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PART II

DEPARTMENT OF LABOR

■

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

■

OCCUPATIONAL SAFETY AND HEALTH STANDARDS

Title 29—LABOR

Chapter XVII—Occupational Safety and Health Administration, Department of Labor

PART 1910—OCCUPATIONAL SAFETY AND HEALTH STANDARDS

Pursuant to authority in sections 6 and 8(g) of the Williams-Steiger Occupational Safety and Health Act of 1970 (84 Stat. 1593, 1600; 29 U.S.C. 655, 657) and in Secretary of Labor's Order No. 12–71 (36 F.R. 8754), Part 1910 of Title 29 of the Code of Federal Regulations is hereby revised to read as set forth below. This revision includes amendments through Sept. 22, 1972. The purpose of the revision is (1) to publish fully in one place the present occupational safety and health standards contained therein in order to reflect many changes made during the current year and thereby to improve their usefulness and facilitate their enforcement; (2) to correct a number of typographical and clerical errors in the text of the standards; and (3) to publish indexes with the standards, which are intended to permit quicker access to pertinent standards.

Since this revision does not make any substantive changes in the standards, it is not necessary to provide notice of proposed rulemaking, opportunity for public participation therein, nor any delay in effective date. For the same reason, good cause is found for not following the regular procedure for rulemaking provided in 5 U.S.C. 553 and for making this revision effective immediately.

Signed at Washington, D.C. this 4 day of October 1972.

G. C. GUENTHER,
Assistant Secretary of Labor.

§ 1910.107 (b)(1), (b)(2), (b)(3), (b)(4), (b)(5)(i), (b)(5)(iii), (b)(5)(iv), (b)(6), (b)(7), (b)(8), (b)(10), (c)(1), (c)(4), (c)(5), (c)(6), (c)(7), (d), (e)(7), (e)(8), (f)(1), (f)(2), (h), (i), (j), (l)(2), (l)(3), (l)(5), (l)(6), (l)(7), and (m)(1).
§ 1910.108 (b), (c), (e)(1), (f)(2), (g)(3), (g)(4), and (g)(8).
§ 1910.109 (g)(6) and (h).
§ 1910.110.
§ 1910.111.

(c) Notwithstanding anything in paragraph (a), (b), or (d) of this section, any provision in any other section of this subpart which contains in itself a specific effective date or time limitation shall become effective on such date or shall apply in accordance with such limitation.

(d) Notwithstanding anything in paragraph (a), or (b) of this section, if any standard in 41 CFR Part 50-204, other than a national consensus standard incorporated by reference in § 50-204.2(a)(1), is or becomes applicable at any time to any employment and place of employment, by virtue of the Walsh-Healey Public Contracts Act, or the Service Contract Act of 1965, or the National Foundation on Arts and Humanities Act of 1965, any corresponding established Federal standard in this Subpart H which is derived from 41 CFR Part 50-204 shall also become effective, and shall be applicable to such employment and place of employment, on the same date.

§ 1910.115 Sources of standards.

Sec.	*Source*
1910.101	41 CFR 50-204.67, 70, and 71.
1910.102	41 CFR 50-204.66.
1910.103	NFPA No. 50B-1968, Standard for Liquified Hydrogen Systems at Consumer Sites.
1910.104	NFPA No. 566-1965, Standard for the Installation of Bulk Oxygen Systems at Consumer Sites.
1910.105	NFPA No. 30-1969, Flammable and Combustible Liquids Code.
1910.107	NFPA No. 33-1968, Standard for Spray Finishing using Flammable and Combustible Materials.
1910.108	NFPA No. 34-1966, Standard for Dip Tanks Containing Flammable or Combustible Liquids.
1910.109	NFPA No. 495-1970, Code for Manufacture, Transportation, Storage and Use of Explosives and Blasting Agents.
1910.110	NFPA 58-69, Standard for the Handling of Liquified Petroleum Gases.
1910.111	ANSI K61.1-1966, Storage and Handling of Anhydrous Ammonia.

§ 1910.116 Standards organizations.

National Fire Protection Association (NFPA), 60 Batterymarch Street, Boston, MA 02110.
National Plant Food Institute, 1700 K Street NW., Washington, DC 20006.
Compressed Gas Association, Inc., 500 Fifth Avenue, New York, NY 10036.
American Society of Mechanical Engineers Inc., United Engineering Center, 345 East 47th Street, New York, NY 10017.
American Petroleum Institute, 1801 K Street NW., Washington, DC 20006.
National Board of Boiler and Pressure Vessel, Inspectors, 1155 North High Street, Columbus, OH 43201.
American National Standards Institute, 1430 Broadway, New York, NY 10018.
American Society for Testing and Materials (ASTM), 1916 Race Street Philadelphia, PA 19103.
Underwriters Laboratories, Inc. (UL), 207 East Ohio Street, Chicago, IL 60611.

Subpart I—Personal Protective Equipment

§ 1910.132 General requirements.

(a) *Application.* Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

(b) *Employee-owned equipment.* Where employees provide their own protective equipment, the employer shall be responsible to assure its adequacy, including proper maintenance, and sanitation of such equipment.

(c) *Design.* All personal protective equipment shall be of safe design and construction for the work to be performed.

§ 1910.133 Eye and face protection.

(a) *General.* (1) Protective eye and face equipment shall be required where there is a reasonable probability of injury that can be prevented by such equipment. In such cases, employers shall make conveniently available a type of protector suitable for the work to be performed, and employees shall use such protectors. No unprotected person shall knowingly be subjected to a hazardous environmental condition. Suitable eye protectors shall be provided where machines or operations present the hazard of flying objects, glare, liquids, injurious radiation, or a combination of these hazards.

(2) Protectors shall meet the following minimum requirements:

(i) They shall provide adequate protection against the particular hazards for which they are designed.

(ii) They shall be reasonably comfortable when worn under the designated conditions.

(iii) They shall fit snugly and shall not unduly interfere with the movements of the wearer.

(iv) They shall be durable.

(v) They shall be capable of being disinfected.

(vi) They shall be easily cleanable.

(vii) Protectors should be kept clean and in good repair.

(3) Persons whose vision requires the use of corrective lenses in spectacles, and who are required by this standard to wear eye protection, shall wear goggles or spectacles of one of the following types:

(i) Spectacles whose protective lenses provide optical correction.

(ii) Goggles that can be worn over corrective spectacles without disturbing the adjustment of the spectacles.

(iii) Goggles that incorporate corrective lenses mounted behind the protective lenses.

(4) Every protector shall be distinctly marked to facilitate identification only of the manufacturer.

(5) When limitations or precautions are indicated by the manufacturer, they shall be transmitted to the user and care taken to see that such limitations and precautions are strictly observed.

(6) Design, construction, testing, and use of devices for eye and face protection shall be in accordance with American National Standard for Occupational and Educational Eye and Face Protection, Z87.1-1968.

§ 1910.134 Respiratory protection.

(a) *Permissible practice.* (1) In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to the following requirements.

(2) Respirators shall be provided by the employer when such equipment is necessary to protect the health of the employee. The employer shall provide the respirators which are applicable and suitable for the purpose intended. The employer shall be responsible for the establishment and maintenance of a respiratory protective program which shall include the requirements outlined in paragraph (b) of this section.

(3) The employee shall use the provided respiratory protection in accordance with instructions and training received.

(b) *Requirements for a minimal acceptable program.* (1) Written standard operating procedures governing the selection and use of respirators shall be established.

(2) Respirators shall be selected on the basis of hazards to which the worker is exposed.

(3) The user shall be instructed and trained in the proper use of respirators and their limitations.

(4) Where practicable, the respirators should be assigned to individual workers for their exclusive use.

(5) Respirators shall be regularly cleaned and disinfected. Those issued for

the exclusive use of one worker should be cleaned after each day's use, or more often if necessary. Those used by more than one worker shall be thoroughly cleaned and disinfected after each use.

(6) Respirators shall be stored in a convenient, clean, and sanitary location.

(7) Respirators used routinely shall be inspected during cleaning. Worn or deteriorated parts shall be replaced. Respirators for emergency use such as self-contained devices shall be thoroughly inspected at least once a month and after each use.

(8) Appropriate surveillance of work area conditions and degree of employee exposure or stress shall be maintained.

(9) There shall be regular inspection and evaluation to determine the continued effectiveness of the program.

(10) Persons should not be assigned to tasks requiring use of respirators unless it has been determined that they are physically able to perform the work and use the equipment. The local physician shall determine what health and physical conditions are pertinent. The respirator user's medical status should be reviewed periodically (for instance, annually).

(11) Approved or accepted respirators shall be used when they are available. The respirator furnished shall provide adequate respiratory protection against the particular hazard for which it is designed in accordance with standards established by competent authorities. The U.S. Department of Interior, Bureau of Mines, and the U.S. Department of Agriculture are recognized as such authorities. Although respirators listed by the U.S. Department of Agriculture continue to be acceptable for protection against specified pesticides, the U.S. Department of the Interior, Bureau of Mines, is the agency now responsible for testing and approving pesticide respirators.

(c) *Selection of respirators.* Proper selection of respirators shall be made according to the guidance of American National Standard Practices for Respiratory Protection Z88.2–1969.

(d) *Air quality.* (1) Compressed air, compressed oxygen, liquid air, and liquid oxygen used for respiration shall be of high purity. Oxygen shall meet the requirements of the United States Pharmacopoeia for medical or breathing oxygen. Breathing air shall meet at least the requirements of the specification for Grade D breathing air as described in Compressed Gas Association Commodity Specification G–7.1–1966. Compressed oxygen shall not be used in supplied-air respirators or in open circuit self-contained breathing apparatus that have previously used compressed air. Oxygen must never be used with air line respirators.

(2) Breathing air may be supplied to respirators from cylinders or air compressors.

(i) Cylinders shall be tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (49 CFR Part 178).

(ii) The compressor for supplying air shall be equipped with necessary safety and standby devices. A breathing air-type compressor shall be used. Compressors shall be constructed and situated so as to avoid entry of contaminated air into the system and suitable in-line air purifying sorbent beds and filters installed to further assure breathing air quality. A receiver of sufficient capacity to enable the respirator wearer to escape from a contaminated atmosphere in event of compressor failure, and alarms to indicate compressor failure and overheating shall be installed in the system. If an oil-lubricated compressor is used, it shall have a high-temperature or carbon monoxide alarm, or both. If only a high-temperature alarm is used, the air from the compressor shall be frequently tested for carbon monoxide to insure that it meets the specifications in subparagraph (1) of this paragraph.

(3) Air line couplings shall be incompatible with outlets for other gas systems to prevent inadvertent servicing of air line respirators with nonrespirable gases or oxygen.

(4) Breathing gas containers shall be marked in accordance with American National Standard Method of Marking Portable Compressed Gas Containers to Identify the Material Contained, Z48.1–1954; Federal Specification BB–A–1034a, June 21, 1968, Air, Compressed for Breathing Purposes; or Interim Federal Specification GG–B–00675b, April 27, 1965, Breathing Apparatus, Self-Contained.

(e) *Use of respirators.* (1) Standard procedures shall be developed for respirator use. These should include all information and guidance necessary for their proper selection, use, and care. Possible emergency and routine uses of respirators should be anticipated and planned for.

(2) The correct respirator shall be specified for each job. The respirator type is usually specified in the work procedures by a qualified individual supervising the respiratory protective program. The individual issuing them shall be adequately instructed to insure that the correct respirator is issued. Each respirator permanently assigned to an individual should be durably marked to indicate to whom it was assigned. This mark shall not affect the respirator performance in any way. The date of issuance should be recorded.

(3) Written procedures shall be prepared covering safe use of respirators in dangerous atmospheres that might be encountered in normal operations or in emergencies. Personnel shall be familiar with these procedures and the available respirators.

(i) In areas where the wearer, with failure of the respirator, could be overcome by a toxic or oxygen-deficient atmosphere, at least one additional man shall be present. Communications (visual, voice, or signal line) shall be maintained between both or all individuals present. Planning shall be such that one individual will be unaffected by any likely incident and have the proper rescue equipment to be able to assist the other(s) in case of emergency.

(ii) When self-contained breathing apparatus or hose masks with blowers are used in atmospheres immediately dangerous to life or health, standby men must be present with suitable rescue equipment.

(iii) Persons using air line respirators in atmospheres immediately hazardous to life or health shall be equipped with safety harnesses and safety lines for lifting or removing persons from hazardous atmospheres or other and equivalent provisions for the rescue of persons from hazardous atmospheres shall be used. A standby man or men with suitable self-contained breathing apparatus shall be at the nearest fresh air base for emergency rescue.

(4) Respiratory protection is no better than the respirator in use, even though it is worn conscientiously. Frequent random inspections shall be conducted by a qualified individual to assure that respirators are properly selected, used, cleaned, and maintained.

(5) For safe use of any respirator, it is essential that the user be properly instructed in its selection, use, and maintenance. Both supervisors and workers shall be so instructed by competent persons. Training shall provide the men an opportunity to handle the respirator, have it fitted properly, test its face-piece-to-face seal, wear it in normal air for a long familiarity period, and, finally, to wear it in a test atmosphere.

(i) Every respirator wearer shall receive fitting instructions including demonstrations and practice in how the respirator should be worn, how to adjust it, and how to determine if it fits properly. Respirators shall not be worn when conditions prevent a good face seal. Such conditions may be a growth of beard, sideburns, a skull cap that projects under the facepiece, or temple pieces on glasses. Also, the absence of one or both dentures can seriously affect the fit of a facepiece. The worker's diligence in observing these factors shall be evaluated by periodic check. To assure proper protection, the facepiece fit shall be checked by the wearer each time he puts on the respirator. This may be done by following the manufacturer's facepiece fitting instructions.

(ii) Providing respiratory protection for individuals wearing corrective glasses is a serious problem. A proper seal cannot be established if the temple bars of eye glasses extend through the sealing edge of the full facepiece. As a temporary measure, glasses with short temple bars or without temple bars may be taped to the wearer's head. Wearing of contact lenses in contaminated atmospheres with a respirator shall not be allowed. Systems have been developed for mounting corrective lenses inside full facepieces. When a workman must wear corrective lenses as part of the facepiece, the facepiece and lenses shall be fitted by qualified individuals to provide good vision, comfort, and a gas-tight seal.

(iii) If corrective spectacles or goggles are required, they shall be worn so as not to affect the fit of the facepiece. Proper selection of equipment will minimise or avoid this problem.

(f) *Maintenance and care of respirators.* (1) A program for maintenance and

care of respirators shall be adjusted to the type of plant, working conditions, and hazards involved, and shall include the following basic services:

(i) Inspection for defects (including a leak check),

(ii) Cleaning and disinfecting,

(iii) Repair,

(iv) Storage

Equipment shall be properly maintained to retain its original effectiveness.

(2) (i) All respirators shall be inspected routinely before and after each use. A respirator that is not routinely used but is kept ready for emergency use shall be inspected after each use and at least monthly to assure that it is in satisfactory working condition.

(ii) Self-contained breathing apparatus shall be inspected monthly. Air and oxygen cylinders shall be fully charged according to the manufacturer's instructions. It shall be determined that the regulator and warning devices function properly.

(iii) Respirator inspection shall include a check of the tightness of connections and the condition of the facepiece, headbands, valves, connecting tube, and canisters. Rubber or elastomer parts shall be inspected for pliability and signs of deterioration. Stretching and manipulating rubber or elastomer parts with a massaging action will keep them pliable and flexible and prevent them from taking a set during storage.

(iv) A record shall be kept of inspection dates and findings for respirators maintained for emergency use.

(3) Routinely used respirators shall be collected, cleaned, and disinfected as frequently as necessary to insure that proper protection is provided for the wearer. Each worker should be briefed on the cleaning procedure and be assured that he will always receive a clean and disinfected respirator. Such assurances are of greatest significance when respirators are not individually assigned to workers. Respirators maintained for emergency use shall be cleaned and disinfected after each use.

(4) Replacement or repairs shall be done only by experienced persons with parts designed for the respirator. No attempt shall be made to replace components or to make adjustment or repairs beyond the manufacturer's recommendations. Reducing or admission valves or regulators shall be returned to the manufacturer or to a trained technician for adjustment or repair.

(5) (i) After inspection, cleaning, and necessary repair, respirators shall be stored to protect against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. Respirators placed at stations and work areas for emergency use should be quickly accessible at all times and should be stored in compartments built for the purpose. The compartments should be clearly marked. Routinely used respirators, such as dust respirators, may be placed in plastic bags. Respirators should not be stored in such places as lockers or tool boxes unless they are in carrying cases or cartons.

(ii) Respirators should be packed or stored so that the facepiece and exhalation valve will rest in a normal position and function will not be impaired by the elastomer setting in an abnormal position.

(iii) Instructions for proper storage of emergency respirators, such as gas masks and self-contained breathing apparatus, are found in "use and care" instructions usually mounted inside the carrying case lid.

(g) *Identification of gas mask canisters.* (1) The primary means of identifying a gas mask canister shall be by means of properly worded labels. The secondary means of identifying a gas mask canister shall be by a color code.

(2) All who issue or use gas masks falling within the scope of this section shall see that all gas mask canisters purchased or used by them are properly labeled and colored in accordance with these requirements before they are placed in service and that the labels and colors are properly maintained at all times thereafter until the canisters have completely served their purpose.

(3) On each canister shall appear in bold letters the following:

(i)—

Canister for .....
(Name for atmospheric contaminant)
or
Type N Gas Mask Canister

(ii) In addition, essentially the following wording shall appear beneath the appropriate phrase on the canister label: "For respiratory protection in atmospheres containing not more than ..... percent by volume of.....
....."
(Name of atmospheric contaminant)

(iii) All of the markings specified above should be placed on the most conspicuous surface or surfaces of the canister.

(4) Canisters having a special high-efficiency filter for protection against radionuclides and other highly toxic particulates shall be labeled with a statement of the type and degree of protection afforded by the filter. The label shall be affixed to the neck end of, or to the gray stripe which is around and near the top of, the canister. The degree of protection shall be marked as the percent of penetration of the canister by a 0.3-micron-diameter dioctyl phthalate (DOP) smoke at a flow rate of 85 liters per minute.

(5) Each canister shall have a label warning that gas masks should be used only in atmospheres containing sufficient oxygen to support life (at least 16 percent by volume), since gas mask canisters are only designed to neutralize or remove contaminants from the air.

(6) Each gas mask canister shall be painted a distinctive color or combination of colors indicated in Table I-1. All colors used shall be such that they are clearly identifiable by the user and clearly distinguishable from one another. The color coating used shall offer a high degree of resistance to chipping, scaling, peeling, blistering, fading, and the effects of the ordinary atmospheres to which they may be exposed under normal conditions of storage and use. Appropriately colored pressure sensitive tape may be used for the stripes.

TABLE I-1

Atmospheric contaminants to be protected against	*Colors assigned**
Acid gases	White.
Hydrocyanic acid gas	White with ½-inch green stripe completely around the canister near the bottom.
Chlorine gas	White with ½-inch yellow stripe completely around the canister near the bottom.
Organic vapors	Black.
Ammonia gas	Green.
Acid gases and ammonia gas	Green with ½-inch white stripe completely around the canister near the bottom.
Carbon monoxide	Blue.
Acid gases and organic vapors	Yellow.
Hydrocyanic acid gas and chloropicrin vapor	Yellow with ½-inch blue stripe completely around the canister near the bottom.
Acid gases, organic vapors, and ammonia gases	Brown.
Radioactive materials, excepting tritium and noble gases	Purple (Magenta).
Particulates (dusts, fumes, mists, fogs, or smokes) in combination with any of the above gases or vapors	Canister color for contaminant, as designated above, with ½-inch gray stripe completely around the canister near the top.
All of the above atmospheric contaminants	Red with ½-inch gray stripe completely around the canister near the top.

*Gray shall not be assigned as the main color for a canister designed to remove acids or vapors.

NOTE: Orange shall be used as a complete body, or stripe color to represent gases not included in this table. The user will need to refer to the canister label to determine the degree of protection the canister will afford.

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APPENDIX B

30 CFR PART 11

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PART II

DEPARTMENT OF THE INTERIOR

Bureau of Mines

■

Respiratory Protective Devices; Tests for Permissibility; Fees

Title 30—MINERAL RESOURCES

Chapter I—Bureau of Mines, Department of the Interior

SUBCHAPTER B—RESPIRATORY PROTECTIVE APPARATUS; TESTS FOR PERMISSIBILITY; FEES

PART 11—RESPIRATORY PROTECTIVE DEVICES; TESTS FOR PERMISSIBILITY; FEES

PART 12—SUPPLIED-AIR RESPIRATORS

PART 13—GAS MASKS

PART 14—FILTER-TYPE DUST, FUME, AND MIST RESPIRATORS

PART 14a—NONEMERGENCY GAS RESPIRATORS (CHEMICAL CARTRIDGE RESPIRATORS, INCLUDING PAINT SPRAY RESPIRATORS)

Pursuant to the authority vested in the Secretary of the Interior under 36 Stat. 369, as amended 37 Stat. 681 (30 U.S.C. 3, 5, and 7), and the authority vested in the Secretary of the Interior and the Secretary of Health, Education, and Welfare under sections 202(h), 204, and 508 of the Federal Coal Mine Health and Safety Act of 1969 (30 U.S.C. 842(h), 844, and 957), there was published in the FEDERAL REGISTER for March 10, 1971 (36 F.R. 4652) a notice of proposed rule making wherein it was proposed to revoke Parts 11, 12, 13, 14, and 14a of Subchapter B, Chapter I, Title 30, Code of Federal Regulations (Bureau of Mines Schedules 13E, 14F, 19B, 21B, and 23B), and to substitute therefor a new Part 11, prescribing the approval procedures, establishing the fees, and consolidating and extending the requirements for obtaining joint approval of respirators by the Bureau of Mines, Department of the Interior and the National Institute for Occupational Safety and Health, Department of Health, Education, and Welfare.

Interested persons were afforded a period of 45 days from the date of publication of the notice within which to submit written comments, suggestions, or objections to the proposed amendments. Approximately 15 associations, companies, labor organizations, individuals, and State and Federal agencies submitted comments, suggestions, or objections. In addition interested parties informally conferred with officials of the Department of the Interior and the Department of Health, Education, and Welfare in March, April, October, and November 1971 in order to discuss the proposed amendments.

Some of the regulations have been revised as suggested; in other instances revisions have been made in view of the comments received.

The proposed regulations specified that protection factors for certain types of respirators would be determined by the Bureau during the course of testing. A suggestion was received that protection factors be determined for all types of respirators. After thorough consideration of this issue, the Bureau and the Institute have decided that although the concept of protection factors is valid, present technology in this area is insufficient to produce reliable data upon which to base such factors. Therefore, references to protection factors have been deleted from the regulations, with a view toward working to improve relevant technology and data in order to incorporate requirements for protection factors into Part 11 at a later date.

Other significant technical revisions are: (1) Performance requirements have replaced certain design specifications; and (2) tests have been included for powered air-purifying respirators.

Certain procedural revisions have also been made. The arrangement and numbering system of the proposed amendments has been totally redesignated so as to place all procedural requirements at the beginning of Part 11 (Subparts A through F), followed by all technical requirements (Subparts G through M). Expanded and more stringent quality control requirements have been established (Subpart E). Examples of causes which may result in revocation of the certificate of approval have been specified. The time limit for phasing out respirators approved under revoked Parts 11, 12, 13, 14, and 14a of this Title 30 has been clarified (see § 11.2).

A suggestion was received that models submitted for testing and approval be made only on regular production tooling with no operations included which would not be incorporated in regular production processing in order to insure that commercially produced respirators would be identical in all respects to those tested and approved under these regulations. This suggestion was carefully considered. However, it was determined by the Bureau and the Institute that such a requirement might well operate to obstruct advances in respirator technology, since substantial investment would be necessary to build production models with no adequate assurance of ultimate approval. Consequently it was decided to continue the testing of soundly designed and constructed prototype models; however, upon completion of such testing the Bureau and the Institute may require the applicant to resubmit a production model for additional testing prior to issuance of a certificate of approval (see §§ 11.11 (e) and 11.30).

Subchapter B of Chapter I, Title 30, Code of Federal Regulations, amended by revoking Parts 11, 12, 13, 14, and 14a, and substituting therefor a new Part 11—Respiratory Protective Devices; Tests for Permissibility; Fees, as set forth below is herewith promulgated and shall become effective 60 days following publication in the FEDERAL REGISTER.

W. T. PECORA,
Acting Secretary of the Interior.

FEBRUARY 17, 1972.

ELLIOT L. RICHARDSON,
Secretary of Health, Education, and Welfare.

MARCH 10, 1972.

Subpart H—Self-Contained Breathing Apparatus

Subpart I—Gas Masks

Subpart J—Supplied-Air Respirators

Subpart K—Dust, Fume, and Mist Respirators

AUTHORITY: The provisions of this Part 11 issued under sections 202(h), 204, and 508 of the Federal Coal Mine Health and Safety Act of 1969 (30 U.S.C. 842(h), 844, and 957) and 36 Stat. 369, as amended 37 Stat. 681 (30 U.S.C. 3, 5, and 7).

Subpart A—General Provisions

§ 11.1 Purpose.

The purpose of the regulations contained in this Part 11 is: (a) To establish procedures and prescribe requirements which must be met in filing applications for joint approval by the Bureau of Mines and the National Institute for Occupational Safety and Health of respirators or changes or modifications of approved respirators; (b) to establish a schedule of fees to be charged each applicant for the inspections, examinations, and testing conducted by the Bureau under the provisions of this part; (c) to provide for the issuance of certificates of approval or modifications of certificates of approval for respirators which have met the applicable construction, performance, and respiratory protection requirements set forth in this part; and (d) to specify minimum requirements and to prescribe methods to be employed by the Bureau and by the applicant in conducting inspections, examinations, and tests to determine the effectiveness of respirators used during entry into or escape from hazardous atmospheres.

§ 11.2 Approved respirators.

(a) Until March 30, 1974, respirators or combinations of respirators shall be considered to be approved for use during entry into hazardous mine atmospheres, escape from hazardous mine atmospheres, or both, where such respirators or combinations of respirators are: (1) The same in all respects as those respirators which have been approved after meeting the minimum requirements for performance and respiratory protection set forth in this Part 11; or (2) fabricated, assembled, or built under any approval, or any modification thereof, issued by the U.S. Bureau of Mines, Department of the Interior, in accordance with the schedules set forth below; and (3) maintained in an approved condition:

(i) Self-contained Breathing Apparatus, Bureau of Mines Schedules 13, March 5, 1919; 13A, January 21, 1930; 13B, August 12, 1935; 13C, July 9, 1946; 13D, September 22, 1956; and 13E, July 19, 1968.

(ii) Gas Masks, Bureau of Mines Schedule 14F, April 23, 1955.

(iii) Supplied-air Respirators, Bureau of Mines Schedule 19B, April 19, 1955.

(iv) Filter-type Dust, Fume, and Mist Respirators, Bureau of Mines Schedule 21B, January 19, 1965.

(v) Nonemergency Gas Respirators, Bureau of Mines Schedule 23B, August 4, 1959.

(b) After March 30, 1974, respirators or combinations of respirators shall be considered to be approved for use during entry into hazardous mine atmospheres, escape from hazardous mine atmospheres, or both, only where such respirators or combinations of such respirators are: (1) The same in all respects as those respirators which have been approved after meeting the minimum requirements for performance and respiratory protection prescribed in this Part 11; and (2) maintained in an approved condition.

§ 11.2–1 Selection, fit, use, and maintenance of approved respirators.

In order to insure the maximum amount of respiratory protection, approved respirators shall be selected,

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fitted, used, and maintained in accordance with the provisions of the American National Standard Practices for Respiratory Protection, Z88.2, obtainable from American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

§ 11.3 Definitions.

As used in this part—

(a) "Air Contamination Level" means the standards of contaminant levels prescribed by the Secretary of Labor in accordance with the provisions of the Occupational Safety and Health Act of 1970 (Public Law 91-596; 84 Stat. 1590).

(b) "Applicant" means an individual, partnership, company, corporation, association, or other organization that designs, manufactures, assembles, or controls the assembly of a respirator and who seeks to obtain a certificate of approval for such respirator.

(c) "Approval" means a certificate or formal document issued by the Bureau and the Institute stating that an individual respirator or combination of respirators has met the minimum requirements of this Part 11, and that the applicant is authorized to use and attach an approval label to any respirator, respirator container, or instruction card for any respirator manufactured or assembled in conformance with the plans and specifications upon which the approval was based, as evidence of such approval.

(d) "Approved" means conforming to the minimum requirements of this Part 11.

(e) "Auxiliary equipment" means a self-contained breathing apparatus, the use of which is limited in underground mine rescue and recovery operations to situations where the wearer has ready access to fresh air and at least one crew equipped with approved self-contained breathing apparatus of 2 hours or longer rating, is in reserve at a fresh-air base.

(f) "Bureau" means the U.S. Bureau of Mines, Department of the Interior.

(g) "Compressed breathing gas" means oxygen or air stored in a compressed state and supplied to the wearer in gaseous form.

(h) "Concentration limits for radionuclides" means the concentration limits set forth in Appendix B, Table 1, Column I of Title 10 CFR Part 20 by the Atomic Energy Commission.

(i) "dBA" means sound pressure levels in decibels, as measured with the A-weighted network of a standard sound level meter using slow response.

(j) "DOP" means a homogenous liquid aerosol, having a particle diameter of 0.3 micrometer, which is generated by vaporization and condensation of dioctyl phthalate.

(k) "Dust" means a solid mechanically produced particle with a size ranging from submicroscopic to macroscopic.

(l) Respirators "for entry into and escape from" means respiratory devices providing protection during entry into and escape from hazardous atmospheres.

(m) Respirators "for escape only" means respiratory devices providing protection only during escape from hazardous atmospheres.

(n) A "facepiece" or "mouthpiece" is a respirator component designed to provide a gas-tight or dust-tight fit with the face and may include headbands, valves, and connections for canisters, cartridges, filters, or respirable gas source.

(o) "Final inspection" means that activity carried out on a product after all manufacturing and assembly operations are completed to insure completeness and adherence to performance or other specifications, including satisfactory appearance.

(p) "Fume" means a solid condensation particle, generally less than 1 micrometer in diameter.

(q) "Gas" means an aeriform fluid which is in a gaseous state at ordinary temperature and pressure.

(r) "Hazardous atmosphere" means: (1) Any atmosphere containing a toxic or disease producing gas, vapor, dust, fume, mist, or pesticide, either immediately or not immediately dangerous to life or health; or (2) any oxygen-deficient atmosphere.

(s) A "hood" or "helmet" is a respirator component which covers the wearer's head and neck, or head, neck, and shoulders, and is supplied with incoming respirable air for the wearer to breathe. It may include a headharness and connection for a breathing tube.

(t) "Immediately dangerous to life or health" means conditions that pose an immediate threat to life or health or conditions that pose an immediate threat of severe exposure to contaminants, such as radioactive materials, which are likely to have adverse cumulative or delayed effects on health.

(u) "Incoming inspection" means the activity of receiving, examining, and accepting only those materials and parts whose quality conforms to specification requirements.

(v) "In-process inspection" means the control of products at the source of production and at each step of the manufacturing process, so that departures from specifications can be corrected before defective components or materials are assembled into the finished product.

(w) "Institute" means the National Institute for Occupational Safety and Health, Department of Health, Education, and Welfare.

(x) "Liquefied breathing gas" means oxygen or air stored in liquid form and supplied to the wearer in a gaseous form.

(y) "Mist" means a liquid condensation particle with a size ranging from submicroscopic to macroscopic.

(z) "Not immediately dangerous to life or health" means any hazardous atmosphere which may produce physical discomfort immediately, chronic poisoning after repeated exposure, or acute adverse physiological symptoms after prolonged exposure.

(aa) "Oxygen deficient atmosphere" means an atmosphere which contains an oxygen partial pressure of less than 148 millimeters of mercury (19.5 percent by volume at sea level).

(bb) "Pesticide" means (1) any substance or mixture of substances (including solvents and impurities) intended to prevent, destroy, repel, or mitigate any insect, rodent, nematode, fungus, weed, or other form of plant or animal life or virus, and (2) any substance or mixture of substances (including solvents and impurities) intended for use as a plant regulator, defoliant, or desiccant, as defined in the Federal Insecticide, Fungicide, and Rodenticide Act of 1947, as amended (7 U.S.C. 135-135k), excluding fumigants which are applied as gases or vapors or in a solid or liquid form as pellets or poured liquids for subsequent release as gases or vapors.

(cc) "Powered air-purifying respirator" means a device equipped with a facepiece, hood, or helmet, breathing tube, canister, cartridge, filter, canister with filter, or cartridge with filter, and a blower.

(dd) "Radionuclide" means an atom identified by the constitution of its nucleus (specified by the number of protons Z, number of neutrons N, and energy, or, alternatively, by the atomic number Z, mass number A=(N+Z), and atomic mass) which exists for a measurable time; decays or disintegrates spontaneously, emits radiation, and results in the formation of new nuclides.

(ee) "Respirable dust" means a dust particle aerodynamically capable of reaching the terminal airways of the lung.

(ff) "Respirator" means any device designed to provide the wearer with respiratory protection against inhalation of a hazardous atmosphere.

(gg) "Smoke" means the products of incomplete combustion of organic substances in the form of solid and liquid particles and gaseous products in air, usually of sufficient concentration to perceptibility obscure vision.

(hh) "Vapor" means the gaseous state of a substance that is solid or liquid at ordinary temperature and pressure.

§ 11.4 Incorporation by reference.

In accordance with 5 U.S.C. 552(a)(1), the technical publications to which reference is made in this Part 11, and which have been prepared by organizations other than the Bureau of Mines, are hereby incorporated by reference and made a part hereof. The incorporated technical publications are available for examination at Approval and Testing, Health and Safety Technical Support Center, Bureau of Mines, 4800 Forbes Avenue, Pittsburgh, Pa. In addition, copies of the American National Standard Practices for Respiratory Protection, Z88.2, are available for examination in every Coal Mine Health and Safety District and Subdistrict Office.

Subpart B—Application for Approval

§ 11.10 Application procedures.

(a) Inspection, examination, and testing leading to the approval of the types of respirators classified in Subpart F of this part shall be undertaken by the Bureau only pursuant to written applications which meet the minimum requirements set forth in this Subpart B.

(b) Applications shall be submitted to Approval and Testing, Bureau of Mines, 4800 Forbes Avenue, Pittsburgh, PA

15213, and shall be accompanied by a check, bank draft, or money order in the amount specified in Subpart C of this part payable to the order of the U.S. Bureau of Mines.

(c) Except as provided in § 11.64, the examination, inspection, and testing of all respirators shall be conducted by Approval and Testing, Bureau of Mines, Pittsburgh, Pa. 15213.

(d) Applicants, manufacturers, or their representatives may visit or communicate with Approval and Testing in order to discuss the requirements for approval of any respirator or the proposed designs thereof. No charge shall be made for such consultation and no written report shall be issued to applicants, manufacturers, or their representatives by the Bureau as a result of such consultation.

§ 11.11 Contents of application.

(a) Each application for approval shall contain a complete written description of the respirator for which approval is requested together with drawings and specifications (and lists thereof) showing full details of construction of the respirator and of the materials used. Drawings and specifications (and lists thereof) shall be submitted in triplicate.

(b) Drawings shall be titled, numbered, and dated; any revision dates shall be shown on the drawings, and the purpose of each revision being sought shall be shown on the drawing or described on an attachment to the drawing to which it applies.

(c) Each application for approval shall contain a proposed plan for quality control which meets the minimum requirements set forth in Subpart E of this part.

(d) Each application shall contain a statement that the respirator has been pretested by the applicant as prescribed in § 11.64, and shall include the results of such tests.

(e) Each application for approval shall contain a statement that the respirator and component parts submitted for approval are either (1) prototypes, or (2) made on regular production tooling, with no operation included which will not be incorporated in regular production processing.

§ 11.12 Delivery of respirators by applicant; requirements.

(a) Each applicant shall, when an application is filed pursuant to § 11.10, be advised by the Bureau of the total number of respirators and component parts required for testing.

(b) The applicant shall deliver, at his own expense, the number of completely assembled respirators and component parts required for testing, to Approval and Testing, Bureau of Mines, Pittsburgh, Pa. 15213.

(c) Respirators and component parts submitted for approval must be made from materials specified in the application.

(d) One completely assembled respirator approved under the provisions of this part may be retained by the Bureau as a laboratory exhibit, the remaining respirators may be returned to the applicant at his own expense, upon written request within 30 days after notice of approval. If no such request is made, the respirators will be disposed of by the Bureau in such manner as it deems appropriate.

(e) Where a respirator fails to meet the requirements for approval set forth in this part, all respirators and components delivered in accordance with this section may be returned to the applicant at his own expense, upon written request within 30 days after notice of disapproval. If no such request is made, the respirators will be disposed of by the Bureau in such manner as it deems appropriate.

Subpart C—Fees

§ 11.20 Examination, inspection and testing of complete respirator assemblies; fees.

Except as provided in § 11.22, the following fees shall be charged by the Bureau for the examination, inspection and testing of complete respirator assemblies:

(a) Self-contained breathing apparatus—	
(1) Entry and escape, 1 hour or more	$3,500
(2) Entry and escape, less than 1 hour	2,750
(3) Escape only	2,000
(b) Gas masks, including pesticide gas masks—	
(1) Single hazard	1,100
(2) Type N	4,100
(c) Supplied-air respirators	750
(d) Dust, fume and mist respirators—	
(1) Single particulate hazard having an Air Contamination Level more than 0.05 mg./m.³ or 2 million particles per cubic foot	500
(2) Combination particulate hazards having an Air Contamination Level more than 0.05 mg./m.³ or 2 million particles per cubic foot	750
(3) Particulate hazards having an Air Contamination Level less than 0.05 mg./m.³ or 2 million particles per cubic foot, radon daughters	1,250
(4) All dusts, fumes and mists	2,000
(e) Chemical cartridge respirators	1,150
(f) Paint spray respirators	1,600
(g) Pesticide respirators	1,600

§ 11.21 Examination, inspection and testing of respirator components or subassemblies; fees.

Except as provided in § 11.22, the following fees shall be charged by the Bureau for the examination, inspection and testing of the individual respirator components or subassemblies:

(a) Facepieces	$450
(b) Canisters	900
(c) Cartridges	600
(d) Filters	650
(e) Hoses	250
(f) Blowers	250
(g) Harnesses	100

§ 11.22 Unlisted fees; additional fees; payment by applicant prior to approval.

(a) Applications for the examination, inspection and testing of complete respirator assemblies which are not listed in § 11.20, or for the examination, inspection, and testing of respirator components or subassemblies which are not listed in § 11.21, shall be accompanied by the following deposits:

(1) Complete respirator assembly	$1,500
(2) Each individual component or subassembly	500

(b) The Bureau reserves the right to conduct any examination, inspection, or test it deems necessary to determine the quality and effectiveness of any listed or unlisted respirator assembly or respirator component or subassembly, and to assess the cost of such examinations, inspections, or tests against the applicant prior to the issuance of any approval for the respiratory equipment examined, inspected, or tested.

(c) The fees charged for the examination, inspection, and testing of unlisted respirator assemblies, unlisted individual respirator components or subassemblies, and for the additional examination, inspection, and testing of listed respirator assemblies and components or subassemblies shall be at the rate of $100 per day for each man-day required to be expended by the Bureau.

(d) Upon completion of all examinations, inspections, and tests of unlisted respirator assemblies or components, or following the completion of any additional examination, inspections, or tests of listed assemblies, or components or subassemblies, including retesting subsequent to disapproval, the Bureau shall advise the applicant in writing of the total cost assessed and the additional amount, if any, which must be paid to the Bureau as a condition of approval.

(e) In the event the amount assessed by the Bureau for unlisted assemblies, or components or subassemblies is less than the amount of the deposit submitted in accordance with paragraph (a) of this section, the Bureau shall refund the overpayment upon the issuance of any approval or notice of disapproval.

Subpart D—Approval and Disapproval

§ 11.30 Certificates of approval; scope of approval.

(a) The Bureau and the Institute shall issue certificates of approval pursuant to the provisions of this subpart only for individual, completely assembled respirators which have been examined, inspected, and tested, and which meet the minimum requirements set forth in Subparts H through M of this part, as applicable.

(b) The Bureau and the Institute will not issue certificates of approval for any respirator component or for any respirator subassembly.

(c) The Bureau and the Institute shall not issue an informal notification of approval. However, if the application for approval, submitted in accordance with § 11.11, states that the submitted respirator and component parts are only prototypes, the Bureau will examine, inspect, and test such respirator and component parts in accordance with the

provisions of this Part 11. If, upon completion of such examinations, inspections and tests, it is found that the prototype meets the minimum requirements set forth in this part, the Bureau and the Institute may inform the applicant, in writing, of the results of the examinations, inspections, and tests, and may require him to resubmit respirators and component parts made on regular production tooling, with no operations included which will not be incorporated in regular production processing, for further examination, inspection, and testing, prior to issuance of the certificate of approval.

(d) Applicants required to resubmit respirators and component parts made on regular production tooling, with no operation included which will not be incorporated in regular production processing, shall be charged fees in accordance with Subpart C of this part.

§ 11.31 Certificates of approval; contents.

(a) The certificate of approval shall contain a classification and a description of the respirator or combination of respirators for which it is issued, as provided in this part.

(b) The certificate of approval shall specifically set forth any restrictions or limitations on the respirator's use in hazardous atmospheres.

(c) Each certificate of approval shall be accompanied by the drawings and specifications (and lists thereof) submitted by the applicant in accordance with § 11.11. These drawings and specifications shall be incorporated by reference in the certificate of approval, and shall be maintained by the applicant. The drawings and specifications listed in each certificate of approval shall set forth in detail the design and construction requirements which shall be met by the applicant during commercial production of the respirator.

(d) Each certificate of approval shall be accompanied by a reproduction of the approval label design to be employed by the applicant with each approved respirator, as provided in § 11.33.

(e) No test data or specific laboratory findings will accompany any certificate of approval, however, the Bureau will release pertinent test data and specific findings upon written request by the applicant, or as required by statute or regulation.

(f) Each certificate of approval shall also contain the approved quality control plan as specified in § 11.42.

§ 11.32 Notice of disapproval.

(a) If, upon the completion of the examinations, inspections, and tests required to be conducted in accordance with the provisions of this part, it is found that the respirator does not meet the minimum requirements set forth in this part, the Bureau and the Institute shall issue a written notice of disapproval to the applicant.

(b) Each notice of disapproval shall be accompanied by all pertinent data or findings with respect to the defects of the respirator for which approval was sought with a view to the possible correction of any such defects.

(c) The Bureau and the Institute shall not disclose, except to the applicant or as required by statute or regulation, any data, findings, or other information with respect to any respirator for which a notice of disappoval is issued.

§ 11.33 Approval labels and markings; approval of contents; use.

(a) Full-scale reproductions of approval labels and markings, and a sketch or description of the method of application and position on the harness, container, canister, cartridge, filter, or other component, together with instructions for the use and maintenance of the respirator shall be submitted to the Bureau and the Institute for approval.

(b) Approval labels shall bear the seals of the U.S. Bureau of Mines and the Department of Health, Education, and Welfare, the applicant's name and address, an approval number assigned by the Bureau, and, where appropriate, restrictions or limitations placed upon the use of the respirator by the Bureau and the Institute.

(c) The Bureau shall, where necessary, notify the applicant when additional labels, markings, or instructions will be required.

(d) Approval labels and markings shall only be used by the applicant to whom they were issued.

(e) Legible reproductions or abbreviated forms of the label approved by the Bureau and the Institute for use on each respirator shall be attached to or printed at the following locations:

Respirator type	Label type	Location
Self-contained breathing apparatus.	Entire	Harness assembly and canister (where applicable).
Gas mask	Entire	Mask container and canister
Supplied-air respirator.	Entire	Respirator container or instruction card.
Dust, fume, and mist respirator.	Entire	Respirator container and filter container.
	Abbreviated.	Filters.
Chemical-cartridge respirator, including paint spray respirator.	Entire	Respirator container, cartridge container, and filter containers (where applicable).
	Abbreviated.	Cartridges and filters and filter containers.
Pesticide respirator	Entire	Respirator container, and cartridge and filter containers.
	Abbreviated.	Cartridges and filters.

(f) The use of any Bureau and Institute approval label obligates the applicant to whom it is issued to maintain or cause to be maintained the approved quality control sampling schedule and the acceptable quality level for each characteristic tested, and to assure that it is manufactured according to the drawings and specifications upon which the certificate of approval is based.

(g) Each respirator, respirator component, and respirator container shall, as required by the Bureau and the Institute to assure quality control and proper use of the respirator, be labeled distinctly to show the name of the applicant, and the name and letters or numbers by which the respirator or respirator component is designated for trade purposes, and the lot number, serial number, or approximate date of manufacture.

§ 11.34 Revocation of certificates of approval.

The Bureau and the Institute reserve the right to jointly revoke, for cause, any certificate of approval issued pursuant to the provisions of this part. Such causes include, but are not limited to, misuse of approval labels and markings, misleading advertising, violations of section 109(e) of the Federal Coal Mine Health and Safety Act of 1969 (30 U.S.C. 819 (e)), and failure to maintain or cause to be maintained the quality control requirements of the certificate of approval.

§ 11.35 Changes or modification of approved respirators; issuance of modification of certificate of approval.

(a) Each applicant may, if he desires to change any feature of an approved respirator, request a modification of the original certificate of approval issued by the Bureau and the Institute for such respirator by filing an application for such modification in accordance with the provisions of this section.

(b) Applications shall be submitted as for an original certificate of approval, with a request for a modification of the existing certificate to cover any proposed change.

(c) The application shall be accompanied by appropriate drawings and specifications, and by a proposed quality control plan which meets the requirements of Subpart E of this part.

(d) The application for modification, together with the accompanying material, shall be examined by the Bureau to determine whether testing will be required.

(e) The Bureau shall inform the applicant of the fee required for any additional testing and the applicant will be charged for the actual cost of any examination, inspection, or test required, and such fees shall be submitted in accordance with the provisions of Subpart C of this part.

(f) If the proposed change or modification meets the requirements of this part, a formal certificate of modification will be issued, accompanied, where necessary, by a list of new and revised drawings and specifications covering the change(s) and reproductions of revised approval labels.

§ 11.36 Delivery of changed or modified approved respirator.

An approved respirator for which a formal certificate of modification has been issued shall be delivered, with proper markings and containers, by the applicant to the Bureau of Mines, Approval and Testing, 4800 Forbes Avenue, Pittsburgh, PA 15213, as soon as it is commercially produced.

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Subpart E—Quality C ntrol

1.40 Quality control plans, filing requirements.

As a part of each application for approval or modification of approval submitted pursuant to this part, each applicant shall file with the Bureau and the Institute a proposed quality control plan which shall be designed to assure the quality of respiratory protection provided by the respirator for which approval is sought.

§ 11.41 Quality control plans; contents.

(a) Each quality control plan shall contain provisions for the management of quality, including: (1) Requirements for the production of quality data and the use of quality control records; (2) control of engineering drawings, documentations, and changes; (3) control and calibration of measuring and test equipment; (4) control of purchased material to include incoming inspection; (5) lot identification, control of processes, manufacturing, fabrication, and assembly work conducted in the applicant's plant; (6) audit of final inspection of the completed product; and, (7) the organizational structure necessary to carry out these provisions.

(b) Each provision for incoming and final inspection in the quality control plan shall include a procedure for the selection of a sample of respirators and the components thereof for testing, in accordance with procedures set forth in Military Standard MIL-STD-105D, "Sampling Procedures and Tables for Inspection by Attributes," or Military Standard MIL-STD-414, "Sampling Procedures and Tables for Inspection by Variables for Percent Defective," or an approved equivalent sampling procedure, or an approved combination of sampling procedures. Incoming bulk raw material inspection or verification of specification, and in-process inspection shall be sufficient to ensure control of product quality through the manufacturing cycle.

(c) The sampling procedure shall include a list of the characteristics to be tested by the applicant or his agent.

(d) The characteristics listed in accordance with paragraph (c) of this section shall be classified according to the potential effect of such defect and grouped into the following classes:

(1) *Critical.* A defect that judgment and experience indicate is likely to result in a condition immediately hazardous to life or health for individuals using or depending upon the respirator;

(2) *Major A.* A defect, other than critical, that is likely to result in failure to the degree that the respirator does not provide any respiratory protection, or a defect that reduces protection and is not detectable by the user;

(3) *Major B.* A defect, other than Major A or critical, that is likely to result in reduced respiratory protection, and is detectable by the user; and

(4) *Minor.* A defect that is not likely to materially reduce the usability of the respirator for its intended purpose, or a defect that is a departure from established standards and has little bearing on the effective use or operation of the respirator.

(e) The quality control inspection test method to be used by the applicant or his agent for each characteristic required to be tested shall be described in detail.

(f) Each item manufactured shall be 100 percent inspected for defects in all critical characteristics and all defective items shall be rejected.

(g) The Acceptable Quality Level (AQL) for each major or minor defect so classified by the applicant shall be:

(1) *Major A.* 1.0 percent;

(2) *Major B.* 2.5 percent; and

(3) *Minor.* 4.0 percent.

(h) Except as provided in paragraph (i) of this section, inspection level II as described in MIL-STD-105D, or inspection level IV as described in MIL-STD-414, shall be used for major and minor characteristics and 100 percent inspection for critical characteristics.

(i) Subject to the approval of the Bureau and the Institute, where the quality control plan provisions for raw material, processes, manufacturing, and fabrication inspection are adequate to insure control of finished article quality, destructive testing of finished articles may be conducted at a lower level of inspection than that specified in paragraph (h) of this section.

§ 11.42 Proposed quality control plans; approval by the Bureau and the Institute.

(a) Each proposed quality control plan submitted in accordance with this subpart shall be reviewed by the Bureau and the Institute to determine its effectiveness in insuring the quality of respiratory protection provided by the respirator for which an approval is sought.

(b) If the Bureau and the Institute determine that the proposed quality control plan submitted by the applicant will not insure adequate quality control, the Bureau and the Institute shall require the applicant to modify the procedures and testing requirements of the plan prior to approval of the plan and issuance of any certificate of approval.

(c) Approved quality control plans shall constitute a part of and be incorporated into any certificate of approval issued by the Bureau and the Institute, and compliance with such plans by the applicant shall be a condition of approval.

§ 11.43 Quality control records; review by the Bureau and the Institute; revocation of approval.

(a) The applicant shall keep quality control inspection records sufficient to carry out the procedures required in MIL-STD-105D or MIL-STD-414, or an approved equivalent sampling procedure.

(b) The Bureau and the Institute reserve the right to have their representatives inspect the applicant's quality control test methods, equipment, and records, and to interview any employee or agent of the applicant in regard to quality control test methods, equipment, and records.

(c) The Bureau and the Institute reserve the right to jointly revoke, for cause, any certificate of approval where it is found that the applicant's quality control test methods, equipment, or records do not insure effective quality control over the respirator for which the approval was issued.

Subpart F—Classification of Approved Respirators; Scope of Approval; Atmospheric Hazards; Service Time

§ 11.50 Types of respirators to be approved; scope of approval.

Approvals shall be issued for the types of respirators which have been classified pursuant to this Subpart F, have been inspected, examined and tested by the Bureau in accordance with the provisions of Subparts G through M of this part, and have been found to provide respiratory protection for fixed periods of time against the hazards specified in such approval.

§ 11.51 Entry and escape, or escape only; classification.

Respirators described in Subparts H through M of this part shall be classified for use as follows:

(a) *Entry and escape.* Respirators designed and approved for use during entry into a hazardous atmosphere, and for escape from a hazardous atmosphere; or,

(b) *Escape only.* Respirators designed and approved for use only during escape from a hazardous atmosphere.

§ 11.52 Respiratory hazards; classification.

Respirators described in Subparts H through M of this part shall be classified as approved for use against any or all of the following respiratory hazards:

(a) Oxygen deficiency;

(b) Gases and vapors;

(c) Particles, including dusts, fumes and mists; and

(d) Pesticides.

§ 11.53 Service time; classification.

(a) Respirators described in Subparts H through M of this part shall be classified, where applicable, as approved for use during the following prescribed service times:

(1) Four hours;

(2) Three hours;

(3) Two hours;

(4) One hour;

(5) Forty-five minutes;

(6) Thirty minutes;

(7) Fifteen minutes;

(8) Ten minutes;

(9) Five minutes;

(10) Three minutes.

(b) Other service times may be prescribed by the Bureau and the Institute.

Subpart G—General Construction and Performance Requirements

§ 11.60 Construction and performance requirements; general.

(a) The Bureau and the Institute shall issue approvals for the types of respirators described in Subparts H through M

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of this part which have met the minimum requirements set forth for such respirators in this Part 11.

(b) In addition to the types of respirators specified in Subparts H through M, the Bureau and the Institute shall issue approvals for other respiratory protective devices not specifically described in this Part 11 subject to such additional requirements as may be imposed in accordance with § 11.63(c).

§ 11.61 General construction requirements.

(a) Respirators will not be accepted by the Bureau for examination, inspection and testing unless they are designed on sound engineering and scientific principles, constructed of suitable materials and evidence good workmanship.

(b) Respirator components which come into contact with the wearer's skin shall be made of nonirritating materials.

(c) Components replaced during or after use shall be constructed of materials which will not be damaged by normal handling.

(d) Mouthpieces, hoods, helmets, and facepieces, except those employed in single-use respirators, shall be constructed of materials which will withstand repeated disinfection as recommended by the applicant in his instructions for use of the device.

(e) The components of each respirator approved by the Bureau and the Institute for use where permissibility is required shall meet the requirements for permissibility and intrinsic safety set forth in Part 18, Subchapter D of this chapter (Bureau of Mines Schedule 2G).

§ 11.62 Component parts; minimum requirements.

(a) The component parts of each respirator shall be:

(1) Designed, constructed, and fitted to insure against creation of any hazard to the wearer;

(2) Assembled to permit easy access for inspection and repair of functional parts; and

(3) Assembled to permit easy access to parts which require periodic cleaning and disinfecting.

(b) Replacement parts shall be designed and constructed to permit easy installation and to maintain the effectiveness of the respirator.

§ 11.63 Test requirements; general.

(a) Each respirator and respirator component shall when tested by the applicant and by the Bureau, meet the applicable requirements set forth in Subparts H through M of this part.

(b) Where a combination respirator is assembled from two or more types of respirators, as described in this part, each of the individual respirator types which have been combined shall, as applicable, meet the minimum requirements for such respirators set forth in Subparts H through M of this part, and such combination respirators, except as specified in § 11.70(b)(2), will be classified by the type of respirator in the combination which provides the least protection to the user.

(c) In addition to the minimum requirements set forth in Subparts H through M of this part, the Bureau and the Institute reserve the right to require, as a further condition of approval, any additional requirements deemed necessary to establish the quality, effectiveness, and safety of any respirator used as protection against hazardous atmospheres.

(d) Where it is determined after receipt of an application that additional requirements will be required for approval, the Bureau will notify the applicant in writing of these additional requirements, and necessary examinations, inspections, or tests, stating generally the reasons for such requirements, examinations, inspections, or tests.

§ 11.64 Pretesting by applicant; approval of test methods by the Bureau.

(a) Prior to making or filing any application for approval or modification of approval, the applicant shall conduct, or cause to be conducted, examinations, inspections, and tests of respirator performance which are equal to or exceed the severity of those prescribed in this part.

(b) With the application, the applicant shall provide a statement to the Bureau showing the types and results of the examinations, inspections, and tests required under paragraph (a) of this section and state that the respirator meets the minimum requirements of Subparts H through M of this part, as applicable. Complete examination, inspection, and test data shall be retained on file by the applicant and be submitted, upon request, to the Bureau.

(c) The Bureau may, upon written request by the applicant, provide drawings and descriptions of its test equipment and otherwise assist the applicant in establishing a test laboratory or securing the services of a testing agency.

(d) The Bureau will not issue an approval to the applicant until it has validated the applicant's test results.

§ 11.65 Conduct of examinations, inspections, and tests by the Bureau and the Institute; assistance by applicant; observers; recorded data; public demonstrations.

(a) All examinations, inspections, and tests conducted pursuant to Subparts H through M of this part will be under the sole direction and control of the Bureau and the Institute.

(b) The Bureau and the Institute may, as a condition of approval, require the assistance of the applicant or agents of the applicant during the assembly, disassembly, or preparation of any respirator or respirator component prior to testing or in the operation of such equipment during testing.

(c) Only Bureau and Institute personnel, persons assisting the Bureau pursuant to paragraph (b) of this section, and such other persons as are requested by the Bureau, the Institute, or the applicant to be observers, shall be present during any examination, inspection, or test conducted prior to the issuance of an approval by the Bureau and the Institute for the equipment under consideration.

(d) The Bureau and the Institute shall hold as confidential any analyses, drawings, specifications, or materials submitted by the applicant and shall not disclose any principles or patentable features of such equipment, except as required by statute or regulation.

(e) As a condition of each approval issued for any respirator, the Bureau and the Institute reserve the right, following the issuance of such approval, to conduct such public tests and demonstrations of the approved respiratory equipment as is deemed appropriate.

§ 11.66 Withdrawal of applications; refund of fees.

(a) Any applicant may, upon a written request submitted to the Bureau or the Institute, withdraw any application for approval of any respirator.

(b) Upon receipt of a written request for the withdrawal of an application, the Bureau shall determine the total man-days expended and the amount due for services already performed during the course of any examinations, inspections, or tests conducted pursuant to such application. The total amount due shall be determined in accordance with the provisions of § 11.22 and assessed against the fees submitted by the applicant. If the total amount assessed is less than the fees submitted, the Bureau shall refund the balance together with a statement of the charges made for services rendered.

Subpart H—Self-Contained Breathing Apparatus

§ 11.70 Self-contained breathing apparatus; description.

(a) Self-contained breathing apparatus, including all completely assembled, portable, self-contained devices designed for use as respiratory protection during entry into and escape from or escape only from hazardous atmospheres, are described as follows:

(1) *Closed-circuit apparatus.* An apparatus of the type in which the exhalation is rebreathed by the wearer after the carbon dioxide has been effectively removed and a suitable oxygen concentration restored from sources composed of:

(i) Compressed oxygen; or

(ii) Chemical oxygen; or

(iii) Liquid-oxygen.

(2) *Open-circuit apparatus.* An apparatus of the following types from which exhalation is vented to the atmosphere and not rebreathed:

(i) *Demand-type apparatus.* An apparatus in which the pressure inside the facepiece in relation to the immediate environment is positive during exhalation and negative during inhalation.

(ii) *Pressure-demand-type apparatus.* An apparatus in which the pressure inside the facepiece in relation to the immediate environment is positive during both inhalation and exhalation.

(b) The following respirators may be classified as designed and approved for

use during emergency entry into a hazardous atmosphere: A combination respirator which includes a self-contained breathing apparatus and a Type "C" or Type "CE" supplied air respirator, where (1) the self-contained breathing apparatus is classified for 3-, 5-, or 10-minute service time and the air line supply is used during entry, or (2) the self-contained breathing apparatus is classified for 15 minutes or longer service time and not more than 20 percent of the rated capacity of the air supply is used during entry.

(c) Self-contained breathing apparatus classified for less than 1 hour service time will not be approved for use during underground mine rescue and recovery operations except as auxiliary equipment.

(d) Self-contained breathing apparatus classified for less than 30 minutes' service time will not be approved for use as auxiliary equipment during underground mine rescue and recovery operations.

§ 11.71 Self-contained breathing apparatus; required components.

(a) Each self-contained breathing apparatus described in § 11.70 shall, where its design requires, contain the following component parts:

(1) Facepiece or mouthpiece, and noseclip;

(2) Respirable breathing gas container;

(3) Supply of respirable breathing gas;

(4) Gas pressure or liquid level gages;

(5) Timer;

(6) Remaining service life indicator or warning device;

(7) Hand-operated valves;

(8) Breathing bag;

(9) Safety relief valve or safety relief system; and

(10) Harness.

(b) The components of each self-contained breathing apparatus shall meet the minimum construction requirements set forth in Subpart G of this part.

§ 11.72 Breathing tubes; minimum requirements.

(a) Flexible breathing tubes used in conjunction with breathing apparatus shall be designed and constructed to prevent:

(1) Restriction of free head movement;

(2) Disturbance of the fit of facepieces and mouthpieces;

(3) Interference with the wearer's activities; and,

(4) Shutoff of airflow due to kinking, or from chin or arm pressure.

§ 11.73 Harnesses; installation and construction; minimum requirements.

(a) Each apparatus shall, where necessary, be equipped with a suitable harness designed and constructed to hold the components of the apparatus in position against the wearer's body.

(b) Harnesses shall be designed and constructed to permit easy removal and replacement of apparatus parts, and, where applicable, provide for holding a full facepiece in the ready position when not in use.

§ 11.74 Apparatus containers; minimum requirements.

(a) Apparatus may be equipped with a substantial, durable container bearing markings which show the applicant's name, the type and commercial designation of the respirator it contains, and all appropriate approval labels.

(b) Containers supplied by the applicant for carrying or storing self-contained breathing apparatus will be inspected, examined, and tested as components of the respirator for which approval is sought.

(c) Containers for self-contained breathing apparatus shall be designed and constructed to permit easy removal of the apparatus.

§ 11.75 Half-mask facepieces, full facepieces, mouthpieces; fit; minimum requirements.

(a) Half-mask facepieces and full facepieces shall be designed and constructed to fit persons with various facial shapes and sizes, either (1) by providing more than one facepiece size, or (2) by providing one facepiece size which will fit varying facial shapes and sizes.

(b) Full facepieces shall provide for the optional use of corrective spectacles or lenses which shall not reduce the respiratory protective qualities of the apparatus.

(c) Apparatus with mouthpieces shall be equipped with noseclips which are securely attached to the mouthpiece or apparatus and provide an airtight seal.

(d) Facepieces shall be designed to prevent eyepiece, spectacle, and lens fogging.

§ 11.76 Facepieces; eyepieces; minimum requirements.

(a) Facepieces shall be designed and constructed to provide adequate vision which is not distorted by the eyepiece.

(b) All eyepieces shall be designed and constructed to meet the impact and penetration requirements specified in Federal Specification, Mask, Air Line, and Respirator, Air Filtering, Industrial, GGG-M-125d, October 11, 1965. This Federal Specification is available from the Government Printing Office or the General Services Administration.

§ 11.77 Inhalation and exhalation valves; minimum requirements.

(a) Inhalation and exhalation valves shall be provided where necessary and protected against damage and distortion.

(b) Exhalation valves shall be:

(1) Protected against external influence, and

(2) Designed and constructed to prevent inward leakage of contaminated air.

§ 11.78 Head harnesses; minimum requirements.

(a) Facepieces shall be equipped with adjustable and replaceable head harnesses designed and constructed to provide adequate tension during suspension and an even distribution of pressure over the entire area in contact with the face.

(b) Mouthpieces shall be equipped, where applicable, with adjustable and replaceable harnesses designed and constructed to hold the mouthpiece in place.

§ 11.79 Breathing gas; minimum requirements.

(a) Breathing gas used to supply apparatus shall be respirable and contain no less than 19.5 (dry atmosphere) volume percent of oxygen.

(b) Oxygen, including liquid oxygen, shall meet the minimum requirements for medical or breathing oxygen set forth in the U.S. Pharmacopeia.

(c) Compressed, gaseous breathing air shall meet the applicable minimum grade requirements for Type I gaseous air set forth in the Compressed Gas Association Commodity Specification for Air, G-7.1 (Grade D or higher quality).

(d) Compressed, liquefied breathing air shall meet the applicable minimum grade requirements for Type II liquid air set forth in the Compressed Gas Association Commodity Specification for Air, G-7.1 (Grade B or higher quality).

§ 11.79-1 Interchangeability of oxygen and air prohibited.

Approvals shall not be issued by the Bureau and the Institute for any apparatus, combination of respirator assemblies, or any apparatus or respirator component which is designed or constructed to permit the interchangeable use of oxygen and air.

§ 11.80 Compressed breathing gas and liquified breathing gas containers; minimum requirements.

(a) Compressed breathing gas and liquefied breathing gas containers shall meet the minimum requirements of the Department of Transportation for Interstate shipment of such containers when fully charged.

(b) Such containers shall be permanently and legibly marked to identify their contents, e.g., compressed breathing air, compressed breathing oxygen, liquefied breathing air, or liquefied breathing oxygen.

(c) Containers normally removed from apparatus for refilling shall be equipped with a dial indicating gage which shows the pressure in the container.

(d) Compressed breathing gas contained valves or a separate charging system or adapter provided with each apparatus shall be equipped with outlet threads specified for the service by the American National Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections, B57.1 (1965), obtainable from American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

§ 11.81 Gas pressure gages; minimum requirements.

(a) Gas pressure gages employed on compressed breathing gas containers shall be calibrated in pounds per square inch.

(b) Liquid-level gages shall be calibrated in fractions of total container capacity, or in units of liquid volume.

(c) Gas pressure gages other than those specified in paragraphs (a) and (b) of this section shall be calibrated in:

(1) Pounds per square inch, or

(2) In fractions of total container capacity, or

(3) Both in pounds per square inch inch and fractions of total container capacity.

(d) (1) Dial-indicating gages shall be reliable to within ±5 percent of full scale when tested both up and down the scale at each of 5 equal intervals.

(2) The full scale graduation of dial-indicating gages shall not exceed 150 percent of the maximum rated cylinder pressures specified for the container in applicable Department of Transportation specifications or permits.

(e) (1) Stem-type gages shall be readable by sight and by touch and shall have a stem travel distance of not less than one-fourth inch between each graduation.

(2) A minimum of five graduations shall be engraved on the stem of each gage and these graduations shall include readings for empty, one-quarter, one-half, three-quarters, and full.

(3) Stem gage readings shall not vary from true readings by more than one-sixteenth inch per inch of stem travel.

(f) The loss of gas through a broken gage or severed gage connection shall not exceed 70 liters per minute when the cylinder pressure is 6,900 kN/m.² (1,000 pounds per square inch gage) or when the liquid level is at one-half.

(g) Where gages are connected to the apparatus through a gage line, the gage and line shall be capable of being isolated from the apparatus except where the failure of the gage or line would not impair the performance or service life of the apparatus.

(h) Oxygen pressure gages shall have the words, "Oxygen" and "Use No Oil," marked prominently on the gage.

(i) (1) Apparatus using compressed breathing gas, except apparatus classified for escape only, shall be equipped with gages visible to the wearer which indicate the remaining gas content in the container.

(2) Apparatus using liquefied breathing gas, except apparatus classified for escape only, shall be equipped with gages visible to the wearer which indicate the remaining liquid content in the container; however, where the liquid content cannot be rapidly vented, and the service time of the device begins immediately after filling, a timer shall be provided in place of a visible gage.

§ 11.82 Timers; elapsed time indicators; remaining service life indicator; minimum requirements.

(a) Elapsed time indicators shall be provided for apparatus with a chemical oxygen source, except:

(1) Apparatus used for escape only; or,

(2) Liquefied breathing gas apparatus equipped with gages visible to the wearer which indicate the remaining liquid content in the container.

(b) The timer or other indicator shall be accurately calibrated in minutes of remaining service life.

(c) Timers shall be readable by sight and by touch during use by the wearer.

(d) Timers shall be equipped with automatically preset alarms which will warn the wearer for a period of 7 seconds or more after the preset time has elapsed.

(e) Remaining service-life indicators or warning devices shall be provided in addition to a pressure gage on compressed gas self-contained breathing apparatus, except apparatus used for escape only, and shall operate automatically without preadjustment by the wearer.

(f) Each remaining service-life indicator or warning device shall give an alarm when the remaining service life of the apparatus is reduced within a range of 20 to 25 percent of its rated service time.

§ 11.83 Hand-operated valves; minimum requirements.

(a) Hand-operated valves shall be designed and constructed to prevent removal of the stem from the valve body during normal usage to insure against a sudden release of the full pressure of the container when the valve is opened.

(b) Valves shall be designed or positioned to prevent accidental opening and closing, and damage from external forces.

(c) Valves operated during use of the apparatus shall be installed in locations where they can be readily adjusted by the wearer.

(d) Main-line valves, designed and constructed to conserve gas in the event of a regulator or demand valve failure, shall be provided in addition to gas container valves, except when such failure will not affect performance.

(e) Hand-operated bypass systems designed and constructed to permit the wearer to breathe and to conserve his gas supply in the event of a regulator or demand valve failure, shall be provided where necessary.

(f) Valves installed on apparatus shall be clearly distinguishable from one another by sight and touch.

(g) The bypass system valve control shall be colored red.

(h) A main-line or bypass valve or system will not be required on apparatus for escape only.

(i) Safety relief valves or systems, designed and constructed to release excess pressure in the breathing circuit, shall be provided on closed-circuit apparatus, and shall meet the following requirements:

(1) The relief valve or system shall operate automatically when the pressure in the breathing circuit on the inhalation side of the breathing bag reaches 13 mm. (one-half inch) water-column height of pressure above the minimum pressure required to fill the breathing bag, within the breathing resistance requirements for the apparatus.

(2) The relief valve or system shall be designed to prevent external atmospheres from entering the breathing circuit.

(3) The relief valve or system shall be designed to permit manual overriding for test purposes and in the event of a failure in the valve or system.

§ 11.84 Breathing bags; minimum requirements.

(a) Breathing bags shall have sufficient volume to prevent gas waste during exhalation and to provide an adequate reserve for inhalation.

(b) Breathing bags shall be constructed of materials which are flexible and resistant to gasoline vapors.

(c) Breathing bags shall be installed in a location which will protect them from damage or collapse by external forces, except on apparatus classified for escape only.

§ 11.85 Self-contained breathing apparatus; performance requirements; general.

Self-contained breathing apparatus and the individual components of each such device shall as applicable meet the requirements specified in §§ 11.85–1 through 11.85–19.

§ 11.85–1 Component parts exposed to oxygen pressures; minimum requirements.

Each applicant shall certify that the materials employed in the construction of component parts exposed to oxygen pressures above atmospheric pressure are safe and compatible for their intended use.

§ 11.85–2 Compressed gas filters; minimum requirements.

All self-contained breathing apparatus using compressed gas shall have a filter downstream of the gas source to effectively remove particles from the gas stream.

§ 11.85–3 Breathing bag test.

(a) Breathing bags will be tested in an air atmosphere saturated with gasoline vapor at room temperature (24°–30° C./75°–85° F.) for a continuous period of twice the rated time of the apparatus (except for apparatus for escape only where the test period shall be the rated time of the apparatus).

(b) The bag will be operated during this test by a breathing machine with 24 respirations per minute and a minute-volume of 40 liters.

(c) A breathing machine cam with a work rate of 622 kg.-m./min. will be used.[1]

(d) The air within the bag(s) shall not contain more than 100 parts per million of gasoline vapor at the end of the test.

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[1] Silverman, L., G. Lee, T. Plotkin, L. Amory, and A. R. Yancey, Fundamental Factors in Design of Protective Equipment, O.S.R.D. Report No. 5732, issued Apr. 1, 1945. The dimensions of the breathing machine cam are available from the Bureau upon request.

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§ 11.85–4 Weight requirement.

(a) The completely assembled and fully charged apparatus shall not weigh more than 16 kg. (35 pounds); however, where the weight decreases by more than 25 percent of its initial charge weight during its rated service life, the maximum allowable weight of a completely assembled and fully charged apparatus shall be 18 kg. (40 pounds).

(b) Where an apparatus employs equipment which contributes materially to the wearer's comfort, e.g., a cooling system, the completely assembled and fully charged apparatus shall not weigh more than 18 kg. (40 pounds) regardless of the decrease in weight during use.

§ 11.85–5 Breathing resistance test; inhalation.

(a) Resistance to inhalation airflow will be measured in the facepiece or mouthpiece while the apparatus is operated by a breathing machine as described in § 11.85–3.

(b) The inhalation resistance of open-circuit apparatus shall not exceed 32 mm. (1.25 inch) water-column height (at a flow rate of 120 liters per minute).

(c) The inhalation resistance of closed-circuit apparatus shall not exceed the difference between exhalation resistance (§ 11.85–6(e)) and 10 cm. (4 inches) water-column height.

§ 11.85–6 Breathing resistance test; exhalation.

(a) Resistance to exhalation airflow will be measured in the facepiece or mouthpiece of open-circuit apparatus with air flowing at a continuous rate of 85 liters per minute.

(b) The exhalation resistance of demand apparatus shall not exceed 25 mm. (1 inch) water-column height.

(c) The exhalation resistance of pressure-demand apparatus shall not exceed the static pressure in the facepiece by more than 51 mm. (2 inches) water-column height.

(d) The static pressure (at zero flow) in the facepiece shall not exceed 38 mm. (1.5 inches) water-column height.

(e) Resistance to exhalation airflow will be measured in the facepiece or mouthpiece of closed-circuit apparatus with a breathing machine as described in § 11.85–3, and the exhalation resistance shall not exceed 51 mm. (2 inches) water-column height.

§ 11.85–7 Exhalation valve leakage test.

(a) Dry exhalation valves and valve seats will be subjected to a suction of 25 mm. (1 inch) water-column height while in a normal operating position.

(b) Leakage between the valve and the valve seat shall not exceed 30 milliliters per minute.

§ 11.85–8 Gas flow test; open-circuit apparatus.

(a) A static-flow test will be performed on all open-circuit apparatus.

(b) The flow from the apparatus shall be greater than 200 liters per minute when the pressure in the facepiece of demand-apparatus is lowered by 51 mm. (2 inches) water-column height when full container pressure is applied.

(c) Where pressure demand apparatus are tested, the flow will be measured at zero gage pressure in the facepiece.

(d) Where apparatus with compressed-breathing-gas containers are tested, the flow test shall also be made with 3,450 kN/m.² (500 p.s.i.g.) container pressure applied.

§ 11.85–9 Gas flow test; closed-circuit apparatus.

(a) Where oxygen is supplied by a constant-flow device only, the rate of flow shall be at least 3 liters per minute for the entire rated service time of the apparatus.

(b) Where constant flow is used in conjunction with demand flow, the constant flow shall be greater than 1.5 liters per minute for the entire rated service time.

(c) All demand-flow devices shall provide at least 30 liters of oxygen per minute when in the fully open position.

§ 11.85–10 Service time test; open-circuit apparatus.

(a) Service time will be measured with a breathing machine as described in § 11.85–3.

(b) The open-circuit apparatus will be classified according to the length of time it supplies air or oxygen to the breathing machine.

(c) The service time obtained on this test will be used to classify the open-circuit apparatus in accordance with § 11.53.

§ 11.85–11 Service time test; closed-circuit apparatus.

(a) The closed-circuit apparatus will be classified according to the length of time it supplies adequate breathing gas to the wearer during man test No. 4 described in Table 4.

(b) The service time obtained on man test No. 4 will be used to classify the closed-circuit apparatus in accordance with § 11.53.

§ 11.85–12 Test for carbon dioxide in inspired gas; open- and closed-circuit apparatus; maximum allowable limits.

(a) Open-circuit apparatus:

(1) The concentration of carbon dioxide in inspired gas in open-circuit apparatus will be measured at the mouth while the apparatus mounted on a dummy head is operated by a breathing machine.[1]

(2) The breathing rate will be 14.5 respirations per minute with a minute-volume of 10.5 liters.

(3) A sedentary breathing machine can will be used.

(4) The apparatus will be tested at a temperature of 27°±2° C. (80°±5° F.).

(5) A concentration of 5 percent carbon dioxide in air will be exhaled into the facepiece.

(b) Closed-circuit apparatus:

(1) The concentration of carbon dioxide in inspired gas in closed-circuit apparatus will be measured at the mouth while the parts of the apparatus contributing to dead-air space are mounted on a dummy head and operated by the breathing machine as in paragraphs (a) (1) through (5) of this section.

(c) During the testing required by paragraphs (a) and (b) of this section, the concentration of carbon dioxide in inspired gas at the mouth will be continuously recorded, and the maximum average concentration during the inhalation portion of the breathing cycle shall not exceed the following limits:

Where the service time is:	*Maximum allowable average concentration of carbon dioxide in inspired air, percent by volume*
Not more than 30 minutes	2.5
1 hour	2.0
2 hours	1.5
3 hours	1.0
4 hours	1.0

(d) In addition to the tests requirements for closed-circuit apparatus set forth in paragraph (b) of this section, gas samples will be taken during the course of the man tests described in Tables 1, 2, 3, and 4. These gas samples will be taken from the closed-circuit apparatus at a point downstream of the carbon dioxide sorbent, and they shall not contain more than 0.5 percent carbon dioxide at any time.

§ 11.85–13 Tests during low temperature operation.

(a) The applicant shall specify the minimum temperature for safe operation and two persons will perform the tests described in paragraphs (c) and (d) of this section wearing the apparatus according to applicant's directions. At the specified temperature, the apparatus shall meet all the requirements described in paragraph (e) of this section.

(b) The apparatus will be precooled at the specified minimum temperature for 4 hours.

(c) The apparatus will be worn in the low temperature chamber for 30 minutes, or for the service time of the apparatus, whichever is less.

(d) During the test period, alternate 1-minute periods of exercise and rest will be required with the exercise periods consisting of stepping onto and off a box 21.5 cm. (8½ inches) high at a rate of 30 cycles per minute.

(e) (1) The apparatus shall function satisfactorily at the specified minimum temperature on duplicate tests.

(2) The wearer shall have sufficient unobscured vision to perform the work.

(3) The wearer shall not experience undue discomfort because of airflow restriction or other physical or chemical changes in the operation of the apparatus.

[1] Kloos, E. J., and J. Lamonica. A Machine-Test Method for Measuring Carbon Dioxide in the Inspired Air of Self-Contained Breathing Apparatus. Bureau of Mines Report of Investigations 6865, 1966, 11 pp.

(f) Auxiliary low-temperature parts which are commercially available to the user may be used on the apparatus to meet the requirements described in paragraph (e) of this section.

§ 11.85–14 Man tests; testing conditions; general requirements.

(a) The man tests described in Tables 1, 2, 3, and 4 represent the workload performed in the mining, mineral, or allied industries by a person wearing the apparatus tested.

(b) The apparatus tested will be worn by Bureau personnel trained in the use of self-contained breathing apparatus, and the wearer will, before participating in these tests, pass a physical examination conducted by a qualified physician.

(c) All man tests will be conducted by the Bureau.

(d) The apparatus will be examined before each man test to ensure that it is in proper working order.

(e) Breathing resistance will be measured within the facepiece or mouthpiece and the wearer's pulse and respiration rate will be recorded during each 2 minute sample period prescribed in tests 1, 2, 3, and 4.

(f) Man tests 1, 2, 3, 4, 5, and 6 will be conducted in duplicate.

(g) If man tests are not completed through no fault of the apparatus, the test will be repeated.

§ 11.85–15 Man tests 1, 2, 3, and 4; requirements.

(a) Man tests 1, 2, 3, and 4, set forth in Tables 1, 2, 3, and 4 respectively, prescribe the duration and sequence of specific activities. These tests will be conducted to:

(1) Familiarize the wearer with the apparatus during use;

(2) Provide for a gradual increase in activity;

(3) Evaluate the apparatus under different types of work and physical orientation; and

(4) Provide information on the operating and breathing characteristics of the apparatus during actual use.

§ 11.85–16 Man test 5; requirements.

(a) Test 5 will be conducted to determine the maximum length of time the apparatus will supply the respiratory needs of the wearer while he is sitting at rest.

(b) The wearer will manipulate the devices controlling the supply of breathing gas to the advantage of the apparatus.

(c) Samples of inspiration from within the apparatus facepiece or mouthpiece shall be taken once every 15 minutes, and shall meet the minimum requirement for oxygen specified in § 11.79(a) of this part, and the maximum allowable average concentration of carbon dioxide specified in § 11.85–12(c).

(d) One sample of inspiration will be taken in the case of 3-, 5-, and 10-minute apparatus.

§ 11.85–17 Man test 6; requirements.

(a) Man test 6 will be conducted with respect to liquefied breathing gas apparatus only.

(b) This test will be conducted to evaluate operation of the apparatus in other than vertical positions.

(c) The wearer will lie face downward for one-fourth the service life of the apparatus with a full charge of liquefied breathing gas, and then a one-quarter full charge of liquefied breathing gas.

(d) The test will be repeated with the wearer lying on each side and on his back.

(e) The oxygen content of the gas supplied to the wearer by the apparatus will be continuously measured.

§ 11.85–18 Man tests; performance requirements.

(a) The apparatus shall satisfy the respiratory requirements of the wearer for the classified service time.

(b) Fogging of the eyepiece shall not obscure the wearer's vision, and the wearer shall not experience undue discomfort because of fit or other characteristics of the apparatus.

(c) When the ambient temperature during testing is 24° ± 6° C. (75° ± 10° F.), the maximum temperature of inspired air recorded during man tests shall not exceed the following, after correction for deviation from 24° C. (75° F.):

Where service life of apparatus is	Where percent relative humidity of inspired air is—	Maximum permissible temperature of inspired air shall not exceed	
		°F.	°C.
¼ hour or less	0–100	136	57
¼ hour to ¾ hour	0–50	125	52
	50–100	[1] 110	[1] 43
1 to 2 hours	0–50	116	46
	50–100	[1] 105	[1] 41
3 hours	0–50	110	43
	50–100	[1] 100	[1] 38
4 hours	0–50	105	41
	50–100	[1] 95	[1] 35

[1] Where percent relative humidity is 50–100 and apparatus is designed for escape only, these maximum permissible temperatures will be increased by 5° C. (10° F.)

§ 11.85–19 Gas tightness test; minimum requirements.

(a) Each apparatus will be tested for tightness by persons wearing it in an atmosphere of 1,000 p.p.m. isoamyl acetate.

(b) Six persons will each wear the apparatus in the test concentrations specified in paragraph (a) of this section for 2 minutes and none shall detect the odor or taste of the test vapor.

TABLE 1.—DURATION AND SEQUENCE OF SPECIFIC ACTIVITIES FOR TEST 1, IN MINUTES

(30 CFR Part 11, Subpart H, § 11.85, et seq.)

Activity	Service time—							
	3 minutes	5 minutes	10 minutes	15 minutes	30 minutes	45 minutes	1 hour	2, 3, and 4 hours
Sampling and readings				2	2	2	2	Perform 1 hour test 2, 3, or 4 times respectively.
Walks at 4.8 km. (3 miles) per hour	3	5	3	4	8	12	18	
Sampling and readings			2	2	2	2	2	
Walks at 4.8 km. (3 miles) per hour			3	5	8	12	18	
Sampling and readings			2	2	2	2	2	
Walks at 4.8 km. (3 miles) per hour					6	13	16	
Sampling and readings					2	3	2	

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TABLE 2.—DURATION AND SEQUENCE OF SPECIFIC ACTIVITIES FOR TEST 2, IN MINUTES
(30 CFR Part 11, Subpart H, § 11.86, et seq.)

Activity	Service Time—							
	3 minutes	5 minutes	10 minutes	15 minutes	30 minutes	45 minutes	1 hour	2, 3 and 4 hours [1]
Sampling and readings				2	2	2	2	2.
Walks at 4.8 km. (3 miles) per hour			1	1	2	4	6	10.
Carries 23 kg. (50 pound) weight over overcoat.			1 time in 2 minutes.	1 time in 2 minutes.	2 times in 4 minutes.	3 times in 6 minutes.	4 times in 8 minutes.	5 times in 10 minutes.
Walks at 4.8 km. (3 miles) per hour				1	3	3	3	5.
Climbs vertical treadmill [2] (or equivalent).	1	1	1	1	1	1	1	1.
Walks at 4.8 km. (3 miles) per hour		1	1			2	3	5.
Climbs vertical treadmill (or equivalent)		1				1	1	1.
Sampling and readings					2	2	2	2.
Walks at 4.8 km. (3 miles) per hour				2	2	3	5	11.
Climbs vertical treadmill (or equivalent)				1	1	1	1	1.
Carries 23 kg. (50 pound) weight over overcoat.				1 time in 3 minutes.	3 times in 6 minutes.	4 times in 8 minutes.	5 times in 10 minutes.	5 times in 10 minutes.
Sampling and readings			2			2	2	2.
Walks at 4.8 km. (3 miles) per hour				1	3	3	3	
Climbs vertical treadmill (or equivalent)			1		1	1	1	Then repeat above activities once.
Walks at 4.8 km. (3 miles) per hour			2			2	3	
Climbs vertical treadmill (or equivalent)						1	1	
Carries 20 kg. (45 pound) weight and walks at 4.8 km. (3 miles) per hour.	1						2	
Walks at 4.8 km. (3 miles) per hour	1	2				1	4	
Sampling and readings				2	2	2	2	

[1] Total test time for Test 2 for 2-hour, 3-hour, and 4-hour apparatus is 2 hours.
[2] Treadmill shall be inclined 15° from vertical and operated at a speed of 1 foot per second.

TABLE 3.—DURATION AND SEQUENCE OF SPECIFIC ACTIVITIES FOR TEST 3, IN MINUTES
(30 CFR Part 11, Subpart H, § 11.86, et seq.)

Activity	Service time—							
	3 minutes	5 minutes	10 minutes	15 minutes	30 minutes	45 minutes	1 hour	2, 3 and 4 hours [1]
Sampling and readings				2	2	2	2	Perform test No. 3 for 1 hr. apparatus; then perform test No. 1 for 1 hour apparatus.
Walks at 4.8 km. (3 miles) per hour			1	1	2	2	3	
Runs at 9.7 km. (6 miles) per hour	1	1	1	1	1	1	1	
Pulls 20 kg. (45 pound) weight to 5 feet		15 times in 1 minute.		30 times in 2 minutes.	30 times in 2 minutes.	30 times in 2 minutes.	60 times in 6 minutes.	
Lies on side	½	1	1	2	3	4	5	
Lies on back	½	1	1	2	2	3	3	
Crawls on hands and knees	1	1	1	2	2	2	2	
Sampling and readings			2		2	2	2	
Runs at 9.7 km. (6 miles) per hour				1	1	1	1	
Walks at 4.8 km. (3 miles) per hour					2	6	10	
Pulls 20 kg. (45 pound) weight to 5 feet			30 times in 2 minutes.		60 times in 6 minutes.	60 times in 6 minutes.	60 times in 6 minutes.	
Sampling and readings				2		2	2	
Walks at 4.8 km. (3 miles) per hour			1		3	4	10	
Lies on side						2	4	
Lies on back						2	1	
Sampling and readings					2	2	2	

[1] Total test time for Test 3 for 2-hour, 3-hour, and 4-hour apparatus is 2 hours.

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TABLE 4.—DURATION AND SEQUENCE OF SPECIFIC ACTIVITIES FOR TEST 4, IN MINUTES
(30 CFR Part 11, Subpart H, § 11.86, et seq.)

Activity	Service time—									
	5 minutes	8 minutes	10 minutes	15 minutes	30 minutes	45 minutes	1 hour	2 hours	3 hours	4 hours
Sampling and readings				2	2	2	2	Perform test No. 1 for 30-minute apparatus; then perform test No. 4 for 1-hour apparatus; then perform test No. 1 for 30-minute apparatus.	Perform test No. 1 for 1-hour apparatus; then perform test No. 4 for 1-hour apparatus; then perform test No. 1 for 1-hour apparatus.	Perform test No. 1 for 1-hour apparatus; then perform test No. 4 for 1-hour apparatus; then perform test No. 1 for 1-hour apparatus twice (i.e., two one-hour tests).
Walks at 4.8 km. (3 miles) per hour				1	2	2	2			
Climbs vertical treadmill [1] (or 1 equivalent).		1	1	1	1	1	1			
Walks at 4.8 km. (3 miles) per hour		1	1	1	2	2	2			
Pulls 20 kg. (45 pound) weight to 5 feet.		30 times in 2 minutes.	30 times in 2 minutes.	30 times in 2 minutes.	60 times in 5 minutes.	60 times in 5 minutes.	60 times in 5 minutes.			
Walks at 4.8 km. (3 miles) per hour			1	1	1	2	3			
Carries 23 kg. (50 pound) weight over overcast.				1 time in 1 minute.	1 time in 1 minute.	2 times in 3 minutes.	4 times in 8 minutes.			
Sampling and readings			2		2	2	2			
Walks at 4.8 km. (3 miles) per hour				1	3	3	4			
Runs at 9.7 km. (6 miles) per hour		1	1	1	1	1	1			
Carries 23 kg. (50 pound) weight over overcast.			1 time in 1 minute.	1 time in 1 minute.	2 times in 3 minutes.	4 times in 6 minutes.	6 times in 9 minutes.			
Pulls 20 kg. (45 pound) weight to 5 feet.	15 times in 1 minute.			15 times in 1 minute.	60 times in 5 minutes.	30 times in 2 minutes.	36 times in 3 minutes.			
Sampling and readings				2	2	2	2			
Walks at 4.8 km. (3 miles) per hour	1		1			2	6			
Pulls 20 kg. (45 pound) weight to 5 feet.						60 times in 5 minutes.	60 times in 5 minutes.			
Carries 20 kg. (45 pound) weight and walks at 4.8 km. (3 miles) per hour.						3	3			
Sampling and readings						2	2			

[1] Treadmill shall be inclined 15° from vertical and operated at a speed of 30 cm. (1 foot) per second.

Subpart I—Gas Masks

§ 11.90 Gas masks; description.

(a) Gas masks including all completely assembled air purifying masks which are designed for use as respiratory protection during entry into and escape or escape only from hazardous atmospheres containing adequate oxygen to support life are described as follows:

(1) *Front-mounted or back-mounted gas mask.* A gas mask which consists of a full facepiece, a breathing tube, a canister at the front or back, a canister harness, and associated connections.

(2) *Type "N" front-mounted or back-mounted gas mask.* A gas mask specifically designed to protect against acid gases, ammonia, carbon monoxide, organic vapors, and particulate contaminants which consists of a full facepiece, breathing tube, a canister at the front or back, a canister harness, and associated connections.

(3) *Chin-style gas mask.* A gas mask which consists of a full facepiece, a canister which is usually attached to the facepiece, and associated connections.

(4) *Escape gas mask.* A gas mask designed for use during escape only from hazardous atmospheres which consists of a half-mask facepiece or mouthpiece, a canister, and associated connections.

(b) Gas masks shall be further described according to the specific gases or vapors against which they are designed to provide respiratory protection, as follows:

Type of front-mounted or back-mounted gas mask:	*Maximum use concentration, percent by volume*
Acid gas [2, 4]	[5] 2
Ammonia [3]	3
Carbon monoxide [6]	2
Organic vapors [2, 4]	[5] 2

Type of chin-style gas mask:	*Maximum use concentration, percent by volume*
Acid gas [2, 4]	[5] 0.5
Ammonia	.5
Organic vapors [2, 4]	[5] .5

Type of escape gas mask:	*Maximum use concentration, parts per million*
Acid gas [2, 4, 6]	[5] 1,000
Ammonia [3]	5,000
Carbon monoxide	10,000
Organic vapors [2, 4, 6]	[5] 5,000

[2] Approval may be for acid gases or organic vapors as a class or for specific acid gases, ammonia, or organic vapors. Approval may also be granted for combinations of acid gases, organic vapors, and other gases and vapors.

[3] Not for use against acid gases or organic vapors with poor warning properties or which generate high heats of reaction with sorbent materials in the canister.

[4] Suggested maximum use concentrations are lower than these for some acid gases and organic vapors.

[5] Eye protection may be required in certain concentrations of acid gases, ammonia, and organic vapors.

(c) Gas masks for respiratory protection against gases and vapors other than those specified in paragraph (b) of this section may be approved. The applicant shall submit a request for approval, in writing, to the Bureau of Mines, Approval and Testing, 4800 Forbes Avenue, Pittsburgh, PA 15213, listing the gas or vapor and suggested maximum use concentration for the specific type of gas mask. The Bureau and the Institute will consider the application and accept or reject the application on the basis of effect on the wearer's health and safety and any field experience in use of gas masks for such exposures. If the application is accepted the Bureau will test such gas mask in accordance with the requirements of this subpart.

§ 11.91 Gas masks; required components.

(a) Each gas mask described in § 11.90 shall, where its design requires, contain the following component parts:

(1) Facepiece or mouthpiece and noseclip;

(2) Canister or cartridge;

(3) Canister harness;

(4) External check valve; and

(5) Breathing tube.

(b) The components of each gas mask shall meet the minimum construction requirements set forth in Subpart G of this part.

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§ 11.92 Canisters and cartridges in parallel; resistance requirements.

Where two or more canisters or cartridges are used in parallel, their resistance to airflow shall be essentially equal.

§ 11.93 Canisters and cartridges; color and markings; requirements.

The color and markings of all canisters and cartridges or labels shall conform with the requirements of the American National Standard for Identification of Gas Mask Canisters, K13.1, obtainable from American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

§ 11.94 Filters used with canisters and cartridges; location; replacement.

(a) Particulate matter filters used in conjunction with a canister or cartridge shall be located on the inlet side of the canister or cartridge.

(b) Filters shall be incorporated in or firmly attached to the canister or cartridge and each filter assembly shall, where applicable, be designed to permit its easy removal from and replacement in the canister or cartridge.

§ 11.95 Breathing tubes; minimum requirements.

(a) Flexible breathing tubes used in conjunction with gas masks shall be designed and constructed to prevent:

(1) Restriction of free head movement;

(2) Disturbance of the fit of facepieces or mouthpieces;

(3) Interference with the wearer's activities; and,

(4) Shutoff of airflow due to kinking, or from chin or arm pressure.

§ 11.96 Harnesses; installation and construction; minimum requirements.

(a) Each gas mask shall, where necessary, be equipped with a suitable harness designed and constructed to hold the components of the gas mask in position against the wearer's body.

(b) Harnesses shall be designed and constructed to permit easy removal and replacement of gas mask parts, and where applicable, provide for holding a full facepiece in the ready position when not in use.

§ 11.97 Gas mask containers; minimum requirements.

(a) Gas masks shall be equipped with a substantial, durable container bearing markings which show the applicant's name, the type and commercial designation of mask it contains and all appropriate approval labels.

(b) Containers for gas masks shall be designed and constructed to permit easy removal of the mask.

§ 11.98 Half-mask facepieces, full facepieces and mouthpieces; fit; minimum requirements.

(a) Half-mask facepieces and full facepieces shall be designed and constructed to fit persons with various facial shapes and sizes either: (1) By providing more than one facepiece size, or (2) by providing one facepiece size which will fit varying facial shapes and sizes.

(b) Full facepieces shall provide for optional use of corrective spectacles or lenses, which shall not reduce the respiratory protective qualities of the gas mask.

(c) Half-mask facepieces shall not interfere with the fit of common industrial safety spectacles, as determined by the Bureau's facepiece tests in § 11.102–3.

(d) Gas masks with mouthpieces shall be equipped with noseclips which are securely attached to the mouthpiece or gas mask and provide an airtight seal.

(e) Facepieces shall be designed to prevent eyepiece fogging.

§ 11.99 Facepieces; eyepieces; minimum requirements.

(a) Full facepieces shall be designed and constructed to provide adequate vision which is not distorted by the eyepiece.

(b) All eyepieces shall be designed and constructed to meet the impact and penetration requirements specified in Federal Specification, Mask, Air Line; and Respirator, Air Filtering, Industrial, GGG–M–125d, October 11, 1965.

§ 11.100 Inhalation and exhalation valves; minimum requirements.

(a) Inhalation and exhalation valves shall be provided where necessary and protected against damage and distortion.

(b) Inhalation valves shall be designed and constructed to prevent excessive exhaled air from adversely affecting cartridges, canisters, and filters.

(c) Exhalation valves shall be protected against external influence, and designed and constructed to prevent inward leakage of contaminated air.

§ 11.101 Head harnesses; minimum requirements.

(a) Facepieces shall be equipped with adjustable and replaceable head harnesses, designed and constructed to provide adequate tension during use and an even distribution of pressure over the entire area in contact with the face.

(b) Mouthpieces shall be equipped, where applicable, with adjustable and replaceable harnesses designed and constructed to hold the mouthpiece in place.

§ 11.102 Gas masks; performance requirements; general.

Gas masks and the individual components of each such device shall, as appropriate, meet the requirements for performance and protection specified in the tests described in §§ 11.102–1 through 11.102–5.

§ 11.102–1 Breathing resistance test; minimum requirements.

(a) Resistance to airflow will be measured in the facepiece or mouthpiece of a gas mask mounted on a breathing machine both before and after each test conducted in accordance with §§ 11.102–3, 11.102–4, and 11.102–5, with air flowing at a continuous rate of 85 liters per minute

(b) The maximum allowable resistance requirements for gas masks are as follows:

MAXIMUM RESISTANCE

(mm. water-column height)

Type of gas mask	Inhalation		Exhalation
	Initial	Final[1]	
Front-mounted or back-mounted (without particulate filter)	60	75	20
Front-mounted or back-mounted (with approved particulate filter)	70	85	20
Chin-style (without particulate filter)	40	55	20
Chin-style (with approved particulate filter)	55	80	20
Escape (without particulate filter)	60	75	20
Escape (with approved particulate filter)	70	85	20

[1] Measured at end of the service life specified in Tables 5, 6, and 7.

§ 11.102–2 Exhalation valve leakage test.

(a) Dry exhalation valves and valve seats will be subjected to a suction of 25 mm. water-column height while in a normal operating position.

(b) Leakage between the valve and valve seat shall not exceed 30 milliliters per minute.

§ 11.102–3 Facepiece tests; minimum requirements.

(a) The complete gas mask will be fitted to the faces of persons having varying facial shapes and sizes.

(b) Where the applicant specifies a facepiece size or sizes for the gas mask, together with the approximate measurements of faces they are designed to fit, the Bureau will insure that test subjects suit such facial measurements.

(c) Any gas mask parts which must be removed to perform the facepiece or mouthpiece fit test shall be replaceable without special tools and without disturbing the facepiece or mouthpiece fit.

(d) The facepiece or mouthpiece fit test, using positive or negative pressure recommended by the applicant and described in his instructions will be used before each test specified in paragraph (e) of this section, and in § 11.102–4.

(e) (1) Each wearer will enter a chamber containing 100 p.p.m. isoamyl acetate vapor for a half-mask facepiece and 1,000 p.p.m. isoamyl acetate vapor for a full facepiece or mouthpiece.

(2) The facepiece or mouthpiece may be adjusted, if necessary, in the test chamber before starting the tests.

(3) Each wearer will remain in the chamber for 8 minutes while performing the following activities:

(i) Two minutes, nodding and turning head;

(ii) Two minutes, calisthenic arm movements;

(iii) Two minutes, running in place, and

(iv) Two minutes, pumping with a tire pump into a 28 liter (1 cubic foot) container.

(4) Each wearer shall not detect the odor of isoamyl acetate during the test.

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§ 11.102–4 Dust, fume, mist, and smoke tests; canisters containing filters; minimum requirements.

(a) Gas mask canisters containing filters for protection against dusts, fumes, mists, and smokes in combination with gases, vapors, or gases and vapors, will be tested as prescribed in § 11.140.

(b) Gas mask canisters designed for protection against smokes will be tested in an atmospheric concentration of 100 micrograms of dioctyl phthalate per liter of air at continuous flow rates of (1) 32 liters per minute, and (2) 85 liters per minute for a period of 5 to 10 seconds, and the DOP leakage through the canister shall not exceed 0.03 percent of the test concentration.

§ 11.102–5 Canister bench tests; minimum requirements.

(a) (1) Bench tests, except for carbon monoxide tests, will be made on an apparatus that allows the test atmosphere at 50±5 percent relative humidity and room temperature (25°±2.5° C.) to enter the canister continuously at concentrations and rates of flow specified in Tables 5, 6, and 7.

(2) Three canisters will be removed from containers and tested as received from the applicant.

(3) Two canisters, other than those described in paragraph (a)(2) of this section, will be equilibrated at room temperature by passing 25 percent relative humidity air through them at 64 liters per minute for 6 hours.

(4) Two canisters, other than those described in paragraphs (a) (2) and (3) of this section, will be equilibrated at room temperature by passing 85 percent relative humidity air through them at 64 liters per minute for 6 hours.

(5) The equilibrated canisters will be resealed, kept in an upright position at room temperature, and tested within 18 hours.

(b) Front-mounted and back-mounted gas mask canisters will be tested and shall meet the minimum requirements set forth in Table 5.

(c) (1) Front-mounted and back-mounted canisters designated as Type N canisters shall have a window or other indicator to warn the gas mask wearer when the canister will no longer satisfactorily remove carbon monoxide from the inhaled air.

(2) Other types of front- and back-mounted canisters may also be equipped with a window or other indicator to warn of imminent leakage of other gases or vapors.

(3) The window indicator canisters will be tested as regular canisters, but shall show a satisfactory indicator change or other warning before the allowable canister penetration has occurred.

(d) Chin-style gas mask canisters shall meet the minimum requirements set forth in Table 6.

(e) Escape gas mask canisters shall meet the minimum requirements set forth in Table 7.

TABLE 5.—CANISTER BENCH TESTS AND REQUIREMENTS FOR FRONT AND BACK-MOUNTED GAS MASK CANISTERS

(30 CFR Part 11, Subpart I, § 11.102–5)

Canister type	Test condition	Test atmosphere: Gas or vapor	Test atmosphere: Concentration, p.p.m.	Test atmosphere: Flow rate, l.p.m.	Number of tests	Maximum allowable penetration, p.p.m.	Minimum service life, minutes [1]
Acid gas	As received	SO_2	20,000	64	3	5	12
		Cl_2	20,000	64	3	5	12
		NO_2	20,000	64	3	5	12
	Equilibrated	SO_2	20,000	32	4	5	12
		Cl_2	20,000	32	4	5	12
		NO_2	20,000	32	4	5	12
Organic vapors	As received	CCl_4	20,000	64	3	5	12
	Equilibrated	CCl_4	20,000	32	4	5	12
Ammonia	As received	NH_3	30,000	64	3	50	12
	Equilibrated	NH_3	30,000	32	4	50	12
Carbon monoxide	As received	CO	20,000	[2] 64	2	(3)	60
		CO	5,000	[4] 32	3		60
		CO	3,000	[5] 32	3		60
Type N	As received	SO_2	20,000	64	3	5	6
		Cl_2	20,000	64	3	5	6
		NO_2	20,000	64	3	5	6
		CCl_4	20,000	64	3	5	6
		NH_3	30,000	64	3	50	6
		CO	20,000	[2] 64	2	(3)	60
		CO	5,000	[4] 32	3		60
		CO	3,000	[5] 32	3		60
	Equilibrated	SO_2	20,000	32	4	5	6
		Cl_2	20,000	32	4	5	6
		NO_2	20,000	32	4	5	6
		CCl_4	20,000	32	4	5	6
		NH_3	30,000	32	4	50	6

[1] Minimum life will be determined at the indicated penetration.
[2] Relative humidity of test atmosphere will be 95±3 percent; temperature of test atmosphere will be 25±2.5° C.
[3] Maximum allowable CO penetration will be 385 cc. during the minimum life. The penetration shall not exceed 500 p.p.m. during this time.
[4] Relative humidity of test atmosphere will be 95±3 percent; temperature of test atmosphere entering the test fixture will be 0+2.5° C.–0° C.

TABLE 6.—CANISTER BENCH TESTS AND REQUIREMENTS FOR CHIN-STYLE GAS MASK CANISTERS

(30 CFR Part 11, Subpart I, § 11.102–5)

Canister type	Test condition	Test atmosphere: Gas or vapor	Test atmosphere: Concentration, p.p.m.	Test atmosphere: Flow rate, l.p.m.	Number of tests	Maximum allowable penetration, p.p.m.	Minimum service life, minutes [1]
Acid gas	As received	SO_2	5,000	64	3	5	12
		Cl_2	5,000	64	3	5	12
		NO_2	5,000	64	3	5	12
	Equilibrated	SO_2	5,000	32	4	5	12
		Cl_2	5,000	32	4	5	12
		NO_2	5,000	32	4	5	12
Organic vapors	As received	CCl_4	5,000	64	3	5	12
	Equilibrated	CCl_4	5,000	32	4	5	12
Ammonia	As received	NH_3	5,000	64	3	50	12
	Equilibrated	NH_3	5,000	32	4	50	12

[1] Minimum life will be determined at the indicated penetration.

TABLE 7.—CANISTER BENCH TESTS AND REQUIREMENTS FOR ESCAPE GAS MASK CANISTERS

(30 CFR Part 11, Subpart I, § 11.102–5)

Canister type	Test condition	Test atmosphere: Gas or vapor	Test atmosphere: Concentration, p.p.m.	Test atmosphere: Flow rate, l.p.m.	Number of tests	Maximum allowable penetration, p.p.m.	Minimum service life, minutes [1]
Acid gas	As received	SO_2	5,000	64	3	5	12
		Cl_2	5,000	64	3	5	12
		NO_2	5,000	64	3	5	12
	Equilibrated	SO_2	5,000	32	4	5	12
		Cl_2	5,000	32	4	5	12
		NO_2	5,000	32	4	5	12
Organic vapors	As received	CCl_4	5,000	64	3	5	12
	Equilibrated	CCl_4	5,000	32	4	5	12
Ammonia	As received	NH_3	5,000	64	3	50	12
	Equilibrated	NH_3	5,000	32	4	50	12
Carbon monoxide	As received	CO	10,000	[2] 32	2	(3)	60
		CO	5,000	[2] 32	3	(3)	60
		CO	3,000	[2] 32	3	(3)	60

[1] Minimum life will be determined at the indicated penetration.
[2] Relative humidity of test atmosphere will be 95±3 percent; temperature of test atmosphere will be 25±2.5° C.
[3] Maximum allowable CO penetration will be 385 cc. during the minimum life. The penetration shall not exceed 500 p.p.m. during this time.
[4] If effluent temperature exceeds 100° C. during this test, the escape gas mask shall be equipped with an effective heat exchanger.
[5] Relative humidity of test atmosphere will be 95±3 percent; temperature of test atmosphere entering the test fixture will be 0+2.5° C.–0° C.

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...—Supplied-Air Respirators

...Supplied-air respirators; de...

...plied-air respirators, including ...letely assembled respirators de... ...use as respiratory protection ...ntry into and escape from ... atmospheres are described as

...*Type "A" supplied-air respirators.* ...ask respirator, for entry into ...e from hazardous atmospheres, ...consists of a motor-driven or ...erated blower that permits the ...nce of air when the blower is ...ling, a strong large-diameter ...g a low resistance to airflow, a ... which the hose and the life- ...attached and a tight-fitting

...*Type "AE" supplied-air respira...* ...pe "A" supplied-air respirator ...ith additional devices designed ... the wearer's head and neck ...mpact and abrasion from re... ...abrasive material, and with ...material such as plastic, glass, ..., sheet metal, or other suitable ...do protect the window(s) of ...hoods, and helmets which do ...y interfere with the wearer's ... permit easy access to the ex... ...face of such window(s) for

...*Type "B" supplied-air respirators.* ...ask respirator, for entry into ...e from atmospheres not im... ...dangerous to life or health, ...consists of a strong large- ...hose with low resistance to air... ...ough which the user draws ...air by means of his lungs alone, ... to which the hose is attached, ...ght-fitting facepiece.

...*Type "BE" supplied-air respira...* ...ype "B" supplied-air respirator ...with additional devices de... ...protect the wearer's head and ...nst impact and abrasion from ...g abrasive material, and with ...material such as plastic, glass, ..., sheet metal, or other suit... ...rial to protect the window(s) ...ces, hoods, and helmets which ...duly interfere with the wearer's ...nd permit easy access to the ... surface of such window(s) for ...

...*Type "C" supplied-air respirators.* ...e respirator, for entry into and ...from atmospheres not immedi... ...gerous to life or health, which ...of a source of respirable breath... ...a hose, a detachable coupling, ...l valve, orifice, a demand valve ...ure demand valve, an arrange... ...r attaching the hose to the ...nd a facepiece, hood, or helmet.

...*Type "CE" supplied-air respira...* ...A type "C" supplied-air respirator ...d with additional devices de... ...protect the wearer's head and ...nst impact and abrasion from ...g abrasive material, and with ...material such as plastic, glass, ...ire, sheet metal, or other suit... ...rial to protect the window(s) ...ces, hoods, and helmets which do not unduly interfere with the wearer's vision and permit easy access to the external surface of such window(s) for cleaning.

§ 11.111 Supplied-air respirators; required components.

(a) Each supplied-air respirator described in § 11.110 shall, where its design requires, contain the following component parts:

(1) Facepiece, hood, or helmet;
(2) Air supply valve, orifice, or demand or pressure-demand regulator;
(3) Hand operated or motor driven air blower;
(4) Air supply hose;
(5) Detachable couplings;
(6) Flexible breathing tube; and
(7) Respirator harness.

(b) The component parts of each supplied-air respirator shall meet the minimum construction requirements set forth in Subpart G of this part.

§ 11.112 Breathing tubes; minimum requirements.

(a) Flexible breathing tubes used in conjunction with supplied-air respirators shall be designed and constructed to prevent:

(1) Restriction of free head movement;
(2) Disturbance of the fit of facepieces, mouthpieces, hoods, or helmets;
(3) Interference with the wearer's activities; and
(4) Shutoff of airflow due to kinking, or from chin or arm pressure.

§ 11.113 Harnesses; installation and construction; minimum requirements.

(a) Each supplied-air respirator shall, where necessary, be equipped with a suitable harness designed and constructed to hold the components of the respirator in position against the wearer's body.

(b) Harnesses shall be designed and constructed to permit easy removal and replacement of respirator parts, and where applicable, provide for holding a full facepiece in the ready position when not in use.

§ 11.114 Respirator containers; minimum requirements.

Supplied-air respirators shall be equipped with a substantial, durable container bearing markings which show the applicant's name, the type and commercial designation of the respirator it contains, and all appropriate approval labels.

§ 11.115 Half-mask facepieces, full facepieces, hoods, and helmets; fit; minimum requirements.

(a) Half-mask facepieces and full facepieces shall be designed and constructed to fit persons with various facial shapes and sizes either (1) by providing more than one facepiece size, or (2) by providing one facepiece size which will fit varying facial shapes and sizes.

(b) Full facepieces shall provide for optional use of corrective spectacles or lenses, which shall not reduce the respiratory protective qualities of the respirator.

(c) Hoods and helmets shall be designed and constructed to fit persons with various head sizes, provide for the optional use of corrective spectacles or lenses, and insure against any restriction of movement by the wearer.

(d) Facepieces, hoods, and helmets shall be designed to prevent eyepiece fogging.

§ 11.116 Facepieces, hoods, and helmets; eyepieces; minimum requirements.

(a) Facepieces, hoods, and helmets shall be designed and constructed to provide adequate vision which is not distorted by the eyepiece.

(b) All eyepieces except those on Types B, BE, C, and CE supplied-air respirators shall be designed and constructed to meet the impact and penetration requirements specified in Federal Specification, Mask, Air Line, and Respirator, Air Filtering, Industrial GGG-M-125d, October 11, 1965.

(c) (1) The eyepieces of AE, BE, and CE type supplied-air respirators shall be shielded by plastic, glass, woven wire, sheet metal, or other suitable material which does not interfere with the vision of the wearer.

(2) Shields shall be mounted and attached to the facepiece to provide easy access to the external surface of the eyepiece for cleaning.

§ 11.117 Inhalation and exhalation valves; check valves; minimum requirements.

(a) Inhalation and exhalation valves shall be provided where necessary and protected against distortion.

(b) Exhalation valves shall be:

(1) Protected against damage and external influence; and

(2) Designed and constructed to prevent inward leakage of contaminated air.

(c) Check valves designed and constructed to allow airflow toward the facepiece only shall be provided in the connections to the facepiece or in the hose fitting near the facepiece of all Type A, AE, B, and BE supplied-air respirators.

§ 11.118 Head harnesses; minimum requirements.

Facepieces shall be equipped with adjustable and replaceable head harnesses which are designed and constructed to provide adequate tension during use, and an even distribution of pressure over the entire area in contact with the face.

§ 11.119 Head and neck protection; supplied-air respirators; minimum requirements.

Type AE, BE, and CE supplied-air respirators shall be designed and constructed to provide protection against impact and abrasion from rebounding abrasive materials to the wearer's head and neck.

§ 11.120 Air velocity and noise levels; hoods and helmets; minimum requirements.

Noise levels generated by the respirator will be measured inside the hood or helmet at maximum airflow obtainable

within pressure and hose length requirements and shall not exceed 80 dBA.

§ 11.121 Breathing gas; minimum requirements.

(a) Breathing gas used to supply supplied-air respirators shall be respirable breathing air and contain no less than 19.5 volume-percent of oxygen.

(b) Compressed, gaseous breathing air shall meet the applicable minimum grade requirements for Type I gaseous air set forth in the Compressed Gas Association Commodity Specification for Air, G–7.1 (Grade D or higher quality).

(c) Compressed, liquefied breathing air shall meet the applicable minimum grade requirements for Type II liquid air set forth in the Compressed Gas Association Commodity Specification for Air, G–7.1 (Grade B or higher quality).

§ 11.122 Air supply source; hand-operated or motor driven air blowers; Type A supplied-air respirators; minimum requirements.

(a) Blowers shall be designed and constructed to deliver an adequate amount of air to the wearer with either direction of rotation, unless constructed to permit rotation in one direction only, and to permit the free entrance of air to the hose when the blower is not operated.

(b) No multiple systems, whereby more than one user is supplied by one blower, will be approved, unless each hose line is connected directly to a manifold at the blower.

§ 11.123 Terminal fittings or chambers; Type B supplied-air respirators; minimum requirements.

(a) Blowers or connections to air supplies providing positive pressures shall not be approved for use on Type B supplied-air respirators.

(b) Terminal fittings or chambers employed in Type B supplied-air respirators, shall be:

(1) Installed in the inlet of the hose;

(2) Designed and constructed to provide for the drawing of air through corrosion resistant material arranged so as to be capable of removing material larger than 0.149 mm. in diameter (149 micrometers, 100-mesh, U.S. Standard sieve).

(3) Installed to provide a means for fastening or anchoring the fitting or chamber in a fixed position in a zone of respirable air.

§ 11.124 Supplied-air respirators; performance requirements; general.

Supplied-air respirators and the individual components of each such device shall, as appropriate, meet the requirements for performance and protection specified in the tests described in §§ 11.124–1 through 11.124–24.

§ 11.124–1 Hand-operated blower test; minimum requirements.

(a) Hand-operated blowers shall be tested by attaching them to a mechanical drive and operating them 6 to 8 hours daily for a period of 100 hours at a speed necessary to deliver 50 liters of air per minute through each completely assembled respirator. Each respirator shall be equipped with the maximum length of hose with which the device is to be approved and the hose shall be connected to each blower or manifold outlet designed for hose connections.

(b) The crank speed of the hand-operated blower shall not exceed 50 revolutions per minute in order to deliver the required 50 liters of air per minute to each facepiece.

(c) The power required to deliver 50 liters of air per minute to each wearer through the maximum length of hose shall not exceed one-fiftieth horsepower, and the torque shall not exceed a force of 2.3 kg. (5 pounds) on a 20 cm. (8-inch) crank, as defined in § 11.124–3.

(d) The blower shall operate throughout the period without failure or indication of excessive wear of bearings or other working parts.

§ 11.124–2 Motor-operated blower test; minimum requirements.

(a) Motor-operated blowers shall be tested by operating them at their specified running speed 6 to 8 hours daily for a period of 100 hours when assembled with the kind and maximum length of hose for which the device is to be approved and when connected to each blower or manifold outlet designed for hose connections.

(b) The connection between the motor and the blower shall be so constructed that the motor may be disengaged from the blower when the blower is operated by hand.

(c) The blower shall operate throughout the period without failure or indication of excessive wear of bearings or other working parts.

(d) Where a blower, which is ordinarily motor driven, is operated by hand, the power required to deliver 50 liters of air per minute to each wearer through the maximum length of hose shall not exceed one-fiftieth horsepower, and the torque shall not exceed a force of 2.3 kg. (5 pounds) on a 20 cm. (8-inch) crank, as defined in § 11.124–3.

(e) Where the respirator is assembled with the facepiece and 15 m. (50 feet) of the hose for which it is to be approved, and when connected to one outlet with all other outlets closed and operated at a speed not exceeding 50 revolutions of the crank per minute, the amount of air delivered into the respiratory-inlet covering shall not exceed 150 liters per minute.

§ 11.124–3 Method of measuring the power and torque required to operate blowers.

As shown in Figure 1, the blower crank is replaced by a wooden drum, *a* (13 cm. (5 inches) in diameter is convenient). This drum is wound with about 12 m. (40 feet) of No. 2 picture cord, *b*. A weight, *c*, of sufficient mass to rotate the blower at the desired speed is suspended from this wire cord. A mark is made on the cord about 3 to 4.5 m. (10 to 15 feet) from the weight, *c*. Another mark is placed at a measured distance (6–9 m./20–30 feet is convenient) from the first. These are used to facilitate timing. To determine the torque or horsepower required to operate the blower, the drum is started in rotation manually at or slightly above the speed at which the power measurement is to be made. The blower is then permitted to assume constant speed, and then as the first mark on the wire leaves the drum, a stopwatch is started. The watch is stopped when the second mark leaves the drum. From these data the foot-pounds per minute and the torque may be calculated.

§ 11.124–4 Type B supplied-air respirator; minimum requirements.

No Type B supplied-air respirator shall be approved for use with a blower or with connection to an air supply device at positive pressures.

§ 11.124–5 Type C supplied-air respirator, continuous flow class; minimum requirements.

(a) Respirators tested under this section shall be approved only when they supply respirable air at the pressures and quantities required.

(b) The pressure at the inlet of the hose connection shall not exceed 863 kN/m^2. (125 pounds per square inch gage).

(c) Where the pressure at any point in the supply system exceeds 863 kN/m^2 (125 pounds per square inch gage), the respirator shall be equipped with a pressure-release mechanism that will prevent the pressure at the hose connection from exceeding 863 kN/m^2 (125 pounds per square inch gage) under any conditions.

§ 11.124–6 Type C supplied-air respirator, demand and pressure demand class; minimum requirements.

(a) Respirators tested under this section shall be approved only when used to supply respirable air at the pressures and quantities required.

(b) The manufacturer shall specify the range of air pressure at the point of attachment of the air-supply hose to the air-supply system, and the range of hose length for the respirator. For example, he might specify that the respirator be used with compressed air at pressures ranging from 280–550 kN/m^2 (40 to 80 pounds per square inch) with from 6 to 76 m. (15 to 250 feet) of air-supply hose.

(c) The specified air pressure at the point of attachment of the hose to the air-supply system shall not exceed 853 kN/m^2 (125 pounds per square inch gage).

(d) (1) Where the pressure in the air-supply system exceeds 863 kN/m^2 (125 pounds per square inch gage), the respirator shall be equipped with a pressure-release mechanism that will prevent the pressure at the point of attachment of the hose to the air-supply system from exceeding 863 kN/m^2 (125 pounds per square inch gage).

(2) The pressure-release mechanism shall be set to operate at a pressure not more than 20 percent above the manufacturer's highest specified pressure. For example, if the highest specified pressure is 863 kN/m^2 (125 pounds per square inch), the pressure-release mechanism

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would be set to operate at a maximum of 1,035 kN/m.² (150 pounds per square inch).

§ 11.124–7 Air-supply line tests; minimum requirements.

Air supply lines employed on Type A, Type B, and Type C supplied-air respirators shall meet the minimum test requirements set forth in Table 8.

§ 11.124–8 Harness test; minimum requirements.

(a) (1) Shoulder straps employed on Type A supplied-air respirators shall be tested for strength of material, joints, and seams and must separately withstand a pull of 113 kg. (250 pounds) for 30 minutes without failure.

(2) Belts, rings, and attachments for life lines must withstand a pull of 136 kg. (300 pounds) for 30 minutes without failure.

(3) The hose shall be firmly attached to the harness so as to withstand a pull of 113 kg. (250 pounds) for 30 minutes without separating, and the hose attachments shall be arranged so that the pull or drag of the hose behind an advancing wearer does not disarrange the harness or exert pull upon the facepiece.

(4) The arrangement and suitability f all harness accessories and fittings will be considered.

(b) (1) The harness employed on Type B supplied-air respirators shall not be uncomfortable, disturbing, or interfere with the movements of the wearer.

(2) The harness shall be easily adjustable to various sizes.

(3) The hose shall be attached to the harness in a manner that will withstand a pull of 45 kg. (100 pounds) for 30 minutes without separating or showing signs of failure.

(4) The design of the harness and attachment of the line shall permit dragging the maximum length of hose considered for approval over a concrete floor without disarranging the harness or exerting a pull on the facepiece.

(5) The arrangement and suitability of all harness accessories and fittings will be considered.

(c) The harness employed on Type C respirators shall be similar to that required on the Type B respirator, or, it may consist of a simple arrangement for attaching the hose to a part of the wearer's clothing in a practical manner that prevents a pull equivalent to dragging the maximum length of the hose over a concrete floor from exerting pull upon the respiratory-inlet covering.

(d) Where supplied-air respirators have a rigid or partly rigid head covering, a suitable harness shall be required to assist in holding this covering in place.

§ 11.124–9 Breathing tube test; minimum requirements.

(a) (1) Type A and Type B supplied-air respirators shall employ one or two flexible breathing tubes of the nonkinking type which extend from the facepiece to a connecting hose coupling attached to the belt or harness.

(2) The breathing tubes employed shall permit free head movement, insure against closing off by kinking or by chin or arm pressure, and they shall not create a pull that will loosen the facepiece or disturb the wearer.

(b) Breathing tubes employed on Type C supplied-air respirators of the continuous flow class shall meet the minimum requirements set forth in paragraph (a) of this section, however, an extension of the connecting hose may be employed in lieu of the breathing tubes required.

(c) (1) A flexible, nonkinking type breathing tube shall: (i) Be employed on Type C supplied-air respirators of the demand and pressure-demand class; and (ii) extend from the facepiece to the demand or pressure-demand valve, except where the valve is attached directly to the facepiece.

(2) The breathing tube shall permit free head movement, insure against closing off by kinking or by chin or arm pressure, and shall not create a pull that will loosen the facepiece or disturb the wearer.

§ 11.124–10 Airflow resistance test, Type A and Type AE supplied-air respirators; minimum requirements.

(a) Airflow resistance will be determined when the respirator is completely assembled with the respiratory-inlet covering, the air-supply device, and the maximum length of air-supply hose coiled for one-half its length in loops 1.5 to 2.1 m. (5 to 7 feet) in diameter.

(b) The inhalation resistance, drawn at the rate of 85 liters (3 cubic feet) per minute when the blower is not operating or under any practical condition of blower operation shall not exceed the following amounts:

Maximum length of hose for which respirator is approved		Maximum resistance, water column height	
Feet	Meters	Inches	Millimeters
75	23	1.5	38
150	46	2.5	64
250	76	3.5	89
300	91	4.0	102

(c) The exhalation resistance shall not exceed 25 mm. (1 inch) of water-column height at a flow rate of 85 liters (3 cubic feet) per minute when the blower is not operating or under any practical condition of blower operation.

§ 11.124–11 Airflow resistance test; Type B and Type BE supplied-air respirators; minimum requirements.

(a) Airflow resistance shall be determined when the respirator is completely assembled with the respiratory-inlet covering and the hose in the maximum length to be considered for approval, coiled in loops 1.5 to 2.1 m. (5 to 7 feet) in diameter.

(b) Airflow resistance shall not exceed 38 mm. (1.5 inches) of water-column height to air drawn at the flow rate of 85 liters (3 cubic feet) per minute.

(c) The exhalation resistance shall not exceed 25 mm. (1 inch) of water-column height at this flow rate.

§ 11.124–12 Airflow resistance test; Type C supplied-air respirator, continuous flow class and Type CE supplied-air respirator; minimum requirements.

The resistance to air flowing from the respirator shall not exceed 25 mm. (1 inch) of water-column height when the air flow into the respiratory-inlet covering is 115 liters (4 cubic feet) per minute.

§ 11.124–13 Airflow resistance test; Type C supplied-air respirator, demand class; minimum requirements.

(a) Inhalation resistance shall not exceed 50 millimeters (2 inches) of water at an air flow of 115 liters (4 cubic feet) per minute.

(b) The exhalation resistance to a flow of air at a rate of 85 liters (3 cubic feet) per minute shall not exceed 25 millimeters (1 inch) of water.

§ 11.124–14 Airflow resistance test; Type C supplied-air respirator, pressure-demand class; minimum requirements.

(a) The static pressure in the facepiece shall not exceed 38 mm. (1.5 inches) of water-column height.

(b) The pressure in the facepiece shall not fall below atmospheric at inhalation airflows less than 115 liters (4 cubic feet) per minute.

(c) The exhalation resistance to a flow of air at a rate of 85 liters (3 cubic feet) per minute shall not exceed the static pressure in the facepiece by more than 51 mm. (2 inches) of water-column height.

§ 11.124–15 Exhalation valve leakage test.

(a) Dry exhalation valves and valve seats will be subjected to a suction of 25 mm. water-column height while in a normal operating position.

(b) Leakage between the valve and valve seat shall not exceed 30 milliliters per minute.

§ 11.124–16 Man tests for gases and vapors; supplied-air respirators; general performance requirements.

(a) Wearers will enter a chamber containing a gas or vapor as prescribed in §§ 11.124–17, 11.124–18, 11.124.19, and 11.124–20.

(b) Each wearer will spend 10 minutes in work to provide observations on freedom of the device from leakage. The freedom and comfort allowed the wearer will also be considered.

(c) Time during the test period will be divided as follows:

(1) *Five minutes.* Walking, turning head, dipping chin; and

(2) *Five minutes.* Pumping air with a tire pump into a 28-liter (1 cubic foot) container, or equivalent work.

(d) No odor of the test gas or vapor shall be detected by the wearer in the air breathed during any such test, and the wearer shall not be subjected to any undue discomfort or encumbrance because of the fit, air delivery, or other features of the respirator during the testing period.

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§ 11.124–17 Man test for gases and vapors; Type A and Type AE respirators; test requirements.

(a) The completely assembled respirator will be worn in a chamber containing 0.1 ±0.025 percent isoamyl acetate vapor, and the blower, the intake of the hose, and not more than 25 percent of the hose length will be located in isoamyl acetate-free air.

(b) The man in the isoamyl acetate atmosphere will draw his inspired air through the hose, connections, and all parts of the air device by means of his lungs alone (blower not operating).

(c) The 10-minute work test will be repeated with the blower in operation at any practical speed up to 50 revolutions of the crank per minute.

§ 11.124–18 Man test for gases and vapors; Type B and Type BE respirators; test requirements.

(a) The completely assembled respirator will be worn in a chamber containing 0.1±0.025 percent isoamyl acetate vapor, and the intake of the hose, and not more than 25 percent of the hose length will be located in isoamyl acetate-free air.

(b) The man in the isoamyl acetate atmosphere will draw his inspired air through the hose and connections by means of his lungs alone.

§ 11.124–19 Man test for gases and vapors; Type C respirators, continuous-flow class and Type CE supplied-air respirators; test requirements.

(a) The completely assembled respirator will be worn in a chamber containing 0.1±0.025 percent isoamyl acetate vapor, the intake of the hose will be connected to a suitable source of respirable air, and not more than 25 percent of the hose length will be located in isoamyl acetate-free air.

(b) The minimum flow of air required to maintain a positive pressure in the respiratory-inlet covering throughout the entire breathing cycle will be supplied to the wearer, provided however, that airflow shall not be less than 115 liters per minute for tight-fitting and not less than 170 liters per minute for loose-fitting respiratory inlet-coverings.

(c) The test will be repeated with the maximum rate of flow attainable within specified operating pressures.

§ 11.124–20 Man test for gases and vapors; Type C supplied-air respirators, demand and pressure-demand classes; test requirements.

(a) The completely assembled respirator will be worn in a chamber containing 0.1±0.025 percent isoamyl acetate vapor, the intake of the hose will be connected to a suitable source of respirable air, and not more than 25 percent of the hose length will be located in isoamyl acetate free air.

(b) The test will be conducted at the minimum pressure with the maximum hose length and will be repeated at the maximum pressure with the minimum hose length.

§ 11.124–21 Tests for protection during abrasive blasting; Type AE, Type BE, and Type CE supplied-air respirators; general performance requirements.

(a) Tests will be made under conditions of typical abrasive blasting operation.

(b) The tests prescribed in §§ 11.124–22, 11.124–23, and 11.124–24 will be conducted under the following conditions:

(1) A suction-feed abrasive blasting outfit will be used by the wearer;

(2) The diameter of the air jet shall be 5 mm. ($\frac{3}{16}$ inch);

(3) Air pressure will be 276–483 kN/m.^{2} (40–70 pounds per square inch);

(4) The abrasive used will contain a composition of 99+ percent free silica (SiO_2);

(5) The size properties of the abrasive used will be a mixture of 90 percent by weight of essentially No. 1 sandblast sand and 10 percent air-floated fines; and

(6) The No. 1 sand used will meet a size specification of not more than 10 percent on a 20-mesh sieve and not more than 10 percent through a 35-mesh sieve; 99+ percent of the fines will be able to pass through a 270-mesh sieve. All size determinations will be made by standard-mesh sieves.

(c) Tests will be conducted for 30 minutes continuously.

(d) (1) The person wearing the respirator will sandblast the inside surface of a common iron kettle of approximate hemispherical shape (about 76 cm. (30 inches) in diameter, and 113.6 liters (30 gallons) capacity).

(2) The kettle will be placed with the plane of the opening inclined 45° from a vertical position and with the lowest point of the rim at about the height of the person's hips.

(3) The wearer will stand at one position in front of the kettle and lean over until the upper part of the body is inclined to parallel the face of the kettle.

(4) The wearer will blast the entire inner surface of the kettle with the blast at all times directed approximately at right angles to the surface with the nozzle of the gun approximately 15 cm. (6 inches) from the surface, and with his head approximately 46 cm. (18 inches) from the nozzle.

(5) The wearer will move his head forward, backward, and sideways during each blasting operation.

(e) (1) Air will be withdrawn continuously during the test at the rate of 32 liters (1.13 cubic feet) per minute from the respiratory-inlet covering at a point as near as convenient to the wearer's nostrils.

(2) Simultaneously air will be drawn at the same rate from the source of intake air to the respirator.

(f) Respirators tested in accordance with §§ 11.124–22, 11.124–23, and 11.124–24 shall meet the following minimum requirements:

(1) The amount of particulate matter in the air withdrawn from the respiratory-inlet covering shall not exceed the amount of particulate matter supplied to the respirator by more than 0.5 mg. for the 30-minute test period;

(2) The wearer of the respirator in this test shall not experience undue encumbrance and discomfort because of the fit, air delivery, or other features of the respirator; and,

(3) The head and shoulder covering shall adequately protect the wearer from discomfort or injury due to impact or abrasion from the rebounding material during the test.

§ 11.124–22 Test for protection during abrasive blasting; Type AE supplied-air respirator; test requirements.

(a) The respirator will be arranged as prescribed in § 11.124–17(a), and the tests prescribed in § 11.124–21 will be performed.

(b) The wearer will draw his inspired air through the hose, connections, and all parts of the air device by means of his lungs alone (blower not operating).

(c) The test will be repeated with the blower in operation at any practical speed up to 50 revolutions per minute of the crank.

§ 11.124–23 Test for protection during abrasive blasting; Type BE supplied-air respirator; test requirements.

(a) The respirator will be arranged as prescribed in § 11.124–18(a), and the tests prescribing in § 11.124–21 will be performed.

(b) The wearer will draw his inspired air through the hose, connections, and all parts of the air device by means of his lungs alone.

§ 11.124–24 Test for protection during abrasive blasting; Type CE supplied-air respirator; test requirements.

(a) The respirator will be arranged as prescribed in § 11.124–19(a), and the tests prescribed in § 11.124–21 will be performed.

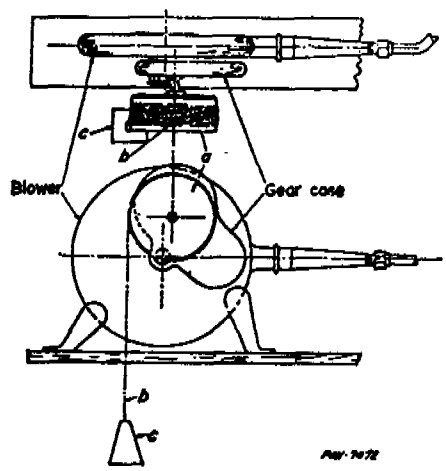

Figure 1.—Apparatus for measuring power required to operate blower. (30 CFR Part 11, Subpart J, § 11.124–8)

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TABLE 8.—AIR-SUPPLY-LINE REQUIREMENTS AND TESTS

(30 CFR Part 11, Subpart J, § 11.134-7)

Specific requirements	Requirements for the air-supply lines of the indicated type of supplied-air respirators		
	Type A	Type B	Type C
Length of hose	Maximum of 91 m. (300 feet), in multiples of 7.6 m. (25 feet).	Maximum of 23 m. (75 feet) in multiples of 7.6 m. (25 feet).	Maximum of 91 m. (300 feet) in multiples of 7.6 m. (25 feet). It will be permissible for the applicant to supply hose of the approved type of shorter length than 7.6 m. (25 feet) provided it meets the requirements of the part.
Air flow	None	None	The air-supply hose with air regulating valve or orifice shall permit a flow of not less than 115 liters (4 cubic feet) per minute to tight-fitting and 170 liters (6 cubic feet) per minute to loose-fitting respiratory-inlet coverings through the maximum length of hose for which approval is granted and at the minimum specified air-supply pressure. The maximum flow shall not exceed 425 liters (15 cubic feet) per minute at the maximum specified air-supply pressure with the minimum length of hose for which approval is granted. The air-supply hose, detachable coupling, and demand valve of the demand class or pressure-demand valve of the pressure-demand class for Type C supplied-air respirators, demand and pressure-demand classes, shall be capable of delivering respirable air at a rate of not less than 115 liters (4 cubic feet) per minute to the respiratory-inlet covering at an inhalation resistance not exceeding 50 millimeters (2 inches) of water-column height measured in the respiratory-inlet covering with any combination of air-supply pressure and length of hose within the applicant's specified range of pressure and hose length. The air-flow rate and resistance to inhalation shall be measured while the demand or pressure-demand valve is actuated 20 times per minute by a source of intermittent suction. The maximum rate of flow to the respiratory-inlet covering shall not exceed 425 liters (15 cubic feet) per minute under the specified operating conditions.
Air-regulating valve.	None	None	If an air-regulating valve is provided, it shall be so designed that it will remain at a specific adjustment, which will not be affected by the ordinary movement of the wearer. The valve must be so constructed that the air supply with the maximum length of hose and at the minimum specified air-supply pressure will not be less than 115 liters (4 cubic feet) of air per minute to tight-fitting and 170 liters (6 cubic feet) of air per minute of loose-fitting respiratory inlet coverings for any adjustment of the valve. If a demand or pressure-demand valve replaces the air-regulating valve, it shall be connected to the air-supply at the maximum air pressure for which approval is sought by means of the minimum length of air-supply hose for which approval is sought. The outlet of the demand or pressure-demand valve shall be connected to a source of intermittent suction so that the demand or pressure-demand valve is actuated approximately 20 times per minute for a total of 100,000 inhalations. To expedite this test, the rate of actuation may be increased if mutually agreeable to the applicant and the Bureau. During this test the valve shall function without failure and without excessive wear of the moving parts. The demand or pressure-demand valve shall not be damaged in any way when subjected at the outlet to a pressure or suction of 25 cm. (10 inches) of water gage for 2 minutes.

TABLE 8.—AIR-SUPPLY-LINE REQUIREMENTS AND TESTS—Continued

(30 CFR Part 11, Subpart J, § 11.134-7)

Specific requirements	Requirements for the air-supply lines of the indicated types of supplied-air respirators		
	Type A	Type B	Type C
Noncollapsibility.	The hose shall not collapse or exhibit permanent deformation when a force of 90 kg. (200 pounds) is applied for 5 minutes between 2 planes 7.6 cm. (3 inches) wide on opposite sides of the hose.	Same as Type A	None.
Nonkinkability.	None	None	A 7.6 m. (25 foot) section of the hose will be placed on a horizontal-plane surface and shaped into a one-loop coil with one end of the hose connected to an airflow meter and the other end of the hose supplied with air at the minimum specified supply pressure. The connection shall be in the plane of the loop. The other end of the hose will be pulled tangentially to the loop and in the plane of the loop until the hose straightens. To meet the requirements of this test the loop shall maintain a uniform near-circular shape and ultimately unfold as a spiral, without any localized deformation that decreases the flow of air to less than 90 percent of the flow when the hose is tested while remaining in a straight line.
Strength of hose and couplings.	Hose and couplings shall not separate or fail when tested with a pull of 113 kg. (250 pounds) for 5 minutes.	Same as Type A	Hose and couplings shall not exhibit any separation or failure when tested with a pull of 45 kg. (100 pounds) for 5 minutes and when tested by subjecting them to an internal air pressure of 2 times the maximum respirator-supply pressure that is specified by the applicant or at 175 kN/m.² (25 pounds per square inch) gage, whichever is higher.
Tightness	No air leakage shall occur when the hose and couplings are joined and the joint(s) are immersed in water and subjected to an internal air pressure of 35 kN/m.² (5 pounds per square inch) gage.	None	Leakage of air exceeding 50 cc. per minute at each coupling shall not be permitted when the hose and couplings are joined and are immersed in water, with air flowing through the respirator under a pressure of 175 kN/m.² (25 pounds per square inch) gage applied to the inlet end of the air-supply hose, or at twice the maximum respirator-supply pressure that is specified by the applicant, whichever is higher.
Permeation of hose by gasoline.	The permeation of the hose by gasoline will be tested by immersing 7.6 m. (25 feet) of hose and one coupling in gasoline, with air flowing through the hose at the rate of 5 liters per minute for 5 hours. The air from the hose shall not contain more than 0.01 percent by volume of gasoline vapor at the end of the test.	Same as for Type A.	Same as for Type A, except the test period shall be 1 hour.
Detachable coupling.	None	None	A hand-operated detachable coupling by which the wearer can readily attach or detach the connecting hose shall be provided at a convenient location. This coupling shall be durable, remain connected under all conditions of normal respirator use, and meet the prescribed tests for strength and tightness of hose and couplings.

Subpart K—Dust, Fume, and Mist Respirat rs

§ 11.130 Dust, fume, and mist respirators; description.

Dust, fume, and mist respirators, including all completely assembled respirators designed for use as respiratory protection during entry into and escape from hazardous particulate atmospheres which contain adequate oxygen to support life, are described as follows:

(a) Respirators, either with replaceable or reusable filters, designed as respiratory protection against dusts (1) having an air contamination level not less than 0.05 milligram per cubic meter of air, including but not limited to coal, arsenic, cadmium, chromium, lead, and manganese; or (2) dusts having an air contamination level not less than 2 million particles per cubic foot of air, including but not limited to aluminum, flour, iron ore, and free silica, resulting principally from the disintegration of a solid, e.g., dust clouds produced in mining, quarrying, and tunneling, and in dusts produced during industrial operations, such as grinding, crushing, and the general processing of minerals and other materials.

(b) Respirators, with replaceable filters, designed as respiratory protection against fumes of various metals having an air contamination level not less than 0.05 milligram per cubic meter, including but not limited to aluminum, antimony, arsenic, cadmium, chromium, copper, iron, lead, magnesium, manganese, mercury (except mercury vapor), and zinc, which result from the sublimation r condensation of their respective vapors, or from the chemical reaction between their respective vapors and gases.

(c) Respirators, with replaceable filters, designed as respiratory protection against mists of materials having an air contamination level not less than 0.05 milligram per cubic meter or 2 million particles per cubic foot, e.g., mists produced by spray coating with vitreous enamels, chromic acid mist produced during chromium plating, and other mists of materials whose liquid vehicle does not produce harmful gases or vapors.

(d) Respirators, with replaceable filters, designed as respiratory protection against dusts, fumes, and mists having an air contamination level less than 0.05 milligram per cubic meter, including but not limited to lithium hydride and beryllium, and against radionuclides.

(e) Respirators, with replaceable filters, designed as respiratory protection against radon daughters, and radon daughters attached to dusts, fumes, and mists.

(f) Respirators, with replaceable filters, designed as respiratory protection against asbestos-containing dusts and mists.

(g) Respirators, with replaceable filters, designed as protection against various combinations of particulate matter.

(h) Single-use dust respirators designed as respiratory protection against pneumoconiosis- and fibrosis-producing dusts, or dusts and mists, including but not limited to aluminum, asbestos, coal, flour, iron ore, and free silica.

(i) The types of dust, fume, and mist respirators in paragraphs (a) through (g) of this section may also be classified according to their design as follows:

(1) Air-purifying respirators; and

(2) Powered air-purifying respirators.

§ 11.131 Dust, fume and mist respirators; required components.

(a) Each dust, fume, and mis respirator described in § 11.130 shall, where its design requires, contain the following component parts:

(1) Facepiece, mouthpiece with noseclip, hood, or helmet;

(2) Filter unit;

(3) Harness;

(4) Attached blower; and

(5) Breathing tube.

(b) The components of each dust, fume, and mist respirator shall meet the minimum construction requirements set forth in Subpart G of this part.

§ 11.132 Breathing tubes; minimum requirements.

(a) Flexible breathing tubes used in conjunction with respirators shall be designed and constructed to prevent:

(1) Restriction of free head movement;

(2) Disturbance of the fit of facepieces, mouthpieces, hoods, or helmets;

(3) Interference with the wearer's activities; and

(4) Shutoff of airflow due to kinking, or from chin or arm pressure.

§ 11.133 Harnesses; installation and construction; minimum requirements.

(a) Each respirator shall, where necessary, be equipped with a suitable harness designed and constructed to hold the components of the respirator in position against the wearer's body.

(b) Harnesses shall be designed and constructed to permit easy removal and replacement of respirator parts, and, where applicable, provide for holding a full facepiece in the ready position when not in use.

§ 11.134 Respirator containers; minimum requirements.

(a) Except as provided in paragraph (b) of this section each respirator shall be equipped with a substantial, durable container bearing markings which show the applicant's name, the type of respirator is contains, and all appropriate approval labels.

(b) Containers for single-use respirators may provide for storage of more than one respirator, however, such containers shall be designed and constructed to prevent contamination of respirators which are not removed, and to prevent damage to respirators during transit.

§ 11.135 Half-mask facepieces, full facepieces, hoods, helmets, and mouthpieces; fit; minimum requirements.

(a) Half-mask facepieces and full facepieces shall be designed and constructed to fit persons with various facial shapes and sizes either: (1) By providing more than one facepiece size, or (2) by providing one facepiece size which will fit varying facial shapes and sizes.

(b) Full facepieces shall provide for optional use of corrective spectacles or lenses, which shall not reduce the respiratory protective qualities of the respirator.

(c) Hoods and helmets shall be designed and constructed to fit persons with various head sizes, provide for the optional use of corrective spectacles or lenses, and insure against any restriction of movement by the wearer.

(d) Mouthpieces shall be equipped with noseclips which are securely attached to the mouthpiece or respirator and provide an airtight seal.

(e) Facepieces, hoods, and helmets shall be designed to prevent eyepiece fogging.

(f) Half-mask facepieces shall not interfere with the fit of common industrial safety corrective spectacles, as determined by the Bureau's facepiece tests in §§ 11.140–1 and 11.140–2.

§ 11.136 Facepieces, hoods, and helmets; eyepieces; minimum requirements.

Facepieces, hoods, and helmets shall be designed and constructed to provide adequate vision which is not distorted by the eyepieces.

§ 11.137 Inhalation and exhalation valves; minimum requirements.

(a) Inhalation and exhalation valves shall be protected against distortion.

(b) Inhalation valves shall be designed and constructed and provided where necessary to prevent excessive exhaled air from adversely affecting filters, except where filters are specifically designed to resist moisture as prescribed in § 11.140–5.

(c) Exhalation valves shall be: (1) Provided where necessary; (2) protected against damage and external influence; and (3) designed and constructed to prevent inward leakage of contaminated air.

§ 11.138 Head harnesses: minimum requirements.

(a) All facepieces shall be equipped with head harnesses designed and constructed to provide adequate tension during use and an even distribution of pressure over the entire area in contact with the face.

(b) Facepiece head harnesses, except those employed on single-use respirators, shall be adjustable and replaceable.

(c) Mouthpieces shall be equipped, where applicable, with adjustable and replaceable harnesses, designed and constructed to hold the mouthpiece in place.

§ 11.139 Air velocity and noise levels; hoods and helmets; minimum requirements.

Noise levels generated by the respirator will be measured inside the hood or helmet at maximum airflow obtainable and shall not exceed 80 dBA.

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§ 11.140 Dust, fume, and mist respirators; performance requirements; general.

Dust, fume, and mist respirators and the individual components of each such device shall, as appropriate, meet the requirements for performance and protection specified in the tests described in §§ 11.140–1 through 11.140–12 and prescribed in Tables 9 and 10.

§ 11.140–1 Isoamyl acetate tightness test; dust, fume, and mist respirators designed for respiratory protection against fumes of various metals having an air contamination level not less than 0.05 milligram per cubic meter; minimum requirements.

(a) The respirator will be modified in such a manner that all of the air that normally would be inhaled through the inhalation port(s) is drawn through an efficient activated charcoal-filled canister, or cartridge(s), without interference with the face-contacting portion of the facepiece.

(b) The modified respirator will be worn by persons for at least 2 minutes each in a test chamber containing 100 parts (by volume) of isoamyl-acetate vapor per million parts of air.

(c) The odor of isoamyl-acetate shall not be detected by the wearers of the modified respirator while in the test atmosphere.

§ 11.140–2 Isoamyl acetate tightness test; respirators designed for respiratory protection against dusts, fumes, and mists having an air contamination level less than 0.05 milligram per cubic meter, or against radionuclides; minimum requirements.

(a) The applicant shall provide a charcoal-filled canister or cartridge of a size and resistance similar to the filter unit with connectors which can be attached to the facepiece in the same manner as the filter unit.

(b) (1) The canister or cartridge will be used in place of the filter unit, and persons will each wear a modified half-mask facepiece for 5 minutes in a test chamber containing 100 parts (by volume) of isoamyl-acetate vapor per million parts of air.

(2) The following work schedule will be performed by each wearer in the test chamber:

(i) Two minutes walking, nodding, and shaking head in normal movements; and

(ii) Three minutes exercising and running in place.

(3) The facepiece shall be capable of adjustment, according to the applicant's instructions, to each wearer's face, and the odor of isoamyl-acetate shall not be detectable by any wearer during the test.

(c) Where the respirator is equipped with a full facepiece, hood, helmet, or mouthpiece, the canister or cartridge will be used in place of the filter unit, and persons will each wear the modified respiratory-inlet covering for 5 minutes in a test chamber containing 1,000 parts (by volume) of isoamyl-acetate vapor per million parts of air, performing the work schedule specified in paragraph (b)(2) of this section.

§ 11.140–3 Air-purifying filter tests; performance requirements; general.

Dust, fume, and mist respirators will be tested in accordance with the schedule set forth in Table 10 to determine their effectiveness as protection against the particulate hazards specified therein.

§ 11.140–4 Silica dust test; single-use or reuseable filters; minimum requirements.

(a) Three respirators with single-use filters will be tested for periods of 90 minutes each at a continuous airflow rate of 32 liters per minute for air-purifying respirators, and for periods of 4 hours each at a flowrate not less than 115 liters per minute to tight-fitting facepieces, and not less than 170 liters per minute to loose-fitting hoods and helmets for powered air-purifying respirators.

(b) The relative humidity in the test chamber will be 20–80 percent, and the room temperature approximately 25° C.

(c) The test suspension in the chamber will not be less than 50 nor more than 60 milligrams of flint (99+ percent free silica) per cubic meter of air.

(d) The flint in suspension will be ground to pass 99+ percent through a 270-mesh sieve.

(e) The particle-size distribution of the test suspension will have a geometric mean of 0.4 to 0.6 micrometer, and the standard geometric deviation will not exceed 2.

(f) The total amount of unretained test suspension in samples taken during testing shall not exceed 1.5 milligrams for an air-purifying respirator, 14.4 milligrams for a powered air-purifying respirator with tight-fitting facepiece, and 21.3 milligrams for a powered air-purifying respirator with loose-fitting hood or helmet.

(g) Three respirators with reusable filters will be tested and shall meet the requirements specified in paragraphs (a) through (f) of this section; each filter shall be tested three times: Once as received; once after cleaning; and once after recleaning. The applicant's instructions shall be followed for each cleaning.

§ 11.140–5 Silica-dust test; single-use dust respirators; minimum requirements.

(a) Three respirators will be tested.

(b) As described in § 11.140–4, airflow will be cycled through the respirator by a breathing machine at the rate of 24 respirations per minute with a minute volume of 40 liters; a breathing machine cam with a work rate of 622 kg.-m.^{3}/minute shall be used.

(c) Air exhaled through the respirator will be 35° ±2° C. (95° ±3° F.) with 94 ±3 percent relative humidity.

(d) Air inhaled through the respirator will be sampled and analyzed for respirator leakage.

(e) The total amount of unretained test suspension, after drying, in samples taken during testing, shall not exceed 1.8 milligrams for any single test.

§ 11.140–6 Lead fume test; minimum requirements.

(a) Three respirators will be tested for a period of 312 minutes each at a continuous airflow rate of 32 liters per minute for air-purifying respirators, and for periods of 4 hours each at a flow rate not less than 115 liters per minute to tight-fitting facepieces, and not less than 170 liters per minute to loose-fitting hoods and helmets for powered air-purifying respirators.

(b) The relative humidity in the test chamber will be 20–80 percent, and the room temperature approximately 25° C.

(c) The test suspension in the test chamber will not be less than 15 nor more than 20 milligrams of freshly generated lead-oxide fume, calculated as lead (Pb), per cubic meter of air.

(d) The fume will be generated by impinging an oxygen-gas flame on molten lead.

(e) Samples of the test suspension will be taken during each test period for analysis.

(f) The total amount of unretained test suspension in the samples taken during testing, which is analyzed and calculated as lead (Pb), shall not exceed 1.5 milligrams of lead for an air-purifying respirator, 4.2 milligrams of lead for a powered air-purifying respirator with tight-fitting facepiece, and 6.2 milligrams of lead for a powered air-purifying respirator with loose-fitting hood or helmet.

§ 11.140–7 Silica mist test; minimum requirements.

(a) Three respirators will be tested for a period of 312 minutes each at a continuous airflow rate of 32 liters per minute for air-purifying respirators, and for periods of 4 hours each at a flow rate not less than 115 liters per minute to tight-fitting facepieces, and not less than 170 liters per minute to loose-fitting hoods and helmets for powered air-purifying respirators.

(b) The room temperature in the test chamber will be approximately 25° C.

(c) The test suspension in the test chamber will not be less than 20 nor more than 25 milligrams of silica mist, weighed as silica dust, per cubic meter of air.

(d) Mist will be produced by spraying an aqueous suspension of flint (99+ percent free silica), and the flint shall be ground to pass 99+ percent through a 270-mesh sieve.

(e) Samples of the test suspension will be taken during each test period for analysis.

(f) The total amount of silica mist unretained in the samples taken during testing, weighed as silica dust, shall not exceed 2.5 milligrams for an air-purifying respirator, 6.9 milligrams for a powered air-purifying respirator with tight-fitting facepiece, and 10.2 milligrams for a powered air-purifying respirator with loose-fitting hood or helmet.

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§ 11.140–8 Tests for respirators designed for respiratory protection against more than one type of dispersoid; minimum requirements.

Respirators designed as respiratory protection against more than one particulate hazard (dust, fume, or mist) shall comply with all the requirements of this part, with respect to each of the specific hazards involved.

§ 11.140–9 Airflow resistance tests; all dust, fume, and mist respirators; minimum requirements.

(a) Resistance to airflow will be measured in the facepiece, mouthpiece, hood, or helmet of a dust, fume, or mist respirator mounted on a test fixture with air flowing at a continuous rate of 85 liters per minute, both before and after each test conducted in accordance with §§ 11.140–4 through 11.140–7.

(b) The maximum allowable resistance requirements for dust, fume, and mist respirators are as follows:

MAXIMUM RESISTANCE
(mm. water-column height)

Type of respirator	Initial Inhalation	Final Inhalation	Exhalation
Single-use	12	15	15
Dust, fume, and mist, with single-use filter	30	50	20
Dust, fume, and mist, with reusable filter	20	40	20
Radon daughter	15	[1] 25	15
Asbestos dust and mist	15	25	15

[1] Measured after silica dust test described in § 11.140–4.

§ 11.140–10 Exhalation valve leakage test; minimum requirements.

(a) Dry exhalation valves and valve seats will be subjected to a suction of 25 mm. water-column height while in a normal operating position.

(b) Leakage between the valve and valve seat shall not exceed 30 milliliters per minute.

§ 11.140–11 DOP filter test; respirators designed as respiratory protection against dusts, fumes, and mists having an air contamination level less than 0.05 milligram per cubic meter and against radionuclides; minimum requirements.

(a) All single air-purifying respirator filter units will be tested in an atmosphere concentration of 100 micrograms of DOP per liter of air at continuous flow rates of 32 and 85 liters per minute for a period of 5 to 10 seconds.

(b) Where filters are to be used in pairs, the flow rates will be 16 and 42.5 liters per minute, respectively, through each filter.

(c) The filter will be mounted on a connector in the same manner as used on the respirator, and the total leakage for the connector and filter shall not exceed 0.03 percent of the ambient DOP concentration at either flow rate.

§ 11.140–12 Silica dust loading test; respirators designed as protection against dusts, fumes, and mists having an air contamination level less than 0.05 milligram per cubic meter and against radionuclides; minimum requirements.

Three respirators will be tested in accordance with the provisions of § 11.140–4 and shall meet the minimum requirements of §§ 11.140–4 and 11.140.9.

TABLE 9.—FACEPIECE TEST REQUIREMENTS
(30 CFR Part 11, Subpart K, § 11.140–1, et seq.)

Respirator types	Pressure tightness test [1]	Isoamyl acetate test	
		11.140–1	11.140–3
Dusts: Air Contamination Level not less than 0.05 mg/M³ or 2 mppcf	X		
Fumes: Air Contamination Level not less than 0.05 mg/M³	X	X	
Mists: Air Contamination Level not less than 0.05 mg/M³ or 2 mppcf	X		
Dusts, Fumes, and Mists: Air Contamination Level less than 0.05 mg/M³ or 2 mppcf, and radionuclides	X		X
Radon daughters	X	X	
Asbestos-containing dusts and mists	X		

[1] Test is required only where applicable.

TABLE 10—AIR-PURIFYING AND POWERED AIR-PURIFYING RESPIRATOR FILTER TESTS REQUIRED FOR APPROVAL
(30 CFR Part 11, Subpart K, § 11.140–4, et seq.)

Respirator types	Silica dust tests			Lead fume test	Silica mist test	DOP test
	11.140–4	11.140–5	11.140–12	11.140–6	11.140–7	11.140–11
Dusts: Air Contamination Level not less than 0.05 mg/M³ or 2 mppcf	X					
Fumes: Air Contamination Level not less than 0.05 mg/M³				X		
Mists: Air Contamination Level not less than 0.05 mg/M³ or 2 mppcf					X	
Dusts, Fumes, and Mists: Air Contamination Level less than 0.05 mg/M³ or 2 mppcf, and radionuclides			X			X
Radon daughters	X[1]			X[2]		
Asbestos-containing dusts and mists	X[3]				X[3]	
Single-use dust and mist respirators		X[3]			X[3]	

[1] For resistance only.
[2] For penetration only.
[3] Test required only where applicable.

Subpart L—Chemical Cartridge Respirators

§ 11.150 Chemical cartridge respirators; description.

Chemical cartridge respirators including all completely assembled respirators which are designed for use as respiratory protection during entry into or escape from atmospheres not immediately dangerous to life and health, are described according to the specific gases or vapors against which they are designed to provide respiratory protection, as follows:

Type of chemical cartridge respirator:	*Maximum use concentration, parts per million*
Ammonia	300
Chlorine	10
Hydrogen chloride	50
Methyl amine	100
Organic vapor [1]	[2] 1,000
Sulfur dioxide	50

[1] Not for use against organic vapors with poor warning properties or those which generate high heats of reaction with sorbent material in the cartridge.

[2] Maximum use concentrations are lower for organic vapors which produce atmospheres immediately hazardous to life or health at concentrations equal to or lower than this concentration.

NOTE: Chemical cartridge respirators for respiratory protection against gases or vapors, which are not specifically listed with their maximum use concentration except pesticides, may be approved if the applicant submits a request for such approval, in writing, to the Bureau. The Bureau and the Institute shall consider each such application and accept or reject the application after a review of the effects on the wearer's health and safety and in the light of any field experience in use of chemical cartridge respirators as protection against such hazards.

§ 11.151 Chemical cartridge respirators; required components.

(a) Each chemical cartridge respirator described in § 11.150 shall, where its design requires, contain the following component parts:

(1) Facepiece, mouthpiece, and noseclip, hood, or helmet;
(2) Cartridge;
(3) Cartridge with filter;
(4) Harness;
(5) Breathing tube; and
(6) Attached blower.

(b) The components of each chemical cartridge respirator shall meet the minimum construction requirements set forth in Subpart G of this part.

§ 11.152 Cartridges in parallel; resistance requirements.

Where two or more cartridges are used in parallel, their resistance to airflow shall be essentially equal.

§ 11.153 Cartridges; color and markings; requirements.

The color and markings of all cartridges or labels shall conform with the requirements of the American National Standard for Identification of Gas Mask

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Canisters, K13.1, obtainable from American National Standards Institute, Inc., 1430 Broadway New York, NY 10018.

§ 11.154 Filters used with chemical cartridges; location; replacement

(a) Particulate matter filters used in conjunction with a chemical cartridge shall be located on the inlet side of the cartridge.

(b) Filters shall be incorporated in or firmly attached to the cartridge and each filter assembly shall, where applicable, be designed to permit its easy removal from and replacement on the cartridge.

§ 11.155 Breathing tubes; minimum requirements.

(a) Flexible breathing tubes used in conjunction with respirators shall be designed and constructed to prevent:

(1) Restriction of free head movement;

(2) Disturbance of the fit of facepieces, mouthpieces, hoods, or helmets;

(3) Interference with the wearer's activities; and

(4) Shutoff of airflow due to kinking, or from chin or arm pressure.

§ 11.156 Harnesses; installation and construction; minimum requirements.

(a) Each respirator shall, where necessary, be equipped with a suitable harness designed and constructed to hold the componements of the respirator in position against the wearer's body.

(b) Harnesses shall be designed and constructed to permit easy removal and replacement of respirator parts and, where applicable, provide for holding a full facepiece in the ready position when not in use.

§ 11.157 Respirator containers; minimum requirements.

Respirators shall be equipped with a substantial, durable container bearing markings which show the applicant's name, the type and commercial designation of the respirator it contains and all appropriate approval labels.

§ 11.158 Half-mask facepieces, full facepieces, mouthpieces, hoods, and helmets; fit; minimum requirements.

(a) Half-mask facepieces and full facepieces shall be designed and constructed to fit persons with various facial shapes and sizes either: (1) By providing more than one facepiece size, or (2) by providing one facepiece size which will fit varying facial shapes and sizes.

(b) Hoods and helmets shall be designed and constructed to fit persons with various head sizes, provide for the optional use of corrective spectacles or lenses, and insure against any restriction of movement by the wearer.

(c) Mouthpieces shall be equipped with noseclips which are securely attached to the mouthpiece or respirator and provide an airtight fit.

(d) Full facepieces shall provide for optional use of corrective spectacles or lenses which shall not reduce the respiratory protective qualities of the respirator.

(e) Facepieces, hoods, and helmets shall be designed to prevent eyepiece fogging.

§ 11.158–1 Facepieces, hoods, and helmets; eyepieces; minimum requirements.

Facepieces, hoods, and helmets shall be designed and constructed to provide adequate vision which is not distorted by the eyepieces.

§ 11.159 Inhalation and exhalation valves; minimum requirements.

(a) Inhalation and exhalation valves shall be provided where necessary and protected against distortion.

(b) Inhalation valves shall be designed and constructed to prevent excessive exhaled air from entering cartridges or adversely affecting canisters.

(c) Exhalation valves shall be: (1) Protected against damage and external influence, and (2) designed and constructed to prevent inward leakage of contaminated air.

§ 11.160 Head harnesses; minimum requirements.

(a) Facepieces shall be equipped with adjustable and replaceable head harnesses designed and constructed to provide adequate tension during use and an even distribution of pressure over the entire area in contact with the face.

(b) Mouthpieces shall be equipped where applicable, with an adjustable and replaceable harness designed and constructed to hold the mouthpiece in place.

§ 11.161 Air velocity and noise levels; hoods and helmets; minimum requirements.

Noise levels generated by the respirator will be measured inside the hood or helmet at maximum airflow obtainable and shall not exceed 80 dBA.

§ 11.162 Chemical cartridge respirators; performance requirements; general.

Chemical cartridge respirators and the individual components of each such device shall, as appropriate, meet the minimum requirements for performance and protection specified in the tests described in §§ 11.162–1 through 11.162–8.

§ 11.162–1 Breathing resistance test; minimum requirements.

(a) Resistance to airflow will be measured in the facepiece, mouthpiece, hood, or helmet of a chemical cartridge respirator mounted on a test fixture with air flowing at a continuous rate of 85 liters per minute, both before and after each test conducted in accordance with §§ 11.162–5 through 11.162–8.

(b) The maximum allowable resistance requirements for chemical cartridge respirators are as follows:

MAXIMUM RESISTANCE
(mm. water-column height)

Type of chemical cartridge respirator	Inhalation		Exhalation
	Initial	Final [1]	
For gases, vapors, or gases and vapors	40	45	20
For gases, vapors, or gases and vapors, and dusts, fumes, and mists	60	70	20
For gases, vapors, or gases and vapors, and mists of paints, lacquers, and enamels	60	70	20

[1] Measured at end of service life specified in Table 11.

§ 11.162–2 Exhalation valve leakage test; minimum requirements.

(a) Dry exhalation valves and valve seats will be subjected to a suction of 25 mm. water-column height while in a normal operating position.

(b) Leakage between the valve and valve seat shall not exceed 30 milliliters per minute.

§ 11.162–3 Facepiece test; minimum requirements.

(a) The complete chemical cartridge respirator will be fitted to the faces of persons having varying facial shapes and sizes.

(b) Where the applicant specifies a facepiece size or sizes for the respirator together with the approximate measurement of faces they are designed to fit, the Bureau will provide test subjects to suit such facial measurements.

(c) Any chemical cartridge respirator part which must be removed to perform the facepiece or mouthpiece fit test shall be replaceable without special tools and without disturbing facepiece or mouthpiece fit.

(d) The facepiece or mouthpiece fit test using the positive or negative pressure recommended by the applicant and described in his instructions will be used before each test.

(e) (1) Each wearer will enter a chamber containing 100 p.p.m. isoamyl acetate vapor for half-mask facepieces, and 1,000 p.p.m. for full facepieces, mouthpieces, hoods, and helmets.

(2) The facepiece or mouthpiece may be adjusted, if necessary, in the test chamber before starting the test.

(3) Each wearer will remain in the chamber for 8 minutes while performing the following activities:

(i) Two minutes, nodding and turning head;

(ii) Two minutes, calisthenic arm movements;

(iii) Two minutes, running in place; and

(iv) Two minutes, pumping with a tire pump into a 28-liter (1 cubic-foot) container.

(4) Each wearer shall not detect the odor of isoamyl-acetate vapor during the test.

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§ 11.162–4 Lacquer and enamel mist tests; respirators with filters; minimum requirements; general.

(a) Three respirators with cartridges containing or having attached to them, filters for protection against mists of paints, lacquers, and enamels shall be tested in accordance with the provisions of § 11.162–8.

(b) In addition to the test requirements set forth in paragraph (a) of this section, three such respirators will be tested against each aerosol in accordance with the provisions of §§ 11.162–5 and 11.162–6.

§ 11.162–5 Lacquer mist test; minimum requirements.

(a) Temperature in the test chamber will be approximately 25° C.

(b) Continuous airflow through the respirator will be 32 liters per minute for air-purifying respirators, and not less than 115 liters per minute to tight fitting facepieces and 170 liters per minute to loose-fitting hoods and helmets of powered air-purifying respirators.

(c) Airflow through the chamber will be 20–25 air changes per minute.

(d) The atomizer employed will be a No. 64–5 nozzle with setup 3, or equivalent, operating at 69 kN/m². (10 pounds per square inch gage).

(e) The test aerosol will be prepared by atomizing a mixture of one volume of clear cellulose nitrate lacquer and one volume of lacquer thinner.

(f) The lacquer used will conform essentially to Federal Specification TT–L–31, October 7, 1953.

(g) The concentration of cellulose nitrate in the test aerosol will be 95–125 milligrams per cubic meter.

(h) The test aerosol will be drawn to each respirator for a total of 156 minutes for air-purifying respirators and 240 minutes for powered air-purifying respirators.

(i) The total amount of unretained mist in the samples taken during testing, weighed as cellulose nitrate, shall not exceed 5 milligrams for an air-purifying respirator, 28 milligrams for a powered air-purifying respirator with tight-fitting facepiece, and 41 milligrams for a powered air-purifying respirator with loose-fitting hood or helmet.

§ 11.162–6 Enamel mist test; minimum requirements.

(a) Temperature in the test chamber will be approximately 25° C.

(b) Continuous airflow through the respirator will be 32 liters per minute for air-purifying respirators, and not less than 115 liters per minute to tight-fitting facepieces and 170 liters per minute to loose-fitting hoods and helmets of powered air-purifying respirators.

(c) Airflow through the chamber will be 20–25 air changes per minute.

(d) The atomizer employed will be a No. 64 nozzle with setup 1A, or equivalent, operating at 69 kN/m². (10 pounds per square inch gage).

(e) The test aerosol will be prepared by atomizing a mixture of 1 volume of white enamel and 1 volume of turpentine.

(f) The enamel used will conform essentially to Federal Specification TT–E–489b, May 12, 1953 (an enamel having a phthalic alkyd resin vehicle and a titanium dioxide pigment).

(g) The concentration of pigment in the test aerosol, weighed as ash, will be 95–125 milligrams per cubic meter.

(h) The test aerosol will be drawn to each respirator for a total of 156 minutes for air-purifying respirators and 240 minutes for power air-purifying respirators.

(i) The total amount of unretained mist in the samples taken during testing, weighed as ash, shall not exceed 1.5 milligrams for any air-purifying respirator, 8.3 milligrams for a powered air-purifying respirator with tight-fitting facepiece, and 12.3 milligrams for a powered air-purifying respirator with loose-fitting hood or helmet.

§ 11.162–7 Dust, fume, and mist tests; respirators with filters; minimum requirements; general.

(a) Three respirators with cartridges containing, or having attached to them, filters for protection against dusts, fumes, and mists, except the mists of paints, lacquers, and enamels, will be tested in accordance with the provisions of § 11.162–8.

(b) In addition to the test requirements set forth in paragraph (a) of this section, three such respirators will be tested, as appropriate, in accordance with the provisions of §§ 11.140–1 through 11.140–14, however, the maximum allowable resistance of complete dust, fume, and mist, and gas, vapor, or gas and vapor chemical cartridge respirators shall not exceed the maximum allowable limits set forth in § 11.162–1.

§ 11.162–8 Bench tests; gas and vapor tests; minimum requirements; general.

(a) Bench tests will be made on an apparatus that allows the test atmosphere at 50 ±5 percent relative humidity and room temperature, approximately 25° C., to enter the cartridges continuously at predetermined concentrations and rates of flow, and that has means for determining the test life of the cartridges.

(b) Where two cartridges are used in parallel on a chemical cartridge respirator, the bench test will be performed with the cartridges arranged in parallel, and the test requirements will apply to the combination rather than to the individual cartridges.

(c) Three cartridges or pairs of cartridges will be removed from containers and tested as received from the applicant.

(d) Two cartridges or pairs of cartridges will be equilibrated at room temperature by passing 25 percent relative humidity air through them at the following flow rates (expressed in liters per minute (l.p.m.)) for 6 hours:

Type of cartridge:	*Airflow rate, l.p.m.*
Air purifying	25
Powered air purifying with tight-fitting facepiece	115
Powered air purifying with loose-fitting hood or helmet	170

(e) Two cartridges or pairs of cartridges will be equilibrated by passing 85 percent relative humidity air through them at the flow rates stated in paragraph (d) of this section.

(f) All cartridges will be resealed, kept in an upright position, at room temperatures, and tested within 18 hours.

(g) Cartridges will be tested and shall meet the minimum requirements set forth in Table 11.

TABLE 11.—CARTRIDGE BENCH TESTS AND REQUIREMENTS

(30 CFR Part 11, Subpart L, § 11.162–8)

Cartridge	Test condition	Test atmosphere: Gas or vapor	Test atmosphere: Concentration (p.p.m.)	Flowrate (l.p.m.)	Number of tests	Penetration[1] (p.p.m.)	Minimum life[2] (min.)
Ammonia	As received	NH_3	1000	64	3	50	50
Ammonia	Equilibrated	NH_3	1000	32	4	50	50
Chlorine	As received	Cl_2	500	64	3	5	35
Chlorine	Equilibrated	Cl_2	500	32	4	5	35
Hydrogen chloride	As received	HCl	500	64	3	5	50
Hydrogen chloride	Equilibrated	HCl	500	32	4	5	50
Methylamine	As received	CH_3NH_2	1000	64	3	10	25
Methylamine	Equilibrated	CH_3NH_2	1000	32	4	10	25
Organic vapors	As received	CCl_4	1000	64	3	5	50
Organic vapors	Equilibrated	CCl_4	1000	32	4	5	50
Sulfur dioxide	As received	SO_2	500	64	3	5	30
Sulfur dioxide	Equilibrated	SO_2	500	32	4	5	30

[1] Minimum life will be determined at the indicated penetration.

[2] Where a respirator is designed for respiratory protection against more than one type of gas or vapor, as for use in ammonia and in chlorine, the minimum life shall be one-half that shown for each type of gas or vapor. Where a respirator is designed for respiratory protection against more than one gas of a type, as for use in chlorine and sulfur dioxide, the stated minimal life shall apply.

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Subpart M—Pesticide Respirators

§ 11.170 Pesticide respirators; description.

Pesticide respirators, including all completely assembled respirators which are designed for use as respiratory protection during entry into and escape from atmospheres which contain pesticide hazards, are described according to their construction as follows:

(a) Front-mounted or back-mounted gas masks;

(b) Chin-style gas mask;

(c) Chemical cartridge;

(d) Air-purifying respirator with attached blower; and,

(e) Other devices, including combination respirators.

§ 11.171 Pesticide respirators; required components.

(a) Each pesticide respirator described in § 11.170 shall, where its design requires, contain the following component parts:

(1) Facepiece, mouthpiece, and noseclip, helmet, or hood;

(2) Canister with filter;

(3) Cartridge with filter;

(4) Harness;

(5) Attached blower; and,

(6) Breathing tube.

(b) The components of each pesticide respirator shall meet the minimum construction requirements set forth in Subpart G of this part.

§ 11.172 Canisters and cartridges in parallel; resistance requirements.

Where two or more canisters or cartridges are used in parallel, their resistance to airflow shall be essentially equal.

§ 11.173 Canisters and cartridges; color and markings; requirements.

The color and markings of all canisters and cartridges or labels shall conform with the requirements of the American National Standard for Identification of Gas Mask Canisters, K13.1.

§ 11.174 Filters used with canisters and cartridges; location; replacement.

(a) Particulate matter filters used in conjunction with a canister or cartridge shall be located on the inlet side of the canister or cartridge.

(b) Filters shall be incorporated into or firmly attached to the canister or cartridge and each filter assembly shall, where applicable, be designed to permit its easy removal from and replacement on the canister or cartridge.

§ 11.175 Breathing tubes; minimum requirements.

(a) Flexible breathing tubes used in conjunction with respirators shall be designed and constructed to prevent:

(1) Restriction of free head movement;

(2) Disturbance of the fit of facepieces, mouthpieces, hoods, or helmets;

(3) Interference with the wearer's activities; and,

(4) Shutoff of airflow due to kinking, or from chin or arm pressure.

§ 11.176 Harnesses; installation and construction; minimum requirements.

(a) Each respirator shall, where necessary, be equipped with a suitable harness designed and constructed to hold the components of the respirator in position against the wearer's body.

(b) Harnesses shall be designed and constructed to permit easy removal and replacement of respirator parts, and, where applicable, provide for holding a full facepiece in the ready position when not in use.

§ 11.177 Respirator containers; minimum requirements.

(a) Respirators shall be equipped with a substantial, durable, container bearing markings which show the applicant's name, type, and commercial designation of the respirator it contains, and all appropriate approval labels.

(b) Containers for gas masks shall be designed and constructed to permit easy removal of the mask.

§ 11.178 Half-mask facepieces, full facepieces, hoods and helmets, and mouthpieces; fit; minimum requirements.

(a) Half-mask facepieces and full facepieces shall be designed and constructed to fit persons with various facial shapes and sizes either: (1) By providing more than one facepiece size, or (2) by providing one facepiece size which will fit varying facial shapes and sizes.

(b) Full facepieces shall provide for optional use of corrective spectacles or lenses, which shall not reduce the respiratory protective quality of the respirator.

(c) Hoods and helmets shall be designed and constructed to fit persons with various head sizes, permit optional use of corrective spectacles without reducing the respiratory protective qualities of the respirator, and insure against any restriction of movement by the wearer.

(d) Pesticide respirators with mouthpieces shall be equipped with noseclips which are securely attached to the mouthpiece or respirator and provide an airtight seal.

(e) Facepieces, hoods, and helmets shall be designed to prevent eyepiece fogging.

(f) Half-mask facepieces shall not interfere with the fit of common industrial safety corrective spectacles as determined by the facepiece tests in § 11.183–3.

§ 11.179 Facepieces, hoods, and helmets; eyepieces; minimum requirements.

(a) Facepieces, hoods, and helmets shall be designed and constructed to provide adequate vision which is not distorted by the eyepiece.

(b) All eyepieces of gas masks shall be designed and constructed to meet the impact and penetration requirements specified in Federal Specification, Mask, Air line: and Respirator, Air Filtering, Industrial, GGG–M–125d, October 11, 1965.

§ 11.180 Inhalation and exhalation valves; minimum requirements.

(a) Inhalation and exhalation valves shall be protected against distortion.

(b) Inhalation valves shall be designed and constructed and provided where necessary to prevent excessive exhaled air from adversely affecting cartridges, canisters, and filters.

(c) Exhalation valves shall be:

(1) Provided where necessary;

(2) Protected against damage and external influence; and,

(3) Designed and constructed to prevent inward leakage of contaminated air.

§ 11.181 Head harnesses; minimum requirements.

(a) Facepieces shall be equipped with adjustable and replaceable head harnesses designed and constructed to provide adequate tension during use and an even distribution of pressure over the entire area in contact with the face.

(b) Mouthpieces shall be equipped, where applicable, with adjustable and replaceable harnesses designed and constructed to hold the mouthpiece in place.

§ 11.182 Air velocity and noise levels; hoods and helmets; minimum requirements.

Noise levels generated by the respirator will be measured inside the hood or helmet at maximum obtainable airflow and shall not exceed 80 dBA.

§ 11.183 Pesticide respirators; performance requirements; general.

Pesticide respirators and the individual components of each such device shall, as appropriate, meet the requirements for performance and protection specified in the tests described in §§ 11.183–1 through 11.183–7.

§ 11.183–1 Breathing resistance test; minimum requirements.

(a) Airflow resistance will be measured in the facepiece, mouthpiece, hood, or helmet of a pesticide respirator mounted on a test fixture with air flowing at a continuous rate of 85 liters per minute, both before and after each test conducted in accordance with §§ 11.183–4 and 11.183–7.

(b) The maximum allowable resistance requirements for pesticide respirators are as follows:

MAXIMUM RESISTANCE
(mm. water-column height)

Type of Pesticide respirator	Inhalation		Exhalation
	Initial	Final [1]	
Front- or back-mounted gas mask	70	85	20
Chin-style gas mask	65	80	20
Powered air-purifying	[2] 35	[2] 70	[2] 20
Chemical cartridge	50	70	20

[1] Measured at end of the service life specified in Table 12.

[2] Resistance of filter(s), cartridge(s), and breathing tube(s) only with blower not operating.

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§ 11.183–2 Exhalation valve leakage test; minimum requirements.

(a) Dry exhalation valves and valve seats will be subjected to a suction of 25 mm. water-column height while in a normal operating position.

(b) Leakage between the valve and valve seat shall not exceed 30 milliliters per minute.

§ 11.183–3 Facepiece test; minimum requirements.

(a) The complete pesticide respirator will be fitted to the faces of persons having varying facial shapes and sizes.

(b) Where the applicant specifies a facepiece size or sizes for his respirator together with the approximate measurements of faces they are designed to fit, the Bureau will provide test subjects to suit such facial measurements.

(c) Any pesticide respirator part which must be removed to perform the facepiece fit test shall be replaceable without special tools and without disturbing facepiece fit.

(d) The facepiece or mouthpiece fit test using positive or negative pressure recommended by the applicant and described in his instructions will be used during each test.

(e) (1) Each wearer will enter a chamber containing 1,000 p.p.m. isoamyl-acetate vapor for a respirator equipped with a full facepiece, mouthpiece, hood, or helmet and 100 p.p.m. isoamyl-acetate vapor for a respirator equipped with a half-mask facepiece.

(2) The facepiece, mouthpiece, hood, or helmet may be adjusted, if necessary, in the test chamber before starting the test.

(3) Each wearer will remain in the chamber while performing the following activities:

(i) Two minutes, nodding and turning head;

(ii) Two minutes, calisthenic arm movements;

(iii) Two minutes, running in place; and,

(iv) Two minutes, pumping with a tire pump into a 26-liter (1 cubic foot) container.

(4) Each wearer shall not detect the odor of isoamyl-acetate during the test.

§ 11.183–4 Silica dust test; minimum requirements.

Three completely assembled pesticide respirators will be tested with a mechanical-testing apparatus as follows:

(a) Temperature in the test chamber will be approximately 25° C.

(b) Continuous airflow through the respirator will be 32 liters per minute for front-mounted, back-mounted, and chin-style gas mask pesticide respirators and chemical cartridge pesticide respirators, and not less than 115 (4 cubic feet) liters per minute to tight-fitting facepieces and 170 liters (6 cubic feet) per minute to loose-fitting hoods and helmets of powered air-purifying respirators.

(c) The test aerosol will contain 50–60 milligrams of 99+ percent free silica per cubic meter of air.

(d) The particle size distribution of the test suspension will have a geometric mean diameter of 0.4 to 0.6 micrometer, with a standard geometric deviation less than 2.

(e) Front-mounted, back-mounted, and chin-style gas mask pesticide respirators and chemical cartridge pesticide respirators will be tested for 90 minutes and powered air-purifying respirators will be tested for 4 hours.

§ 11.183–5 Lead fume test; minimum requirements.

Three completely assembled pesticide respirators will be tested with a mechanical-testing apparatus as follows:

(a) Continuous airflow through the respirator will be 32 liters per minute for front-mounted, back-mounted, and chin-style gas mask pesticide respirators and chemical cartridge pesticide respirators and not less than 115 liters (4 cubic feet) per minute, for powered air-purifying respirators with tight-fitting facepieces, and not less than 170 liters (6 cubic feet) per minute for powered air-purifying respirators with loose-fitting hoods and helmets.

(b) The test aerosol will contain 15–20 milligrams of freshly generated lead-oxide fume, calculated as lead, per cubic meter of air.

(c) The fume will be generated by impinging an oxygen-gas flame on molten lead.

(d) Front-mounted, back-mounted, and chin-style gas mask pesticide respirators and chemical cartridge pesticide respirators will be tested for 90 minutes and powered air-purifying pesticide respirators will be tested for 4 hours.

(e) The total amount of unretained test suspension, which is analyzed and calculated as lead, shall not exceed: (1) 0.43 milligram for any 90-minute test; (2) 4.8 milligrams for any 4-hour test made at 115 liters (4 cubic feet) per minute; or (3) 6.2 milligrams for any 4-hour test made at 170 liters (6 cubic feet) per minute.

§ 11.183–6 Dioctyl-phthalate test; minimum requirements.

(a) All canisters submitted for use with front-mounted and back-mounted gas mask pesticide respirators will be tested in an atmospheric concentration of 100 micrograms of dioctyl-phthalate per liter of air at continuous flow rates of 32 and 85 liters per minute for a test period of 5 to 10 seconds.

(b) The DOP leakage through the canister shall not exceed 0.03 percent of the ambient DOP concentration.

§ 11.183–7 Bench tests; minimum requirements.

(a) (1) Bench tests will be made on an apparatus that allows the test atmosphere at 50±5 percent relative humidity and at room temperature (25°±2.5° C.) to enter the canister or cartridge at predetermined concentrations and rates of flow, and that has a means for determining the test life of the canister or cartridge against carbon tetrachloride.

(2) Canisters and cartridges will be tested as they are used on each pesticide respirator, either singly or in pairs.

(3) Three canisters or cartridges or pairs of cartridges will be removed from containers and tested as received from the applicant.

(4) Two canisters, cartridges, or pairs of cartridges will be equilibrated at room temperature by passing 25 percent relative humidity air through them at the following flow rates (expressed as liters per minute (l.p.m.)) for 6 hours:

Type of canister or cartridge	*Airflow rate, l.p.m.*
Air-purifying canister	64
Air-purifying cartridge	25
Powered air-purifying with tight-fitting facepiece	115
Powered air-purifying with loose-fitting hood or helmet	170

(5) Two canisters, cartridges, or pairs of cartridges will be equilibrated at room temperature by passing 85 percent relative humidity air through them at the flow rates stated in subparagraph (4) of this paragraph for 6 hours.

(6) The equilibrated canisters or cartridges will be resealed, kept in an upright position at room temperature, and tested within 18 hours.

(b) Canisters and cartridges tested in accordance with the provisions of this section shall meet the requirements specified in Table 12.

TABLE 12.—CARBON TETRACHLORIDE BENCH TESTS AND REQUIREMENTS FOR CANISTERS AND CARTRIDGES
(30 CFR Part 11, Subpart M, § 11.183-7)

Type of pesticide respirator	Test concentrations, p.p.m. CCl_4	Flow rate l.p.m.	Number of tests	Minimum life, minutes [1]
Chest-mounted or back-mounted gas mask (as received)	20,000	64	3	12
Chest-mounted or back-mounted gas mask (equilibrated)	20,000	32	4	12
Chin-style gas mask (as received)	5,000	64	3	9
Chin-style gas mask (equilibrated)	5,000	32	4	9
Chemical-cartridge respirator (as received)	1,000	64	3	50
Chemical-cartridge respirator (equilibrated)	1,000	32	4	50
Powered air-purifying respirator (tight-fitting facepiece, as received)	1,000	[2] 115	3	50
Powered air-purifying respirator (tight-fitting facepiece, equilibrated)	1,000	[2] 115	4	8
Powered air-purifying respirator (loose-fitting hood or helmet as received)	1,000	[3] 170	3	50
Powered air-purifying respirator (loose-fitting hood or helmet, equilibrated)	1,000	[3] 170	4	25

[1] Minimum life will be determined at 5 p.p.m. leakage.
[2] The flow rate shall be the effective flow rate of the device, but shall be not less than 115 l.p.m.
[3] The flow rate shall be the effective flow rate of the device, but shall be not less than 170 l.p.m.

[FR Doc.72-4116 Filed 3-24-72;8:46 am]

APPENDIX C

RESPIRATOR DRYING CABINET

One 18 by 36 by 78-in. three-shelf steel cabinet with double doors
Three 15-3/4 by 35-3/4 in. pieces of 1/4-in. stainless steel mesh for shelves
One 10 by 10 in. piece of window screen for exhaust port
One small portable electric heater with fan, 115 Vac, 1650 W
Thirty-two size 10 eyebolts
Thirty-two clothespins with metal hanging clips
Thirty-two spring clips
0 to 180°F thermometer
Size 10 nuts and bolts.

CABINET MODIFICATION

On one side, near the bottom, cut a hole and bolt the heater in place. Make sure the heater has a three-wire (grounded) plug. In the top of the cabinet, cut an 8 by 8-in. exhaust port and cover it with window screen. Cut away each shelf, leaving 1-1/2 in. at each edge, and bolt the stainless steel mesh in place. On the bottom and second shelves, screw the small eye bolts into this mesh about 3 in. apart, and spaced so that 16 masks can hang in a double row from each shelf without touching each other. The clothespins hang from the eyebolts by specially fabricated metal clips. The thermometer is suspended by a small clamp.

The temperature inside the cabinet is kept at 120 to 140°F. After the cabinet has been loaded with masks, the temperature averages about 125°F on the top shelf to 135°F at the bottom of the low-hanging masks.

The normal cabinet load is 10 to 15 full-face and 24 half-mask respirators and their filter holders. The greatest practical capacity, using both hangers and shelves, is 30 full-face or 60 half-mask respirators. The average drying time is 1 to 1-1/2 h. The total cost of materials and labor is less than $150.00. Figures C-1through C-3 show this cabinet.

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Figure C-1.
Outside of cabinet showing heater unit.

Figure C-2.
Unloaded cabinet.

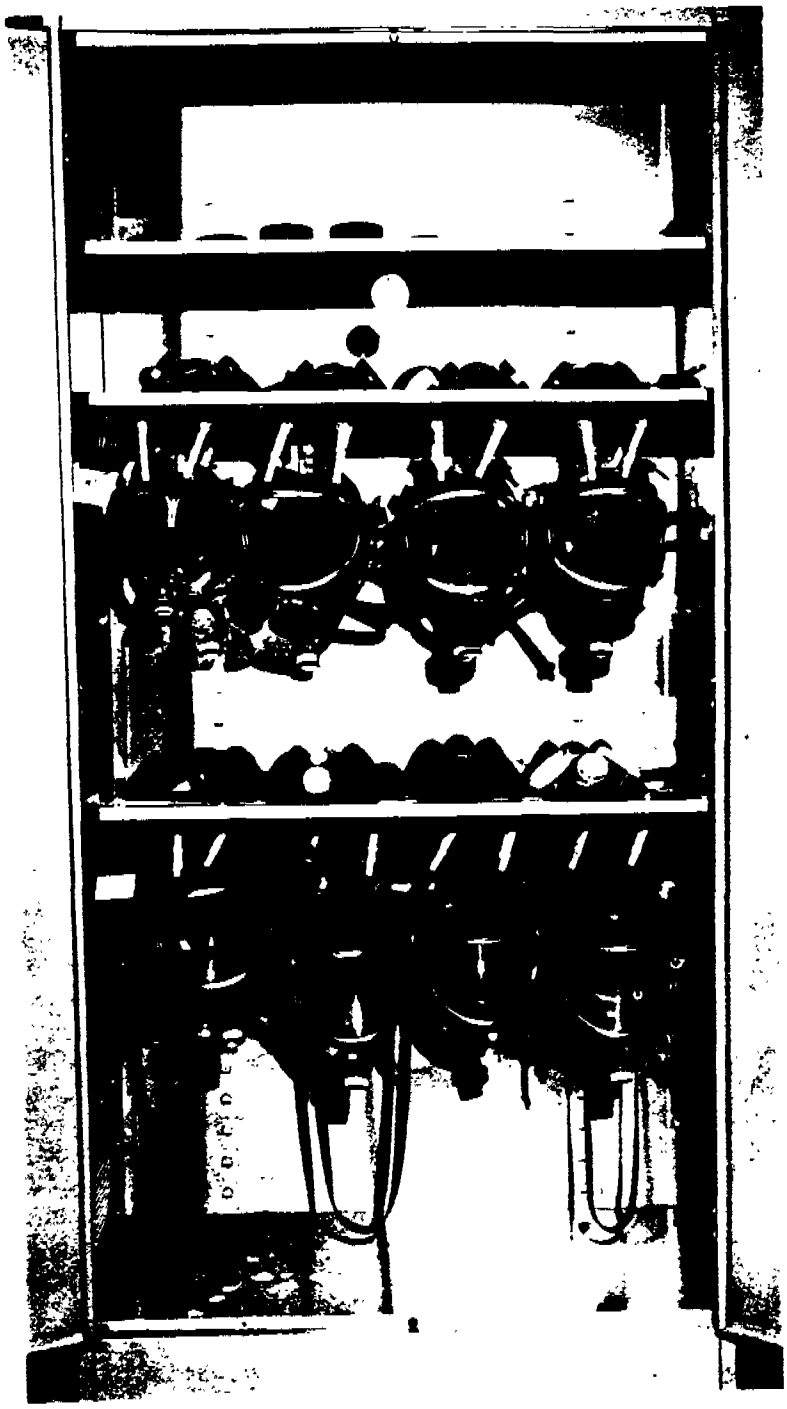

Figure C-3.
Cabinet loaded with masks.

APPENDIX D

QUANTITATIVE RESPIRATOR FITTING TEST PROCEDURES

Except for procedures peculiar to instrument operation and calibration, quantitative respirator fitting tests are practically identical. The following is a suggested procedure for use in all types of test systems.

I. PRELIMINARY CHECKOUT PROCEDURES

A. Start up and calibrate the test system according to manufacturer's instructions. Be sure that the system is stable and that the aerosol or gas concentration in the enclosure has reached equilibrium.

B. Inspect all respirators to be used in the tests for defects and cleanness according to the procedures described in Chap. Nine.

II. QUANTITATIVE FITTING TEST PROCEDURES

A. Recheck the respirator before handing it to the test subject, paying particular attention to the sampling probe and line attached to the facepiece.

B. Describe the test to the subject, making sure that he fully understands its purpose, the procedures, and the actions expected of him.

C. If the subject is not familiar with wearing respirators, demonstrate correct wearing procedures. The subject's level of expertise usually becomes apparent as he puts on the respirator. The untrained or poorly trained subject will put the respirator on incorrectly or be hesitant in his movements.

D. Have the subject put on the respirator, according to manufacturer's instructions. Be sure he does not tighten the headstraps to the point of discomfort. Remember that this test should approximate working conditions in which the subject might have to wear the respirator continuously for an hour or two at a time.

In testing a half- or quarter-mask, check its compatibility with safety glasses. If the subject's safety glasses interfere, try other brands of respirators of the same type. The subject may have to wear a full facepiece, which provides eye protection, if a half- or quarter-mask compatible with safety glasses cannot be found.

E. Once it has been determined that the respirator is worn properly, the fit can be checked quickly using a qualitative fitting test. Make sure that the correct filter, cartridge, or canister for the particular test is installed in the respirator. Also make sure that the subject pinches off the sampling hose. If leakage is detected, try to determine its source and cause. If the leakage is from a poorly fitting facepiece, try another brand of the same type of respirator. In fact, several different brands of respirators should be made available so the subject can choose the most comfortable, a very important aspect of fitting respirators.

F. After the best possible qualitative fit has been obtained, the subject enters the test enclosure and connects the sampling hose. If necessary, and without disturbing the facepiece fit, replace the filter, cartridge, or canister used during the qualitative test with the air-purifying element required for the quantitative test. To minimize filter leakage, use high-efficiency particulate filters when the test agent is an aerosol. Allow enough time (2-3 min) at this point for the test enclosure concentration to stabilize. Then recheck the test system calibration.

G. In response to verbal instructions, the subject begins head and facial movements simulating those made during normal work.

(1) Normal breathing with head motionless for 1 min;

(2) Deep breathing (simulating that during hard work) with head motionless for 30 seconds. Do not prolong this exercise because of the danger of hyperventilation;

(3) Turning head slowly from side to side while breathing normally, pausing for at least two breaths before changing direction. Continue for at least 1 min;

(4) Moving head slowly up and down while breathing normally, pausing for at least two breaths before changing direction. Continue for at least 1 min;

(5) Reading from a prepared text, slowly and clearly, and loudly enough to be heard and understood by the test operator. Continue for 1 min;

(6) Normal breathing with head motionless for at least 1 min.

These exercises are more or less "standard" and have been found to provide a meaningful evaluation of respirator performance. Therefore, if they are used, the data can be compared with published information. The times suggested for each are minimal and may be extended if needed to obtain better data.

H. After the test, the subject leaves the test enclosure and removes the repirator. The operator should then ask about the respirator comfort and note any marks on the subject's face which indicate pressure points. If the test indicated a good fit, any discomfort may be due to a mismatch between the subject and the facepiece or to headstraps that are too tight. Every effort should be made to provide the most comfortable respirator possible.

I. The test results may be analyzed and the protection level determined by one of two methods. The first involves watching a meter during the test to determine that penetration does not exceed a certain value. On the basis of a protection factor (PF) of 10 for respirators with half- and quarter-mask facepieces and 50 for those with full facepieces, maximum penetrations by the test agent should not significantly exceed 10 and 2%, respectively. A certain amount of professional judgment is involved in using this method.

The second, much preferred, method is to record the entire test using a strip chart recorder operated at a chart speed of about 2 in. per min. Figure D-1 is a simulated recording that illustrates most of the things likely to occur in a test.

Starting at the bottom of Fig. D-1, the first information should uniquely identify the test by number, date, subject, and type of respirator. Next comes the test system calibration after the subject has entered the test enclosure, to establish the maximum span of the penetration-measuring instrument ("100%" calibration). This should be done at least twice to ensure that the calibration is correct.

Next follow the five exercises, separated by horizontal lines across the chart. As the penetration-measuring instrument has several ranges, the range should be shown next to the right margin of the chart. When it becomes necessary to change the penetration range, as in the example under turning head from side to side (TH), make a short mark where the change was made and indicate the new scale setting.

Each exercise should be identified by some notation. In Fig. D-1 the following were used.

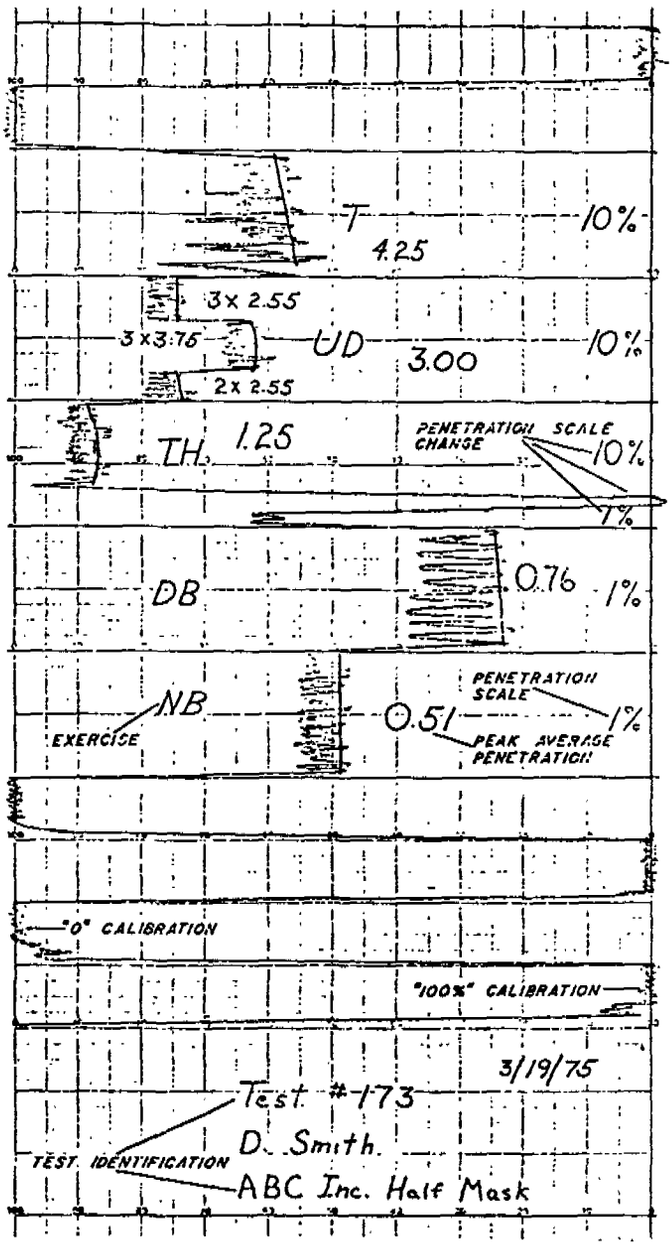

Figure D-1.
Typical quantitative fitting test strip chart recording.

Normal breathing	NB
Deep breathing	DB
Turning head from side to side	TH
Moving head up and down	UD
Talking	T

These are suggested notations; others may be used, but they should be consistent.

All the above notations should be made during the test. However, it is neither necessary nor desirable to calculate the penetrations until later. The operator should pay full attention to running the equipment and noting the subject's actions during the test.

The cyclic nature of the recorder trace is a function of the subject's breathing cycle. As this example shows, in an air-purifying respirator with a half-mask, negative air pressure created in the facepiece during inhalation increases the leakage. Exhalation creates slightly positive air pressure, reducing the leakage. Also, the lungs absorb some of the test agent, especially if it is an aerosol, thus reducing the quantity of test agent in the exhaled breath. Consequently, the maximum penetration during inhalation indicates the fraction of ambient concentration which has penetrated the facepiece. Therefore respirator performance is based on the average of the peak penetrations.

After the test, the operator may analyze the recording. This is done, treating each exercise separately, by drawing a line through the inhalation peaks to approximate their average. The midpoint of each line is the "average peak penetration" for the exercise. This number should be entered on the chart for each exercise. Where the penetration changes abruptly, as in Fig. D-1 during the moving head up and down (UD) exercise, it is usually advantageous to split the data into more than one section and treat each separately.

In the example, five chart divisions under UD showed a penetration of 2.55% and three showed 3.75%. The average peak penetration for the entire exercise is calculated as follows.

5 divisions x 2.55 = 12.75
3 divisions x 3.75 = 11.25
8 divisions 24.00

24.00/8 = 3.00% peak average penetration.

After the average peak penetration has been calculated for each exercise, the data may be entered on the fitting test record, shown in Fig. D-2. This form is only a suggestion, other formats may be devised to better meet individual needs.

Shown in Fig. D-2 on lines (1)-(3), is the information from the recorder chart which uniquely identifies the test. Lines (4) and (5) show the results of the qualitative pretest. In this case, the subject did not have a qualitative fit and had to readjust the respirator or tighten the headstraps. As line (5) shows, he then obtained a satisfactory seal. Line (6) indicates that the subject was able to wear safety glasses with the particular respirator without interference. This is important information as most workers are now required to wear eye protection.

(1) Test No. 173

QUANTITATIVE FITTING TEST

(2) Subject D. Smith Date 3/19/75
(3) Respirator ABC Inc. Half Mask
(4) Qualitative Pretest: Type Irr. Smoke Fit: Yes ____ No X
(5) Refit: Yes X No ____
(6) Compatible with safety glasses: Yes X No ____

TEST RESULTS

Exercise	Peak Average Penetration %
(7) Normal Breathing	0.51
(8) Deep Breathing	0.76
(9) Turning Head from Side to Side	1.25
(10) Moving Head Up and Down	3.00
(11) Talking	4.25

(12) AVERAGE: Allowable 10 %; Test Average 1.95 %
(13) FIT: Satisfactory X Unsatisfactory ____
(14) Comfort Rating: 1 2 (3) 4 5

Figure D-2.
Fitting test record.

Lines (7)-(11) show the average peak penetrations calculated for each exercise. Line (12) shows the test criterion expressed as the maximum allowable average peak penetration. This is 10%, as the test involved an air-purifying respirator with a half-mask facepiece. Line (12) also shows the test average peak penetration of 1.95% obtained by averaging the average peak penetrations for each exercise. Line (13) shows whether the overall performance was satisfactory or not. This determination is based on the qualitative fit, compatibility with safety glasses, and average penetration, which in this example had to be less than 10%.

The subjective evaluation of the comfort of the particular respirator, shown on line (14), is based on the criteria shown in Fig. D-3. All other factors being equal, final choice of a respirator should be based on comfort. A worker should not be required to wear a device he considers "uncomfortable" or "intolerable." He may wear a "barely comfortable" respirator if the proposed usage is intermittent for short periods.

1. VERY COMFORTABLE

MASK CAN BE WORN FOR AN INDEFINITE PERIOD WITHOUT BECOMING UNBEARABLY BOTHERSOME OR PAINFUL. NO PAIN POINTS: MASK FEELS COMFORTABLE.

2. COMFORTABLE

MASK CAN BE WORN FOR 2 TO 4 HOURS WITHOUT UNDUE DISCOMFORT. SOME PRESSURE POINTS WITH SLIGHT DISCOMFORT.

3. BARELY COMFORTABLE

MASK CAN BE WORN FOR APPROXIMATELY 1/2 HOUR TO 1 HOUR WITHOUT INTOLERABLE DISCOMFORT. SOME DISCOMFORT FROM PRESSURE.

4. UNCOMFORTABLE

MASK CAN BE TOLERATED FOR THE PERIOD OF THE TEST ONLY.

5. INTOLERABLE

MASK CANNOT BE WORN AT ALL WITHOUT DISCOMFORT.

NOTE: This table can be used as the prepared text for the "Talking" exercise during the quantitative fitting test. This will save the time for the subject to acquaint himself with this table after the test.

Figure D-3.
Respirator comfort ratings.

In summary, the above is a suggested procedure for conducting a quantitative respirator fitting test, evaluating the results, and recording the data meaningfully, without laborious record keeping. Moreover, the data will be compatible with those from other work.

APPENDIX E

QUANTITATIVE RESPIRATOR FITTING TEST EQUIPMENT

Both NaCl and DOP aerosol systems are commercially available (1975) from Air Techniques, Inc., 1717 Whitehead Road, Baltimore, MD 21207 and Frontier Enterprises, Inc., Box 30041, Albuquerque, NM 87110. The systems these concerns make differ little from the basic designs developed by the Los Alamos Scientific Laboratory (LASL). The cost may vary, depending upon accessories, but it is generally about $8-10,000. Both the NaCl and DOP systems consist of an aerosol generation and dilution air system, an analyzing system, and a test enclosure.

Figure E-1 illustrates a typical NaCl test system consisting of an internal or external compressed air source (1) that provides clean air at 50-100 psig to the aerosol generators (2) and combustion air to the burner (12). A Wright-design nebulizer is used in all commercial systems and has been adopted as the standard means of generating an NaCl aerosol. Operated at 24 psi with a 1% NaCl solution, it produces an aerosol with an aerodynamic mass median diameter (AMMD) of 0.6 μm. Two nebulizers are provided in most systems, although the output from one is sufficient for most purposes.

The aerosol generator injects the liquid droplets perpendicularly into the air stream flowing through the mixing and drying chamber (3), in Fig. E-1. The air for drying the aerosol (~4 cfm) is supplied by an internal blower ahead of which is mounted a high-efficiency filter. In passing through the mixing and drying chamber, the liquid NaCl droplets dry into discrete solid particles that are carried in the aerosol stream to the test enclosure. In this instance, the enclosure (5) is a test hood that covers the subject down to his waist, but particles also could be delivered to a small chamber. This test hood, based on a Harvard School of Public Health design, is commercially available. The aerosol is delivered to the center top of the hood. Directly below the inlet is a

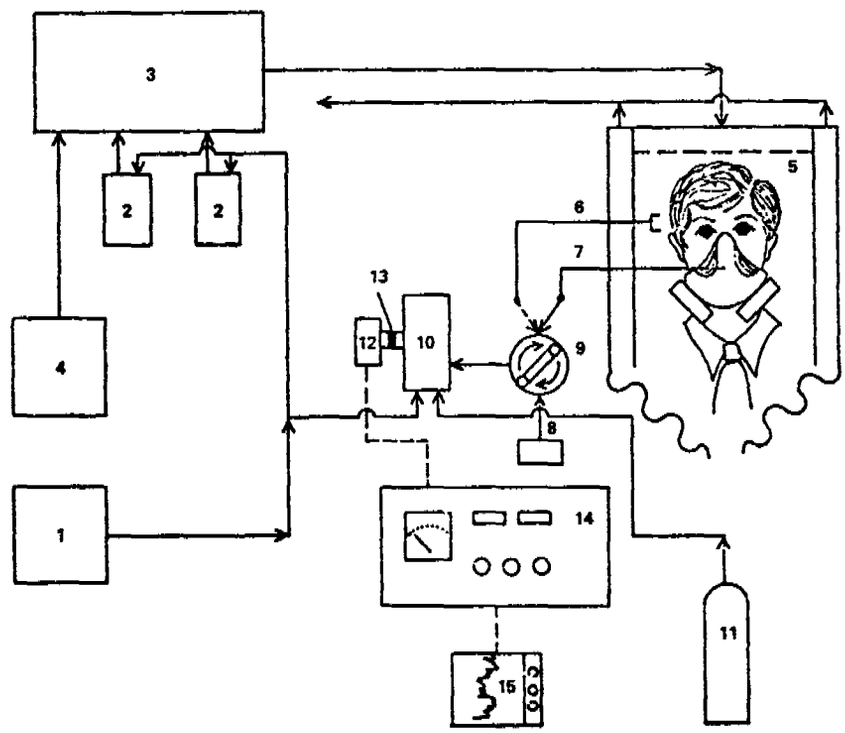

Figure E-1.
NaCl quantitative fitting test system schematic.

small circular plate that helps distribute the aerosol stream evenly inside the hood. Even distribution is further ensured by a large perforated plate that forms the bottom of the aerosol distribution section.

The chamber part of the hood is made of two, slightly separated, cylindrical walls of thin, transparent plastic. At the bottom of the outer wall is a cloth skirt that can be drawn snugly around the subject's waist to minimize leakage into the surrounding area. The aerosol is exhausted through the annular space between the inner and outer walls.

As Fig. E-1 shows, two sampling tubes lead from the hood to the aerosol analyzing system. One tube (6) samples the concentration of NaCl aerosol particles in the chamber atmosphere, and it is used in calibrating the flame photometer. The other tube (7) samples the NaCl aerosol particles in the air inside the respirator. A peristaltic (tubing) pump (9) is used to inject the sample into the flame photometer burner (10).

On the inlet side of this pump are connected the sampling tubes from the test hood as well as a third sampling tube which is connected to a small high-efficiency filter. This tube and filter (8) supply clean sampling air to the burner to calibrate the photometer.

Combustion air for the burner (10) is supplied from the external or internal compressed air source (1), and the propane fuel is supplied from an external tank (11). The amount of NaCl in the sample stream is determined by vaporizing the NaCl particles in the burner and detecting the emitted yellow light characteristic of sodium by using a sensitive photomultiplier tube (12) ahead of which is placed an optical filter (13) that passes only the sodium emission lines. The light intensity is directly related to the concentration of NaCl aerosol particles.

The photomultiplier tube output is fed into the electronics (14) of the test system analyzing section, and the amount of aerosol in the sampled air is displayed as percentage of the ambient concentration in the hood, either on a meter or a separate strip chart recorder (15).

The DOP quantitative respirator fitting test system is very like the NaCl system. As Fig. E-2 shows, an internal or external compressed air source (1) supplies 3- to 5-psig air to the Naval Research Laboratory Model III design DOP generator (2) and LASL-designed round jet impactor (3). The equivalent generator and impactor are found in commercial systems, but external construction details may differ.

The output from the generator and impactor assembly is injected into the dilution air chamber (4), perpendicularly to the air flowing through this chamber. The purpose is not to dry the aerosol, as it

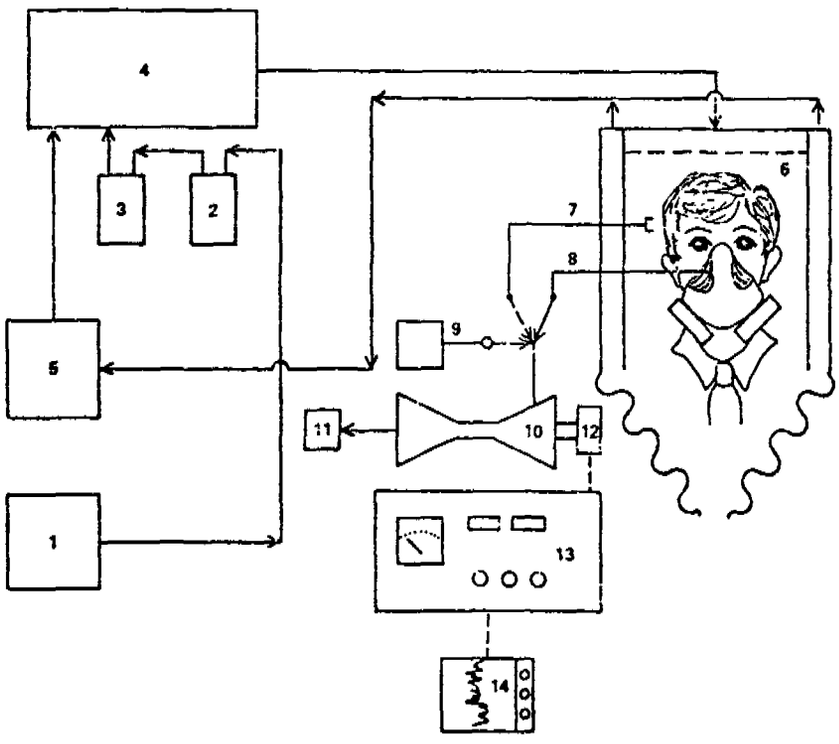

Figure E-2.
DOP quantitative fitting test system schematic.

is an oil mist, but to reduce the aerosol mass concentration to an acceptable level and maintain adequate air flow to the test enclosure. The test enclosure (6) is identical to that for the NaCl system, and two sampling tubes sample the DOP aerosol in the hood and the interior of the respirator. A third sampling tube outside the test hood is connected to a small high-efficiency filter (9) to provide clean air to the forward light-scattering photometer (10). The amount of DOP aerosol in the sample stream is determined by the intensity of the light scattered forward from particles passing through the center of the conical scattering chamber. This light strikes the photomultiplier tube (12), and the tube output is fed into the electronic section (13) of the analyzer which is almost identical to that used in the NaCl system.

The DOP concentration in the sample stream from the respirator, expressed as a percentage of the concentration in the test hood is displayed either on a meter or on a separate strip chart recorder (14).

This description applies primarily to the prototype units designed and built at LASL, upon which the commercial systems are based. Improvements and changes are made continually, so presently available systems may not look like those described. The important point is that the hearts of these systems, the aerosol generators, are identical in all respects.

In summary, these quantitative respirator fitting test systems provide the ultimate method for determining respirator fit. However, it is unrealistic to suggest that every respirator program have this capability. These systems are expensive and complex and require trained operators. Therefore, they are most widely used by industrial firms that have very comprehensive respirator programs. On the other hand, if a small industrial firm must protect workers against highly toxic contaminants, the expenditure for a quantitative respirator fit test system may be justified.

APPENDIX F

JOINT NIOSH/OSHA STANDARDS COMPLETION PROGRAM

RESPIRATOR DECISION LOGIC

18 AUGUST 1975

I. INTRODUCTION

THE PURPOSE OF THE RESPIRATOR DECISION LOGIC IS TO ASSURE TECHNICAL ACCURACY AND UNIFORMITY BETWEEN SUBSTANCES IN THE SELECTION OF RESPIRATORS AND TO PROVIDE NECESSARY CRITERIA TO SUPPORT THIS SELECTION. THE DECISION LOGIC IS A STEP-BY-STEP ELIMINATION OF INAPPROPRIATE RESPIRATORS UNTIL ONLY THOSE WHICH ARE ACCEPTABLE REMAIN. JUDGEMENT BY PERSONS KNOWLEDGEABLE OF INHALATION HAZARDS AND RESPIRATORY PROTECTION EQUIPMENT IS ESSENTIAL TO ENSURE APPROPRIATE SELECTION OF RESPIRATORS.

THE PRIMARY TECHNICAL CRITERIA FOR WHAT CONSTITUTES A PERMISSIBLE RESPIRATOR IS BASED ON THE TECHNICAL REQUIREMENTS OF 30 CFR PART 11 (DEPARTMENT OF THE INTERIOR, BUREAU OF MINES, RESPIRATORY PROTECTIVE DEVICES AND TESTS FOR PERMISSIBILITY). THE PROPOSED SUBSTANCE HEALTH STANDARDS WILL ALLOW ONLY RESPIRATORS APPROVED BY THE BUREAU OF MINES (OR MINING ENFORCEMENT AND SAFETY ADMINISTRATION (MESA)) AND NIOSH UNDER 30 CFR 11.

PROTECTION FACTORS ARE CRITERIA USED IN DETERMINING WHAT LIMITING CONCENTRATIONS ARE TO BE PERMITTED FOR EACH RESPIRATOR TYPE THAT WILL AFFORD ADEQUATE PROTECTION TO THE WEARER. THE REFERENCED SUBPARTS OF 30 CFR 11 GIVE TECHNICAL DESCRIPTIONS CONCERNING EACH TYPE OR CLASS OF RESPIRATORS REFERENCED IN THE DECISION LOGIC. 30 CFR 11 SHOULD BE USED WITH THE DECISION LOGIC IN ORDER TO PROPERLY UNDERSTAND THE CRITERIA FOR THE SPECIFICATION OF ALLOWABLE RESPIRATORS.

II. GENERAL DECISION LOGIC FLOWCHART

STEP 1 = ASSEMBLE INFORMATION ON SUBSTANCE.

ASSEMBLE NECESSARY TOXICOLOGICAL, SAFETY, AND RESEARCH INFORMATION FOR THE PARTICULAR CONTAMINANT. TYPICALLY THE FOLLOWING ARE REQUIRED:

1) PERMISSIBLE EXPOSURE LIMITS SPECIFIED IN 29 CFR 1910.1000 (TABLES Z-1, Z-2, AND Z-3). THESE ARE THE FORMER 29 CFR 1910.93 TABLES.

2) WARNING PROPERTIES IF THE SUBSTANCE IS A GAS OR A VAPOR. REFER TO PART IV(B) OF THIS LOGIC.

3) EYE IRRITATION POTENTIAL OF THE SUBSTANCE. REFER TO PART IV(D) OF THIS LOGIC.

4) LFL (LOWER FLAMMABLE LIMIT) FOR THE SUBSTANCE. REFER TO PART IV(F) OF THIS LOGIC.

5) IDLH CONCENTRATION FOR THE SUBSTANCE. REFER TO PART IV(E) OF THIS LOGIC.

6) POSSIBILITY OF POOR SORBENT EFFICIENCY AT IDLH CONCENTRATION AND BELOW. REFER TO PART IV(C) OF THIS LOGIC.

7) ANY EVIDENCE OF POSSIBLE SYSTEMIC INJURY OR DEATH RESULTING FROM ABSORBANCE OF THE SUBSTANCE (AS A GAS OR VAPOR) THROUGH THE SKIN. REFER TO PART IV(A) OF THIS LOGIC.

8) THE VAPOR PRESSURE OF THE SUBSTANCE (AND EQUIVALENT PPM).

STEP 2 - DETERMINE PHYSICAL STATE OF SUBSTANCE.

DETERMINE THE PHYSICAL STATE(S) OF THE SUBSTANCE AS IT IS LIKELY TO BE ENCOUNTERED IN THE OCCUPATIONAL ENVIRONMENT. IT WILL BE EITHER:

A) GAS OR VAPOR,
B) PARTICULATE (DUST, FUME OR MIST), OR
C) COMBINATION OF (A) AND (B).

STEP 3 - ASSEMBLE A TABLE OF PERMISSIBLE RESPIRATORY PROTECTION FOR SUBSTANCE

THIS IS DONE USING THE MATERIAL FROM STEP 1 AND THE APPROPRIATE SPECIFIC DECISION LOGIC CHART FROM PART III OF THIS LOGIC AND THE RESPIRATOR PROTECTION FACTORS IN APPENDIX I.

III.A. SPECIFIC DECISION LOGIC CHART FOR RESPIRATORY PROTECTION AGAINST GASES OR VAPORS

CONDITION	SELECTION SEQUENCE
ROUTINE USE	A) CONSIDER SKIN SORPTION - (SEE IV A), B) POOR WARNING PROPERTIES - ELIMINATE ALL AIR PURIFYING RESPIRATORS (SEE IV B), C) EYE IRRITATION - ELIMINATE OR RESTRICT USE OF HALF MASK RESPIRATOR (SEE IV D), D) IDLH OR LFL - ABOVE THIS CONCENTRATION ELIMINATE ALL BUT POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS AND COMBINATION POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS (SEE IV E AND F), E) LIST ALL ALLOWED RESPIRATORS BY CONDITION OF USE AND TYPE,
ENTRY AND ESCAPE FROM UNKNOWN CONCENTRATIONS	USE POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS OR COMBINATION POSITIVE PRESSURE SUPPLIED AIR RESPIRATOR WITH POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS,
FIREFIGHTING	USE POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS,
ESCAPE	GAS MASK OR ESCAPE SELF-CONTAINED BREATHING APPARATUS (SEE IV C),

III.B. SPECIFIC DECISION LOGIC CHART FOR RESPIRATORY PROTECTION AGAINST PARTICULATES

CONDITION	SELECTION SEQUENCE
ROUTINE USE	A) CONSIDER SKIN SORPTION - (SEE IV A), B) EYE IRRITATION - ELIMINATE OR RESTRICT USE OF HALF MASK RESPIRATOR (SEE IV D),

C) SYSTEMIC POISON = ELIMINATE SINGLE-USE RESPIRATOR.

D) FOR PERMISSIBLE EXPOSURE LESS THAN 0.05 MG/CU.M. = ELIMINATE DFH RESPIRATORS EXCEPT WITH HIGH EFFICIENCY PARTICULATE FILTER.

E) IDLH OR LFL = ABOVE THIS CONCENTRATION ELIMINATE ALL BUT POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS AND COMBINATION POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS (SEE IV E).

F) LIST ALL ALLOWED RESPIRATORS BY CONDITION OF USE AND TYPE.

ENTRY AND ESCAPE FROM UNKNOWN CONCENTRATION — USE POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS OR COMBINATION POSITIVE PRESSURE SUPPLIED AIR RESPIRATOR WITH POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS.

FIREFIGHTING — USE POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS (SEE IV F).

III.C. SPECIFIC DECISION LOGIC CHART FOR RESPIRATORY PROTECTION AGAINST COMBINATION OF GAS OR VAPOR AND PARTICULATES

CONDITION	SELECTION SEQUENCE
ROUTINE USE	A) CONSIDER SKIN SORPTION = (SEE IV A). B) POOR WARNING PROPERTIES OR INADEQUATE SORBENT EFFICIENCY = ELIMINATE ALL AIR PURIFYING RESPIRATORS (SEE IV B & C). C) ELIMINATE ALL RESPIRATORS EXCEPT WITH COMBINATION SORBENT/PARTICULATE FILTER. D) EYE IRRITATION = ELIMINATE OR RESTRICT USE OF HALF MASK RESPIRATOR (SEE IV D). E) FOR PERMISSIBLE EXPOSURES LESS THAN 0.05 MG/CU.M. = ELIMINATE ALL RESPIRATORS EXCEPT WITH SORBENT/HIGH EFFICIENCY PARTICULATE FILTER. F) IDLH OR LFL = ABOVE THIS CONCENTRATION ELIMINATE ALL BUT POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS AND COMBINATION POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS (SEE IV E). G) LIST ALL ALLOWED RESPIRATORS BY CONDITION OF USE AND TYPE.
ENTRY AND ESCAPE FROM UNKNOWN CONCENTRATION	USE POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS OR COMBINATION POSITIVE PRESSURE SUPPLIED AIR RESPIRATOR WITH POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS.
FIREFIGHTING	USE POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS (SEE IV F).
ESCAPE	GAS MASK OR ESCAPE SELF-CONTAINED BREATHING APPARATUS (SEE IV C).

IV. A. SKIN ABSORPTION

PERSONAL PROTECTION REQUIREMENTS FOR PROTECTION AGAINST EXPOSURE TO SUBSTANCES WHICH MAY CAUSE INJURY BY ABSORPTION THROUGH THE SKIN FROM MATERIALS SPLASHED OR SPILLED ON THE SKIN ARE COVERED IN SECTION (F) OF EACH SUBSTANCE STANDARD. RESPIRATOR SELECTION CRITERIA ARE BASED PRIMARILY ON THE INHALATION HAZARD OF THE SUBSTANCE. A SUPPLIED-AIR SUIT MAY PROVIDE BOTH SKIN AND RESPIRATORY PROTECTION FOR EXTREMELY TOXIC SUBSTANCES WHICH MAY BE ABSORBED THROUGH THE SKIN.

SUPPLIED-AIR SUITS ARE NOT COVERED IN 30 CFR 11. DATA ARE NOT AVAILABLE UPON WHICH TO MAKE RECOMMENDATIONS FOR SUPPLIED-AIR-SUITS FOR ALL TYPES OF EXPOSURES.

WHERE INFORMATION IS AVAILABLE INDICATING SYSTEMIC INJURY OR DEATH RESULTING FROM ABSORPTANCE OF A GAS OR VAPOR THROUGH THE SKIN, THE FOLLOWING STATEMENT IS INCLUDED IN APPENDIX A, SECTION (V) OF THE SUBSTANCE STANDARD:

"USE OF SUPPLIED-AIR SUITS OR OTHER IMPERVIOUS COVERINGS MAY BE NECESSARY TO PREVENT SKIN CONTACT WITH * WHEN THE CONCENTRATION OF * IS UNKNOWN OR GREATER THAN ** (IDLH), SUPPLIED-AIR SUITS SHOULD BE SELECTED, USED, AND MAINTAINED UNDER THE IMMEDIATE SUPERVISION OF PERSONS KNOWLEDGEABLE IN THE LIMITATIONS AND POTENTIAL LIFE ENDANGERING CHARACTERISTICS OF SUPPLIED-AIR SUITS."

A SENTENCE IS ADDED TO THE RESPIRATOR TABLE IN THE ENTRY AND ESCAPE FROM UNKNOWN CONCENTRATIONS SECTION AS SHOWN BELOW:

SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE. A COMBINATION RESPIRATOR WHICH INCLUDES A TYPE C SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE OR CONTINUOUS FLOW MODE AND AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND MODE OR OTHER POSITIVE PRESSURE MODE. (SUPPLIED-AIR SUITS MAY BE NECESSARY.)

IV. B. POOR WARNING PROPERTIES

IT IS IMPORTANT TO REALIZE THAT 30 CFR 11 NIOSH/MESA APPROVALS FOR AIR-PURIFYING (ORGANIC VAPOR) DEVICES PROHIBIT USE AGAINST ORGANIC VAPORS WITH POOR WARNING PROPERTIES. SPECIFICALLY, 30 CFR 11.90(B) (NOTE 4) COVERS GAS MASKS (CANISTER RESPIRATORS) AND 30 CFR 11.150 (NOTE 7) COVERS CHEMICAL CARTRIDGE RESPIRATORS. THUS THESE APPROVALS ARE ONLY FOR THOSE ORGANIC VAPORS WITH ADEQUATE WARNING PROPERTIES AND NOT ALL ORGANIC VAPORS.

WARNING PROPERTIES RELYING UPON HUMAN SENSES ARE NOT FOOLPROOF, HOWEVER, THEY PROVIDE SOME INDICATION TO THE EMPLOYEE OF POSSIBLE SORBENT EXHAUSTION OR OF POOR FACEPIECE FIT OR OTHER RESPIRATOR MALFUNCTION. WARNING PROPERTIES INCLUDE ODOR, EYE IRRITATION, AND RESPIRATORY IRRITATION.

ADEQUATE WARNING PROPERTIES CAN BE ASSUMED WHEN THE SUBSTANCE ODOR, TASTE, OR IRRITATION EFFECTS ARE DETECTABLE AND PERSISTENT AT CONCENTRATIONS "AT" OR "BELOW" THE PERMISSIBLE EXPOSURE LIMIT.

IF THE ODOR OR IRRITATION THRESHOLD OF A SUBSTANCE IS MANY TIMES GREATER THAN THE PERMISSIBLE EXPOSURE LIMIT, THIS SUBSTANCE SHOULD BE CONSIDERED TO HAVE POOR WARNING PROPERTIES. IF THE SUBSTANCE ODOR OR IRRITATION THRESHOLD IS SOMEWHAT ABOVE THE PERMISSIBLE EXPOSURE LIMIT (NOT IN EXCESS OF THREE TIMES THE LIMIT) AND THERE IS NO CEILING LIMIT, CONSIDERATION IS GIVEN AS TO WHETHER OR NOT UNDETECTED EXPOSURE IN THIS CONCENTRATION RANGE COULD CAUSE SERIOUS OR IRREVERSIBLE HEALTH EFFECTS. IF NOT, THE SUBSTANCE IS CONSIDERED TO HAVE ADEQUATE WARNING PROPERTIES.

IT IS EXPECTED THAT ENVIRONMENTAL CONCENTRATIONS WILL VARY CONSIDERABLY AND, THEREFORE, WARNING OF A RESPIRATOR FAILURE WOULD SOON BE PERCEIVED AT CONTAMINANT CONCENTRATIONS SOMEWHAT ABOVE THE PERMISSIBLE EXPOSURE LIMIT.

IV. C. SORBENT EFFICIENCIES

WHERE SUPPORTING EVIDENCE EXISTS ON IMMEDIATE (LESS THAN THREE MINUTES) BREAKTHROUGH TIME AT THE IDLH CONCENTRATION AND BELOW FOR A CARTRIDGE OR CANISTER SORBENT, AIR-PURIFYING DEVICES SHALL NOT BE ALLOWED FOR ANY USE, ESCAPE OR OTHERWISE.

IV. D. EYE IRRITATION

FOR ROUTINE WORK OPERATIONS, ANY PERCEPTIBLE EYE IRRITATION IS CONSIDERED UNACCEPTABLE. THEREFORE, ONLY FULL FACEPIECE RESPIRATORS ARE PERMISSIBLE IN CONTAMINANT CONCENTRATIONS WHICH PRODUCE EYE IRRITATION. NOTE THAT 30 CFR 11.90(B)(NOTE 6) SPECIFIES THAT EYE PROTECTION MAY BE REQUIRED IN CERTAIN CONCENTRATIONS OF ACID GASES AND ORGANIC VAPORS. FOR ESCAPE, SOME EYE IRRITATION IS PERMISSIBLE IF IT IS DETERMINED THAT SUCH IRRITATION WOULD NOT INHIBIT ESCAPE AND SUCH IRRITATION IS REVERSIBLE.

WHERE QUANTITATIVE EYE IRRITATION DATA CANNOT BE FOUND IN LITERATURE REFERENCES, AND THEORETICAL CONSIDERATIONS INDICATE THE SUBSTANCE SHOULD NOT BE AN EYE IRRITANT, HALF FACEPIECE RESPIRATORS ARE ALLOWED.

IV. E. IDLH

THE DEFINITION OF IDLH PROVIDED IN 30 CFR 11.3(T) IS AS FOLLOWS:

> "IMMEDIATELY DANGEROUS TO LIFE OR HEALTH" MEANS CONDITIONS THAT POSE AN IMMEDIATE THREAT TO LIFE OR HEALTH OR CONDITIONS THAT POSE AN IMMEDIATE THREAT OF SEVERE EXPOSURE TO CONTAMINANTS, SUCH AS RADIOACTIVE MATERIALS, WHICH ARE LIKELY TO HAVE ADVERSE CUMULATIVE OR DELAYED EFFECTS ON HEALTH.

THE PURPOSE OF ESTABLISHING AN IDLH EXPOSURE CONCENTRATION IS TO INSURE THAT THE WORKER CAN ESCAPE WITHOUT INJURY OR IRREVERSIBLE HEALTH EFFECTS FROM AN IDLH CONCENTRATION IN THE EVENT OF FAILURE OF THE RESPIRATORY PROTECTIVE EQUIPMENT. THE IDLH IS CONSIDERED A MAXIMUM CONCENTRATION ABOVE WHICH ONLY HIGHLY RELIABLE BREATHING APPARATUS PROVIDING MAXIMUM WORKER PROTECTION IS PERMITTED. SINCE IDLH VALUES ARE CONSERVATIVELY SET, ANY APPROVED RESPIRATOR MAY BE USED UP TO ITS MAXIMUM USE CONCENTRATION BELOW THE IDLH.

IN ESTABLISHING THE IDLH CONCENTRATION THE FOLLOWING FACTORS ARE CONSIDERED:

1. ESCAPE WITHOUT LOSS OF LIFE OR IRREVERSIBLE HEALTH EFFECTS. THIRTY MINUTES IS CONSIDERED THE MAXIMUM PERMISSIBLE EXPOSURE TIME FOR ESCAPE.
2. SEVERE EYE OR RESPIRATORY IRRITATION OR OTHER REACTIONS WHICH WOULD INHIBIT ESCAPE WITHOUT INJURY.

IDLH SHOULD BE DETERMINED FROM THE FOLLOWING SOURCES:

1. SPECIFIC IDLH PROVIDED IN THE LITERATURE SUCH AS THE AIHA HYGIENIC GUIDES.
2. HUMAN EXPOSURE DATA.

3. ACUTE ANIMAL EXPOSURE DATA,

4. WHERE SUCH DATA ARE LACKING TOXICOLOGICAL DATA FROM ANALOGOUS SUBSTANCES, AND CHRONIC ANIMAL EXPOSURE DATA MAY BE CONSIDERED.

THE FOLLOWING GUIDELINES SHOULD BE USED TO INTERPRET TOXICOLOGICAL DATA REPORTED IN THE LITERATURE FOR ANIMAL SPECIES:

1. WHERE ACUTE EXPOSURE ANIMAL DATA ARE AVAILABLE (30 MINUTES TO 4-HOUR EXPOSURES), THE LOWEST EXPOSURE CONCENTRATION CAUSING DEATH OR IRREVERSIBLE HEALTH EFFECTS IN ANY SPECIES IS DETERMINED TO BE THE IDLH CONCENTRATION,

2. WHERE ONLY CHRONIC EXPOSURE DATA ARE AVAILABLE AND THESE DATA DO NOT REVEAL ANY EXPOSURE CONCENTRATION WHICH WOULD RESULT IN IRREVERSIBLE HEALTH EFFECTS, THEN THESE DATA HAVE NO RELEVANCE AND SHOULD NOT BE USED IN DETERMINING THE IDLH CONCENTRATION,

WHERE THERE IS EVIDENCE OF AN IDLH CONCENTRATION ABOVE THAT ALLOWED ON THE BASIS OF A PROTECTION FACTOR, RESPIRATORS SHOULD BE SELECTED ON THE BASIS OF THE PROTECTION FACTOR AFFORDED BY EACH DEVICE WITHIN THE LIMITATIONS OF THE DEVICE,

IV. E. LOWER FLAMMABLE LIMIT AND FIREFIGHTING

CONTAMINANT CONCENTRATIONS IN EXCESS OF THE LFL ARE CONSIDERED TO BE IMMEDIATELY DANGEROUS TO LIFE OR HEALTH. AT OR ABOVE THE LFL, THE USE OF RESPIRATORS IS LIMITED TO THOSE DEVICES WHICH PROVIDE THE MAXIMUM PROTECTION, I.E., POSITIVE-PRESSURE SCBA, AND COMBINATION POSITIVE-PRESSURE SUPPLIED-AIR RESPIRATOR WITH POSITIVE PRESSURE SCBA,

FIREFIGHTING IS DEFINED BY ANSI Z88.5-1971 AS BEING IMMEDIATELY DANGEROUS TO LIFE. FOR FIREFIGHTING, THE ONLY DEVICE PROVIDING ADEQUATE PROTECTION IS THE POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS,

IV. G PROTECTION FACTORS

PROTECTION FACTORS ARE A MEASURE OF THE OVERALL EFFECTIVENESS OF A RESPIRATOR. FILTERING EFFICIENCY IS A PART OF THE PROTECTION FACTOR AND BECOMES A SIGNIFICANT CONSIDERATION FOR LESS EFFICIENT AIR PURIFYING RESPIRATORS,

THE PROTECTION FACTORS USED IN THE PREPARATION OF THE STANDARDS ARE BASED ON QUANTITATIVE FIT TESTS PERFORMED AT LOS ALAMOS AND ELSEWHERE, AND IN SOME INSTANCES ON PROFESSIONAL JUDGMENT. IN APPENDIX I, THE PROTECTION FACTORS FOR EACH CLASS OF RESPIRATORS LISTED IN THE CHECKLISTS ARE SHOWN. THE ENTRIES IN EACH LIST ARE FOR AN ENTIRE CLASS OF RESPIRATORS, AND ARE ASSIGNED THE PROTECTION FACTOR OF THE LOWEST PERFORMING DEVICE WITHIN EACH CLASS,

IV. H. VARIATIONS WITH 30 CFR 11

1. THE TYPE A SUPPLIED-AIR RESPIRATOR IS ALLOWED IN 30 CFR 11 FOR USE IN IMMEDIATELY DANGEROUS TO LIFE AND HEALTH ATMOSPHERES. HOWEVER, AIR SUPPLY REQUIREMENTS OF 50 L/MIN, IS INSUFFICIENT TO MAINTAIN A POSITIVE PRESSURE IN THE FACEPIECE UNDER ALL WORKING CONDITIONS. THEREFORE, THIS DEVICE SHOULD HAVE THE SAME PROTECTION FACTOR AS APPLIED TO OTHER AIR-PURIFYING AND ATMOSPHERE SUPPLYING RESPIRATORS HAVING A NEGATIVE PRESSURE IN THE FACEPIECE (SEE APPENDIX I). 30 CFR

11 WILL REQUIRE A REVISION TO ELIMINATE APPROVAL OF TYPE A FOR IDLH ATMOSPHERES.

2. AN AMENDMENT TO 30 CFR 11 IS BEING PROCESSED WHICH WILL DELETE USE OF GAS MASKS FOR ENTRY AND USE IN IDLH ATMOSPHERES. THEREFORE, IN THIS DECISION LOGIC GAS MASKS ARE NOT ALLOWED IN CONCENTRATIONS GREATER THAN THE IDLH OR ENTRY AND ESCAPE FROM UNKNOWN CONCENTRATIONS.

3. IN THE SAME AMENDMENT DESCRIBED ABOVE, MAXIMUM USE CONCENTRATIONS (MUC) FOR GAS MASKS ARE BEING DELETED. THIS DECISION LOGIC IS CONSISTENT WITH THIS AMENDMENT. HOWEVER, CANISTERS APPROVED PRIOR TO THIS AMENDMENT WILL HAVE THE MUC SPECIFIED ON THE LABEL WHICH WILL BE INCONSISTENT WITH THE SUBSTANCE STANDARDS FOR MOST SUBSTANCES.

4. 30 CFR 11 DOES NOT CONTAIN PROTECTION FACTOR REQUIREMENTS. PROTECTION FACTORS ARE USED IN THE DECISION LOGIC. AN AMENDMENT TO 30 CFR 11 IS PLANNED TO INCLUDE PROTECTION FACTOR REQUIREMENTS FOR DFM RESPIRATORS. FUTURE AMENDMENTS ARE CONTEMPLATED FOR OTHER TYPES OF RESPIRATORS.

5. 30 CFR 11 DOES NOT PERMIT THE USE AN ESCAPE GAS MASK AGAINST ACID GASES OR ORGANIC VAPORS WITH POOR WARNING PROPERTIES. A CHANGE TO 30 CFR 11 IS NECESSARY TO PERMIT THE USE OF AN ESCAPE GAS MASK AGAINST SUBSTANCES WITH POOR WARNING PROPERTIES.

~~IV. I.~~ ESCAPE

WHERE ESCAPE RESPIRATORS ARE PROVIDED THEY SHALL BE SELECTED FROM THE ESCAPE CATEGORY IN TABLE 2. THE EMPLOYER SHALL PROVIDE AND ENSURE EMPLOYEES CARRY AN ESCAPE RESPIRATOR WHERE EXPOSURE MAY OCCUR TO EXTREMELY TOXIC SUBSTANCES (AN EXTREMELY TOXIC SUBSTANCE IS DEFINED AS A GAS OR VAPOR HAVING A RAT EXPOSURE MORTALITY LC50 OF LESS THAN 10 PPM.

THE FOLLOWING STATEMENT IS ADDED TO THE INTRODUCTION TO THE RESPIRATOR TABLE FOR THESE SUBSTANCES:

> EMPLOYERS SHALL PROVIDE EACH EMPLOYEE WORKING IN AREAS WHERE **NAME** MAY BE RELEASED INTO THE WORKPLACE AIR WITH AN APPROVED ESCAPE RESPIRATOR AS SPECIFIED IN TABLE 2. THE EMPLOYER SHALL ENSURE THAT EACH EMPLOYEE CARRY THE ESCAPE RESPIRATOR IN THE AREA WHERE **NAME** MAY BE RELEASED INTO THE WORKPLACE.

IV. J. "ENTRY INTO TANKS OR CLOSED VESSELS; OR . . ."
ITEM (D)(6)(IV) IS A VARIABLE PROVISION IN THE INTRODUCTORY STATEMENTS TO THE RESPIRATOR TABLES WHICH LISTS THE SPECIFIC OPERATIONS WHERE A RESPIRATOR IS CONSIDERED TO BE AN ACCEPTABLE MEANS OF CONTROL. EXAMPLES OF WHERE THIS MAY OCCUR ARE FOR OPERATIONS WHICH REQUIRE OCCASSIONAL ENTRY INTO TANKS OR OTHER CLOSED VESSELS.

APPENDIX I

A. PROTECTION FACTORS FOR PARTICULATE FILTER RESPIRATORS

PROTECTION FACTOR (MINIMAL)	PERMISSIBLE RESPIRATORY PROTECTION
5X	ANY DUST AND MIST RESPIRATOR (30 CFR 11.130)
5X	ANY DUST AND MIST RESPIRATOR, EXCEPT SINGLE USE (30 CFR 11.130).

10X	ANY DUST AND MIST RESPIRATOR, EXCEPT SINGLE-USE OR QUARTER-MASK RESPIRATOR (30 CFR 11.130).
10X	ANY FUME RESPIRATOR OR HIGH EFFICIENCY PARTICULATE FILTER RESPIRATOR (30 CFR 11.130).
10X	ANY HIGH EFFICIENTY PARTICUALTE FILTER RESPIRATOR (30 CFR 11.130)
50X	A HIGH EFFICIENCY PARTICULATE FILTER RESPIRATOR WITH A FULL FACEPIECE (30 CFR 11.130).
1000X	A POWERED AIR-PURIFYING RESPIRATOR WITH A HIGH EFFICIENCY PARTICULATE FILTER (30 CFR 11.130).

B. PROTECTION FACTORS FOR CHEMICAL CARTRIDGES AND GAS MASKS

PROTECTION FACTOR (MINIMAL)	PERMISSIBLE RESPIRATORY PROTECTION
10X	ANY CHEMICAL CARTRIDGE RESPIRATOR WITH AN ** NAME ** CARTRIDGE(S) (30 CFR 11.150)
50X	A CHEMICAL CARTRIDGE RESPIRATOR WITH FULL FACEPIECE AND ** NAME **_ CARTRIDGE(S) (30 CFR 11.150)
50X	A GAS MASK WITH A CHIN-STYLE ** NAME ** CANISTER (30 CFR 11.90(A))
50X	A GAS MASK WITH A FRONT OR BACK-MOUNTED ** NAME ** CANISTER (30 CFR 11.90 (A))
1000X	A POWERED AIR-PURIFYING CHEMICAL CARTRIDGE RESPIRATOR WITH A ** NAME ** CARTRIDGE (UNLISTED DEVICE).
ESCAPE	ANY GAS MASK PROVIDING PROTECTION AGAINST ** NAME ** VAPORS (30 CFR 11.90).

NOTE: THE APPROVAL ** NAME ** MAY CONSIST OF ACID GASES OR ORGANIC VAPORS AS A CLASS OR SPECIFIC ACID GASES, AMMONIA, OR ORGANIC VAPORS. IT MAY ALSO CONSIST OF COMBINATIONS OF ACID GASES, ORGANIC VAPORS, AND OTHER GASES AND VAPORS.

C. PROTECTION FACTORS FOR COMBINATION CHEMICAL CARTRIDGES AND PARTICULATE FILTERS AND GAS MASKS AND PARTICULATE FILTERS

PROTECTION FACTORS (MINIMAL)	PERMISSIBLE RESPIRATORY PROTECTION
10X	ANY CHEMICAL CARTRIDGE RESPIRATOR WITH ** NAME ** CARTRIDGE(S) AND ** NAME ** FILTER(S) (30 CFR 11.150 AND 11.130)
50X	A CHEMICAL CARTRIDGE RESPIRATOR WITH A FULL FACEPIECE, ** NAME ** CARTRIDGE(S), AND ** TYPE ** FILTER(S) (30 CFR 11.150 AND 11.130)
50X	A GAS MASK WITH A CHIN-STYLE ** NAME ** CANISTER AND ** TYPE **_ FILTER (30 CFR 11.90(A) AND 11.130)
50X	A GAS MASK WITH A FRONT OR BACK MOUNTED ** NAME ** CANISTER AND ** TYPE ** FILTER (30 CFR 11.90(A) AND 11.130).

1000X	A POWERED AIR PURIFYING CHEMICAL CARTRIDGE RESPIRATOR WITH A ** NAME ** CARTRIDGE AND HIGH EFFICIENCY PARTICULATE FILTER,
ESCAPE	ANY GAS MASK PROVIDING PROTECTION AGAINST ** NAME ** AND PARTICULATES (30 CFR 11.90 AND 11.130)

** NAME ** REFERS TO ANY ACID GAS, AKALINE GAS, ORGANIC VAPOR, OR OTHER SPECIFIC GAS OR VAPOR,
** TYPE ** REFERS TO DUST AND MIST, FUME, OR HIGH EFFICIENCY PARTICULATE,

D. PROTECTION FACTORS FOR SUPPLIED-AIR RESPIRATORS

PROTECTION FACTOR (MINIMAL)	PERMISSIBLE RESPIRATORY PROTECTION
10X	ANY SUPPLIED AIR-RESPIRATOR (30 CFR 11.110(A))
50X	ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, HELMET, OR HOOD, (30 CFR 11.110(A))
1000X	*A TYPE C SUPPLIED-AIR RESPIRATOR OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE OR CONTINUOUS FLOW MODE (30 CFR 11.110(A))
2000X	A TYPE C SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE OR WITH A FULL FACEPIECE, HOOD, OR HELMET OPERATED IN CONTINUOUS FLOW MODE (30 CFR 11.110(A))

*THIS CATEGORY IS NOT FULLY COVERED BY PRECEDING CATEGORY,

E. PROTECTION FACTORS FOR SELF-CONTAINED BREATHING APPARATUS

PROTECTION FACTOR (MINIMAL)	PERMISSIBLE RESPIRATORY PROTECTION
10X	ANY SELF-CONTAINED BREATHING APPARATUS (30 CFR 11.70(A))
50X	ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE (30 CFR 11.70(A))
10,000+X OR FIRE-FIGHTING	SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE (30 CFR 11.70(A))
10,000+X	A COMBINATION RESPIRATOR WHICH INCLUDES A TYPE C SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE OR CONTINUOUS FLOW MODE AND AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR POSITIVE PRESSURE MODE (30 CFR 11.70(B))
ESCAPE	ANY ESCAPE SELF-CONTAINED BREATHING APPARATUS (30 CFR 11.70(A))

APPENDIX II - LITERATURE REFERENCES

THE FOLLOWING ARE THE PRIMARY REFERENCE SOURCES USED IN THIS DECISION LOGIC.

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APPENDIX G

STANDARD OPERATING PROCEDURES

Selection of the proper type of respirator is vital, but it is only part of the complete respirator program. Unless a standard operating procedure is set up, a correctly chosen respirator may be used incorrectly. The OSHA regulations 1910.134b require written standard operating procedures whenever respirators are used. Examples are given below.

STANDARD OPERATING PROCEDURES FOR USE OF RESPIRATORS IN THE MULLER AREA

The first respirator selection example in Chapter Six concerned a muller operator in a foundry. If we assume that this is a small foundry with only one operator, we can write a simple procedure as follows.

Respirator Selection

On the basis of the 5-mg/m^3 dust concentration and a permissible exposure limit of 1.5 mg/cm of silica dust, we have chosen the brand X disposable respirator, approved for use in silica dust, to be worn whenever the muller is operated. Properly used, this respirator provides a protection factor of 5.

User Instructions in Training

The muller operator who wears this respirator is trained in its use when hired and yearly thereafter. During training, he is taught to wear the respirator and a fit test using talc dust is performed to see whether the respirator leaks. If it does leak, another brand of disposable respirator is obtained. After the fit test, the employee continues to wear the respirator during the rest of the instruction and training class. He is told that he may have a new respirator whenever he wants and that he must use a new one whenever breathing becomes difficult and at the start of each shift. He is also told that silica dust may be harmful to health some years after exposure and that it is important that he use the respirators provided. It is further explained that it is impossible to install a ventilation system to take care of the dust problem in this area.

Respirator Sanitation Program

As the respirators are discarded after each day's use, there is no need for a sanitation program.

Respirator Use Surveillance

It is the foreman's responsibility to see that safety devices provided are used. He checks the muller operator's use of the respirator daily.

Work Area Surveillance

If operating conditions change, dust concentration in the muller area will be remeasured to ensure that the respiratory protection provided is still adequate.

STANDARD OPERATING PROCEDURES FOR USE OF SELF-CONTAINED BREATHING APPARATUS DURING DEGREASER PIT MAINTENANCE

In the fourth example in Chapter Six, maintenance personnel occasionally had to enter a degreaser pit while it was cool to clean it and perform necessary maintenance. The written operating procedure might be as follows.

Respirator Selection

Extremely high trichlor concentrations may be encountered during degreaser cleaning. The pit is to be ventilated, but use of pressure demand supplied-air respirators with escape packs is required.

User Instruction and Training

Maintenance men required to wear this equipment are trained in its use within 30 days of their employment. The training consists of wearing the equipment in fresh air and being taught how to regulate air flow and how to react in emergencies and if the main air supply fails. They are shown the alarm bell in the degreaser pit which rings if the air compressor fails. They are told that at that time they have 10 minutes air supply from their escape packs.

The equipment is used in a training exercise four times a year and is cleaned approximately twice a year. The exercise consists of entering the pit after it has been ventilated and inspecting the equipment in the bottom of it. Escape bottles of compressed air that have been opened are replaced through an arrangement with the distributor.

Cleaning, Maintenance, and Storage

After use, the respirators are cleaned by the maintenance staff using the manufacturer's sanitizing solutions. They are dried and stored in special cases in the maintenance department.

Respirator Air Supply

Air for normal use of these masks is supplied by an oilless portable compressor placed at the edge of the pit.

Respirator Use Surveillance

The Safety Director is responsible for seeing that training is carried out as specified and he must oversee the training.

Emergency Respirator Inspection

The respirators are inspected monthly for deterioration and to see that the escape bottles are fully charged. This is the Safety Director's responsibility.

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Appendix N

APPENDIX N

NIOSH CERTIFIED EQUIPMENT LIST

This list is published annually by NIOSH. A limited number of updated lists are made available free-of-charge to the Tenneco Chemicals, Inc. Industrial Hygiene Department. When updated lists are published, recipients of the manual will receive either a revised copy of the "list" or instructions on how to obtain a copy free-of-charge.

APPENDIX N

REMOVAL OF NIOSH CERTIFIED EQUIPMENT LIST

Due to the large content of this manual, the NIOSH Certified Equipment List may be removed to make the manual more manageable, prevent tearing of pages and provide room for insertion of ANSI Z88.2 (Appendix L).

An up-to-date copy of the NIOSH Certified Equipment List should be kept with the manual for reference purposes.

J. M. Hochstrasser

J. M. Hochstrasser, Ph.D., P.E.
Manager, Industrial Hygiene