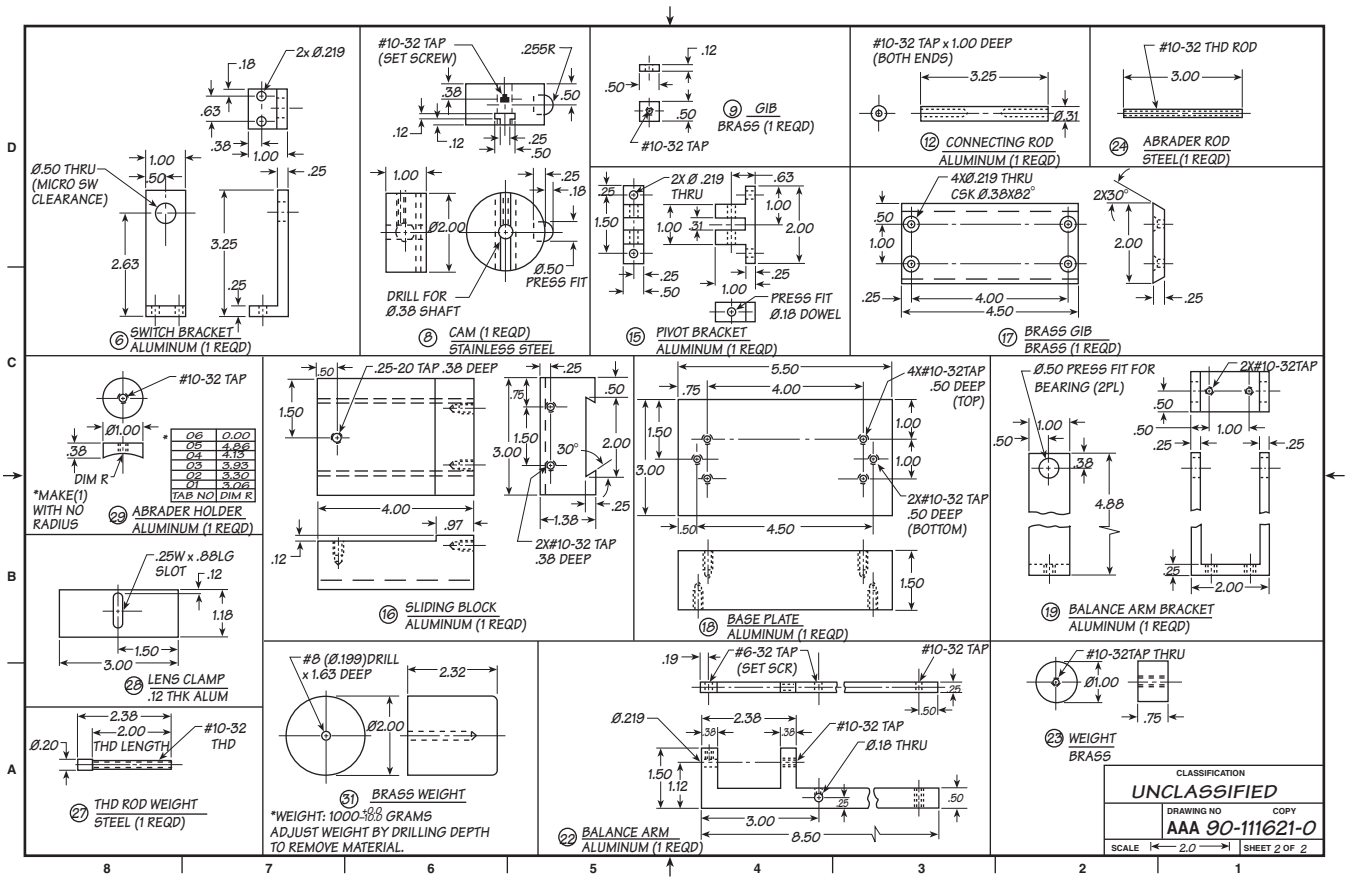


FIGURE 8.6.4(b) Lens Abrasion Tester (details).

8.6.5.4 The pad holder shall consist of a cylinder 10 mm (3/8 in.) high and 25 mm (1 in.) in diameter with a radius of curvature equal to the radius of curvature of the outside of the lens in the viewing area, ±0.25 diopter. The cylinder shall be rigidly affixed to the stroking arm by a #10-32 UNF threaded rod.

8.6.5.5 The pad shall be a Blue Streak M306M wool felt polishing pad or equivalent, 24 mm (15/16 in.) in diameter.

8.6.5.6 The abrasive disc shall be made from 3M Part Number 7415, Wood Finishing Pad or equivalent.

8.6.5.6.1 A disc 24 mm (15/16 in.) in diameter shall be cut from the abrasive sheet.

8.6.5.6.2 The marked side of the disc shall be placed against the pad.

8.6.5.6.3 The orientation described in 8.6.5.6.2 shall be maintained for each abrasive disc throughout the testing.

8.6.5.7 The pad holder, pad, and abrasive disc shall be installed on the stroking arm.

8.6.5.7.1 The stroking arm shall be leveled to ±3 degrees by adjusting the threaded pin.

8.6.5.7.2 The pin shall be secured to prevent rotation of the pad holder.

8.6.5.7.3 The axis of curvature of the pad holder shall be coincident with the axis of curvature of the lens.

8.6.5.8 The stroking arm shall be counterbalanced with the pad holder, pad, and abrasive disc in place.

8.6.5.9 The set-up specimen shall be replaced with one of the six specimens to be tested.

8.6.5.10 The 1000 g, ±5 g (2.2 lb, ±0.18 lb) test weight shall be installed on the pin above the test specimen.

8.6.5.11 The test shall be run for 200 cycles, ±1 cycle. One cycle shall consist of a complete revolution of the eccentric wheel.

8.6.5.12 The length of stroke shall be 14.5 mm (9/16 in.), producing a pattern 38 mm (1½ in.) long.

8.6.5.12.1 The frequency of the stroke shall be 60 cycles, ±1 cycle, per minute.

8.6.5.12.2 The center of the stroke shall be within ±2 mm (± 1/16 in.) of the center of the specimen.

8.6.5.13 The specimen shall be removed and cleaned following the procedure specified in 8.6.3.4.

8.6.5.14 The abrasive disc shall be discarded.

8.6.5.15 The haze of the specimen shall be measured following the procedure specified in 8.6.5.1.

8.6.5.16 The delta haze shall be calculated by subtracting the initial haze from the final haze.

8.6.5.17 The testing steps specified in 8.6.3.4 through 8.6.5.16 shall be repeated five times with a new specimen and abrasive disc.

8.6.6 Report.

8.6.6.1 The six delta haze values shall be recorded, and the values shall be averaged and reported.

8.6.6.2 The average value shall be used to determine pass or fail.

8.6.7 Interpretation.

8.6.7.1 The average delta haze shall be used to determine pass or fail performance.

8.6.7.2 Failure of the average value shall constitute failure for the entire sample.

8.7 Nonelectronic Communications Test.

8.7.1 Application. This test method shall apply to complete SCBA facepieces and second stage regulator(s).

8.7.2 Samples. Each sample to be tested shall be as specified in 4.3.9 with all voice communications systems installed, including supplementary voice communications systems, and in the "off" mode in accordance with the manufacturer's instructions.

8.7.3 Specimen Preparation.

8.7.3.1 Prior to testing, specimens shall be conditioned for a minimum of 4 hours and tested at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

8.7.3.2 Specimens for conditioning shall be complete medium-size SCBA facepiece(s) and inner mask(s), with the second stage regulator(s) installed in the "as worn" position as specified by the manufacturer.

8.7.4 Apparatus.

8.7.4.1 Testing shall be conducted in a chamber having the following minimum characteristics:

(1) Minimum room dimensions: 4.6 m long × 3.1 m wide × 2.7 m high (15 ft long × 10 ft wide × 9 ft high)
(2) Construction: hemi-anechoic
(3) Ambient noise level inside chamber: NC-25
(4) Walls and ceiling: ≥90 percent absorptive for 100 Hz

8.7.4.1.1 All surfaces above the floor shall be acoustically treated for internal acoustic absorption, as well as for external noise mitigation.

8.7.4.2 A G.R.A.S. KEMAR Head and Torso Simulator (HATS) Type 45BM shall be used for testing.

8.7.4.2.1 The mouth simulator shall be capable of producing 112 dB/1 kHz sine tone at 25 mm (1 in.) with the mouth reference point unequalized, and the total harmonic distortion (THD) shall be ≤3 percent.

8.7.4.2.2 The mouth simulator frequency response shall be able to be equalized flat ±1 dB between 100 Hz and 10 kHz, and the response shall be –15 dB or less at 100 Hz and –20 dB or less at 15 kHz.

8.7.4.3 The sound pressure level (SPL) meter having the following characteristics shall be used:

(1) The SPL meter shall be capable of applying an equivalent continuous sound pressure level (Leq) using an A-weighted filter.
(2) The SPL meter shall have a dynamic range from 30 dB (or less) to 130 dB (or more).
(3) The SPL meter shall display the measurement to at least one decimal place.

8.7.4.4 The signal/pink noise analog audio signal generators having the characteristics described in 8.7.4.4.1 and 8.7.4.4.2 shall be used.

8.7.4.4.1 One generator shall be capable of playing wave files in the following format: 48 kHz, 16-bit mono at the output level of 0 dB, FS = 18 dBu, according to EBU Technical Recommendation R68, *Alignment level in digital audio production equipment and in digital audio recorders*.

8.7.4.4.2 The second generator shall be capable of generating pink noise and sine waves from –80 dBu to –2 dBu in one digit steps, with a THD+N of –90 dB (0.0032 percent) at 8 dBu noise floor type 25uv, and shall also have the following characteristics:

(1) A frequency range of 10 Hz to 20 Hz in one digit steps ±0.01 percent
(2) An amplitude accuracy of within ±0.5 dB or less

8.7.4.5 A digital equalizer having the following characteristics shall be used:

(1) The digital equalizer shall be capable of at least two concurrently selectable equalizer sections:
    (a) One 31-band graphic with an adjustment range of at least ±18 dB
    (b) A 10-band parametric with an adjustment range of at least ±18 dB
(2) The digital equalizer shall have a dynamic range of 112 dB.
(3) The digital equalizer shall be capable of equalizing the frequency response of the HATS mannequin of ±1 dB flat between 100 Hz and 10 kHz, applying a 180 Hz high pass filter with a slope of –24 dB octave, and a 10 Hz low pass filter with a slope of –24 dB octave (–15 dB at 100 Hz, –20 dB at 15 kHz).

8.7.4.6 A powered speaker having the following characteristics shall be used:

(1) The sensitivity shall be ≥84 dB at 1 watt at 1 meter.
(2) The frequency response shall be rated at ≤80 Hz to ≥13 kHz.
(3) The amplifier shall deliver ≥10 watts with a total harmonic distortion <1 percent.

8.7.4.7 A microphone having the following characteristics shall be used:

(1) The microphone shall be a condenser type.
(2) The microphone polar pattern shall be omnidirectional.
(3) The frequency response shall be flat ±0.5 dB from 100 Hz to 15 kHz.
(4) The residual noise shall be ≤–30 dB.
(5) The microphone shall accept signals of at least 130 dBA.

8.7.4.8 A speech transmission index (STI) analyzer having the following characteristics shall be used:

(1) The STI PA analyzer shall be capable of measuring and displaying a single value STI PA result to two decimal places with a seven octave band modulated noise test signal using the Netherlands Organization for Applied Scientific Research (TNO) verified algorithm.
(2) The STI PA analyzer shall conform to IEC 60268, *Sound System Equipment — Part 16: Objective Rating of Speech Intelligibility by Speech Transmission Index*.

8.7.4.9 All the apparatus identified in 8.7.4.2, 8.7.4.3, 8.7.4.4, 8.7.4.5, 8.7.4.6, and 8.7.4.7 shall be located in the hemi-anechoic chamber and arranged as shown in Figure 8.7.4.9(a) and Figure 8.7.4.9(b).

8.7.4.10 The HATS test mannequin shall be positioned in the chamber in the following manner as shown in Figure 8.7.4.9(a) and Figure 8.7.4.9(b).

8.7.4.10.1 The distance between the HATS test mannequin and the microphone shall be 1.5 m, +25 mm/–0 mm (5 ft, +1 in./–0 in.), and they shall be facing each other.

8.7.4.10.2 The distance between the HATS test mannequin mouth reference point (MRP) and the floor shall be 1.5 m, +25 mm/–0 mm (5 ft, +1 in./–0 in.).

8.7.4.10.3 The distance between the microphone and the floor shall be 1.5 m, +25 mm/–0 mm (±5 ft, +1 in./–0 in.).

8.7.4.11 The test chamber shall be filled with broadband pink noise with a tolerance of ±1 dB per octave band from 100 Hz to 10 kHz.

8.7.4.12 The pink noise speaker shall be placed directly beneath the microphone and oriented such that the central axis of the speaker cone is directly facing the microphone.

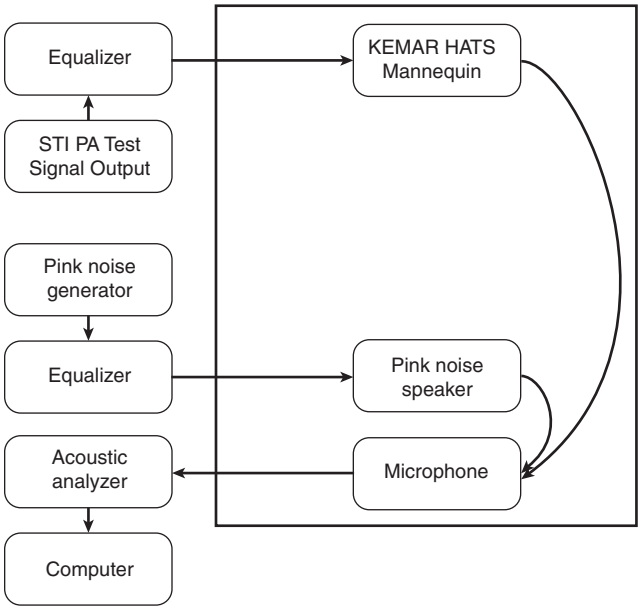


FIGURE 8.7.4.9(a) Hemi-Anechoic Chamber.

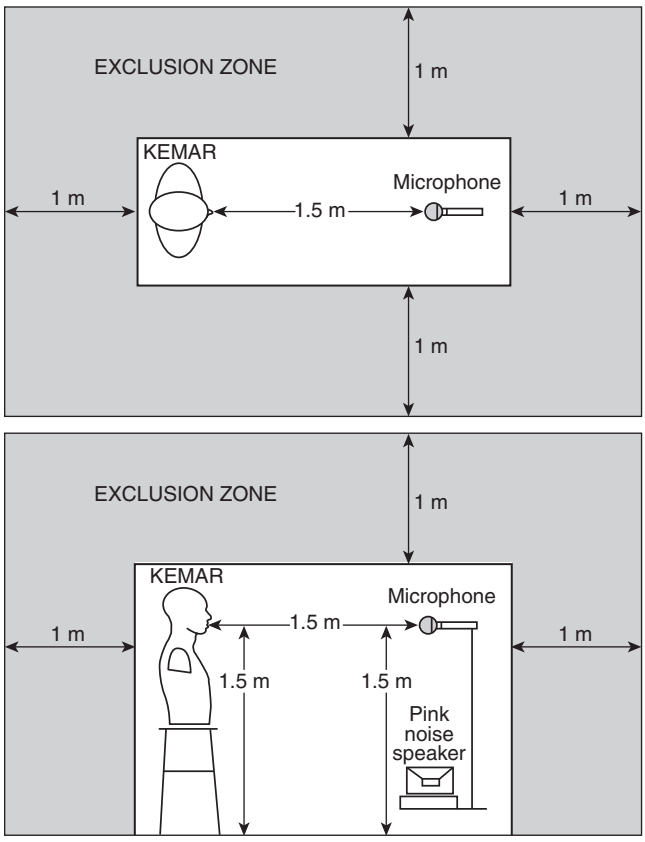


FIGURE 8.7.4.9(b) HATS Test Mannequin Position.

8.7.4.12.1 The speaker shall be situated on top of a block of isolating acoustic foam such that no part of the speaker box is contacting the floor or the microphone stand, to prevent conduction of sound to the microphone.

8.7.4.12.2* The height of the speaker off the floor shall be at least 125 mm (5 in.), as measured from the bottom of the speaker box, and the distance between the speaker and the microphone shall be no less than 1 m (40 in.), as measured from the top of the speaker grille/enclosure.

8.7.4.12.3 The pink noise speaker shall be placed as indicated in Figure 8.7.4.12.3.

8.7.4.13 The pink noise speaker shall be fully equalized flat, from 100 Hz to 10 kHz, to within ±1 dB on a relative scale in ⅓ octave bands, as measured at the microphone position.

8.7.4.14 The STI test signal from the mannequin shall be adjusted to achieve an A-weighted sound level of 97 dB, ±0.5 dB at the mouth reference point (MRP), 50 mm, ±3 mm (2 in., ± ⅛ in.) from the test mannequin's mouth.

8.7.4.14.1 The microphone used for calibrating the STI signal shall be omnidirectional and oriented in a horizontal front-facing manner.

8.7.4.14.2 The STI signal shall be equalized flat to within ±1 dB on a relative scale in ⅓ octave bands as measured at the MRP of the HATS.

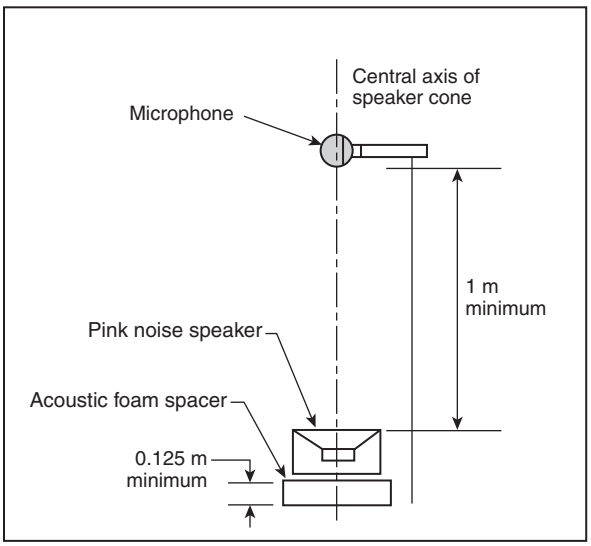


FIGURE 8.7.4.12.3 Test Chamber.

8.7.4.14.3 The HATS shall be calibrated as follows:

(1) Equalize flat with pink noise to 97 dBA from 100 Hz – 10 kHz to ±1 dB on a ⅓ octave scale.
(2) Reduce the levels for the 125 Hz octave band (the 100, 125, 160 ⅓ octave bands) by 10 dB.
(3) Reduce the levels for the 250 Hz octave band (the 200, 250, 315 ⅓ octave bands) by 2 dB.
(4) Apply the STI PA signal and adjust the sound pressure level (SPL) to 97 dBA, ±0.5 dBA.

8.7.4.15* The gain of the powered speaker amplifier used to generate the pink noise shall be adjusted to achieve an A-weighted sound level of 32 dB, ±0.5 dB below the signal level generated as identified in 8.7.4.14, measured at the microphone placed as identified in 8.7.4.10.1 and 8.7.4.10.3.

8.7.5 Procedure.

8.7.5.1 The method for measuring the STI shall be as specified in IEC 60268, *Sound System Equipment — Part 16: Objective Rating of Speech Intelligibility by Speech Transmission Index*, with the modified apparatus specified in 8.7.4.

8.7.5.2 The medium-size facepiece with inner mask and second stage regulator in the normal use mode shall be fitted to the HATS test mannequin in the following manner:

(1) Place the chin of the mannequin in the "chin cup" of the facepiece.
(2) Place the facepiece to seal against the face of the HATS test mannequin.
(3) Pass the head harness of the facepiece over the HATS test mannequin and tighten it in a manner that maintains the symmetry of the facepiece on the HATS test mannequin, using talc to minimize friction between the HATS test mannequin and the strap.
(4) Tighten the straps to a tension of 50 N (11.2 lbf).

8.7.5.3 Three medium-size facepieces shall be tested in the chamber having an ambient noise field as specified in 8.7.4.11 through 8.7.4.15.

8.7.5.4 Each facepiece shall be mounted as specified in 8.7.5.2 and then tested as follows:

(1) Three separate measurements shall be recorded for each donning of the facepiece.
(2) Five separate donnings shall be performed.
(3) A total of 45 measurements shall be taken: 3 (facepieces) × 3 (measurements) × 5 (donnings) = 45 measurements.

8.7.6 Report.

8.7.6.1 The STI PA signal (SPL per octave band, the modulation transfer index per octave band, and the overall STI score at the mouth reference point (MRP) *(see 3.3.41)* shall be recorded and reported.

8.7.6.2 The STI PA signal SPL per octave band, the modulation transfer index per octave band, and the overall STI score at the microphone measurement point (MMP) *(see 3.3.38)* shall be recorded and reported.

8.7.6.3 The pink noise SPL per octave band at the MMP *(see 3.3.38)* shall be recorded and reported.

8.7.6.4 The STI score for each facepiece measurement sampled as described in 8.7.5.3 (a total of 45 scores) shall be recorded and reported, and the starting time of each facepiece donning shall be recorded.

8.7.6.5 The average for each donning shall be calculated, recorded, and reported. There shall be a total of 15 averages of three measurements (five averages for each of the three facepiece samples). See Figure 8.7.6.5.

8.7.7 Interpretation.

8.7.7.1 The averages calculated in 8.7.6.5 shall be used to determine a pass or fail in accordance with Section 7.7.

8.7.7.2 If any of the 15 averages score less than the minimum threshold specified in Section 7.7, the facepiece shall be considered to have failed and shall be reported as such.

8.7.7.3 If all of the 15 averages score are equal to or greater than the minimum threshold specified in Section 7.7, the facepiece shall be considered to have passed and shall be reported as such.

8.8 Flame Test.

8.8.1 Application. This test method shall apply to complete SCBA.

8.8.2 Samples. Each sample to be tested shall be as specified in 4.3.9.

8.8.3 Specimen Preparation.

8.8.3.1 Prior to testing, specimens shall be conditioned for a minimum of 4 hours and tested at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

8.8.3.2 Specimens for conditioning shall be complete SCBA.

8.8.4 Apparatus.

8.8.4.1 A test mannequin meeting the requirements specified in Figure 8.8.4.1 shall be provided.

8.8.4.2 Both the calibration mannequin and the flame test mannequin shall have protective coverings.

Sample Recording Sheet for STI Test

1. Tested Per Procedure:

_____ **7.10** Nonelectronic Communications Performance Requirements.

_____ **7.17** Supplementary Voice Communications System Performance Requirements.

2. Setup Information:

STIPA Signal data at Mouth Reference Point (MRP)

		Sound Pressure Levels							Modulation Transfer Index						
#	STI	125	250	500	1000	2000	4000	8000	125	250	500	1000	2000	4000	8000
1															
2															
3															
4															

1 — Initial measurement prior to fireplace testing started
2 — Final measurement after fireplace testing commenced
3 & 4 — Supplemental measurements for testing breaks greater than 1 hour during testing

STIPA Signal data at Microphone Measurement Point (MMP)

		Sound Pressure Levels							Modulation Transfer Index						
#	STI	125	250	500	1000	2000	4000	8000	125	250	500	1000	2000	4000	8000
1															
2															
3															
4															

1 — Initial measurement prior to fireplace testing started
2 — Final measurement after fireplace testing commenced
3 & 4 — Supplemental measurements for testing breaks greater than 1 hour during testing

Pink Noise data at Microphone Measurement Point (MMP)

		Sound Pressure Levels							Modulation Transfer Index						
#	STI	125	250	500	1000	2000	4000	8000	125	250	500	1000	2000	4000	8000
1															
2															
3															
4															

1 — Initial measurement prior to fireplace testing started
2 — Final measurement after fireplace testing commenced
3 & 4 — Supplemental measurements for testing breaks greater than 1 hour during testing

FIGURE 8.7.6.5 Sample Recording Sheet for STI Test.

3. Measurement Information

- Record STI score per facepiece/donning/measurement
- Use the notes column to indicate Pass/Fail and/or observations
- Extra rows are provided if necessary

Faceplate Sample 1

	STI Scores				
Don #	Meas 1	Meas 2	Meas 3	Avg	Notes
1					
2					
3					
4					
5					

Faceplate Sample 2

	STI Scores				
Don #	Meas 1	Meas 2	Meas 3	Avg	Notes
1					
2					
3					
4					
5					

Faceplate Sample 3

	STI Scores				
Don #	Meas 1	Meas 2	Meas 3	Avg	Notes
1					
2					
3					
4					
5					

4. Pass/Fail

Indicate whether the facepiece passed or failed as whole per 8.10.7.1 or 8.25.7.1 respectively

_____ PASS

_____ FAIL

FIGURE 8.7.6.5 *Continued*

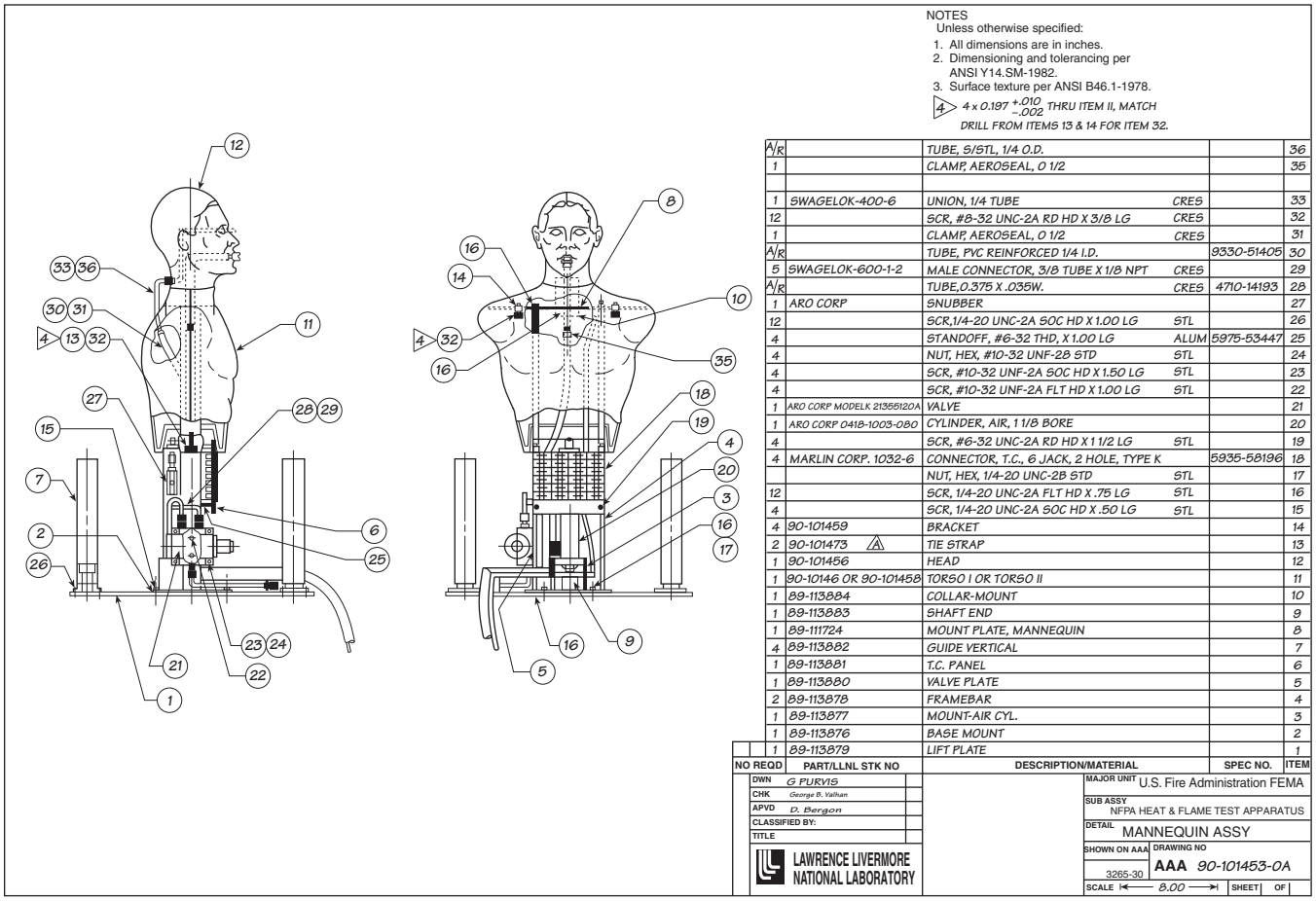


FIGURE 8.8.4.1 Test Mannequin.

8.8.4.2.1 The protective coverings shall be a weld blanket made of fireproof silica cloth of a minimum weight of 18 oz/yd^2.

8.8.4.2.2 The protective coverings shall be designed and constructed to provide coverage over the surface of the mannequins.

8.8.4.2.3 Where additional insulation is needed to protect the mannequin electronics, an additional thermal liner underlayer shall be permitted.

8.8.4.2.4 The complete protective covering shall be discarded and shall not be used where the damage to any portion indicates the covering can no longer provide thermal protection for the test mannequin.

8.8.4.3 A test headform meeting the requirements specified in 8.1.4.1 shall be used on the test mannequin.

8.8.4.4 The test headform shall be attached to the breathing machine as specified in Figure 8.1.4.9 with the modification that a 38 mm (1½ in.) I.D. breathing hose not longer than 7.6 m (25 ft) shall connect the breathing machine and the throat tube of the test mannequin headform.

8.8.4.5 The test headform shall be covered with an undyed aramid hood for protection of the headform during testing.

8.8.4.5.1 The protective hood shall meet the hood requirements of NFPA 1971.

8.8.4.5.2 The protective hood, when placed on the test headform, shall not affect the seal of the facepiece to the headform.

8.8.4.5.3 The protective hood shall not cover or protect any part of the facepiece or the facepiece retention system that holds the facepiece to the headform.

8.8.4.6 The flame test apparatus shall be as specified in Figure 8.8.4.6.

8.8.5 Procedure.

8.8.5.1 The SCBA shall be mounted on the test mannequin to simulate the correct wearing position on a person as specified by the SCBA manufacturer's instructions.

8.8.5.2 The facepiece shall be mounted and tested on the test headform as specified in 8.1.4.1.

8.8.5.3 For calibration prior to the flame test, the mannequin for calibration shall be the same as the test mannequin specified in 8.8.4.1 and shall be exposed to direct flame contact for 10 seconds using the flame test apparatus.

8.8.5.3.1 All peak temperature readings shall be within a temperature range of 815°C to 1150°C (1500°F to 2102°F).

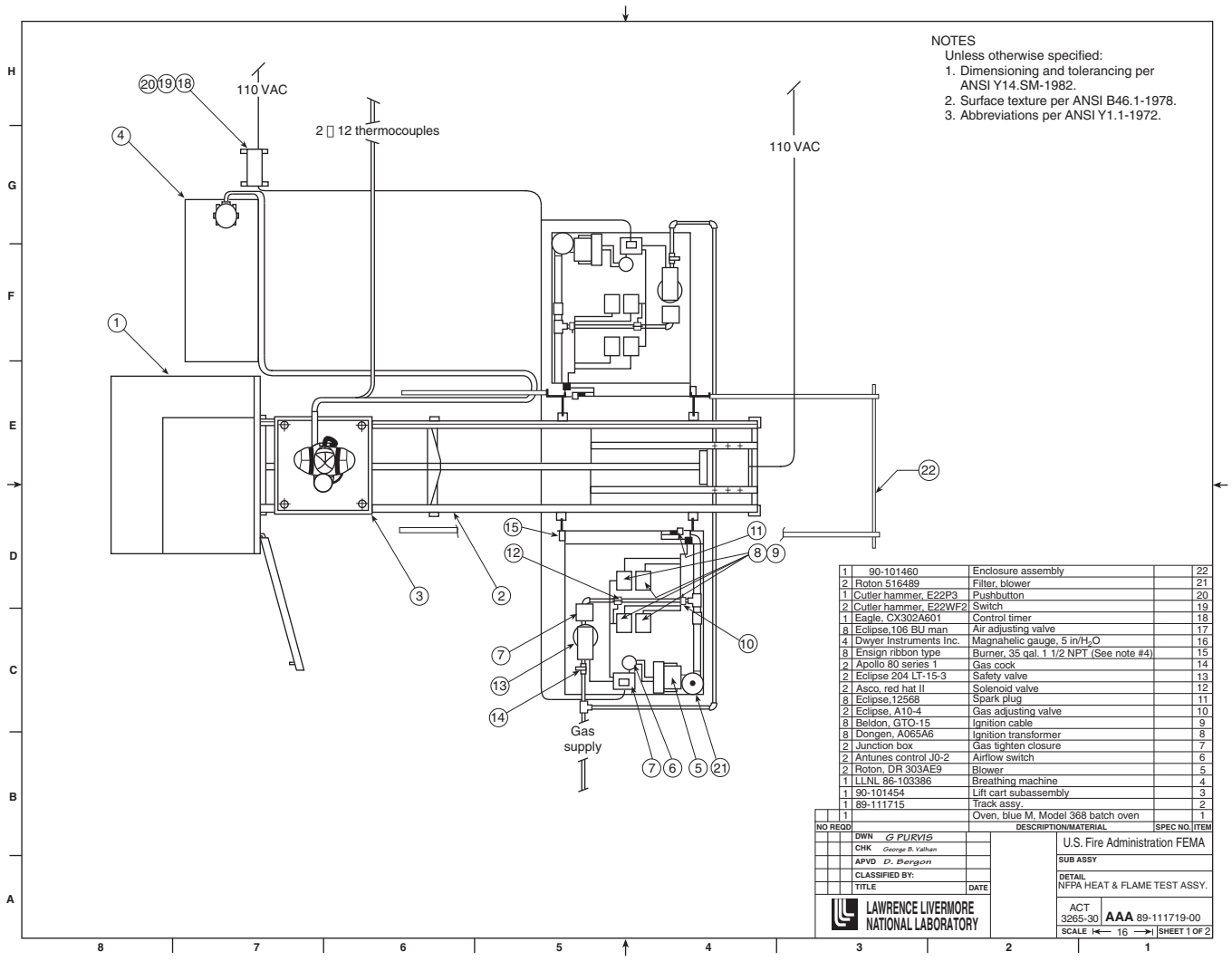


FIGURE 8.8.4.6 Flame Test Apparatus.

8.8.5.3.2 The average mean of all peak temperature readings specified in 8.8.5.3.1 shall be no higher than 950°C (1742°F).

8.8.5.4 The airflow performance test shall be conducted as specified in 8.1.5, with the ventilation rate specified in 8.8.5.7 and with the test temperatures specified in 8.8.5.3.

8.8.5.4.1 The variation in pressure extremes caused by the flame test mannequin configuration shall be determined as specified in 8.8.5.4.2 and 8.8.5.4.3.

8.8.5.4.2 The airflow performance test as specified in Section 8.1, Airflow Performance Test, shall be carried out using the configuration specified in 8.8.4.4 at the same ventilation rates.

8.8.5.4.3 The difference in pressure between the two tests shall be calculated by subtracting the values obtained using the configuration defined in 8.8.4.4 from the values obtained using the configuration specified in Section 8.1, Airflow Performance Test.

8.8.5.5 The airflow performance test shall continue through the drop test specified in 8.8.5.12.

8.8.5.6 The ventilation rate shall be set at 40 L/min, ±2 L/min, with a respiratory frequency of 24 breaths/min, ±1 breath/min at ambient conditions as specified in 8.1.3.2.

8.8.5.7 Prior to the test mannequin being entered into the burner array, the ventilation rate shall be set to 103 L/min, ±3 L/min, as specified in 8.1.4.10.7.

8.8.5.8 The SCBA mounted on the test mannequin shall be moved into the center of the burner array.

8.8.5.9 The SCBA shall then be exposed to direct flame contact for 5 seconds, +0.25 second/−0.0 second.

8.8.5.10 The exposure shall begin no less than 1 minute and no more than 3 minutes after the start of breathing.

8.8.5.11 The SCBA shall be observed for any afterflame, and the afterflame duration shall be recorded to determine pass or fail as specified in 7.8.2.

8.8.5.12 Within 20 seconds after the direct flame exposure has been completed, the SCBA mounted on the test mannequin

shall be raised 150 mm, +6 mm/–0 mm (6 in., + ¼ in./–0 in.) and dropped freely.

8.8.5.13 The SCBA shall be observed to determine pass or fail performance as specified in 7.8.3.

8.8.5.14 The facepiece pressure during the entire test shall be read from the strip chart recorder and corrected by adding the value of the difference in pressure calculated in 8.8.5.4.1 to determine pass or fail as specified in 7.8.1.

8.8.5.15 Any pressure spike caused by the impact of the drop test and measured within a duration of three cycles of the breathing machine after the apparatus drop shall be disregarded.

8.8.5.16 The SCBA facepiece shall be removed from the test headform and shall be donned by a test subject without touching the facepiece lens. If the SCBA is equipped with a HUD, the SCBA facepiece and the HUD shall be removed from the test headform and shall be donned by a test subject without touching the facepiece lens or the HUD.

8.8.5.16.1 The test subject shall have visual acuity of 20/20 in each eye, uncorrected or corrected with contact lenses.

8.8.5.16.2 If the SCBA is equipped with a HUD, the test subject shall then observe the HUD display to see that visual alert signal(s) have activated.

8.8.5.16.2.1 The test subject shall identify the visual alert signals that are activated.

8.8.5.17 The SCBA facepiece removed from the test headform and donned by the test subject as specified in 8.8.5.16 shall be used for determining facepiece lens vision.

8.8.5.17.1 The test shall be conducted using a standard 6.1 m (20 ft) eye chart with normal lighting range of 120 to 150 ft-candles at the chart and with the test subject positioned at a distance of 6.1 m (20 ft) from the chart.

8.8.5.17.2 The test subject shall then read the standard eye chart through the nominal center of the lens of the facepiece to determine pass or fail performance as specified in 7.8.4.

8.8.5.17.3 The nominal center of the lens shall be the area bounded by a line 50 mm (2 in.) above, 50 mm (2 in.) below, 50 mm (2 in.) left of, and 50 mm (2 in.) right of the intersection of the basic and midsagittal planes.

8.8.5.18 The activation of the EOSTI shall be observed.

8.8.6 Report.

8.8.6.1 The facepiece pressure peak inhalation and peak exhalation shall be recorded and reported for each test condition.

8.8.6.2 Any afterflame beyond 5 seconds shall be recorded and reported.

8.8.6.3 The facepiece lens vision shall also be recorded and reported.

8.8.6.4 The activation and operation of the EOSTI or the failure of the EOSTI to activate and operate shall be recorded and reported.

8.8.6.5 The activation and identification of HUD visual alert signals shall be recorded and reported.

8.8.7 Interpretation.

8.8.7.1 Pass or fail performance shall be based on any observed afterflame, the peak inhalation and exhalation values, and the facepiece vision value.

8.8.7.2 Failure to meet any of the test condition requirements shall constitute failure of the SCBA.

8.8.7.3 Failure of any EOSTI alarm signals to activate and remain active during the test shall constitute failing performance.

8.8.7.4 Failure of the HUD to display the breathing air cylinder content or to display the visual alert signals during the test shall constitute failing performance.

8.9 Facepiece Carbon Dioxide Content Test.

8.9.1 Application. This test shall apply to all SCBA facepieces.

8.9.2 Specimens. Each SCBA facepiece model and size shall be tested.

8.9.3 Specimen Preparation. Prior to testing, specimens shall be conditioned for a minimum of 4 hours and then tested at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

8.9.4 Procedure. Specimens shall be tested as specified in Section 8.14 of EN 136, *Respiratory protective devices — Full face masks — Requirements, testing, marking.*

8.9.5 Report. The facepiece carbon dioxide content shall be recorded and reported for each test specimen.

8.9.6 Interpretation.

8.9.6.1 The facepiece carbon dioxide content shall be used to determine pass or fail performance.

8.9.6.2 One or more specimens failing this test shall constitute failing performance.

8.10 EOSTI Recognition Test.

8.10.1 Application. This test method shall apply to complete SCBA.

8.10.2 Sample. The sample for testing shall be selected as specified in 4.3.9.

8.10.3 Specimen Preparation. Prior to testing, the specimen shall be conditioned for a minimum of 4 hours at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

8.10.4 Apparatus.

8.10.4.1 An adapter shall be provided that allows the test subject to manually switch between a breathing air supply greater than 30 percent of the SCBA breathing air cylinder rated service pressure and a breathing air supply pressure of 18 bar, ±1 bar (265 psi, ±15 psi).

8.10.4.2 The test subject shall wear a complete Class 2 nonencapsulating ensemble with gloves and footwear certified as compliant with NFPA 1994.

8.10.4.3 Testing shall be performed with the test subject walking at 5 km/hr, ±0.2 km/hr (3 mph, ±0.12 mph) on a treadmill at zero percent grade.

8.10.4.4 Testing shall be conducted in a test chamber that absorbs a minimum of 90 percent of all sound from 500 Hz to 5000 Hz.

8.10.4.5 The test subject shall have "audiometrically normal" hearing as defined in Section 5.3 of ANSI/ASA S3.2, *Method for Measuring the Intelligibility of Speech over Communication Systems,* in the range of 500 Hz to 3000 Hz.

8.10.4.6 The test subject shall have had a physical examination conducted by a physician within the 12 months immediately preceding the date of testing.

8.10.4.7 The treadmill shall be positioned in the test chamber specified in 8.10.4.4 in a location that meets the conditions for background noise, lighting, and distraction specified in 8.10.4.8 and 8.10.4.9.

8.10.4.8 The test chamber shall be filled with pink noise with a tolerance of 6 dB per octave band from 400 Hz to 4000 Hz and shall be adjusted to achieve an A-weighted sound level of 75 dB, ±2 dB measured at each ear of the test subject when the subject is walking on the treadmill as specified in 8.10.4.3.

8.10.4.8.1 The forward axis of the loudspeaker shall be located as far as possible from and pointed away from the test subject so as to create a quasi-uniform sound field at the test subject's ears.

8.10.4.8.2 More than one loudspeaker shall be permitted to be used to achieve the desired sound level.

8.10.4.9 The area in the test chamber where the test subject's head is positioned when the subject is standing in the walking location on the treadmill shall be artificially lighted to achieve a light level between 100 lux and 500 lux.

8.10.4.10 A reading stand containing printed text shall be positioned relative to the treadmill as follows:

(1) The vertical center of the text shall be in line with the center of the treadmill track within ±100 mm (±4 in.).
(2) The horizontal center of the text shall be at the same height, ±100 mm (±4 in.), as the eye level of the test subject when the subject is standing in the walking position on the treadmill.
(3) The text shall be at a distance from the test subject that permits the text to be read by the subject while the subject is walking on the treadmill.

8.10.5 Procedure.

8.10.5.1 SCBA test specimens shall be tested at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

8.10.5.2 The test subject wearing the protective ensemble specified in 8.10.4.3 shall don the test specimen SCBA and begin walking on the treadmill in the ambient conditions specified in 8.10.4.8 and 8.10.4.9.

8.10.5.3 While breathing from the SCBA, the test subject shall read aloud the printed text.

8.10.5.4 The person conducting the testing shall switch from the breathing air supply at greater than 30 percent of cylinder rated service pressure to 18 bar, ±1 bar (265 psi, ±15 psi) at a random point between 30 seconds and 120 seconds from the commencement of the test.

8.10.5.5 The test subject shall acknowledge recognition of the alarm signal immediately upon becoming aware of it by a gesture that has been predetermined between the test subject and the person performing the testing.

8.10.6 Report. The time elapsed between the switch to low supply air pressure and the acknowledgement of recognition of the EOSTI alarm signal by the test subject shall be recorded and reported.

8.10.7 Interpretation. Failure of either of the two test subjects to acknowledge recognition of the EOSTI alarm signal within the time period specified in Section 7.10, EOSTI Alarm Recognition, shall constitute failing performance.

8.11 HUD Wiring Connection Strength Test.

8.11.1 Application. This test method shall apply to SCBA facepieces with HUD and any associated assemblies with interconnecting wiring.

8.11.2 Samples. Each sample to be tested shall be as specified in 4.3.9.

8.11.3 Specimen Preparation.

8.11.3.1 Specimens for conditioning shall be SCBA facepieces with HUD and any associated assemblies with interconnecting wiring.

8.11.3.2 Prior to testing, specimens shall be conditioned for a minimum of 4 hours and tested at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

8.11.4 Apparatus. A mass of known weight with the means for attachment to wiring shall be provided.

8.11.5 Procedure. A force of 156 N, ±9 N (35 lbf, ±2 lbf) shall be applied gradually, in an axial direction, to the wiring of the specimen being tested.

8.11.6 Report. Observations of the HUD functionality shall be recorded and reported.

8.11.7 Interpretation. Observation of HUD functionality in accordance with 6.3.5 shall be used to determine pass or fail performance.

8.12 HUD Low Power Source Alert Signal Test.

8.12.1 Application. This test shall apply to all HUD low power source alert signals.

8.12.2 Samples. Each sample to be tested shall be as specified in 4.3.9.

8.12.3 Specimen Preparation. Specimens shall be conditioned for a minimum of 4 hours and tested at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

8.12.4 Apparatus. A variable power source that is capable of supplying dc voltage of at least 30 percent more than the nominal power source voltage shall be provided.

8.12.5 Procedure.

8.12.5.1 Each HUD shall be tested with a variable power source to determine that the low power source alert signal will activate at the voltage ±3 percent that is specified by the manufacturer.

8.12.5.2 Each HUD shall be tested with a variable power source to determine that the HUD will continue to provide the visual information and alert signals down to the cease-proper-operation voltage ±3 percent that is specified by the manufacturer.

8.12.5.3 Each HUD power source shall be tested by discharging it at the nominal operating current specified by the manufacturer until the voltage falls to the level at which the HUD low power source alert signal activates as specified in 6.3.8.4.

8.12.5.4 Upon reaching that voltage, the current drain shall be increased to the peak current drain of the power source specified by the manufacturer for all systems supplied by that power source. Under those conditions and for a period of at least 2 hours, the power source voltage shall remain above the voltage that would cause the HUD to cease proper operation.

8.12.6 Report.

8.12.6.1 The HUD shall be observed for activation of the low power source alert signal.

8.12.6.2 The HUD shall be observed for the display of the visual information and alert signals down to the cease-proper-operation voltage.

8.12.6.3 The power source voltage shall be observed with respect to the cease-proper-operation voltage.

8.12.6.4 The events in 8.12.6.1 through 8.12.6.3 shall be recorded and reported.

8.12.7 Interpretation.

8.12.7.1 The HUD low power source alert signal function shall be evaluated to determine pass or fail performance.

8.12.7.2 The HUD power source voltage greater than or equal to the cease-proper-operation voltage shall constitute pass.

8.13 HUD Visibility Tests.

8.13.1 Darkness Test.

8.13.1.1 Application. This test method shall apply to complete SCBA.

8.13.1.2 Samples. Each sample to be tested shall be as specified in 4.3.9.

8.13.1.3 Specimen Preparation. Prior to testing, specimens shall be conditioned for a minimum of 4 hours and tested at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

8.13.1.4 Apparatus.

8.13.1.4.1 The SCBA breathing air cylinder shall be permitted to be replaced with a cylinder of lesser capacity. The breathing air capacity of the replacement cylinder shall be greater than 200 L (7.1 ft^3).

8.13.1.4.2 Testing shall be performed in a light-controlled enclosure designated as the "testing enclosure." A diffused-light source that provides a luminance of 2 lux, ±1 lux shall be used to illuminate across the surface of the SCBA facepiece lens.

8.13.1.5 Procedure.

8.13.1.5.1 The selected test subjects shall have visual acuity of 20/20 in each eye uncorrected or corrected with contact lenses. Selected test subjects shall be able to read lowercase letters measuring 2.5 mm ($\frac{3}{32}$ in.) in height at a distance of 305 mm (12 in.).

8.13.1.5.2 The test subject shall don a complete SCBA.

8.13.1.5.3 The test subject shall enter the testing enclosure and be positioned so that the SCBA facepiece is illuminated as specified in 8.13.1.4.2.

8.13.1.5.4 The test subject shall wait 1 minute to allow the eyes to acclimate to the illumination.

8.13.1.5.5 The SCBA shall be activated so as to activate the HUD.

8.13.1.5.6 The cylinder shall be fully charged, and the HUD shall show full cylinder charge.

8.13.1.5.7 The SCBA pressure shall be slowly decreased so as to activate all HUD visual displays.

8.13.1.6 Report.

8.13.1.6.1 Each visual display of information and each visual alert signal as defined by the manufacturer's instructions shall be observed for distinctness and identifiability.

8.13.1.6.2 The test subject's observations of distinctness and identifiability shall be recorded and reported.

8.13.1.7 Interpretation.

8.13.1.7.1 The test subject's ability to distinguish between each visual display of information and each visual alert signal as defined by the manufacturer's instructions shall be observed, and the distinguishing features shall be distinct and identifiable.

8.13.1.7.2 Failure of the test subject to be able to observe each visual display of information and each visual alert signal as distinct, identifiable, or both shall constitute failing performance.

8.14 Light Test.

8.14.1 Application. This test method shall apply to complete SCBA.

8.14.2 Samples. Each sample to be tested shall be as specified in 4.3.9.

8.14.3 Specimen Preparation. Prior to testing, specimens shall be conditioned for a minimum of 4 hours and tested at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

8.14.4 Apparatus.

8.14.4.1 The SCBA breathing air cylinder shall be permitted to be replaced with a cylinder of lesser capacity. The breathing air capacity of the replacement cylinder shall be greater than 200 L (7.1 ft^3).

8.14.4.2 Testing shall be performed in a light-controlled enclosure designated as the "testing enclosure." A diffused light source that provides a luminance of 10,000 lux, ±1000 lux shall be used to illuminate across the surface of the SCBA facepiece lens.

8.14.5 Procedure.

8.14.5.1 The selected test subjects shall have visual acuity of 20/20 in each eye uncorrected or corrected with contact

lenses. Selected test subjects shall be able to read lowercase letters measuring 2.5 mm (3⁄32 in.) in height at a distance of 305 mm (12 in.).

8.14.5.2 The test subject shall don a complete SCBA.

8.14.5.3 The test subject shall enter the testing enclosure and be positioned so that the SCBA facepiece is illuminated as specified in 8.14.4.2.

8.14.5.4 The test subject shall wait 1 minute to allow the eyes to acclimate to the illumination.

8.14.5.5 The SCBA shall be activated so as to activate the HUD.

8.14.5.6 The cylinder shall be fully charged, and the HUD shall show full cylinder charge.

8.14.5.7 The SCBA pressure shall be slowly decreased so as to activate all HUD visual displays.

8.14.6 Report.

8.14.6.1 Each visual display of information and each visual alert signal as defined by the manufacturer's instructions shall be observed and shall be distinct and identifiable.

8.14.6.2 The test subject's observations shall be recorded and reported.

8.14.7 Interpretation. The test subject's ability to distinguish among the visual displays of information and the visual alert signals as defined by the manufacturer's instructions shall be observed, and distinguishing features shall be distinct and identifiable.

8.15 HUD Disabling Glare Test.

8.15.1 Application. This test method shall apply to complete SCBA.

8.15.2 Samples. Each sample to be tested shall be as specified in 4.3.9.

8.15.3 Specimen Preparation. Prior to testing, test specimens shall be conditioned for a minimum of 4 hours and tested at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

8.15.4 Apparatus.

8.15.4.1 Testing shall be performed in a light-controlled enclosure designated as the "testing enclosure," with a diffused light source that provides a luminance of 2 lux, +0/−1 lux measured at the surface of the reading text card.

8.15.4.2 At least eight text cards for reading shall be provided. Each text card shall have 10 different randomly selected letters of 2.5 mm (3⁄32 in.) in height printed in lowercase on the card.

8.15.4.3 The SCBA breathing air cylinder shall be permitted to be replaced with a cylinder of lesser capacity. The breathing air capacity of the replacement cylinder shall be greater than 200 L (7.1 ft^3).

8.15.5 Procedure.

8.15.5.1 The selected test subjects shall have visual acuity of 20/20 in each eye uncorrected or corrected with contact lenses. Selected test subjects shall be able to read lowercase letters measuring 2.5 mm (3⁄32 in.) in height at a distance of 305 mm (12 in.).

8.15.5.2 The test subject shall enter the testing enclosure that is illuminated as specified in 8.15.4.1.

8.15.5.3 The test subject shall wait at least 1 minute to allow the eyes to acclimate to the illumination.

8.15.5.4 A text card as specified in 8.15.4.2 shall be used for each before-reading procedure and for each after-reading procedure of a single test.

8.15.5.5 Different text cards as specified in 8.15.4.2 shall be used for each test.

8.15.5.6 With the test subject's vision blocked, the text card shall be placed in a fixed position inside the testing enclosure at a distance of 305 mm, +0/−25 mm (12 in., +0/−1 in.) from the test subject's face.

8.15.5.7 For the before-reading portion of the test procedure, the test subject shall read out loud the 10 letters on the text card.

8.15.5.8 The test subject shall then don a complete SCBA.

8.15.5.9 The SCBA shall be activated so as to activate the HUD.

8.15.5.10 With the test subject's vision blocked, a different text card shall be placed in a fixed position inside the testing enclosure at a distance of 305 mm, +0/−25 mm (12 in., +0/−1 in.) from the test subject's SCBA facepiece lens.

8.15.5.11 The SCBA cylinder pressure shall then be slowly decreased until the breathing air supply in the cylinder is exhausted.

8.15.5.12 The after-reading portion of the test procedure shall be conducted while the cylinder pressure is being slowly decreased. The test subject shall read out loud the 10 letters on the text card.

8.15.6 Report.

8.15.6.1 The test subject's visual acuity as required in 8.15.5.1 shall be recorded and reported.

8.15.6.2 The test subject's ability to read the lowercase letters as required in 8.15.5.1 shall be recorded and reported.

8.15.6.3 The test subject's reading of the 10 letters in the before-reading portion of the test as required in 8.15.5.7 shall be recorded and reported for each letter.

8.15.6.4 The test subject's reading of the 10 letters in the after-reading portion of the test as required in 8.15.5.12 shall be recorded and reported for each letter.

8.15.7 Interpretation.

8.15.7.1 The test subject's inability to read at least 9 of the 10 before-reading letters shall constitute failing performance.

8.15.7.2 The test subject's inability to read at least 9 of the 10 after-reading letters shall constitute failing performance.

8.16 Cylinder Refill Breathing Performance Test.

8.16.1 Application. Where the SCBA is equipped with an RIC UAC, this test method shall apply to complete SCBA.

8.16.2 Samples. Each sample to be tested shall be as specified in 4.3.9.

8.16.3 Specimen Preparation. Prior to testing, test specimens shall be conditioned for a minimum of 4 hours at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

8.16.4 Apparatus.

8.16.4.1 The test apparatus shall be as specified in 8.1.4.

8.16.4.2 An RIC UAC filling hose assembly shall be provided.

8.16.4.3 The breathing air source shall provide a constant pressure equal to the rated service pressure of the SCBA breathing air cylinder, +0/−6.8 bar (+0/−100 psi).

8.16.5 Procedure.

8.16.5.1 The SCBA shall be tested for airflow performance as specified in 8.1.5, with the modification that the test will begin with the SCBA breathing air cylinder pressurized to 25 percent of the rated pressure.

8.16.5.2 The RIC UAC filling hose shall be connected to the constant pressure source.

8.16.5.3 At 10 cycles, ±5 cycles of the breathing machine, the RIC UAC female fitting on the RIC filling hose shall be connected to the RIC UAC male fitting on the SCBA. The RIC UAC coupling shall remain connected until the air transfer is completed.

8.16.5.4 The duration of the airflow performance test shall end 4 minutes after the air transfer has commenced in accordance with 8.16.5.3.

8.16.6 Report. The facepiece peak inhalation and exhalation pressure shall be recorded and reported.

8.16.7 Interpretation. The peak inhalation and peak exhalation pressures shall be used to determine pass or fail performance.

8.17 RIC UAC System Fill Rate Test.

8.17.1 Application. Where the SCBA is equipped with an RIC UAC, this test method shall apply to complete SCBA.

8.17.2 Samples. Each sample to be tested shall be as specified in 4.3.9.

8.17.3 Specimen Preparation. Prior to testing, the specimens shall be conditioned for a minimum of 4 hours at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

8.17.4 Apparatus.

8.17.4.1 An RIC UAC filling hose assembly shall be provided.

8.17.4.2 The air source shall provide a constant pressure equal to the rated service pressure of the SCBA cylinder, +0/−6.8 bar (+0/−100 psi).

8.17.4.3 Testing shall be performed using a timer capable of measuring elapsed time within the range of 0 to 5 minutes.

8.17.5 Procedure.

8.17.5.1 The pressure of the SCBA breathing air cylinder shall be 0 bar (0 psi).

8.17.5.2 The RIC UAC filling hose shall be connected to the constant pressure air source.

8.17.5.3 With the SCBA breathing air cylinder valve fully open, the RIC UAC filling hose shall be connected to the RIC UAC male fitting.

8.17.5.4 The test timer shall begin when the RIC UAC filling hose is connected to the SCBA.

8.17.5.5 The pressure in the SCBA breathing air cylinder shall be monitored.

8.17.5.6 When the pressure in the SCBA breathing air cylinder reaches 75 percent of the rated service pressure of the SCBA cylinder, the test timer shall be stopped.

8.17.6 Report. The elapsed time shall be observed, recorded, and reported.

8.17.7 Interpretation. The elapsed fill time shall be used to determine pass or fail.

8.18 Breathing Air Cylinder and Valve Assembly Retention Test.

8.18.1 Application. This test method shall apply to complete SCBA assemblies.

8.18.2 Samples.

8.18.2.1 Samples shall be complete SCBA.

8.18.2.2 Samples shall be fitted with each of the SCBA manufacturer's breathing air cylinder and valve assemblies.

8.18.3 Specimen Preparation.

8.18.3.1 One SCBA sample shall be tested with a cylinder and valve assembly as specified in 8.22.5.

8.18.3.2 Prior to testing, specimens shall be conditioned for a minimum of 4 hours at an ambient temperature of 22ºC, ±3ºC (72ºF, ±5ºF), with RH of 50 percent, ±25 percent.

8.18.4 Apparatus.

8.18.4.1 A test bench or similar fixture that can firmly fix a fully assembled SCBA to the test bench or fixture and that will not allow movement of the SCBA shall be used.

8.18.4.2 Measurements shall be taken with a calibrated measuring device having a resolution of better than ±0.25 mm (±0.010 in.).

8.18.4.3 Loops, straps, or pads shall be positioned on the valve to facilitate the application and measurement of an applied load to the intersection of the valve connection plane with the center line of the breathing air cylinder body.

8.18.5 Procedure.

8.18.5.1 The specimen fitted with the SCBA manufacturer's breathing air cylinder and valve assembly shall be fixed to the backframe/carrier assembly in accordance with the manufacturer's end user instructions provided with the SCBA.

8.18.5.2 The fully assembled SCBA shall be firmly fixed to the test bench or fixture in a manner that prevents movement of the SCBA but that does not interfere with the breathing air cylinder and valve assembly retention method.

8.18.5.3 The distances for each of the six directions specified in 8.18.5.4, the original starting positions, shall be measured and recorded.

8.18.5.4 A force of 200 N (45 lbf) shall be applied to the intersection point specified in 8.18.4.3, in the six directions shown in Figure 8.18.5.4. The force shall be applied for a period of 10 seconds, +5/−0 seconds, allowing the measurements to be taken.

8.18.5.5 Following the application of force for each direction, the distance for each of the six directions shall be measured and recorded.

8.18.6 Report.

8.18.6.1 The distance moved from the original starting position for each of the six directions shall be recorded and reported.

8.18.6.2 No portion of the breathing air cylinder and valve assembly shall show movement greater than 25 mm (1 in.) from its original position prior to load application.

8.18.7 Interpretation. Movement of any part of the breathing air cylinder and valve assembly that exceeds 25 mm (1 in.) shall constitute failing performance.

8.19 Immersion Leakage Test.

8.19.1 Application. This test method shall apply to each electronic device of the SCBA required to meet the mandatory design requirements of Chapter 6, Design Requirements.

8.19.2 Samples.

8.19.2.1 The sample to be tested shall be as specified in 4.3.9.

8.19.2.2 Samples for conditioning shall be complete SCBA.

8.19.3 Specimens.

8.19.3.1 Prior to testing, specimens shall be conditioned for a minimum of 4 hours at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

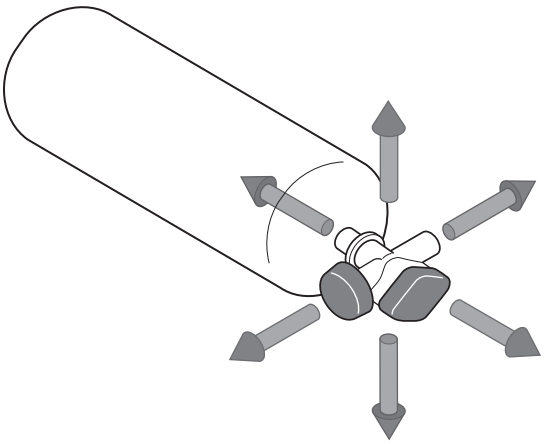


FIGURE 8.18.5.4 Directions of Force Applied for Retention Testing.

8.19.4 Apparatus.

8.19.4.1 The test water container shall be capable of covering the uppermost point of the specimen SCBA with a depth of 1.5 m (4.9 ft) of water.

8.19.4.2 The water temperature shall be 18°C, ±10°C (64°F, ±18°F).

8.19.5 Procedure.

8.19.5.1 The SCBA shall be mounted on the test mannequin and tested for a watertight seal in accordance with 8.1.5.3.

8.19.5.2 The specimen mounted to the mannequin shall be immersed in the test water container for 15 minutes. After 15 minutes, the specimen shall be removed from the test water container and shall be wiped dry. Testing shall begin within 30 seconds of removal from conditioning.

8.19.5.3 The specimen's electronic components shall be operated in accordance with the manufacturer's instructions for normal use to determine the proper functioning.

8.19.5.4 The specimen shall then be re-immersed in the test water container for an additional 5 minutes. The power source compartment(s) shall be open, and the power source shall not be installed.

8.19.5.5 After the 5-minute immersion, the specimen shall be removed from the test water container and shall be wiped dry.

8.19.5.6 The electronic compartment(s) of the specimen shall be opened and inspected for water leakage to determine pass or fail.

8.20 Cylinder Connections and Accessibility Test.

8.20.1 Application. This test method shall apply to complete SCBA assemblies.

8.20.2 Samples.

8.20.2.1 Samples shall be complete SCBA.

8.20.2.2 Samples shall be fitted with each of the SCBA manufacturer's air cylinder and valve assemblies.

8.20.3 Specimen Preparation.

8.20.3.1 The SCBA manufacturer's cylinder and valve assembly shall be fixed to the backframe/carrier according to the manufacturer's end user instructions.

8.20.3.2 Prior to testing, specimens shall be conditioned for a minimum of 4 hours at an ambient temperature of 22ºC, ±3ºC (72ºF, ±5ºF), with RH of 50 percent, ±25 percent.

8.20.4 Procedure.

8.20.4.1 The specimen fitted with each of the SCBA manufacturer's cylinder and valve assemblies shall be fixed to the backframe/carrier assembly in accordance with the manufacturer's end user instructions provided with the SCBA.

8.20.4.2 Specimens shall be evaluated for accessibility, attachment, and detachment by a test subject with a hand that is categorized as large, and the test subject shall perform the test while wearing a size large structural fire-fighting glove that is compliant with NFPA 1971.

8.20.4.3 The test subject shall fully attach the cylinder and valve assembly to the SCBA and then fully detach the cylinder

and valve assembly from the SCBA. The time in seconds to attach and then to detach the cylinder and valve assembly shall be measured.

8.20.4.4 The test subject shall fully attach the breathing air fill hose to the RIC UAC connection and then fully detach the breathing air fill hose from the RIC UAC connection. The time in seconds to attach and then to detach the breathing air fill hose shall be measured.

8.20.5 Report.

8.20.5.1 The time to fully attach and to fully detach the cylinder and valve assemblies, timed in accordance with 8.20.4.3, shall be recorded and reported.

8.20.5.2 The time to fully attach and to fully detach the breathing air fill hose to and from the RIC UAC connection, timed in accordance with 8.20.4.4, shall be recorded and reported.

8.20.6 Interpretation.

8.20.6.1 One or more specimens failing the attachment and detachment times for the cylinder and valve assemblies shall constitute failing performance.

8.20.6.2 One or more specimens failing the attachment and detachment times for the RIC UAC connection shall constitute failing performance.

8.21 Supplementary Voice Communications System Performance Test.

8.21.1 Application. This test method shall apply to complete SCBA facepiece(s) and second stage regulator(s).

8.21.2 Samples. Each sample to be tested shall be as specified in 4.3.9, with voice communications systems installed and in the "on" mode in accordance with the manufacturer's instructions.

8.21.3 Specimen Preparation.

8.21.3.1 Prior to testing, specimens shall be conditioned for a minimum of 4 hours and tested at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

8.21.3.2 Specimens for conditioning shall be complete medium-size SCBA facepiece(s) and inner mask(s) with the second stage regulator(s) installed in the "as worn" position as specified by the manufacturer.

8.21.3.3 Signal processing options that use specific features of natural speech such as, but not limited to, pitch, format analysis, and voice or non-voiced sound to enhance the speech intelligibility or the usability of supplementary voice communications systems shall be disabled during the STI test.

8.21.4 Apparatus.

8.21.4.1 Testing shall be conducted in a chamber having the following characteristics:

(1) Minimum room dimensions: 4.6 m long × 3.1 m wide × 2.7 m high (15 ft long × 10 ft wide × 9 ft high)
(2) Construction: hemi-anechoic
(3) Ambient noise level inside chamber: NC-25
(4) Walls and ceiling: ≥90 percent absorptive for 100 Hz < f < 10000 Hz

8.21.4.1.1 All surfaces above the floor shall be acoustically treated for internal acoustic absorption, as well as for external noise mitigation.

8.21.4.2 A G.R.A.S. KEMAR Head and Torso Simulator (HATS) model 45BM shall be used for testing.

8.21.4.2.1 The mouth simulator shall be capable of producing 112 dB/1 kHz sine tone at 25 mm (1 in.) with the mouth reference point (MRP) unequalized, and the total harmonic distortion (THD) shall be ≤3 percent.

8.21.4.2.2 The mouth simulator frequency response shall be able to be equalized flat ±1 dB between 100 Hz and 10 kHz, and the response shall be –15 dB or less at 100 Hz and –20 dB or less at 15 kHz.

8.21.4.3 The sound pressure level (SPL) meter having the following characteristics shall be used:

(1) The SPL meter shall be capable of applying an equivalent continuous sound pressure level (Leq) using an A-weighted filter.
(2) The SPL meter shall have a dynamic range from 30 dB (or less) to 130 dB (or more).
(3) The SPL meter shall display the measurement to at least one decimal place.

8.21.4.4 The signal/pink noise analog audio signal generators having the characteristics described in 8.21.4.4.1 and 8.21.4.4.2 shall be used.

8.21.4.4.1 One generator shall be capable of playing wave files in the following format: 48 kHz, 16-bit mono at the output level of 0 dB, FS = 18 dBu, according to EBU Technical Recommendation R68, *Alignment level in digital audio production equipment and in digital audio recorders.*

8.21.4.4.2 The second generator shall be capable of generating pink noise and sine waves from –80 dBu to –2 dBu in one-digit steps, with a THD+N of –90 dB (0.0032 percent) at 8 dBu noise floor type 25uv, and shall also have the following characteristics:

(1) A frequency range of 10 Hz to 20 Hz in one-digit steps ±0.01 percent
(2) An amplitude accuracy of within ±0.5 dB or less

8.21.4.5 A digital equalizer having the following characteristics shall be used:

(1) A digital equalizer shall be capable of at least two concurrently selectable equalizer sections:
    (a) One 31-band graphic with an adjustment range of at least ±18 dB
    (b) A 10-band parametric with an adjustment range of at least ±18 dB
(2) The digital equalizer shall have a dynamic range of ≥112 dB.
(3) The digital equalizer shall be capable of equalizing the frequency response of the HATS mannequin of ±1 dB flat between 100 Hz and 10 kHz, applying a 180 Hz high pass filter with a slope of –24 dB octave, and a 10 Hz low pass filter with a slope of –24 dB octave (–15 dB at 100 Hz, –20 dB at 15 kHz).

8.21.4.6 A powered speaker having the following characteristics shall be used:

(1) The sensitivity shall be ≥84 dB at 1 watt at 1 meter.
(2) The frequency response shall be rated at ≤80 Hz to ≤13 kHz.
(3) The amplifier shall deliver ≥10 watts with a total harmonic distortion <1 percent.

8.21.4.7 A microphone having the following characteristics shall be used:

(1) The microphone shall be a condenser type.
(2) The microphone polar pattern shall be omnidirectional.
(3) The frequency response shall be flat ±0.5 dB from 100 Hz to 15 kHz.
(4) The residual noise shall be ≤–30 dB.
(5) The microphone shall accept signals of at least 130 dBA.

8.21.4.8 A speech transmission index (STI) analyzer having the following characteristics shall be used:

(1) The STI PA analyzer shall be capable of measuring and displaying a single value STI PA result to two decimal places with a seven octave band modulated noise test signal using the Netherlands Organization for Applied Scientific Research (TNO) verified algorithm.
(2) The STI PA analyzer shall conform to IEC-60268, *Sound System Equipment—Part 16: Objective Rating of Speech Intelligibility by Speech Transmission Index*.

8.21.4.9 All the apparatus identified in 8.7.4.6 and 8.7.4.7 shall be located in the hemi-anechoic chamber and arranged as shown in Figure 8.7.4.9(a) and Figure 8.7.4.9(b).

8.21.4.10 The HATS test mannequin shall be positioned in the chamber as shown in Figure 8.7.4.9(a) and Figure 8.7.4.9(b).

8.21.4.10.1 The distance between the HATS test mannequin and the microphone shall be 1.5 m, +25 mm/–0 mm (5 ft, +1 in./–0 in.), and they shall be facing each other.

8.21.4.10.2 The distance between the HATS test mannequin MRP and the floor shall be 1.5 m, +25 mm/–0 mm (5 ft, +1 in./–0 in.).

8.21.4.10.3 The distance between the microphone and the floor shall be 1.5 m, +25 mm/–0 mm (5 ft, +1 in./–0 in.).

8.21.4.11 The test chamber shall be filled with broadband pink noise with a tolerance of ±1 dB per octave band from 100 Hz to 10 kHz.

8.21.4.12 The pink noise speaker shall be placed directly beneath the microphone and oriented such that the central axis of the speaker cone is directly facing the microphone.

8.21.4.12.1 The speaker shall be situated on top of a block of isolating acoustic foam such that no part of the speaker box is contacting the floor or the microphone stand, to prevent conduction of sound to the microphone.

8.21.4.12.2* The height of the speaker off the floor shall be at least 0.125 m (5 in.), as measured from the bottom of the speaker box, and the distance between the speaker and microphone shall be no less than 1 m (40 in.), as measured from the top of the speaker grille/enclosure.

8.21.4.12.3 The pink noise speaker shall be placed as indicated in Figure 8.7.4.12.3.

8.21.4.13 The pink noise speaker shall be fully equalized flat, from 100 Hz to 10 kHz, to within ±1 dB on a relative scale in ⅓ octave bands, as measured at the microphone position.

8.21.4.14 The STI test signal from the mannequin shall be adjusted to achieve an A-weighted sound level of 97 dB, ±0.5 dB at the MRP, 50 mm, ±3 mm (2 in. ± ⅛ in.) from the test mannequin's mouth.

8.21.4.14.1 The microphone used for calibrating the STI signal shall be omnidirectional and oriented in a horizontal front-facing manner.

8.21.4.14.2 The STI signal shall be equalized flat to within ±1 dB on a relative scale in ⅓ octave bands, as measured at the MRP of the HATS.

8.21.4.14.3 The HATS shall be calibrated as follows:

(1) Equalize flat with pink noise to 97 dBA from 100 Hz – 10 kHz to ±1 dB on a ⅓ octave scale.
(2) Reduce the levels for the 125 Hz octave band (the 100, 125, 160 ⅓ octave bands) by 10 dB.
(3) Reduce the levels for the 250 Hz octave band (the 200, 250, 315 ⅓ octave bands) by 2 dB.
(4) Apply the STI PA signal and adjust the Sound Pressure Level (SPL) to 97 dBA, ±0.5 dBA.

8.21.4.15 The gain of the powered speaker amplifier used to generate the pink noise shall be adjusted to achieve an A-weighted sound level of 9 dB, ±0.5 dB below the signal level generated as identified in 8.21.4.14, measured at the microphone placed as identified in 8.21.4.10.1 and 8.21.4.10.3.

8.21.5 Procedure.

8.21.5.1 The method for measuring the STI shall be as specified in IEC 60268, *Sound System Equipment — Part 16: Objective Rating of Speech Intelligibility by Speech Transmission Index*, with the modified apparatus specified in 8.21.4.

8.21.5.2 The medium-size facepiece with inner mask and second stage regulator in the normal use mode shall be fitted to the HATS test mannequin in the following manner:

(1) Place the chin of the mannequin in the chin cup of the facepiece.
(2) Place the facepiece to seal against the face of the HATS test mannequin.
(3) Pass the head harness of the facepiece over the HATS test mannequin and tighten it in a manner that maintains the symmetry of the facepiece on the HATS test mannequin, using talc to minimize friction between the HATS test mannequin and the strap.
(4) Tighten the straps to a tension of 50 N (11.2 lbf).

8.21.5.3 Three medium-size facepieces shall be tested in the chamber having an ambient noise field as specified in 8.21.4.11 through 8.21.4.15. Each facepiece shall be mounted as specified in 8.21.5.2 and then tested as follows:

(1) Record three separate measurements for each donning of the facepiece.
(2) Perform five separate donnings.
(3) Record a total of 45 measurements: 3 (facepieces) × 3 (measurements) × 5 (donnings) = 45 measurements.

8.21.6 Report.

8.21.6.1 The STI PA signal sound pressure level (SPL) per octave band, the modulation transfer index per octave band,

and overall STI score at the mouth reference point (MRP) *(see 3.3.31)* shall be recorded and reported.

8.21.6.2 The STI PA signal SPL per octave band, the modulation transfer index per octave band, and overall STI score at the microphone measurement point (MMP) *(see 3.3.30)* shall be recorded and reported.

8.21.6.3 The pink noise SPL per octave band at the MMP *(see 3.3.30)* shall be recorded and reported.

8.21.6.4 The STI score for each facepiece measurement sampled as described in 8.21.5.3 (a total of 45 scores) shall be recorded and reported, and the starting time of each facepiece donning shall be recorded.

8.21.6.5 The average for each donning shall be calculated, recorded, and reported. There shall be a total of 15 averages of 3 measurements (5 averages for each of the three facepiece samples). See Figure 8.7.6.5.

8.21.7 Interpretation.

8.21.7.1 The averages calculated in 8.21.6.5 shall be used to determine a pass or fail in accordance with Section 7.14, Supplementary Voice Communications System Performance Requirements.

8.21.7.2 If any of the 15 averages score less than the minimum threshold specified in Section 7.14, Supplementary Voice Communications System Performance Requirements, the facepiece shall be considered to have failed and shall be reported as such.

8.21.7.3 If all 15 averages score equal to or greater than the minimum threshold specified in Section 7.14, Supplementary Voice Communications System Performance Requirements, the facepiece shall be considered to have passed and shall be reported as such.

8.22 Low Power Capacity Test.

8.22.1 Application. This test shall apply to all electronic devices required for SCBA by the requirements of Chapter 6, Design Requirements.

8.22.2 Samples. Each sample to be tested shall be as specified in 4.3.9.

8.22.3 Specimen Preparation. Specimens shall be conditioned for a minimum of 4 hours and tested at an ambient temperature of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent.

8.22.4 Apparatus. A variable power source that is capable of supplying dc voltage of at least 30 percent more than the nominal power source voltage shall be provided.

8.22.5 Procedure.

8.22.5.1 Each electronic device shall be tested with a variable power source to determine that the low power source alert signal will activate at the voltage specified by the manufacturer, ±3 percent.

8.22.5.2 Each electronic device shall be tested with a variable power source to determine that the electronic device will continue to operate down to the cease-proper-operation voltage specified by the manufacturer.

8.22.5.3 Where multiple electronic devices that are part of the SCBA share a common power source, the minimum amount of power that causes the activation of the low power source alert signal shall be determined with all electronics sharing the common power source operating at their respective maximum power consumption under normal use.

8.22.5.3.1 Each electronic device power source shall be tested by discharging it at the cumulative nominal operating current for all electronic devices utilizing the power source, as specified by the manufacturer, until the voltage falls to the level at which the electronic device low power source alert signal illuminates as specified in Section 7.16, Low Power Capacity.

8.22.5.3.2 Upon reaching this voltage, the current drain shall be increased to the cumulative peak current drain of all electronic devices utilizing the power source, as specified by the manufacturer. Under these conditions and for a period of at least 2 hours, the power source voltage shall remain above the voltage that will cause the electronic device to cease proper operation.

8.22.6 Report.

8.22.6.1 The electronic device shall be observed for activation of the low power source alert signal.

8.22.6.2 The electronic device shall be observed for the display of the low power source alert signal down to the cease-proper-operation voltage.

8.22.6.3 The power source voltage shall be observed with respect to the cease-proper-operation voltage.

8.22.6.4 The events in 8.22.6.1 through 8.22.6.3 shall be recorded and reported.

8.22.7 Interpretation.

8.22.7.1 Electronic device low power source alert signal function shall be evaluated to determine pass or fail performance.

8.22.7.2 Electronic device power source voltage equal to or greater than the cease-proper-operation voltage shall constitute passing performance.

8.23 Emergency Breathing Safety System (EBSS) Cold Temperature Performance Test.

8.23.1 Application. This test method shall apply to two complete SCBA.

8.23.2 Samples. Each sample to be tested shall be as specified in 4.3.9.

8.23.3 Specimen Preparation.

8.23.3.1 Specimens for conditioning shall be two complete SCBA.

8.23.3.2 Prior to testing, the SCBA shall be placed in an ambient environment of 22°C, ±3°C (72°F, ±5°F) and RH of 50 percent, ±25 percent for a minimum 12-hour dwell period.

8.23.3.3 The air used in the SCBA breathing air cylinders shall comply with the quality requirements of NFPA 1989.

8.23.4 Apparatus.

8.23.4.1 The SCBA shall be placed in an environmental chamber and positioned to simulate the normal wearing position of the SCBA on a person as specified by the manufacturer.