84b-473

INTERSPIRO

nsai
I.S. EN ISO 9002

August 14, 1996

NIOSH Docket Office
Robert A. Taft Laboratories
M/S C34
4676 Columbia Parkway
Cincinnati, OH 45226
Attn: NIOSH Docket Officer

RE: Comments to 42 CFR Part 84

Gentlemen:

After reviewing the Department of Health and Human Services request for public comments in preparation of rulemaking to revise current NIOSH procedures included in 42 CFR Part 84, for certifying respiratory devices, Interspiro has the following comments:

Title 42 CFR Part 84 Technical Standard vs. Performance

As now written in the Title 42 CFR Part 84, the technical requirements for respirators are restrictive to improvements in design and performance. Recognizing that an overall change to a performance based specification would be difficult to implement, it is suggested that specific wording be inserted for those design specific items to state that this is only one method of achieving the requirement and consideration will be give to alternate means of demonstrating equivalent performance to Title 42 CFR Part 84 specifications. This would encourage innovative designs and methods which would enhance technology and improve safety.

DOT/CGA Requirements

Title 42 CFR Part 84 currently only recognizes DOT/CGA requirements for cylinders and cylinder valves approved as a main component of an SCBA . The cylinder could be part of the design of an SCBA and could be charged in other ways. As an integral part of the SCBA, there is no basis for requiring a standardized CGA cylinder thread, which is design restrictive to the method of filling a cylinder. In addition, Title 42 CFR Part 84, should recognize other certifying agencies throughout the world i.e., HSE in Great Britain, to satisfy equivalent DOT requirements for cylinders in the United States.

Coordination with CEN (European Committee for Standardization)

European standards for respiratory protective devices should be recognized as an alternate means of equivalent performance to satisfy the requirements of Title 42 CFR Part 84.

INTERSPIRO INC., 31 Business Park Drive, Branford, Connecticut 06405
(203) 481-3899 • FAX (203) 483-1879

ISO 9000 Recognition

ISO 9000 certification should be recognized to satisfy the quality assurance requirements stated in Title 42 CFR Part 84. ISO 9000 currently requires two quality assurance audits per year, eliminating the need for any NIOSH quality assurance audits.

Certifying Components vs. Complete Respirators

Previous European standards allowing the certification of individual respirator components require that the connections interfacing individual respirator components be specified, which has lead to design restrictions. In addition, the practice of allowing approved individual components from one manufacturer to be interfaced and used as part of another manufacturer's approved respirator creates liability issues and possible safety concerns.

NFPA 1981 and NIOSH Title 42 CFR Part 84

Currently the third party NFPA 1981 certification requirements and the NIOSH approval requirements according to Title 42 CFR Part 84, for the same SCBA, creates twofold documentation and testing. Third party testing of the same SCBA to meet the requirements of both standards would eliminate redundant requirements and streamline the testing process. If combined, all certification testing should be performed by a certification organization that is accredited for personal protective equipment by the American National Standards Institute (ANSI) or equivalent.

Carbon Dioxide Measurements in Respirator Facepieces

Current Title 42 CFR Part 84 testing for measurement of C02 levels in respirator facepieces is run at a low ventilation rate which does not simulate actual use and may result in artificially lower recorded CO2 levels because of inadequate mixing in the dead air space of the respirator. This NIOSH testing allows approval of systems with relatively large dead air spaces, which at moderate work loads increase CO2 levels in the mask and reduce the duration time of an SCBA. As documented in the attached D. Beeckman and N. Turner's report, increased buildup of CO2 within a facepiece reduced service time of a SCBA. Also enclosed is NFPA 1981 - A97 ROP, section A-2-1.1.2(h), describing the effect of dead air space on a SCBA. The duration time of a NIOSH approved respirator is measured using a 40 liter minute ventilation which simulates a moderate work rate. Requiring measurement of the C02 in an SCBA facepiece at the same 40 liter minute volume more accurately simulates the CO2 build-up in actual use.

The current CEN testing measuring C02 levels in respirator facepieces is run at a 50 liter minute ventilation. Title 42 CFR Part 84 should be revised to measure C02 levels at a higher ventilation rate and reduce the acceptable C02 levels accordingly.

Title 42 CFR Part 84, Weight Requirement

As now written in Title 42 CFR Part 84, the SCBA weight requirement is restrictive to improvements in design and performance for fire fighters. For example, any integrated system

including a NON-SCBA component which is already required in NFPA 1500 to be worn by the fire fighter, but with the main function different from the SCBA e.g., helmet, would currently be included in the weight of the SCBA. This is design restrictive relative to the future development of integrated systems for improved safety and performance of fire fighters.

Title 42 CFR Part 84, Weight Requirement, should be revised to accept the NFPA 1981- A97 ROP wording as written on page 367 under Substantiation and under 4-1 Design Requirements.

Title 42 CFR Part 84, General

As now written, Title 42 CFR Part 84 does not allow for certification of SCBA combination devices, except at the lower level of the combination. A particular example is covered in the attached NIOSH letter dated 28 January 1994 denying a request to certify a combination SCBA and chemical agent gas-mask approval as an SCBA, and additionally denied the certification of gas mask respirators against specific chemical agents because of poor warning properties. Current national events have indicated the desirability of an approval mechanism for such equipment. First, Chemical DeMil operations at continental U.S. sites have provisions for mutual aid from local municipal and state agencies in the event of accidental release of chemical agents. Although the government facilities utilize respirator systems which are certified to military requirements, the municipal and state agencies typically are under OSHA requirements and specify the use of NIOSH approved equipment. Additionally, a similar threat has developed with the heightened awareness to counterterrorism and the potential of chemical agent use in a civil environment. Local law enforcement and First Response teams are seeking approved systems to provide protection in a potential multi-threat CW environment with additional risk of oxygen deficiency. Consideration should be given to establishing an approval process for a new class of equipment for specialized applications. Since military agencies presently have facilities for test and evaluation of equipment for CW applications, consideration should be given to joint use of those facilities, or acceptance of test data, rather than establishment of new facilities.

Thank you for the opportunity to comment on this document.

Very respectfully,

Kenton D. Warner
General Manager, Acting

Enclosures: NFPA 1981 - A97 ROP
D. Beekman/N. Turner NIOSH Report
NIOSH Letter Dated 1/28/94

RECEIVED FEB 7 1994

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
National Institute for Occupational
Safety and Health – ALOSH
944 Chestnut Ridge Road
Morgantown, WV 26505–2888

January 28, 1994

Mr. Ed Kyder
Configuration Manager
Interspiro Inc.
31 Business Park Drive
Branford, Connecticut 06405

Dear Mr. Kyder:

The National Institute for Occupational Safety and Health (NIOSH) has received your letter of January 7, 1994, requesting information on the approval of a combination self-contained breathing apparatus (SCBA) and chemical agent gas-mask respirator.

The following comments are given with respect to the issues raised in your letter:

1. This agency does not test gas-mask respirators against specific chemical warfare agents because they may have poor warning properties, unless an active indicator is provided with the gas-mask. Also, some chemical warfare agents may be carcinogens. Therefore, gas-masks certified by NIOSH would be certified as a class for organic vapor use with the limitation "Not for use for organic vapors that have poor warning properties."

2. This agency will not certify a combination SCBA and chemical agent gas-mask respirator for entry into an immediately-dangerous-to-life-or-health (IDLH) atmosphere. The reason being that after entering into an IDLH atmosphere using the SCBA portion of the combination unit in a positive-pressure mode, the user could switch to the gas-mask portion in a negative-pressure mode and receive dangerous levels of exposure.

3. If a combination SCBA and chemical agent gas-mask was certified by NIOSH, the unit would receive a 14G or gas-mask approval and could not be used in an IDLH atmosphere.

I trust this information is satisfactory to meet your needs. If you require additional information, do not hesitate to contact me at (304) 284-5713.

Sincerely yours,

Samuel L. Terry

Samuel L. Terry, Chief
Air Supplied Respirator Section
Certification and Quality
Assurance Branch
Division of Safety Research

ABSTRACT OF PROPOSED FREE COMMUNICATION SLIDE OR POSTER

1994 American College of Sports Medicine Annual Meeting
DEADLINE: Must be received in the National Center by November 15, 1993.
(Abstracts received after this date will be returned.)

A MAILING ADDRESS OF PRESENTING AUTHOR
Please type. Provide full name (no initials).

ACSM I.D. Number: 127482 Degree: MS
Birth Date: 12/07/60
Name: Last Beeckman First David C. Middle Initial
Address: 944 Chestnut Ridge Road
Mailstop P119/NIOSH
City: Morgantown State: WV Zip: 26505
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David C. Beeckman
Presenting Author's Signature

Is presenting author a student? ( ) Yes (X) No
Is presenting author a member of ACSM? (X) Yes ( ) No
If not, the signature of an ACSM-member co-author is needed.
Print name _____

ACSM Member's Signature

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EFFECTS OF A NOSECUP ON RESPIRATOR PERFORMANCE IN SELECTED OPEN-CIRCUIT SELF-CONTAINED BREATHING APPARATUSES (SCBAs).

D. Beeckman and N. Turner, National Institute for Occupational Safety and Health, Morgantown, West Virginia.

We investigated the effect of nosecups on respirator performance in three National Fire Protection Association-compliant 60-minute open-circuit positive pressure SCBAs. Six men performed a continuous variable exercise protocol which consisted of three exercise periods of 5, 15, and 10 minutes each while wearing an SCBA without a facepiece. Average VO_2, V_E(STPD), and inspired peak flow (all units $L \cdot min^{-1}$ and mean ± SD) were 3.38 ± 0.13, 79.1 ± 10.6, and 318 ± 48 for the 5-min period; 2.21 ± 0.09, 48.7 ± 5.1, and 228 ± 45 for the 15-min period; and 1.00 ± 0.09, 25.8 ± 7.2, and 142 ± 41 for the 10-min period; respectively. Inspired mean $\%CO_2$ and peak flow were measured continuously with the respirator operational during the same exercise protocol. Service time was recorded for each test. Inspired mean $\%CO_2$ (time-weighted average) was significantly higher ($p < 0.05$) without a nosecup than with one across all exercise intensities. Inspired peak flows during respirator use were similar to those measured with no facepiece. Inspired peak flows with a nosecup tended to be slightly lower than those without a nosecup for all exercise intensities. Service time was significantly greater with a nosecup than without [34.1 min (with) vs 30.0 min (without), $p < 0.01$]. The addition of a nosecup appears to increase service time approximately 14%; however, the practical benefits of such an increase remain unclear. The higher inspired $\%CO_2$ may explain the lower service time observed in these SCBAs when used without a nosecup.

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David C. Beeckman

Presenting Author's Signature

Is presenting author a student? ( ) Yes (X) No

Is presenting author a member of ACSM? (X) Yes ( ) No

If not, the signature of an ACSM-member co-author is needed.

Print name _____

ACSM Member's Signature

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PART I

(Log #CP1)

1981- 1 - (Entire Document): Accept

Note: The Technical Correlating Committee has directed that all product standards carry the following text regarding the accreditation of the third-party certification organizations. Therefore, the Technical Correlating Committee directs the Technical Committee to incorporate the following changes to its document at the Report on Comments stage.

Replace the existing 2-1.2 and 2-2.1 with the following text:

2-1.2 All certification shall be performed by a certification organization that is accredited for personal protective equipment by the American National Standards Institute (ANSI) in accordance with ANSI Z34.1, American National Standard for Third-Party Certification Programs for Products, Processes, and Services."

2-2.1 "The certification organization shall be accredited for personal protective equipment by the American National Standards Institute (ANSI) in accordance with ANSI Z34.1, American National Standard for Third-Party Certification Programs for Products, Processes, and Services."

2. Within the Fire and Emergency Services Protective Clothing and Equipment Project, recertification is already required in some documents and, for consistency, the Technical Correlating Committee will see that it is added to each document that does not currently have it during the normal revision process.

The periodic recertification of compliant product is a necessary measure to assure that the future production of compliant product continues to be compliant. Without specific criteria for retesting and recertification, different certification organizations could have widely divergent programs and the possibility of noncompliant product being produced and reaching the field is significantly increased.

Add new definition for "Model" to Section 1-3 to read:

1-3 Model. The collective term used to identify identical SCBA of the same basic design and components from a single manufacturer produced by the same manufacturing and quality assurance procedures that are covered by the same certification.

Add a new Section 2-4 to read:

2-4 Recertification.

2-4.1 All SCBA that are labeled as being compliant with this standard shall undergo recertification on an annual basis. This recertification shall include inspection and evaluation to all design requirements and testing to all performance requirements as required by 2-3.5 on all manufacturer models and components.

2-4.1.1 Any change that affects the SCBA's performance under the design or performance requirements of this standard shall constitute a different model.

2-4.1.2 For the purpose of this standard, models shall include each unique pattern, style, or design.

2-4.2 Samples of manufacturer models and components for recertification shall be acquired from the manufacturer or component supplier during random and unannounced visits as part of the follow-up inspection program.

2-4.3 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. The manufacturer shall provide such data, upon request, to the purchaser or authority having jurisdiction.

Renumber existing Section 2-4 as Section 2-5.

SUBMITTER: Technical Committee on Respiratory Protection and Personal Alarm Equipment,

RECOMMENDATION: Complete revision to NFPA 1981, Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire Fighters, 1992 edition.

SUBSTANTIATION: The Committee has completely revised the 1992 edition of NFPA 1981.

The new edition will allow an increase of the weight of an SCBA above the current 35 pound maximum up to 40 pounds when the SCBA and another item or items of protective clothing or equipment are integrated with the SCBA. Two examples would be a helmet also serving as the SCBA facepiece, or the harness of the SCBA being part of a protective coat. Such integration could cause the entire SCBA, as NIOSH certified, to exceed 35 pounds. Where the weight gain of the "integrated SCBA" is less than the net weight of the individual parts, an increase up to 40 pounds could be allowed. This permissive requirement is consistent with NIOSH certification of respirators under 42 CFR 84.

The secured vibration test has been deleted from the proposed revision as the unsecured vibration test provides an excellent assessment of the SCBA's performance after vibration and the much less severe secured vibration test has not produced any useful data. Also, cautionary text has been added to alert testers of the dangers associated with testing high pressure cylinders.

The document has been reformatted into seven chapters to conform to the style and layout of all documents in the project. Definitions have been refined, accessory items have been addressed with more specifics, and test methods reviewed to ensure correct methods and procedures are given.

COMMITTEE ACTION: Accept.

NFPA 1981

Standard on

Open-Circuit Self-Contained Breathing Apparatus

for Fire Fighters

1997 Edition

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

Information on referenced publications can be found in Chapter 5 and Appendix B.

Chapter 1 Administration

1-1 Scope.

1-1.1* This standard shall specify the minimum documentation, design criteria, performance criteria, test methods, and certification for open-circuit self-contained breathing apparatus (SCBA) used during fire fighting, rescue, and other hazardous operations.

1-1.2 This standard shall not apply to closed-circuit self-contained breathing apparatus.

1-1.3 The requirements of this standard shall not apply to accessories that might be attached to any open-circuit self-contained breathing apparatus other than as specifically addressed herein.

1-1.4 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 provide minimum requirements for open-circuit SCBA designed to provide respiratory protection for the wearer from the products of combustion, hazardous or toxic atmospheres, oxygen-deficient atmospheres, particulate, and other such IDLH atmospheres (Immediately Dangerous to Life and Health) that might exist at the scene of an emergency.

1-2.2 An additional purpose of this standard shall be to provide requirements to ensure that accessories do not degrade the performance of the SCBA.

1-2.3* Controlled laboratory tests used to determine compliance with the performance requirements of this standard shall not be deemed as establishing performance levels for all situations to which personnel can be exposed.

1-2.4 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 Definitions.

Accessory. An item, provided by the SCBA manufacturer for use with their SCBA, that is attached to the SCBA but is not necessary for the SCBA to meet the requirements of this standard.

Approved.* Acceptable to the authority having jurisdiction.

Authority Having Jurisdiction.* The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

Basic Plane. The plane through the centers of the external ear openings and the lower edges of the eye sockets.

Breathing Air. See Compressed Breathing Gas.

Breathing Air/Gas Container. See "Breathing Gas Cylinder."

Breathing Gas 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.

Certification/Certified. 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.

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

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

Closed-Circuit SCBA. A recirculation-type SCBA in which the exhaled gas is rebreathed by the wearer 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.

Compliance/Compliant. Meeting or exceeding all applicable requirements of this standard.

Component. Any material, part, or subassembly providing the required protection that is used in the construction of the SCBA.

Compressed Breathing Gas.* Oxygen or a respirable gas mixture stored in a compressed state and supplied to the user in gaseous form.

Cylinder. See "Breathing Gas Cylinder."

Demand SCBA. See Negative Pressure SCBA.

Drip. To run or fall in drops or blobs.

End-of-Service-Time Indicator. A warning device on an SCBA that warns the user that the end of the service time of the SCBA is approaching.

Fabric Component. Any pliable, natural, or synthetic material(s), or combination thereof, made by weaving, felting, forming, or knitting.

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

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 listed products that are being produced by the manufacturer to the requirements of this standard.

Gas. An aeriform fluid that is in a gaseous state at standard temperature and pressure.

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

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

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.

Listed.* Equipment, materials, or services included in a list published by an organization 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 either that the equipment, material, or service meets identified standards or has been tested and found suitable for a specified purpose.

Melt. To change from solid to liquid, or become consumed, by action of heat.

Mid-Sagittal Plane. The plane, perpendicular to the basic and coronal planes, that bisects the head symmetrically.

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.

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 Title 42, Code of Federal Regulations, Part 84, Subpart H (42 CFR 84). For the NIOSH certification to remain in effect, the SCBA must be used and maintained in the approved condition.

Open-Circuit SCBA. An SCBA in which exhalation is vented to the atmosphere and not rebreathed. There are two types of open-circuit SCBA: negative pressure or demand type and positive pressure or pressure demand type.

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

Positive Pressure 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.

Pressure Demand SCBA. See Positive Pressure SCBA.

Product Label. A label or marking affixed to the SCBA by the manufacturer, containing general information, care, maintenance, or similar data. This product label is not the certification organization's label, symbol, or identifying mark; however, the certification organization's label, symbol, or identifying mark shall be permitted to be attached to it or be part of it. (*See also Labeled.*)

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

SCBA. See Self-Contained Breathing Apparatus.

Self-Contained Breathing Apparatus (SCBA). A respirator worn by the user that supplies a respirable atmosphere that is either carried in or generated by the apparatus and is independent of the ambient environment.

Service Time. See Rated Service Time.

Shall. Indicates a mandatory requirement.

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

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. Equivalent values in parentheses shall not be considered as the requirement, as these values might be approximate.

Chapter 2 Certification

2-1 General.

2-1.1 Prior to certification of SCBA to the requirements of this standard, SCBA shall be NIOSH certified.

2-1.1.1 SCBA shall have NIOSH certification as positive pressure.

2-1.1.2* SCBA shall have a NIOSH certified rated service time of at least 30 minutes.

2-1.1.3 SCBA that are NIOSH certified as positive pressure but capable of supplying air to the user in a negative pressure, demand-type mode shall NOT be certified to this standard.

2-1.2 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 to the certification program specified in Section 2-2 and shall be in addition to, and shall not be construed to be the same as, the NIOSH certification as specifically defined in Section 1-3.

2-1.3 All certification shall be performed by an approved certification organization.

2-1.4 Compliant SCBA shall be labeled and listed. Compliant SCBA shall also have a *product* label that meets the requirements specified in Section 3-1.

2-1.5 Where accessories are to be attached to or integrated with the SCBA, they shall be tested with and certified as part of the SCBA under this standard.

2-1.6 SCBA shall meet all of the design and performance requirements of this standard with accessories installed. Accessories shall not be required to meet any of the performance requirements of this standard other than as specified herein.

2-2 Certification Program.

2-2.1* The certification organization shall not be owned or controlled by manufacturers or vendors of the product being certified. The certification organization shall be primarily engaged in certification work and shall not have a monetary interest in the product's ultimate profitability.

2-2.2 The certification organization shall refuse to certify products to this standard that do not comply with all requirements of this standard.

2-2.3* The contractual provisions between the certification organization and the manufacturer shall specify that certification is contingent upon compliance with all applicable requirements of this standard. There shall be no conditional, temporary, or partial certifications. Manufacturers shall not be authorized to use any label or reference to the certification organization on products that are not manufactured in compliance with all applicable requirements of this standard.

2-2.4* The certification organization shall have laboratory facilities and equipment for conducting proper tests available, a program for calibration of all instruments shall be in place and operating, and procedures shall be in use to ensure proper control of all testing. Good practice shall be followed regarding the use of laboratory manuals, form data sheets, documented calibration and calibration routines, performance verification, proficiency testing, and staff qualification and training programs.

2-2.5 The certification organization shall require the manufacturer to establish and maintain a program of production inspection and testing that at least meets the requirements of Section 2-4. 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.

2-2.6 The certification organization and the manufacturer shall evaluate any changes affecting the form, fit, or function of the certified product to determine its continued certification to this standard.

2-2.7* The certification organization shall have a follow-up inspection program of the manufacturing facilities of the certified product, with at least two random and unannounced visits per 12-month period. As part of the follow-up inspection program, the certification organization shall select sample product at random from the manufacturer's production line, from the manufacturer's in-house stock, or from the open market. Sample product shall be inspected and tested by the certification organization to verify the product's continued compliance.

2-2.8 The certification organization shall have a program for investigating field reports alleging malperformance or failure of listed products.

2-2.9* The certification organization shall require the manufacturer to have a product recall system as part of the manufacturer's quality assurance program.

2-2.10 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.

2-2.11 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.

2-3 Inspection and Testing.

2-3.1 The testing facility shall take suitable precautions to protect the testing personnel and to guard against catastrophic failure that could result in high pressure gas release, fragmentation, and flying parts or debris due to the fact that the vibration test specified in Section 6-3 involves compressed gas cylinders containing high pressures, and due also to the rigorous nature of the test.

2-3.2 Four identical SCBA selected from the manufacturer's production SCBA and that are to be certified to this standard shall be subjected to the tests specified in Categories A, B, C, and D of Table 2-3.2, for each test series. 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 listed in Category C, and the fourth SCBA shall be subjected to the tests listed in Category D, as shown in Table 2-3.2. SCBA components shall be subjected to the tests specified in Category E of Table 2-3.2.

Table 2-3.2 Test Series

Test Order	Category A (SCBA #1)	Category B (SCBA #2)	Category C (SCBA #3)	Category D (SCBA #4)	Category E (Component Tests)
1.	Air Flow Section 3-1	Air Flow Section 3-1	Air Flow Section 3-1	Air Flow Section 3-1	Fabric Flame Section 3-4
2.	Communication Section 3-10	Accelerated Corrosion Section 3-7	Vibration Section 3-3	Heat and Flame Section 3-11	Fabric Heat Section 3-5
3.	Environmental Temperature Section 3-2				Thread Heat Section 3-6
4.	Particulate Section 3-8				Lens Abrasion Section 3-9

2-3.3 SCBA shall be initially tested and shall meet the performance requirements of three separate test series of Categories A, B, C, and D, as specified in Table 2-3.2. All tests within Categories A, B, C, and D shall be conducted in the order specified and are designed as cumulative damage tests.

2-3.4 SCBA components shall be initially tested and shall meet the performance requirements of one test series of Category E, as specified in Table 2-3.2. SCBA component testing in Category E shall be conducted on test specimens as specified in each respective test method.

2-3.5 After certification, compliant SCBA shall be tested annually within twelve months from previous tests and shall meet the performance requirements of one test series of Categories A, B, C, D, and E, as specified in Table 2-3.2. This requirement shall be waived every fifth year when the testing required by 2-3.5.1 is conducted.

2-3.5.1 Compliant SCBA shall be tested and shall meet the performance requirements of three separate test series of Categories A, B, C, and D, as specified in Table 2-3.2, every fifth year from the date of the initial certification testing specified in 2-3.3.

2-3.5.2 SCBA components shall be tested and shall meet the performance requirements of one test series of Category E, as specified in Table 2-3.2, every fifth year from the date of initial certification testing specified in 2-3.4.

2-3.6 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. 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. 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.

2-3.7 No adjustment, repair, or replacement of parts shall be permitted to any SCBA being tested in accordance with this standard. Breathing gas cylinders shall be permitted to be filled as required.

2-3.8 Inspection and testing for determining compliance with the design requirements of this standard shall be performed on a complete SCBA unless otherwise specified within this standard.

2-3.9 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 accessories that are different from those on the original SCBA tested.

2-3.10 Any modifications made to an SCBA, or any accessories provided for an SCBA, by the SCBA manufacturer after certification shall require the retesting and 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 certifying the modified SCBA as being compliant with this standard.

2-3.11 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 in Section 3-1.

2-3.12 Inspection by the certification organization shall include a review of the user information required by Section 3-2 to ensure that the information has been developed and is available.

2-3.13 Inspection by the certification organization for determining compliance with the design requirements specified in Chapter 4 shall be performed on whole or complete products.

2-3.14 Where SCBA is provided with an accessory or accessories that are attached to or integrated with the SCBA, such accessories shall be tested with the SCBA in accordance with this standard. Accessories shall not be required to meet any of the performance requirements of this standard other than as specified herein.

2-3.15 Where certification testing includes an SCBA with an accessory or accessories, each accessory shall be certified as complying with 4-1.4 and 4-1.5, as applicable.

2-4 Manufacturer's Quality Assurance Program.

2-4.1 The manufacturer shall provide and maintain a quality assurance program that includes a documented inspection and product recall system. The manufacturer shall have an inspection system to substantiate conformance to this standard.

2-4.2 The manufacturer shall maintain written inspection and testing instructions. The instructions shall prescribe inspection and test of materials, work in process, and completed articles. Criteria for acceptance and rejection of materials, processes, and final product shall be part of the instructions.

2-4.3 The manufacturer shall maintain records of all pass/fail tests. Pass/fail records shall indicate the disposition of the failed material or product.

2-4.4 The manufacturer's inspection system shall provide for procedures that assure the latest applicable drawings, specifications, and instructions are used for fabrication, inspection, and testing.

2-4.5 The manufacturer shall, as part of the quality assurance program, maintain a calibration program of all instruments used to ensure proper control of testing. The calibration program shall be documented as to the date of calibration and performance verification.

2-4.6 The manufacturer shall maintain a system for identifying the appropriate inspection status of component materials, work in process, and finished goods.

2-4.7 The manufacturer shall establish and maintain a system for controlling nonconforming material, including procedures for the identification, segregation, and disposition of rejected material. All nonconforming materials or products shall be identified to prevent use, shipment, and intermingling with conforming materials or products.

2-4.8 The manufacturer's quality assurance program shall be audited by the certification organization to determine that the system is sufficient to ensure continued product compliance with this standard.

2-5 ISO Registration for Manufacturers.

2-5.1 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 2-2.9.

2-5.2 The manufacturer shall be registered to ISO 9001.

2-5.3 All elements of the protective ensemble shall be required to be assembled in a facility that is registered at least to ISO 9002.

2-5.4 The ISO registration requirements shall have an effective date of 1 September 1999.

2-5.5 Until 1 September 1999, or until the date the manufacturer becomes ISO registered, whichever date occurs first, the manufacturer shall comply with Section 2-4 .

Chapter 3 Labeling and Information

3-1 Product Label Requirements.

3-1.1 In addition to the NIOSH certification label, each SCBA shall have a product label permanently and conspicuously attached to the SCBA.

3-1.2 Multiple label pieces shall be permitted in order to carry all statements and information required to be on the product label.

3-1.3 The certification organization's label, symbol, or identifying mark shall be attached to the product label or be part of the product label.

3-1.4 All worded portions of the required product label shall at least be in English.

3-1.5 Symbols and other pictorial graphic representations shall be permitted to be used to supplement worded statements on the product label(s).

3-1.6 The following statement shall be legibly printed on the product label. All letters and numbers shall be at least 1/16 in. (1.5 mm) high.

"THIS SCBA MEETS THE REQUIREMENTS OF NFPA 1981, STANDARD ON OPEN-CIRCUIT SELF-CONTAINED BREATHING APPARATUS FOR FIRE FIGHTERS, 1997 EDITION."

3-1.7 The identification of the major components of the SCBA that are required for certification to this standard shall also be printed legibly on the product label. The major components listed by the manufacturer shall be identified with the lot number or serial number or the year and the month of manufacture. All letters and numbers shall be at least 1/16 in. (1.5 mm) high.

3-2 User Information.

3-2.1 The SCBA manufacturer shall provide at least the training material and user instructions specified within this section with each SCBA.

3-2.2 Upon request at the time of purchase, the manufacturer shall provide to the purchaser an information sheet with each SCBA that documents at least the following:

(a) Manufacturing performance tests conducted at time of manufacture, and the results;
(b) Date of manufacture;
(c) Model number;
(d) Serial number;
(e) Lot number, if applicable; and
(f) Hydrostatic test dates and results, if applicable.

3-2.3 Information or training materials regarding pre-use shall be provided on at least the following areas:

(a) Safety considerations;
(b) Limitations of use;
(c) Charging breathing gas cylinders;
(d) Breathing gas quality;
(e) Marking recommendations and restrictions;
(f) Warranty information;
(g) Recommended storage practices; and
(h) Mounting on/in vehicles or fire apparatus.

3-2.4 Information or training materials regarding periodic inspections shall be provided on at least the following areas:

(a) Inspection frequency and details.

3-2.5 Information or training materials regarding donning and doffing shall be provided on at least the following areas:

(a) Donning and doffing procedures;
(b) Adjustment procedures; and
(c) Interface issues.

3-2.6 Information or training materials regarding use shall be provided on at least the following areas:

(a) Pre-use checks;
(b) Proper use consistent with NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*; and
(c) Recharging breathing-gas cylinders.

3-2.7* Information or training materials regarding periodic maintenance and cleaning shall be provided on at least the following areas:

(a) Cleaning instructions and precautions;
(b) Disinfecting procedures;
(c) Maintenance frequency and details; and
(d) Methods of repair, where applicable.

3-2.8 Information or training materials regarding retirement shall be provided on at least the following areas:

(a) Replacement/retirement considerations.

Chapter 4 Design Requirements

4-1 General.

4-1.1* SCBA shall have a NIOSH certified weight not exceeding 35 lb (15.9 kg).

4-1.1.1 Where SCBA or SCBA components are integrated with other elements of protective clothing or protective equipment and the combined weight exceeds 35 lb (15.9 kg), the authority having jurisdiction shall be permitted to specify a maximum weight of the SCBA with the integrated elements.

4-1.1.2 This maximum weight of the SCBA with the integrated elements shall not exceed 40 lb (18.2 kg), as allowed by 42 CFR 84.

4-1.2 All electric circuits integral to an SCBA, or to any SCBA accessories, shall meet the requirements for Class I, 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 Locations.*

4-1.3 All hardware, brackets, and snaps or other fasteners of SCBA or any accessories shall be free of rough spots, burrs, or sharp edges.

4-1.4 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.

4-1.5 Where SCBA are provided with an accessory or accessories that are attached to or integrated with the SCBA, the SCBA shall meet all of the design and performance requirements of this standard with accessories installed. In all cases, such accessories shall not degrade the performance of the SCBA.

Chapter 5 Performance Requirements

5-1* Air Flow Performance.

5-1.1 SCBA shall be tested for air flow performance as specified in Section 6-1, Air Flow Performance Test, and the SCBA facepiece pressure shall not be less than 0.00 in. (0.00 mm) water column nor greater than 3 1/2 in. (89 mm) water column above ambient pressure from the time the test begins until the time the test is concluded.

5-2 Environmental Temperature Performance.

5-2.1 SCBA shall be tested for environmental temperature performance as specified in Section 6-2, Environmental Temperature Tests.

5-2.1.1 When tested for cold environment as specified in 6-2.4, the SCBA facepiece pressure shall not be less than 0.00 in. (0.00 mm) water column nor greater than 3 1/2 in. (89 mm) water column above ambient pressure from the time the air flow test begins until the time the test is concluded.

5-2.1.2 When tested for hot environment as specified in 6-2.5, the SCBA facepiece pressure shall not be less than 0.00 in. (0.00 mm) water column and shall not be greater than 3 1/2 in. (89 mm) water column above ambient pressure from the time the air flow test begins until the time the test is concluded.

5-2.1.3 When tested for hot to cold environment as specified in 6-2.6, the SCBA facepiece pressure shall not be less than 0.00 in. (0.00 mm) water column and shall not be greater than 3 1/2 in. (89 mm) water column above ambient pressure from the time the air flow test begins until the time the test is concluded.

5-2.1.4 When tested for cold to hot environment as specified in 6-2.7, the SCBA facepiece pressure shall not be less than 0.00 in. (0.00 mm) water column and shall not be greater than 3 1/2 in. (89 mm) water column above ambient pressure from the time the test begins until the time the air flow test is concluded.

5-3 Vibration Resistance Performance.

5-3.1 SCBA shall be tested for vibration resistance as specified in Section 6-3, Vibration Tests, and the SCBA facepiece pressure shall not be less than 0.00 in. (0.00 mm) water column and shall not be greater than 3 1/2 in. (89 mm) water column above ambient pressure from the time the air flow test begins until the time the test is concluded.

5-4 Fabric Flame Resistance Performance.

5-4.1 Specimens of the fabric components of SCBA that are used to secure the SCBA to the wearer shall be tested for flame resistance as specified in Section 6-4, Fabric Flame Tests, and shall have an average char length of not more than 4.0 in. (101.6 mm), shall have an average afterflame of not more than 2.0 seconds, and shall not melt or drip.

5-5 Fabric Heat Resistance Performance.

5-5.1 Specimens of the fabric components of SCBA that are used to secure the SCBA to the wearer shall be tested for heat resistance as specified in Section 6-5, Fabric Heat Tests, and shall not melt or ignite.

5-6 Thread Heat Resistance Performance.

5-6.1 Specimens of thread used in SCBA components shall be tested for heat resistance as specified in Section 6-6, Thread Heat Test, and shall not melt or ignite.

5-7 Accelerated Corrosion Resistance Performance.

5-7.1 SCBA shall be tested for corrosion resistance as specified in Section 6-7, 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. In addition, the SCBA facepiece pressure shall not be less than 0.00 in. (0.00 mm) water column and shall not be greater than 3 1/2 in. (89 mm) water column above ambient pressure from the time the air flow test begins until the time the test is concluded.

5-8 Particulate Resistance Performance.

5-8.1 SCBA shall be tested for particulate resistance as specified in Section 6-8, Particulate Test, and the SCBA facepiece pressure shall not be less than 0.00 in. (0.00 mm) water column and shall not be greater than 3 1/2 in. (89 mm) water column above ambient pressure from the time the air flow test begins until the time the test is concluded.

5-9* Facepiece Lens Abrasion Resistance Performance.

5-9.1 Specimen SCBA facepiece lenses shall be tested for abrasion resistance as specified in Section 6-9, Facepiece Lens Abrasion Test, and the average value of the tested specimens shall not exhibit a delta haze greater than 14.0 percent.

5-10* Communications Performance.

5-10.1 Specimens of the SCBA's primary communication means, as identified by the SCBA manufacturer, shall be tested for communications performance as specified in Section 6-10, Communications Test, and shall have an average calculated value of not less than 72 percent.

5-11 Heat and Flame Resistance Performance.

5-11.1 SCBA shall be tested for heat and flame resistance as specified in Section 6-11, Heat and Flame Test, and the SCBA facepiece pressure shall not be less than 0.00 in. (0.00 mm) water column and shall not be greater than 3 1/2 in. (89 mm) water column above ambient pressure from the time the test begins until the time the test is concluded.

5-11.2 When the SCBA and SCBA accessories are tested as specified in Section 6-11, Heat and Flame Test, no components of the SCBA and no accessories shall have an afterflame of more than 2.2 seconds.

5-11.3 When the SCBA are tested as specified in Section 6-11, Heat and Flame Test, 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.

5-11.4 When the SCBA facepiece is tested as specified in Section 6-11, Heat and Flame Test, the facepiece lens shall not obscure vision below the 20/100 vision criterion.

Chapter 6 Test Methods

6-1 Air Flow Performance Test.

6-1.1* The facepiece of the SCBA being tested shall be secured to Scott Aviation Model No. 803608-01 or 803608-02 test headform or equivalent. The facepiece shall be secured to the headform to assure that an initial pressure of 1.0 in., ±0.1 in. (25.4 mm, ±2.5 mm) water column below ambient shall not decay by more than 0.2 in. (5.1 mm) water column in 5 seconds.

6-1.2 The remaining components of the SCBA shall be mounted in accordance with Figure 6-1.2 to simulate its typical wearing position, as specified by the manufacturer, on a fire fighter.

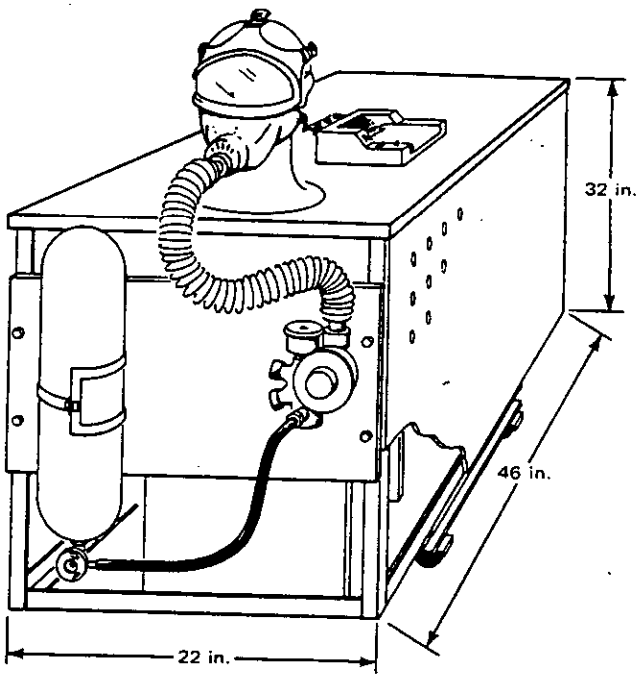


Figure 6-1.2 Typical breathing machine configuration for air flow performance test.

6-1.3 A pressure probe shall be attached to the test headform to monitor facepiece pressure. The pressure probe shall be a 0.25 in. (6.4 mm) OD. with 0.062 in. (1.6 mm) wall thickness metal tube having one open end and one closed end. The closed end shall have four equally spaced holes, each 0.062 in., ±0.005 in. (1.6 mm, ±0.1 mm), and positioned 0.250 in., ±0.02 in. (6.4 mm, ±0.5 mm) from the end of the pressure probe.

6-1.4 The closed end of the pressure probe shall extend through the test head form, exiting out the center of the left eye. The pressure probe shall extend 0.50 in., +0.06/-0.0 in. (12.7 mm, +1.5/-0.0 mm) outward from the surface of the center of the left eye.

6-1.5 The open end of the pressure probe shall extend a maximum of 457 mm (18 in.) and a minimum of 1.0 in. (25.4 mm) outward from the back surface of the test headform.

6-1.6 A maximum of a 5-ft (1.5-m) length of nominal 0.188 in. (4.8 mm) ID. flexible smoothbore tubing with a nominal 0.062-in. (1.6-mm) wall thickness shall be permitted to be connected from the open end of the pressure probe to the inlet of the pressure transducer.

6-1.7* A differential pressure transducer having the following characteristics shall be used:

(a) Range: 8.9 in. (226 mm) of water differential;
(b) Linearity: ±0.5 percent Full Scale (FS) best straight line;
(c) Line Pressure Effect: Less than 1 percent FS zero shift/1000 psig;
(d) Output: ±2.5 Vdc for +FS;
(e) Output Ripple: 10 mv peak to peak;
(f) Regulation: FS output shall not change more than +0.1 percent for input voltage change from 22 to 35 Vdc;
(g) Temperature, Operating: +65°F to 250°F (+54°C to 121°C);
(h) Temperature, Compensated: 0°F to +160°F (-8°C to +71°C); and
(i) Temperature Effects: Within 2 percent FS/100°F (55.6°C), error band.

6-1.8* The differential pressure transducer shall be appropriately connected to a strip chart recorder having the following characteristics:

(a) A chart width of 9.8 in. (250 mm);

(b) A pen speed of at least 29.5 in./sec (750 mm/sec) (0.333 sec FS);

(c) An accuracy of ±0.25 percent FS;

(d) An input voltage range of 1 V FS; and

(e) A span set at 0.98 in. (25 mm) of chart per 1.0 in. (25.4 mm) water column.

6-1.9 The test headform shall be equipped with a stainless steel breathing tube having an 0.90 in. (22.9 mm) ID. with 0.024 in. (0.6 mm) wall thickness. The metal breathing tube shall be located on the centerline of the mouth and shall be flush with the test headform.

6-1.10 The metal breathing tube shall extend outward from either the back or the base surface of the test headform a minimum of 8 in. (203 mm) and a maximum of 18 in. (457 mm).

6-1.11 If flexible smoothbore tubing is used from the metal breathing tube to the inlet connection of the breathing machine, it shall have a maximum length of 4 ft (1.2 m) and a 0.75 in. (19.0 mm) ID. with nominal 0.125 in. (3.2 mm) wall thickness.

6-1.12* A Model 327-6 Breathing Machine, as shown in Figures 6-1.12(a) (shown on page 374), (b) (shown on page 375), and (c) (shown on page 376), shall be used. The breathing machine shall be set to the following characteristics:

(a) Ventilation rate (L/min): 103, ±3;
(b) Respiratory frequency (breaths/min): 30, ±1; and
(c) Tidal volume (L): 3.4 nominal.

6-1.13 The test conditions shall be as follows:

(a) Ambient temperature: 72°F, ±5°F (22°C, ±3°C);
(b) Relative humidity: 50 percent, ±25 percent; and
(c) Barometric pressure: 725 mm Hg, +50/-70 mm Hg.

6-1.13.1 The dew point of breathing gas charged into the SCBA breathing gas cylinders shall not be higher than -65°F (-54°C) at the outlet port of the charge line. The air shall meet or exceed the requirements of the specification for Grade D breathing air as specified in ANSI/CGA G-7.1, *Commodity Specification for Air.*

6-1.14* The test set-up for conducting the air flow performance test shall be calibrated at least once each day before conducting tests and shall be verified at least once each day after testing. The calibration procedure utilized for the differential pressure transducer shall consist of confirming at least three different pressures between 0.0 in. and 5.0 in. (0.0 mm and 127 mm) water column. The pressure shall be measured using an incline manometer or equivalent with a scale measuring in increments of ±0.02 in. (±0.5 mm) water column or less.

6-1.15 The SCBA being tested shall utilize a fully charged breathing gas cylinder. The air flow performance test shall begin after five cycles of the breathing machine and continue to operate through 30 cycles of the breathing machine after actuation of the end-of-service-time indicator.

6-1.16 The facepiece pressure shall be read from the strip chart recorder to determine pass/fail.

6-2 Environmental Temperature Tests.

6-2.1 The environmental temperature tests specified in this section shall be permitted to be conducted in any sequence. After performing each test, the SCBA shall be placed in an ambient environment of 72°F, ±5°F (22°C, ±3°C) with a relative humidity of 50 percent, ±25 percent for a minimum 12-hour dwell period.

6-2.2 The SCBA shall be placed in an appropriate environmental chamber and positioned to simulate the normal wearing position of the SCBA on a fire fighter as specified by the manufacturer. A test headform as specified in 6-1.1 shall be equipped with a thermocouple or other temperature-sensing element to monitor SCBA test chamber temperature. The thermocouple or other temperature-sensing element used shall be attached to the test headform in a manner in which it will be directly exposed to the chamber atmosphere. The test headform shall be connected to the breathing machine in accordance with Section 6-1. The breathing machine shall be permitted to be located either inside or outside the environmental chamber.

6-2.3 The dwell period between environmental temperature tests shall be used for refilling the breathing gas cylinder and visually inspecting the SCBA for any gross damage that could cause unsafe test conditions.

6-2.4 The SCBA shall be cold soaked at -25°F, ±2°F (-32°C, ±1°C) for a minimum of 12 hours. The SCBA shall be tested as specified in Section 6-1, Air Flow Performance Test, at an ambient temperature of -25°F, ±10°F (-32°C, ±5°C).

6-2.5 The SCBA shall be hot soaked at 160°F, ±2°F (71°C, ±1°C) for a minimum of 12 hours. The SCBA shall then be tested as specified in Section 6-1, Air Flow Performance Test, at an ambient temperature of 160°F, ±10°F (71°C, ±5°C).

6-2.6 The SCBA shall be hot soaked at 160°F, ±2°F (71°C, ±1°C) for a minimum of 12 hours. The SCBA shall then be transferred to a chamber with an air temperature of -25°F, ±2°F (-32°C, ±1°C). The SCBA shall then be tested as specified in Section 6-1, Air Flow Performance Test, at a chamber air temperature of -25°F, ±10°F (-32°C, ±5°C). The air flow performance test specified in Section 6-1 shall commence within 3 minutes after removal from hot soak.

6-2.7 The SCBA shall be cold soaked at -25°F, ±2°F (-32°C, ±1°C) for a minimum of 12 hours. The SCBA shall then be transferred to a chamber with an air temperature of 160°F, ±2°F (71°C, ±1°C). The SCBA shall then be tested as specified in Section 6-1, Air Flow Performance Test, at a chamber air temperature of 160°F, ±10°F (71°C, ±5°C). The air flow performance test specified in Section 6-1 shall commence within 3 minutes after removal from cold soak.

6-3 Vibration Tests.

6-3.1 SCBA shall be tested on a typical package tester similar to that shown in Figure 514.4-19 of MIL-STD-810E, *Environmental Test Methods*, within holding boxes as specified in 6-3.2.

6-3.2 Holding boxes for the vibration test shall be constructed with nominal 3/4-in. plywood and shall be sized to encase the complete SCBA in one holding box and the SCBA components in a second holding box.

6-3.2.1 The tops of the holding boxes shall be permitted to be made of transparent material to allow observation during testing.

6-3.2.2 The SCBA holding box shall be constructed to encase the complete SCBA. SCBA regulators and hoses shall remain attached to the complete SCBA. The SCBA facepiece and those components that attach directly to the facepiece, excluding regulators, shall not be included in the SCBA holding box.

6-3.2.3 The travel distance between the widest part of the SCBA and the sideboards of the SCBA holding box shall be a total of 1.0 in., ±0.2 in., or 0.5 in., ±0.1 in. per side (25.4 mm, ±5 mm, or 13 mm, ±3 mm per side). The travel distance between the highest point of the SCBA and the bottom of the SCBA holding box top shall be a total of 1.0 in., ±0.2 in. (25.4 mm, ±5 mm).

6-3.2.4 The total travel distance shall be measured with all movable components, excluding those components specified in 6-3.2.5, configured to minimize the size of the SCBA holding box. The highest point of the SCBA shall be measured with the SCBA oriented with the back plate resting on the bottom of the SCBA holding box as shown in Figure 6-3.2.4 (shown on page 376).

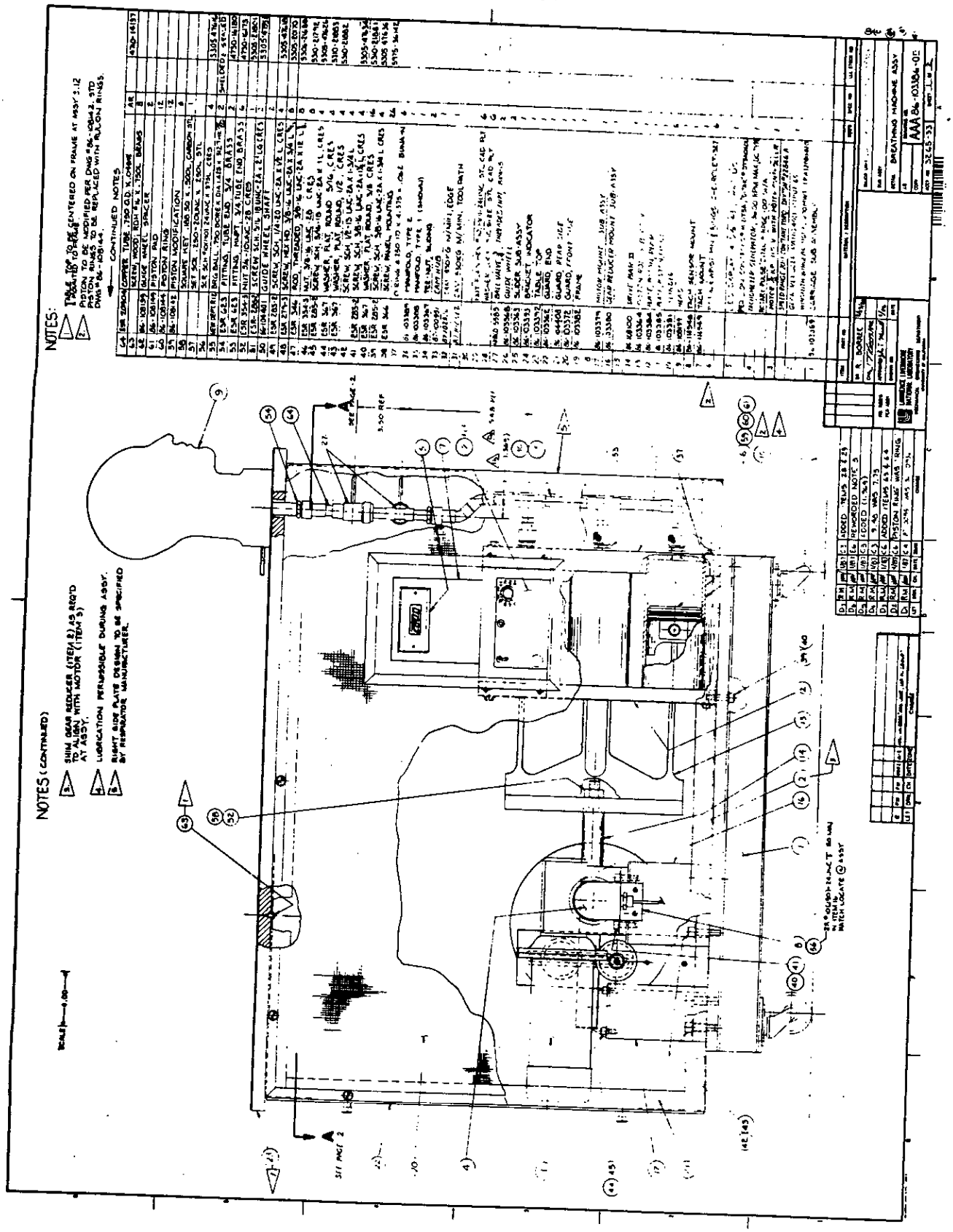


Figure 6-1.12(a) Model 327-6 breathing machine.

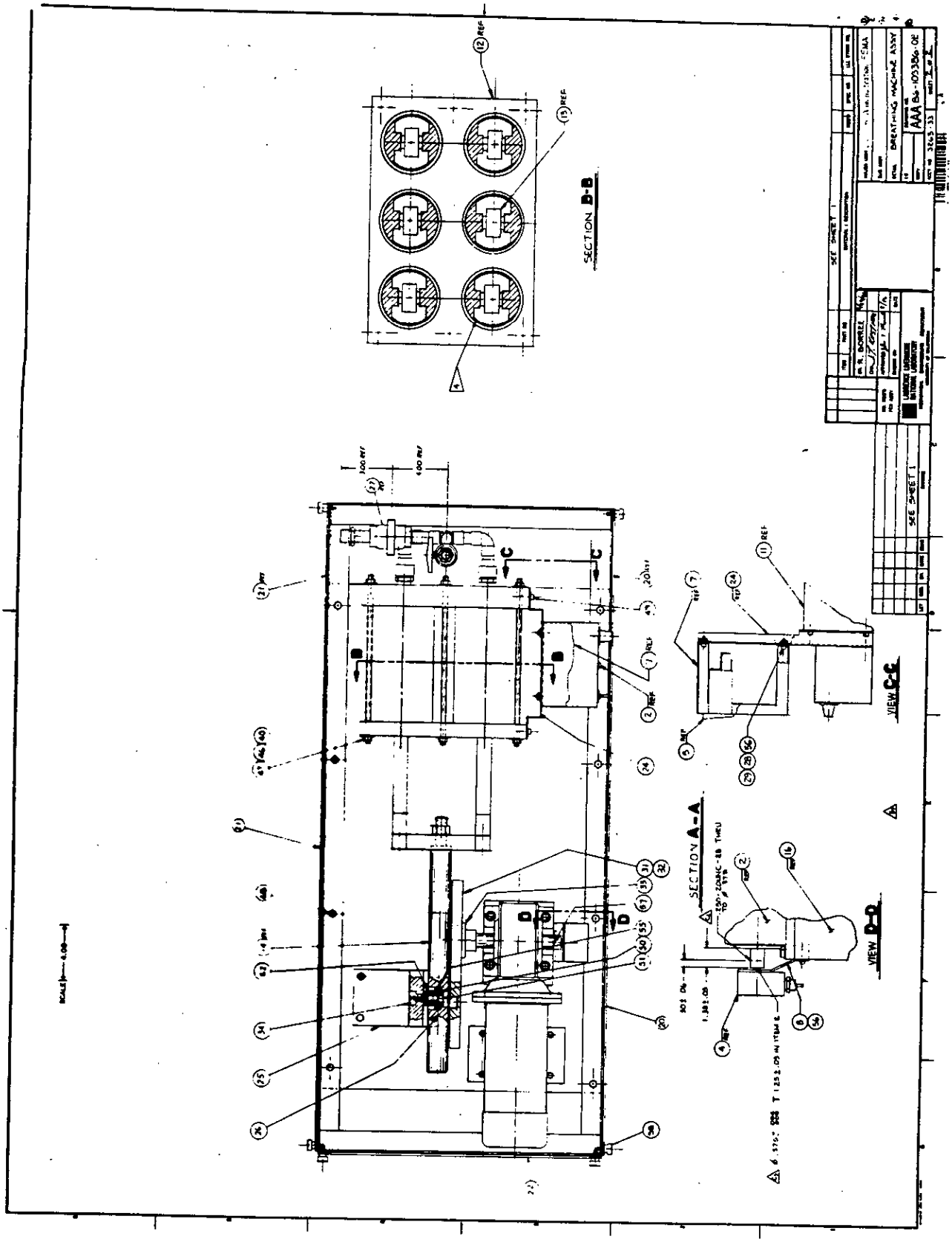


Figure 6-1.12(b) Model 327-6 breathing machine details.

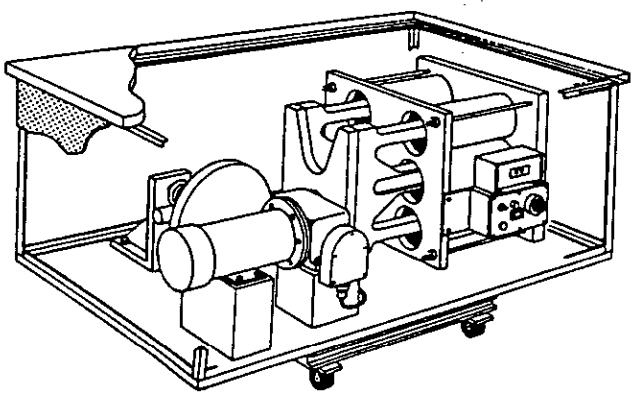


Figure 6-1.12(c) Model 327-6 breathing machine.

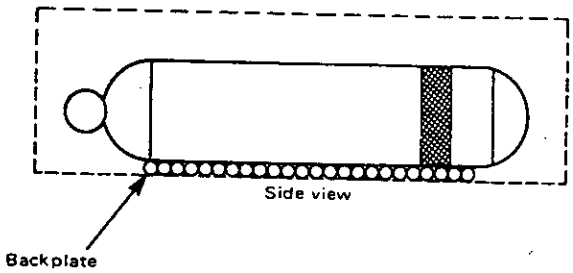


Figure 6-3.2.4 SCBA in holding box.

6-3.2.5 The second holding box for components shall be constructed to encase the facepiece and those components that attach directly to the facepiece, excluding the regulator and associated hoses.

6-3.2.6 The total travel distance between the widest part of the SCBA components and the sideboards of the component holding box shall be 1.0 in., ±0.2 in., or 0.5 in., ±0.1 in. per side (25.4 mm, ±5 mm, or 13 mm, ±3 mm per side). The total travel distance between the highest point of the facepiece and the bottom of the component holding box top shall be 1.0 in., ±0.2 in. (25.4 mm, ±5 mm).

6-3.2.7 The total travel distance shall be measured with all movable components, as specified in 6-3.2.5, configured to minimize the size of the component holding box. The highest point of the SCBA facepiece shall be measured with the facepiece oriented with the outer portion of the lens facing the top of the component holding box.

6-3.3 The test items shall be placed unrestrained in the holding boxes specified in 6-3.2 and shall be tested to the level as specified in I-3.3.3.2 of Method 514.4, Vibration, of MIL-STD-810E, *Environmental Test Methods.*

6-3.4 The test shall be conducted with the test specimen situated in each of the two positions shown in Figure 6-3.4(a) and Figure 6-3.4(b). The total test duration shall be three hours, consisting of two 90-minute periods, one period for each position.

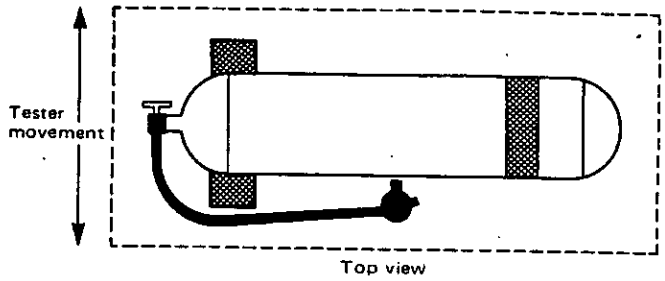


Figure 6-3.4(a) SCBA cylinder axis perpendicular to direction of tester movement.

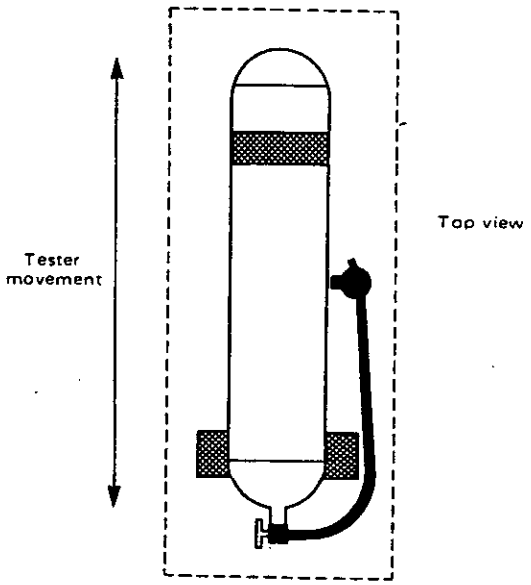


Figure 6-3.4(b) SCBA cylinder axis parallel to direction of tester movement.

6-3.5 After being subjected to the vibration tests, the SCBA shall be tested as specified in Section 6-1, Air Flow Performance Test.

6-4 Fabric Flame Tests.

6-4.1 Five specimens of each different fabric component of the SCBA shall be tested in accordance with Method 5903.1, Flame Resistance of Cloth, Vertical, of Federal Test Method Standard 191A, *Textile Test Methods.*

6-4.2 Test specimens shall be a minimum of 12 in. (305 mm) long and shall be tested in the width specified by the prescribed test method. Test specimens shall be cut from a standard production run of the fabric components used in the SCBA. If the fabric components are not available in the width specified in Method 5903.1, the width of the test specimen shall be the widest width as used on the SCBA, but shall be a minimum of 12 in. (305 mm) long.

6-4.3 The five test specimens shall first be conditioned by five cycles of washing and drying in accordance with the procedures specified in Machine Cycle 1, Wash Temperature V, Drying Procedure Ai, of ANSI/AATCC 135, *Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics,* prior to flame resistance testing.

6-4.4 The char lengths and afterflame shall be recorded, and each shall be averaged to determine pass/fail. Specimens shall be observed for evidence of melting or ignition to determine pass/fail.

6-5 Fabric Heat Tests.

6-5.1 Five specimens of each different fabric component of the SCBA shall be tested in a forced circulating air oven capable of achieving and maintaining an air stream temperature of 500°F, +10°/-0°F (260°C, +5°/-0°C).

6-5.2 Test specimens shall be 15 x 15 in., ±0.5 in. (381 x 381 mm, ±13 mm) and shall be cut from a standard production run of the fabric components used in the SCBA. If the fabric is not available in a 15-in. (381-mm) width, the width of the test specimen shall be the widest width as used on the SCBA, but shall be a minimum of 15 in. (381 mm) long.

6-5.3 The five test specimens shall first be conditioned by five cycles of washing and drying in accordance with the procedures specified in Machine Cycle 1, Wash Temperature V, Drying Procedure Ai, of ANSI/AATCC 135, *Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics*, prior to heat resistance testing.

6-5.4 The test specimen shall be suspended by a metal hook(s) at the top and centered in the oven so that the entire test specimen is not less than 2 in. (51 mm) from any oven surface or another test specimen. Oven air flow shall be parallel to the plane of the material.

6-5.5 Test specimens shall be exposed to the circulating air flow for 5 minutes, +15/-0 seconds. Oven recovery time after the door is closed shall not exceed one minute. Test specimen exposure time shall begin when the oven has recovered to an air temperature of 500°F, +10°/-0°F (260°C, +5°/-0°C).

6-5.6 Specimens shall be observed for evidence of melting or ignition to determine pass/fail.

6-6 Thread Heat Test.

6-6.1 All thread utilized shall be tested in accordance with Method 1534, Melting Point of Synthetic Fibers, of Federal Test Method Standard 191A, *Textile Test Methods*, to a temperature of 500°F, +10°/-0°F (260°C, +5°/-0°C).

6-6.2 Specimens shall be observed for evidence of melting or ignition to determine pass/fail.

6-7 Accelerated Corrosion Test.

6-7.1 An SCBA with a fully charged breathing gas cylinder, with the breathing gas cylinder valve fully closed, shall be tested in accordance with Method 509.3, Salt Fog, Section II, of MIL-STD-810E, *Environmental Test Methods*.

6-7.2 The SCBA shall be attached to a mannequin to simulate its typical wearing position on a fire fighter as specified by the manufacturer. The mannequin shall then be placed in a test chamber. The test chamber temperature shall be adjusted to 95°F, ±3°F (35°C, ±2°C). The SCBA shall be placed in the chamber for 2 hr prior to the introduction of the salt solution.

6-7.3 The SCBA shall be exposed to a 5 percent, ±1 percent salt fog for a period of 48 hr.

6-7.4 The SCBA shall then be stored in an environment of 72°F, ±5°F (22°C, ±3°C) with 50 percent, ±5 percent relative humidity for a minimum of 48 hr.

6-7.5 The SCBA shall then be tested as specified in Section 6-1, Air Flow Performance Test, to determine pass/fail. All controls or operating features of the SCBA shall operate per the SCBA manufacturer's instructions to determine pass/fail.

6-8 Particulate Test.

6-8.1 A fully charged SCBA shall be subjected to Method 510.3, Sand and Dust, Section II-3, Procedure I, of MIL-STD-810E, *Environmental Test Methods*.

6-8.2 The facepiece of the SCBA being tested shall be secured to a test headform as specified in 6-1.1.

6-8.3 The test headform shall be joined to a mannequin with the remaining components of the SCBA attached to the mannequin to simulate its typical wearing position on a fire fighter, as specified by the manufacturer.

6-8.4 The test headform shall be connected, as specified in Section 6-1, to a Model 327-6 Breathing Machine or other respiration simulator producing a minute volume of 40 liters, ±2 liters at ambient conditions, as specified in 6-1.13, with a minimum tidal volume of 1.6 liters per breath at a minimum respiration of 10 breaths per minute.

6-8.5 The mannequin, including the test headform, shall be mounted upright and turned about its vertical axis 180 degrees midway through the test. The test duration shall be 1 hr, and the breathing machine shall be operating throughout the entire test. The test shall be permitted to be interrupted to change the SCBA breathing gas cylinder.

6-8.6 The test conditions as outlined per Method 510.3, Sand and Dust, of MIL-STD-810E, *Environmental Test Methods*, Section I-3d, shall be:

(a) Air velocity: 1750 ft/min., ±250 ft/min. (533.4 m/min., ±76.2 m/min.);

(b) Temperature: 72°F, ±5°F (22°C, ±3°C);

(c) Test item configuration and orientation: mannequin upright and rotated 180 degrees midway through the test;

(d) Dust composition: Refer to Section I-3.2d (1);

(e) Dust concentration: Refer to Section I-3.2e (1); and

(f) Test duration: 1.0 hr.

6-8.7 After the completion of the above test, the SCBA shall be removed from the test compartment; it shall be lightly shaken or brushed free of dust and then shall be tested as specified in Section 6-1, Air Flow Performance Test, to determine pass/fail.

6-9 Facepiece Lens Abrasion Test.

6-9.1 The test apparatus shall be constructed in accordance with Figure 6-9.1 (shown on pages 378 and 379).

6-9.2 Seven samples shall be chosen from a minimum of three facepiece lenses. Four samples shall be taken from the left viewing area, and three samples shall be taken from the right viewing area. One of the four samples taken from the left viewing area shall be the set-up sample.

6-9.2.1 The left test samples shall include all of the following criteria:

(a) The sample shall be a square measuring 2 x 2 in. (51 x 51 mm).

(b) 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 sample.

(c) At least 1 1/2 in. (38 mm) of the 2 x 2-in. (51 x 51-mm) square shall be taken from the left side of the center line of the lens.

(d) The 2 x 2-in. (51 x 51-mm) square shall be cut at approximately eye level.

6-9.2.2 The right test samples shall include all of the following criteria:

(a) The sample shall be a square measuring 2 x 2 in. (51 x 51 mm).

(b) 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 sample.

(c) At least 1 1/2 in. (38 mm) of the 2 x 2-in. (51 x 51-mm) square shall be taken from the right side of the center line of the lens.

(d) The 2 x 2-in. (51 x 51-mm) square shall be cut at approximately eye level.

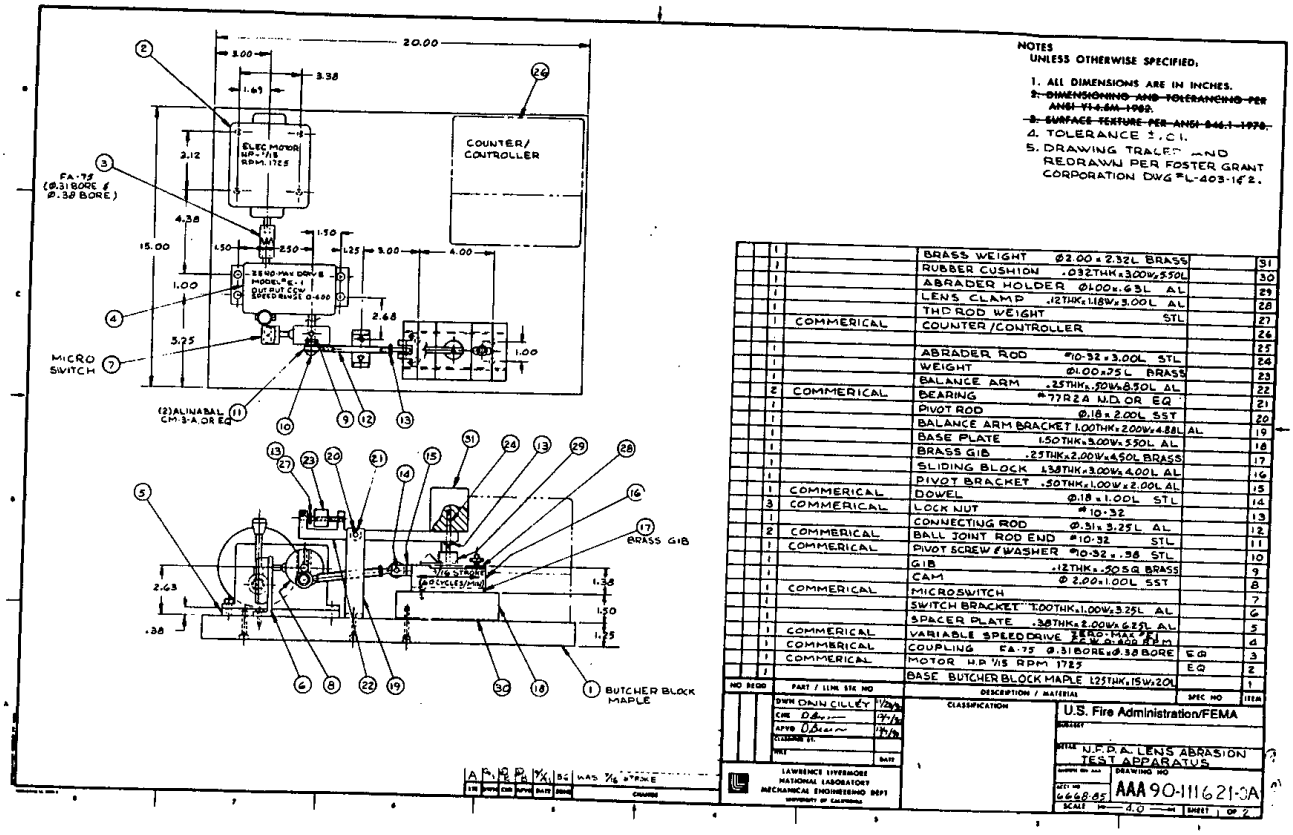


Figure 6-9.1 Lens abrasion tester.

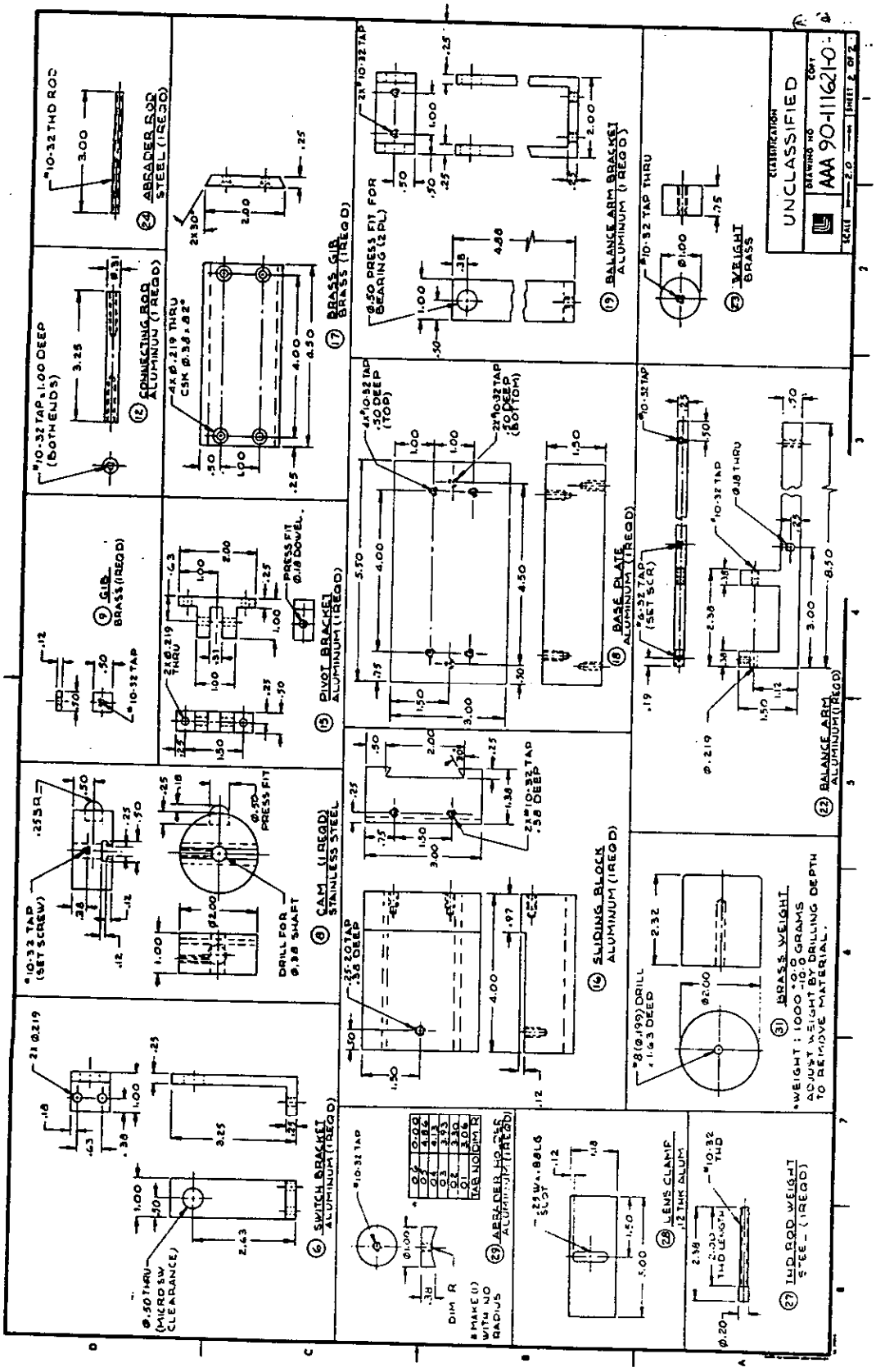


Figure 6-9.1 Lens abrasion tester.

6-9.3 Each of the samples shall be cleaned in the following manner:

(a) The sample shall be rinsed with clean tap water.

(b) The sample shall be washed with a solution of nonionic/low phosphate detergent and water using a clean, soft gauze pad.

(c) The sample shall be rinsed with deionized water.

(d) The sample shall be blown dry with clean compressed air or nitrogen.

6-9.4 The haze of the sample shall be measured using a haze meter in accordance with ASTM D 1003, *Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics*, and recorded with the following additions:

(a) The haze shall be measured in the middle of the sample ±1/16 in. (±1.6 mm).

(b) The sample shall be repositioned to achieve the maximum haze value within the area defined in (a).

(c) The haze meter shall have a specified aperture of 7/8 in. (22.4 mm).

(d) The haze meter shall have a visual display showing 0.1 percent resolution.

(e) The haze meter shall be calibrated before and after each day's use following procedures specified in ASTM D 1003, *Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics*.

6-9.5 The set-up sample shall be placed cover side up in the test apparatus sample holder. The sample holder shall be configured with a flat surface under the lens or with an inner radius support.

6-9.6 The pad holder shall consist of a cylinder 3/8 in. (9.6 mm) high and 1 in. (25.4 mm) 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. This cylinder shall be rigidly affixed to the stroking arm by a #10-32 UNF threaded rod.

6-9.7* The pad shall be a Blue Streak M306M wool felt polishing pad 15/16 in. (23.8 mm) in diameter.

6-9.8* The abrasive disc shall be made from 3M Part Number 7415, Wood Finishing Pad. A disc 15/16 in. (23.8 mm) in diameter shall be cut from the abrasive sheet. The marked side of the disc shall be placed against the pad. Care shall be exercised to maintain this orientation for each abrasive disc throughout the testing.

6-9.9 The pad holder, pad, and abrasive disc shall be installed on the stroking arm. The stroking arm shall be leveled to ±3 degrees by adjusting the threaded pin. The pin shall be secured to prevent rotation of the pad holder. The axis of curvature of the pad holder shall be coincident with the axis of curvature of the lens.

6-9.10 The stroking arm shall be counterbalanced with the pad holder, pad, and abrasive disc in place.

6-9.11 The set-up sample shall be replaced with one of the six samples to be tested.

6-9.12 The 1000-g, ±5 g (2.2-lb, ±0.18 lb) test weight shall be installed on the pin above the test sample.

6-9.13 The test shall be run for 200 cycles, ±1 cycle. One cycle shall consist of a complete revolution of the eccentric wheel.

6-9.14 The length of stroke shall be 9/16 in. (14.4 mm), producing a pattern 1 1/2 in. (38.1 mm) long. The frequency of the stroke shall be 60 cycles, ±1 cycle per minute. The center of the stroke shall be within ±1/16 in. (±1.6 mm) of the center of the sample.

6-9.15 The sample shall be removed and cleaned following the procedure specified in 6-9.3. The abrasive disc shall be discarded.

6-9.16 The haze of the sample shall be measured following the procedure specified in 6-9.4.

6-9.17 The delta haze shall be calculated by subtracting the initial haze from the final haze.

6-9.18 The testing steps specified in 6-9.3 through 6-9.16 shall be repeated five times with a new sample and abrasive disc.

6-9.19 The six delta haze values shall be averaged. The resultant value shall be compared to the value specified in 5-9.1 to determine pass/fail.

6-10 Communication Test.

6-10.1 The method for measuring word intelligibility shall be as specified in ANSI S3.2, *Method for Measuring the Intelligibility of Speech over Communication Systems*, as modified by the following requirements.

6-10.2 Testing shall be conducted in a chamber that absorbs a minimum of 90 percent of all sound from 500 to 5000 Hz.

6-10.3 Five listening subjects and five talkers consisting of four males and one female shall be available for testing. The subjects participating as listeners shall have "audiometrically normal" hearing as defined in Section 5.3 of ANSI S3.2, *Method for Measuring the Intelligibility of Speech over Communication Systems*. Talkers and listeners shall be selected and trained according to Section 7 of ANSI S3.2.

6-10.4 The five talkers shall not have facial hair, any unusual facial characteristics, or any other condition that could cause interference with the seal of the facepiece. The talkers shall perform and pass a qualitative facepiece-to-face fit check per the SCBA manufacturer's instructions. If the talker is qualified to wear several sizes of facepieces, then the talker shall choose the facepiece that is most comfortable.

6-10.5 The five talkers shall be trained in the donning and usage of the SCBA per manufacturer's instructions.

6-10.6 The five talkers shall have no obvious speech defect or strong regional accent. Distance between the talker and listener(s) shall be 5 ft, +1/-0 ft (1.5 m, +30.5/-0 cm), and they shall be facing each other.

6-10.7 The test material shall be the reading of one complete list of phonetically balanced words as contained in Table 1 of ANSI S3.2, *Method for Measuring the Intelligibility of Speech over Communication Systems*. The words shall be spoken singularly in the following carrier sentence: "Would you write (list word) now?" The rate shall be approximately one test word every six seconds. The talkers shall be trained to talk at 65-75 dBA without an SCBA facepiece, measured at the listener's ear, placing no unusual stress on any word. Training shall include the use of background noise as defined in 6-10.9. The talkers shall not vary their voice level after the facepiece is donned from that used without the facepiece. The listeners shall write each word as they hear it.

6-10.8 The talkers shall conduct two tests in the chamber having an ambient noise field as specified in 6-10.9, using a different word list for each of the following conditions:

(a) With no SCBA; and

(b) With SCBA worn and operated per the SCBA manufacturer's instructions.

6-10.9 The test chamber shall be filled with broadband "pink" noise with a tolerance of 6 dB per octave band from 400 to 4000 Hz. The forward axis of the loudspeaker shall be oriented away from the listener group. The distance between the loudspeaker and the listeners shall be as great as possible so as to create a quasi-uniform sound field over the listening group. More than one loudspeaker shall be permitted to be used to achieve the desired sound field. The gain of the power amplifier shall be adjusted to achieve an A-weighted sound level of 60 dB, ±2 dB at each listener's head position, without listeners present.

6-10.10 Each listener's response form shall be scored as to the number of correct responses out of the 50 words recited. Talkers' speech shall be recorded or monitored closely during the tests to determine if the talkers conform to the word list specified for that test. Listeners' scores shall be based on the words actually spoken by the talkers. Listeners' scores shall not be reduced because of speaking mistakes of the talkers or spelling errors that are phonetically correct.

6-10.11 All of the listeners' scores without the SCBA used by the talker shall be averaged. All of the listeners' scores with the SCBA used by the talker shall be averaged. The average score of the five listeners for the talker using the SCBA shall be divided by the

average score of the five listeners for the talker without using the SCBA, and the result shall be called the "score value." This procedure shall be performed for each of the five talkers.

6-10.12 The average of the score values obtained in 6-10.11 shall be calculated.

6-10.12.1 If the average of the score values >72 percent, this average score value shall be used to determine pass/fail as specified in Section 5-10.

6-10.12.2 If the average of the score values <72 percent, the sample standard deviation (s.d.) of the score values shall be calculated in the following manner:

$$s.d. = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{N}}{N-1}}$$

where x = score values and
N = sample size (5).

6-10.12.3 If the calculated sample standard deviation of the test score values >10.0, the test shall be invalidated, and the procedures of 6-10.7 through 6-10.12.6 shall be repeated.

6-10.12.4 If the calculated sample standard deviation of the test score values <10.0, a test statistic T value shall be calculated to determine if the average of the score values obtained is or is not equivalent to 72 percent; it shall be calculated in the following manner:

$$T = \frac{(\mu - \overline{x})\sqrt{N}}{s.d.}$$

where: $\overline{X}$ = average of the score values
N = sample size (5)
μ = 72 percent
s.d. = sample standard deviation.

6-10.12.5 For T values ≤ 2.13, the score value shall be considered to be equivalent to a score value of 72 percent and shall be used to determine pass/fail as specified in Section 5-10.

6-10.12.6 For T values >2.13, the score value shall be as calculated in 6-10.12. This calculated score value shall be used to determine pass/fail as specified in Section 5-10.

6-11* Heat and Flame Test.

6-11.1 A test mannequin meeting the requirements specified in Figure 6-11.1 (shown on page 382) shall be provided.

6-11.2* The test mannequin shall have a protective covering. The protective covering shall be designed and constructed as follows.

6-11.2.1 The assembled protective covering composite consisting of an outer shell, moisture barrier, and thermal liner shall have an average Thermal Protective Performance (TPP) of not less than 35.0 when tested in accordance with Section 5-2 of NFPA 1971, *Standard on Protective Clothing for Structural Fire Fighting.*

6-11.2.2 The outer shell shall be 40 percent PBI®/60 percent Kevlar rip stop weave, weighing approximately 7.5 oz/sq yd (255 g/m^2), with a water repellent finish. Color shall be natural, undyed.

6-11.2.3 The thermal liner shall be constructed of a 3.0-oz/sq yd (102-g/m^2) rip-stop pajama check Nomex® III facecloth quilt-stitched to 100 percent Nomex® III batting of approximately 6.0 oz/sq yd (204 g/m^2).

6-11.2.4 The moisture barrier shall be constructed of approximately 2.25-oz/sq yd (76-g/m^2) polyester/cotton fabric that is coated with approximately 6.5 oz/sq yd (221 g/m^2) of flame-resistant neoprene.

6-11.2.5 The moisture barrier shall be completely sewn to the thermal liner at its perimeter with the neoprene side facing outward from the thermal liner. All edges shall be sewn together and bound with non-wicking moisture barrier material. The liner/moisture barrier shall be no more than 3 in. (76 mm) from the coat hem.

6-11.2.6 The moisture barrier and thermal liner shall be completely detachable from the outer shell.

6-11.2.7 The protective covering shall be stitched with Kevlar thread using a minimum of 6 to 8 stitches per inch (25.4 mm). All major seams are to be double stitched and felled locked with all inside seams to be finished with Kevlar thread. All stress points shall be reinforced. No metal shall pass from the outside of the protective covering through the moisture barrier and liner to cause the transfer of heat to the mannequin when the protective covering is completely assembled. The protective covering, including the front closure, shall be constructed in a manner that provides secure and complete moisture and thermal protection. If nonpositive fasteners, such as snaps or hook-and-pile tape, are utilized in garment closures, a positive locking fastener, such as hooks and dees or zippers, shall also be utilized. Pockets and fluorescent retroreflective trim shall not be installed.

6-11.2.8 The collar shall be made of four-piece construction consisting of outer shell material on both the back, or outside, and next to the mannequin neck. The two inner layers shall consist of a thermal liner and moisture barrier. No throat strap shall be attached.

6-11.2.9 Sleeve outside seams shall be felled, while inside seams shall be lock stitched.

6-11.2.10 All protective covers shall measure 35 in. (889 mm) long when measured from the center of the back collar seam to the hem. The protective cover size shall be 44-in. (118-mm) chest x 34-in. (864-mm) sleeve.

6-11.2.11 The complete protective covering shall be discarded and shall not be used after three flame exposures of the flame and heat test.

6-11.3 A test headform meeting the requirements specified in 6-1.1 shall be used on the test mannequin.

6-11.4 The test headform shall be attached to the Model 327-6 Breathing Machine as specified in Figures 6-1.12(a), (b), and (c), with the modification that a 0.75 in. (19 mm) ID. breathing hose, not longer than 25 ft (7.6 m), shall be attached to the tee in the breathing machine and the throat tube of the test mannequin headform.

6-11.5 The test headform shall be covered with an undyed aramid hood for protection of the headform during testing. The protective hood shall meet the requirements of Section 6-1 of NFPA 1971, *Standard on Protective Clothing for Structural Fire Fighting.*

6-11.6 The protective hood, when placed on the test headform, shall not affect the seal of the facepiece to the headform. 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.

6-11.7 The SCBA shall be mounted on the test mannequin to simulate the correct wearing position on a fire fighter as specified by the SCBA manufacturer's instructions.

6-11.8 The facepiece shall be mounted and tested on the test headform as specified in 6-1.1.

6-11.9 The heat and flame test apparatus shall be as specified in Figure 6-11.9 (shown on pages 383 and 384).

6-11.10 The test oven shall be a horizontal forced circulating air oven with an internal velocity of 200 linear ft (61 m) per minute. The test oven shall have minimum dimensions of 36 in. x 36 in. x 48 in. (914 mm depth x 914 mm width x 1.22 m. height).

6-11.11 The test oven shall be calibrated using a 30-gauge exposed bead type J iron/constantan wire reference thermocouple that has been calibrated to set the 32.0°F (0.0°C) reference point with an ice bath containing ice and deionized or distilled water. Boiling water shall be used to set the 212°F (100°C) reference value. The reference temperatures shall be corrected to standard temperatures using a barometric pressure correction.

6-11.12 For calibration prior to the heat and flame test, the calibration mannequin, as specified in Figure 6-11.12 (shown on page 385), shall be exposed to direct flame contact for 10 seconds using the heat and flame test apparatus. All peak temperature readings shall be within a temperature range of 1500°F to 2102°F (815°C to 1150°C). The average mean of all peak temperature readings shall be no higher than 1742°F (950°C).

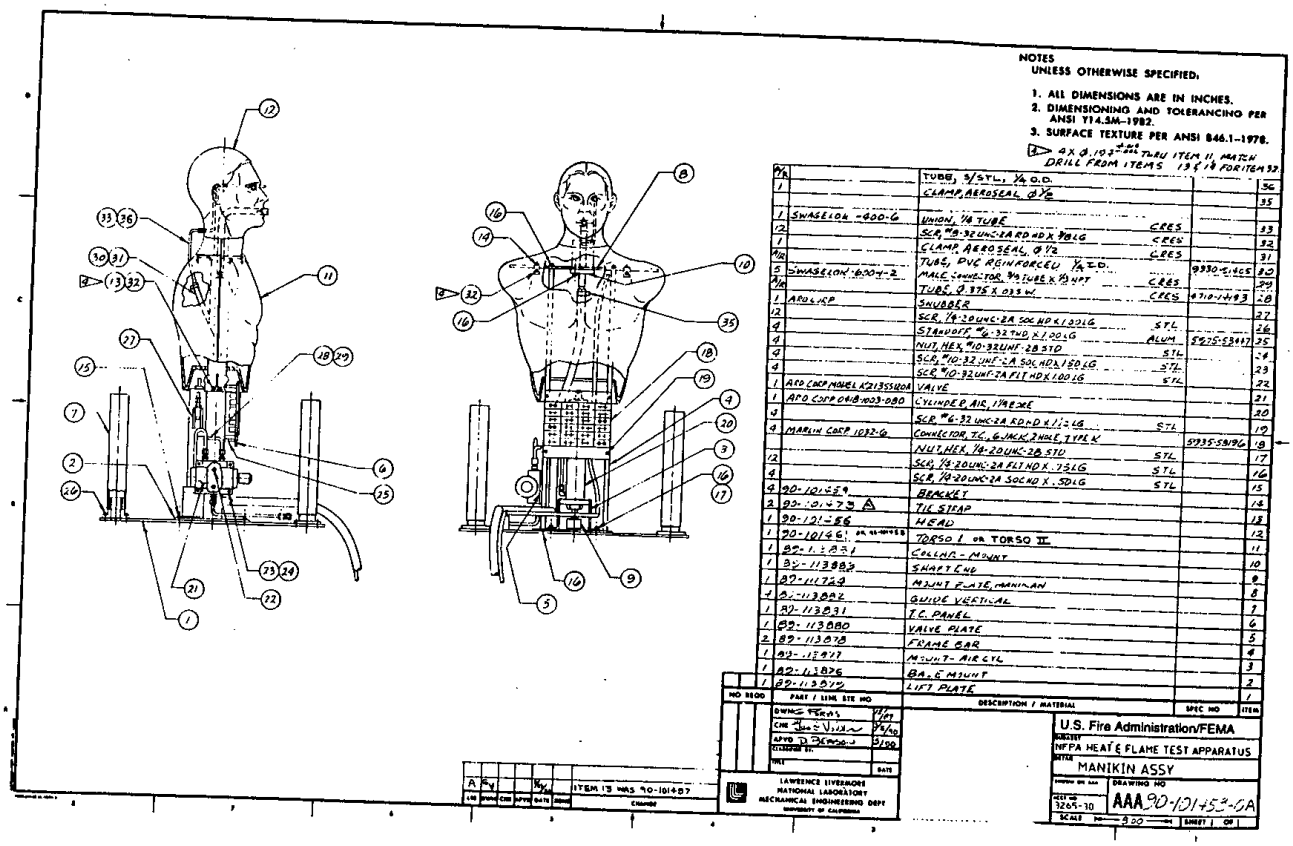


Figure 6-11.1 Test mannequin.

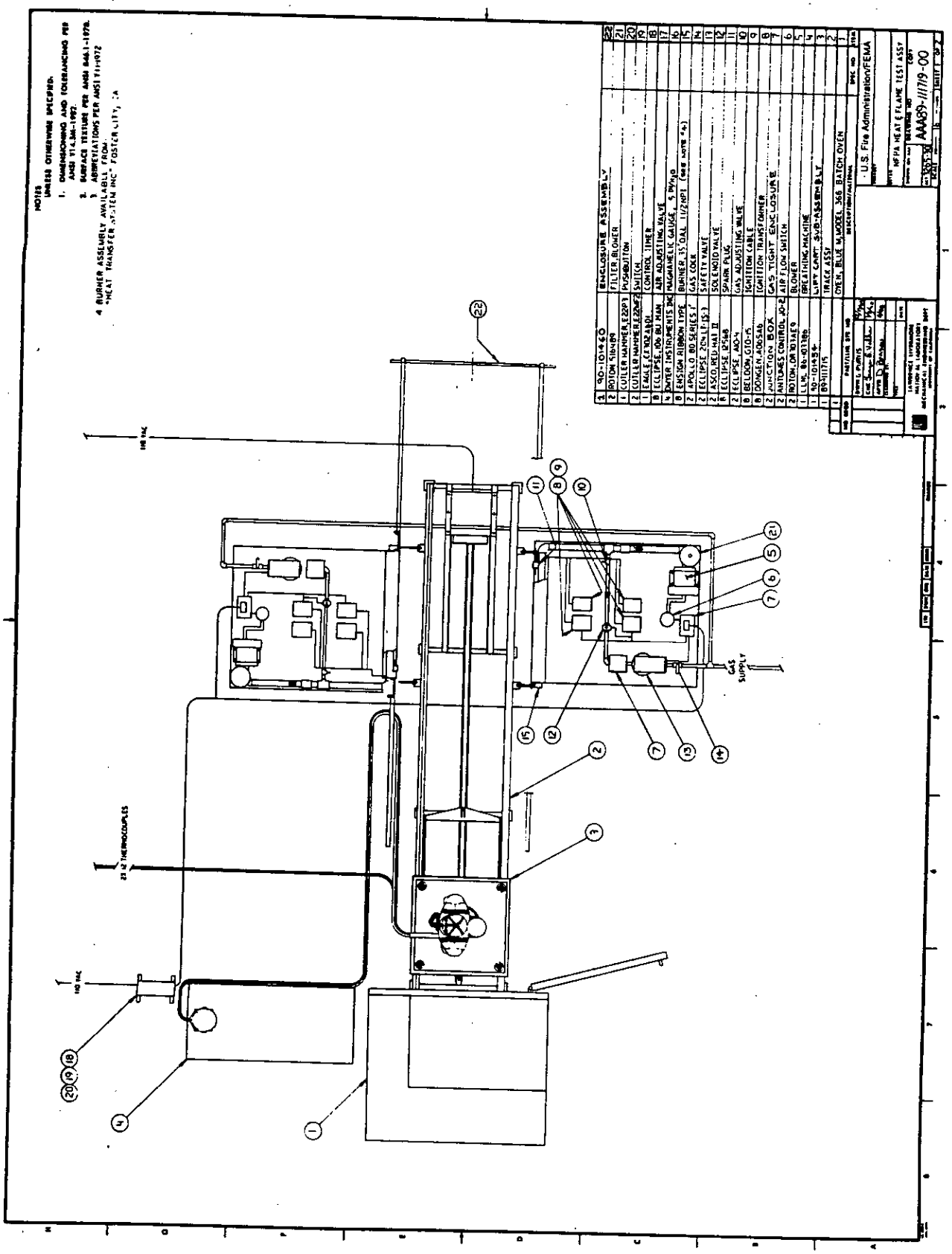


Figure 6-11.9 Heat and flame test apparatus.

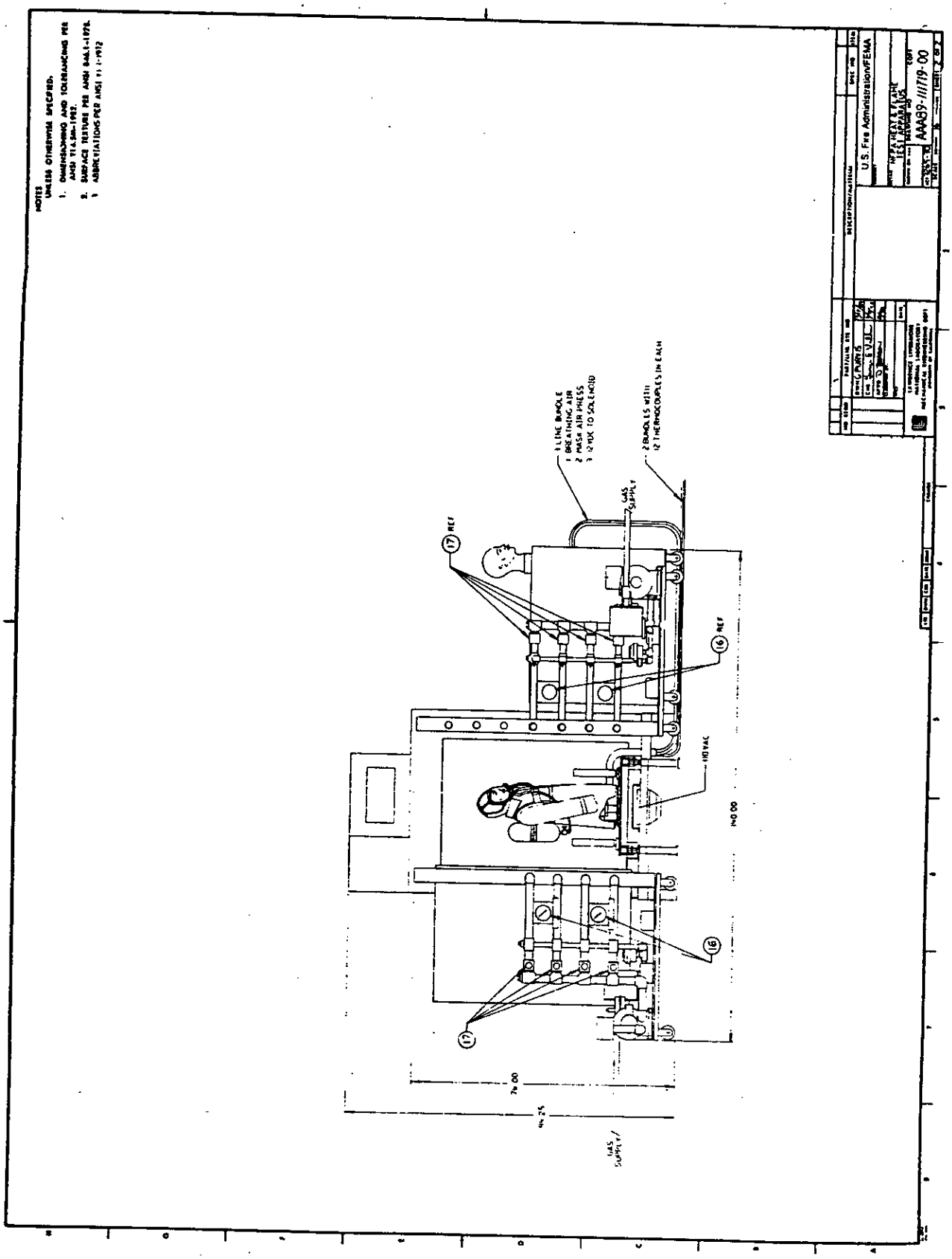
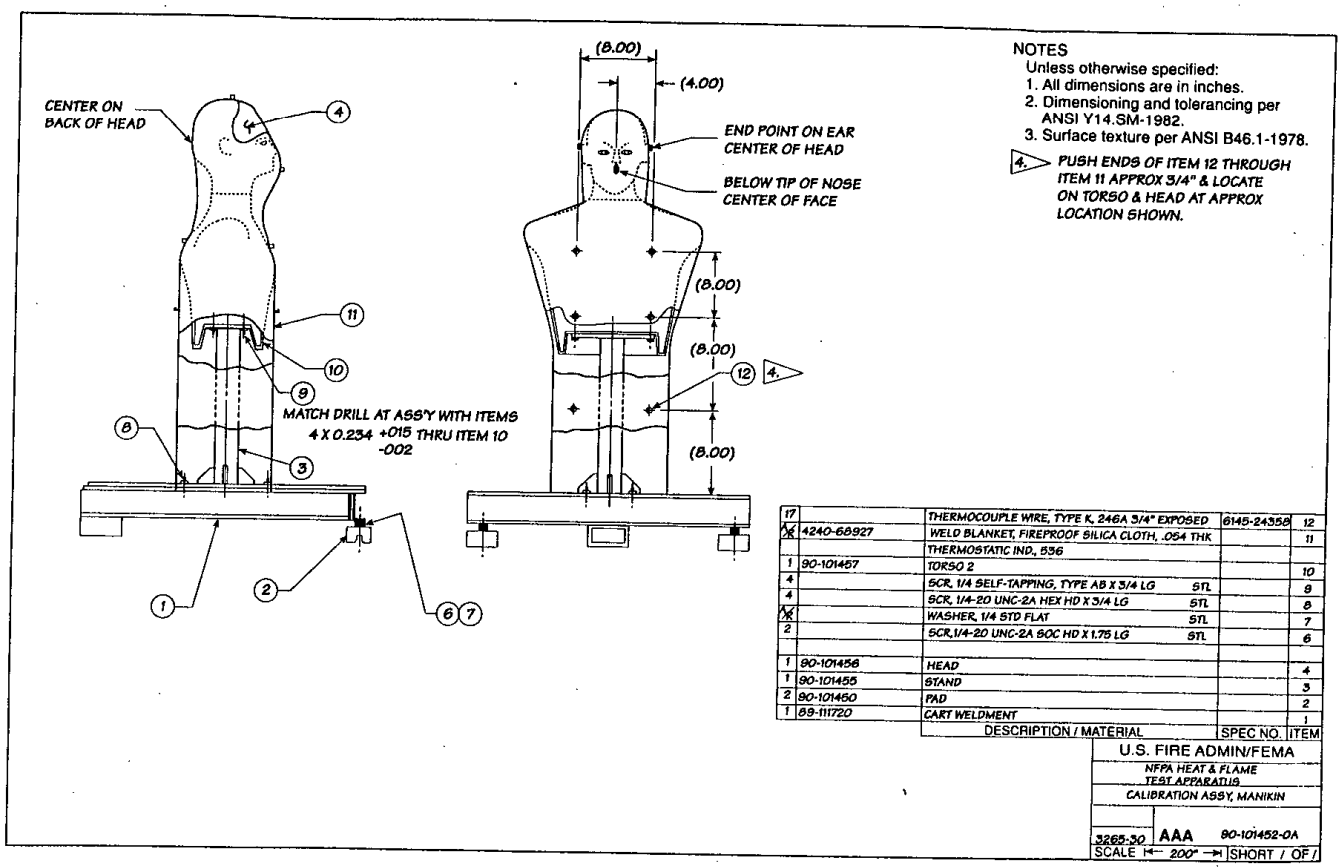


Figure 6-11.9 Heat and flame test apparatus.



ITEM	SPEC NO.	DESCRIPTION / MATERIAL		
17		THERMOCOUPLE WIRE, TYPE K, 24GA 3/4" EXPOSED	6145-24358	12
AR	4240-68927	WELD BLANKET, FIREPROOF SILICA CLOTH, .054 THK		11
		THERMOSTATIC IND., 536		
1	90-101457	TORSO 2		10
4		SCR, 1/4 SELF-TAPPING, TYPE AB X 3/4 LG	STL	9
4		SCR, 1/4-20 UNC-2A HEX HD X 3/4 LG	STL	8
AR		WASHER, 1/4 STD FLAT	STL	7
2		SCR,1/4-20 UNC-2A SOC HD X 1.75 LG	STL	6
1	90-101456	HEAD		4
1	90-101455	STAND		3
2	90-101450	PAD		2
1	89-111720	CART WELDMENT		1

U.S. FIRE ADMIN/FEMA
NFPA HEAT & FLAME TEST APPARATUS
CALIBRATION ASSY, MANIKIN
3265-30 AAA 90-101452-0A
SCALE 200 SHORT / OF /

Figure 6-11.12 Calibration mannequin.

6-11.13 The test oven recovery time, after the door is closed, shall not exceed 1.0 min.

6-11.14 The air flow performance test shall be conducted as specified in 6-1.12, 6-1.13, 6-1.14, and 6-1.15 herein, with modifications to the ventilation rate specified in 6-11.15 and with test temperatures specified in 6-11.12 and 6-11.15 herein. The air flow performance test shall continue through the drop test as specified in 6-11.19.

6-11.14.1 The variation in pressure extremes caused by the flame and heat test mannequin configuration shall be determined in the following manner. The air flow performance test as specified in Section 6-1 shall be carried out at a ventilation rate of 103 L/min, ±3 L/min, and 40 L/min, ±2 L/min. A second air flow performance test shall be carried out using the configuration specified in 6-11.4 at the same ventilation rates. The difference in pressure between the two tests shall be calculated by subtracting the values obtained using the configuration defined in 6-11.4 from the values obtained using the configuration specified in Section 6-1.

6-11.15 The ventilation rate shall be set at 40 L/min, ±2 L/min, with a respiratory frequency of 12, ±1 breaths/minute, at ambient conditions as specified in 6-1.13. The SCBA mounted on the test mannequin shall be placed in the test oven that has been preheated to 203°F, ±4°F (95°C, ±2°C). After the door is closed and the oven temperature recovers to 203°F (95°C), the test exposure time of 15 minutes shall begin.

6-11.16 At the completion of the 15-minute exposure, the ventilation rate shall be increased to 103, ±3 L/min, as specified in 6-1.12. The oven door shall be opened and the SCBA mounted on the test mannequin shall be moved out of the oven and into the center of the burner array.

6-11.17 The SCBA shall then be exposed to direct flame contact for 10 seconds +0.25/±0.0 seconds. This exposure shall begin within 20 seconds of removal of the SCBA from the test oven.

6-11.17.1 The SCBA shall be observed for any afterflame, and the afterflame duration shall be recorded to determine pass/fail as specified in 5-11.2.

6-11.18 Within 20 seconds after completing the direct flame exposure, the SCBA mounted on the test mannequin shall be raised 6 in., +0.25/-0.0 in. (152 mm, +6.3/-0.0 mm) and dropped freely.

6-11.18.1 The SCBA shall be observed to determine pass/fail as specified in 5-11.3.

6-11.19 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 6-11.14 to determine pass/fail as specified in 5-11.1. 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.

6-11.20 The SCBA facepiece shall be removed from the test headform and, without touching the lens, shall be donned by a test subject with visual acuity of 20/20 in each eye, uncorrected or corrected with contact lenses. The test shall be conducted using a standard 20-ft (6.1-m) eye chart with normal lighting range of 100 to 150 ft-candles at the chart and with the test subject positioned at a distance of 20 ft (6.1 m) from the chart. The test subject shall then read the standard eye chart at some point through the nominal center of the lens of the facepiece to determine pass/fail as specified in 5-11.4.

6-11.20.1 The nominal center of the lens shall be the area bounded by a line 2 in. (50.8 mm) above, 2 in. (50.8 mm) below, 2 in. (50.8 mm) left, and 2 in. (50.8 mm) right of the intersection of the basic and midsagital planes.

Chapter 7 Referenced Publications

7-1 The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

7-1.1* NFPA Publication.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, 1992 edition.

NFPA 1971, *Standard on Protective Clothing for Structural Fire Fighting*, 1991 edition.

7-1.2* ANSI Publications.

ANSI/AATCC 135, *Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics*, 1989.

ANSI S3.2, *Method for Measuring the Intelligibility of Speech over Communication Systems*, 1989.

ANSI/CGA G-7.1, *Commodity Specification for Air*, 1989.

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

7-1.3* ASTM Publication.

ASTM D 1003, *Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics*, 1988

7-1.4* GSA Publication.

Federal Test Method Standard 191A, *Textile Test Methods*, 20 July 1978.

7-1.5* Navy Publication.

MIL-STD-810E, *Environmental Test Methods*, 14 July 1989.

7-1.6* U.S. Government Publication.

Title 42, *Code of Federal Regulations*, Part 84 (42 CFR 84), *Respiratory Protective Devices, Tests for Permissibility*, 8 June 1995.

Appendix A

This Appendix is not a part of the requirements of this NFPA document but is included for informational purposes only.

A-1-1.1 The use of self-contained breathing apparatus (SCBA) by fire fighters is always assumed to be in atmospheres immediately dangerous to life or health (IDLH). There is no way to predetermine hazardous conditions, concentrations of toxic materials, or percentages of oxygen in air in a fire environment, during overhaul (salvage) operations, or under other emergency conditions involving spills or releases of hazardous materials. Thus, SCBA are required at all times during any fire fighting, hazardous materials, or overhaul operations.

A-1-2.1 In this 1997 edition, new design requirements were added to allow the increase in weight of an SCBA when the SCBA incorporated other elements of a user's protective clothing or equipment as a component of the SCBA (*see 4-1.1.1 and A-4.1.1*); for intrinsically safe electrical circuits (*see 4-1.2*); and for accessories to meet the heat and flame test requirements (*see 5-11.2*). Also note the change to vibration testing in item 7 below.

The following is a brief description of selected performance requirements of this standard:

1. *Air Flow Performance Test.* This test increases the current NIOSH breathing machine requirement of 40 L/min to 100 L/min. The 100 L/min ventilation rate was derived from a review of several studies indicating that a ventilation rate of 100 standard liters per minute encompasses the 98th percentile of all fire fighters studied.

2. *Environmental Temperature Resistance Tests.* This series of tests exposes SCBA to various temperature extremes and temperature cycles that SCBA might be exposed to during storage conditions and certain environmental changes.

3. *Particulate Resistance Test.* This test exposes SCBA to a specified concentration of particulate to provide a reasonable level of assurance that SCBA is designed to properly function when exposed to the dust conditions commonly present during fire fighting operations.

4. *Facepiece Lens Abrasion Resistance Test.* This test is designed to provide a reasonable level of assurance that the SCBA facepiece lens is not easily scratched during fire fighting operations, thereby resulting in reduced visibility for the fire fighter.

5. *Communications Test.* This test is designed to assure that the SCBA facepiece does not significantly reduce a fire fighter's normal voice communication.

6. *Accelerated Corrosion Resistance Test.* This test is to provide a reasonable level of assurance that SCBA is designed to resist corrosion that can form and interfere with SCBA performance and function.

7. *Vibration Test.* In this 1997 edition, the previous requirement for a secured vibration test has been eliminated, as it was much less severe than the unsecured vibration test that is still required, and provided no additional evaluation of the SCBA. The unsecured vibration test provides a reasonable level of assurance that when SCBA is exposed to vibration and impact, such as being carried on a vehicle that often travels over rough road surfaces, the SCBA will *properly* perform and function.

8. *Fabric Components Test.* Flame, heat, and thread tests are added to provide a reasonable level of assurance that the fabric components of a harness assembly used to hold the SCBA to the wearer's body will remain intact during fire fighting operations.

9. *Heat and Flame Test.* This test is intended to provide a reasonable level of assurance that, when SCBA is exposed to a variety of thermal and physical conditions and breathing rates that simulate the conditions of a flashover accident, the SCBA will perform and function properly.

Users are cautioned that if more unusual conditions prevail, such as higher or lower extremes of temperatures than described herein, or if there are signs of abuse or damage to the SCBA or its components, the user's margin of safety can be reduced or eliminated. Any retrofits or repairs should be approved by the manufacturer whose SCBA complies with this standard.

A-1-2.3 Although SCBA that meet this standard have been tested to more stringent requirements than required for NIOSH certification, there is no inherent guarantee against SCBA failure or fire fighter injury. Even the best-designed SCBA cannot compensate for either abuse or the lack of a respirator training and maintenance program. The severity of these tests should not encourage or condone abuse of SCBA in the field.

The environmental tests utilized in this standard alone might not simulate actual field conditions, but are devised to put extreme loads on SCBA in an accurate and reproducible manner by test laboratories. However, the selection of the environmental tests was based on summary values derived from studies of conditions that relate to field use.

A-1-3 **Approved.** The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization concerned with product evaluations that is in a position to determine compliance with appropriate standards for the current production of listed items.

A-1-3 **Authority Having Jurisdiction.** The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A-1-3 **Compressed Breathing Gas.** The quality of breathing air to be used in open-circuit SCBA, as well as other SCBA use criteria, is contained in NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program.*

A-1-3 **Listed.** The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A-2-1.1.2 SCBA that are certified by NIOSH include a rated service time based on laboratory tests required by NIOSH. The SCBA is tested using a specified breathing machine with a breathing rate of 40 L/min. NIOSH uses this 40 L/min rate because it represents a moderate work rate that an average user can sustain for a period of time. To attain a rated service time of 30 minutes during this 40 L/min test, the typical SCBA cylinder must contain 1200 L or more of compressed breathable air. A 45-cu ft cylinder has a capacity of 1273.5 L, based on 28.3 L/cu ft. Because actual work performed by a fire fighter often results in a ventilation rate that exceeds 40 L/min, fire fighters will frequently not attain the rated service time of 30 minutes. During extreme exertion, for example, actual service time can be reduced by 50 percent or more.

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

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

(a) The physical condition of the user (*see also ANSI Z88.6*).

(b) Emotional conditions, such as fear or excitement, that can increase the user's breathing rate.

(c) The degree of training or experience the user has had with such equipment.

(d) Whether or not the cylinder is fully charged at the beginning of use.

(e) The facepiece fit.

(f) Use in a pressurized tunnel or caisson. At two atmospheres of pressure (29.4 psig), the duration will be one-half the duration obtained at one atmosphere of pressure (14.7 psig); at three atmospheres of pressure (44.1 psig), the duration will be one-third the duration obtained at one atmosphere of pressure.

(g) The condition of the SCBA.

(h) The SCBA effective dead air space. Dead air space is a volume proportional to the CO_2 concentration in the inhaled breathing gas.

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

The full effect of increased dead air space has not been demonstrated. However, the scientific work done in this area shows that an increase of CO_2 in the inhalation air leads to increased ventilation and, consequently, shorter service time for a given air supply. Means to reduce CO_2 in the inhalation air by using, for example, a well-fitting nose cup have been demonstrated to give longer service time. Contact each manufacturer for specific data.

A-2-2.1 The certification organization should have sufficient breadth of interest and activity so that the loss or award of a specific business contract would not be a determining factor in the financial well-being of the agency.

A-2-2.3 The contractual provisions covering certification programs should contain clauses advising the manufacturer that if requirements change, the product should be brought into compliance with the new requirements by a stated effective date through a compliance review program involving all currently listed products.

Without these clauses, certifiers would not be able to move quickly to protect their name, marks, or reputation. A product safety certification program would be deficient without these contractual provisions and the administrative means to back them up.

A-2-2.4 Investigative procedures are important elements of an effective and meaningful product safety certification program. A preliminary review should be carried out on products submitted to the agency before any major testing is undertaken.

A-2-2.7 Such inspections should include, in most instances, witnessing of production tests. With certain products the certification organization inspectors should select samples from the production line and submit them to the main laboratory for countercheck testing. With other products, it might be desirable to purchase samples in the open market for test purposes.

A-2-2.9 For further information and guidance on recall programs, see Title 21, *Code of Federal Regulations*, Part 7, Subpart C (21 CFR 7, Subpart C).

A-3-2.7 Users should be aware that NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, requires that all SCBA be air flow tested at least annually in accordance with the manufacturer's instructions. This interval of testing might not be adequate when SCBA are more frequently used. It is recommended that air flow testing be based on the number of SCBA uses rather than based solely on time intervals.

A-4-1.1 Since additional weight can reduce the fire fighter's ability to carry out assigned tasks, weight reduction is a prime concern. It is recommended that SCBA of rated 30-minute duration should be limited to a maximum weight of 25 lb (11 kg). Purchasers are advised to specifically address weight in their purchase specifications, regardless of the rated service time. Consideration should be given to reducing the overall weight of fire fighters' protective equipment by having certain elements serve multiple functions, resulting in an overall weight loss over the total of the original individual elements. Examples could include a helmet also serving as the SCBA facepiece, the SCBA harness integrated as part of the protective coat, or a PASS device integrated as part of the SCBA.

A-5-1 The current NIOSH certification test method, 42 CFR 84, uses a ventilation rate of 40 L/min, while NFPA 1981 requires an air flow test based on a ventilation rate of 100 L/min. A ventilation rate of 100 standard L/min encompasses the 98th percentile of all fire fighters studied. The ability of the SCBA to supply the 100 L/min of breathing gas is measured in this air flow performance test by monitoring the pressure within the facepiece.

Specific response times for both the pressure transducer and recorder are specified in this standard. It is important to note that if other types of recording devices, measuring equipment, and testing methods are used, pressure fluctuations might appear in the facepiece as short (millisecond) negative pressure spikes. The significance of these spikes to the actual protection afforded the user by the SCBA is not fully understood at this time. Additional studies are needed to determine the significance, if any, of these spikes. Because these negative spikes might affect the actual protection offered by the SCBA, it is recommended that a facepiece fitting program be established. Quantitative fitting tests are recognized to be the best method for determining the facepiece-to-face seal, and should be performed by the fire service wherever SCBA are used. For departments that wish to perform quantitative fit testing, a suggested procedure for conducting such tests can be found in ANSI Z88.2, *Practices for Respiratory Protection*.

A-5-9 This standard contains an abrasion test that is used to evaluate the outside surface of the facepiece lens. This standard does not address the abrasion resistance of the interior surface of the facepiece lens. Current facepiece lens interior surfaces can be uncoated, coated with an anti-fog agent, coated with an abrasion-resistant agent that does not comply with the performance required in Section 5-9, or coated with an abrasion-resistant coating that does comply with the performance required in Section 5-9. Information regarding coatings on the lens interior surface should be obtained from the SCBA manufacturer.

A-5-10 As the communications test is the only test that requires human subjects, there were variations in the data used to determine the appropriate pass/fail criteria. Therefore, a statistical approach to analyze the data was required to determine whether an individual SCBA meets the pass/fail criteria of Section 5-10. A null hypothesis test utilizing the Student t-distribution is the appropriate method to do this.

The Student t-distribution of 2.13 results from the following conditions:

Degrees of freedom = 4 Confidence level = 95 percent

Refer to any current statistical text for further information.

A-6-1.1 The headform, Models 803608-01 and 803608-02, can be obtained from Scott Aviation, 225 Erie St., Lancaster, NY 14086. Drawings can be obtained from NFPA for Model 803608-01 or 803608-02.

A-6-1.7 A Model P24 differential pressure transducer with a range of ±8.9 in. (±226 mm) of water differential is recommended and available from Validyne Engineering Corporation, 8626 Wilbur Avenue, Northridge, CA 91324.

A-6-1.8 A Model #1241 B00 one-pen recorder is recommended and available from Soltec Corporation, 11684 Pendleton Street, Sun Valley, CA 91352.

A-6-1.12 Complete engineering drawings to construct the Model 327-6 Breathing Machine can be obtained from NFPA. A fully fabricated machine can be obtained from Hy Tech Machine, Inc., 25 Leonburg Road, Mashuda Industrial Park, Mars, PA 16046.

The respiratory frequency is determined by dividing the minute volume by the tidal volume for each Model 327-6 Breathing Machine manufactured.

A-6-1.14 Calibration Procedure for NFPA Model 327-6 Breathing Machine.

CALIBRATION PROCEDURE FOR NFPA MODEL 327-6 BREATHING MACHINE

I. Set up equipment.

1. Remove plug fitting and open valve at side port of the breathing machine (BM), then close the valve to the test headform.

2. Connect a nonreturn two-way valve to the side port. (*See Figure A-6-1.14.*) (Figure shown on page 389).

3. Make sure all gas has been expelled from a gas collection bag by rolling the bag up. Connect the bag to the dead-ended gas-collection port of a three-way valve. (*See Detail 2.*) A recommended gas-collection bag is a 120-liter meteorological bag (Catalog No. 022631) or a 150-liter Douglas bag (Catalog No. 022622), available from Warren C. Collins, Inc., 220 Wood Road, Braintree, MA 02184. Equivalent or similar collection bags can be substituted. Collins also supplies a three-way valve (T-shape stopcock — Catalog No. 021043).

4. Connect the common port of the three-way valve to the exhalation port of the nonreturn two-way valve. (*See Detail 3.*)

5. Connect the Validyne Transducer DP 24 to a pressure tap on the collection side of the three-way valve. The transducer output goes to the Soltec Recorder.

II. Collect gas.

1. With the vent port of the three-way valve open, start BM and allow BM to "warm up" for at least 10 minutes.

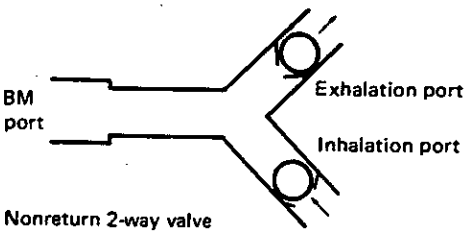
2. After the 10-minute "warm-up" period, adjust the speed to approximately 30 rpm if the machine has not been calibrated within the last few days. If the machine has recently been calibrated, leave it at its preset adjustment.

3. Set the chart speed on the Soltec Recorder to 60 cm/min and start the recorder.

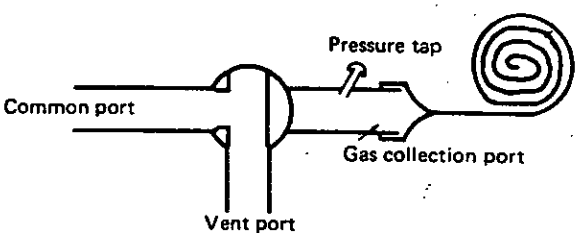
4. At the start of an inhalation, turn the three-way valve so that the air exhaled from the BM goes into the collection bag. (*See Detail 4.*)

5. Each exhalation stroke should produce a positive peak on the strip-chart recording, which can be used as a counter. The operator can use a substitute method to count the exhaled tidal volumes (TV) that go into the bag.

6. After 30 to 35 exhalations, turn the three-way valve at the start of an inhalation so that the gas collection port is closed and the BM vents to atmosphere. Turn off the Soltec Recorder.

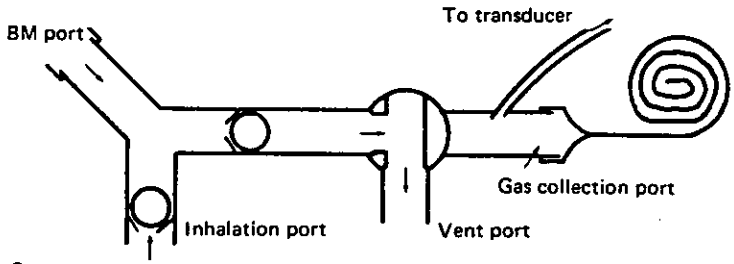


Detail 1



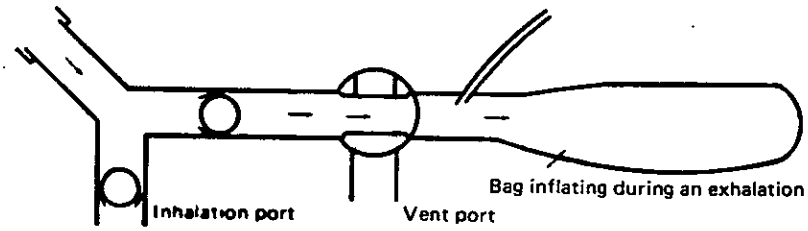
3-way valve with gas collection bag

Detail 2



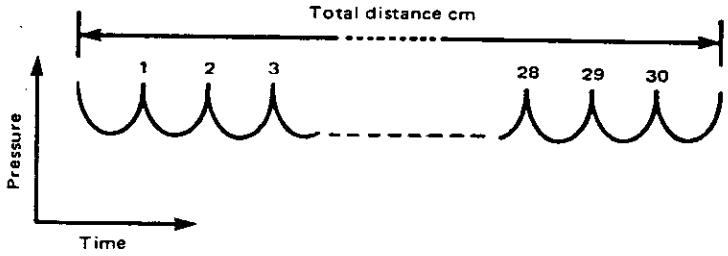
3-way valve connected to nonreturn 2-way valve

Detail 3



System in gas collecting mode

Detail 4



Detail 5

The total distance is the length that the 30 exhalations take on the strip chart recording. Each positive pressure peak indicates an exhalation stroke.

Figure A-6-1.14

III. Measure the volume (liters) of gas collected (V_L).

1. The recommended method to measure the volume of gas in the bag is to transfer the air into a Spirometer. Make sure the bag is completely empty by rolling it up.

2. Another method to measure the gas volume in the bag is to slowly empty the bag through a calibrated dry-gas meter. Ensure that a correction factor is applied as required.

IV. Calculate minute volume.

1. From the positive peaks on the strip chart recording, count the number of exhalations (NE) that were made into the bag or use your own counting method if you are sure it is correct.

2. Measure the total distance (in cm) between the peaks of 30 exhalations, which should be approximately 60 cm at a chart speed of 60 cm/min. (*See Detail 5.*) If the pressure in the gas-collection port has not been measured, the operator can use another method to accurately measure the breathing machine's rpm.

3. Calculate rpm,

$$RPM = \frac{30 \text{ breaths}}{\text{distance} \times \frac{\text{min}}{60\text{cm}}}$$

4. Determine the tidal volume (TV),

$$TV = \frac{V_L}{NE}$$

5. Determine the Minute Volume, V_M.

$$V_M = TV \leq RPM$$

NOTE: A record of TV and rpm should be maintained for each machine. As the seals on the pistons wear, the TV for a given rpm might decrease, an indication that the seals should be replaced.

V. Adjust minute volume.

1. If the V_M is between 100 liters and 106 liters, no adjustment is necessary and the BM is ready to perform the NFPA Air Flow Performance Test at the present rpm setting.

2. If the $V_M < 100$, the rpm must be increased and the V_M recalculated.

3. If the $V_M > 106$ liters, the rpm must be decreased and the V_M recalculated.

A-6-9.7 The Blue Streak M306M wool felt polishing pad can be obtained from J.I. Morris Co., 394 Elm Street, Southbridge, MA.

A-6-9.8 The 3M, 7415 Wood Finishing Pad is an abrasive sheet that has markings on one side. The pad can be obtained from 3M Corp., Box 33053, St. Paul, MN 55133.

A-6-11 Complete engineering drawings to construct the heat and flame test apparatus can be obtained from the NFPA.

A-6-11.2 The protective covering has been selected solely for the purpose of protecting the Flame and Heat Test mannequin and providing a reproducible exterior configuration to support the SCBA being tested. The intention of this standard is to test the SCBA and not the protective covering.

A-7-1.1 NFPA publications can be obtained from the National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

A-7-1.2 ANSI publications can be obtained from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

A-7-1.3 ASTM publications can be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

A-7-1.4 GSA publications can be obtained from the General Services Administration, Specifications Activities, Printed Materials Supply Division, Building 197, Naval Weapons Plant, Washington, DC 20407.

A-7-1.5 Navy publications can be obtained from the Navy Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

A-7-1.6 U.S. government publications can be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Appendix B Referenced Publications

B-1 The following documents or portions thereof are referenced within this standard for informational purposes only and thus are not considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

B-1.1 NFPA Publication. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, 1992 edition.

B-1.2 Other Publications.

B-1.2.1 ANSI Publications. American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

ANSI Z88.2, *Practices for Respiratory Protection*, 1982.

ANSI Z88.6, *Respiratory Protection — Respirator Use — Physical Qualifications for Personnel*, 1984.

B-1.2.2 U.S. Government Publication. Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Title 21, *Code of Federal Regulations*, Part 7 (21 CFR 7).

Title 42, *Code of Federal Regulations*, Part 84 (42 CFR 84), *Respiratory Protective Devices, Tests for Permissibility*, 8 June 1995.