

Engineering Standard



Safety Division



PLAINTIFF'S
EXHIBIT
AL-1796

18.1.1

RESPIRATORY PROTECTION

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1. SCOPE

This standard sets forth accepted practices for respirator users. It provides guidance on the proper selection, use, and care of respirators, and describes the essentials of a respiratory protection program. The standard conforms with regulations promulgated under the Occupational Safety and Health Act (OSHA) CFR 29, Section 1910.134. Specific state and foreign safety and health standards may require special consideration.

2. DEFINITIONS

AIR-PURIFYING RESPIRATOR - A respirator designed to remove contaminants from ambient air prior to its inhalation.

APPROVED RESPIRATOR - A respirator tested and listed as satisfactory in the United States by the Mine Safety and Health Administration, U.S. Department of Labor, and the National Institute of Occupational Safety and Health, U.S. Department of Health, Education and Welfare.

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH - Any hazardous atmosphere that poses an immediate threat to life or health or that poses an immediate threat of severe exposure to contaminants such as radioactive materials which are likely to have adverse delayed effects on health.

NEGATIVE PRESSURE RESPIRATOR - A respirator in which the air pressure inside the facepiece is positive during exhalation in relation to the air pressure of the outside atmosphere and negative during inhalation in relation to the air pressure of the outside atmosphere.

POSITIVE PRESSURE RESPIRATOR - A respirator in which the air pressure inside the respiratory-inlet covering is positive in relation to the air pressure of the outside atmosphere during exhalation and inhalation.

RESPIRATOR - A device designed to protect the wearer from inhalation of harmful atmospheres.

SHALL - Denotes a requirement.

SHOULD - Denotes a recommendation.

3. POLICY

3.1 Priorities or Control Methods. Control of potentially harmful occupational exposures shall be accomplished as far as feasible by work practices, or engineering control measures. When these methods of control are not feasible, or while they are being instituted, employees' health shall be protected by the use of appropriate respirators. Alcoa shall provide respirators as needed for protecting the health of the Alcoa employee.

4. ELEMENTS OF A RESPIRATORY PROTECTION PROGRAM

4.1 Assignment of Responsibility.

4.1.1 Respiratory Protection Administrator. Where the use of respirators is required, a respiratory protection program shall be established which shall comply with the provisions of this standard. A Respiratory Protection Administrator shall be selected from plant safety, industrial hygiene or other qualified personnel to administer and coordinate the overall plant respiratory protection program.

4.1.2 Employee Responsibility. Employees shall use the provided respiratory protection in strict accordance with the training received. They will immediately report any respirator malfunctions to the responsible persons in their departments.

4.1.3 Program Evaluation. An appraisal of the effectiveness of the respirator program shall be carried out at least annually by the Respiratory Protection Administrator. Action shall be taken to correct defects found in the program.

4.2 Respirator Selection.

4.2.1 General. The selection of a proper respirator for any given situation shall require consideration of the following factors:

- (1) The nature of the hazard.
- (2) The location of the hazardous area with respect to a safe area having respirable air.

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- (3) The period of time for which respiratory protection may be provided.
- (4) The physical characteristics, functional capabilities, and limitations of respirators of various types.
- (5) The respirator protection factors and respirator fit.

4.2.2 Nature of Hazard. The following factors concerning the nature of the hazard requiring the use of respirators shall be considered in respirator selection:

- (1) Type of hazard
 - (a) oxygen deficiency
 - (b) contaminant
- (2) Physical properties
- (3) Chemical properties
- (4) Physiological effects on the body.
- (5) Actual concentration of a toxic material
 - (a) Average
 - (b) Peak
- (6) Established permissible exposure limit or peak concentration of a toxic material.
- (7) Whether the hazard is an immediately dangerous to life or health concentration of a toxic material.
- (8) Warning properties.

4.2.3 Location of Hazardous Area. The location of the hazardous area with respect to a safe area having respirable air shall be considered in selecting a respirator, since this will permit planning for the escape of workers if an emergency occurs, for the entry of workers to perform maintenance duties, and for rescue operations.

4.2.4 Duration of Respirator Use. The period of time that a respirator must be worn is an important factor that shall be taken into account in selecting a respirator. Consideration shall be given to the type of respirator application, such as for routine, nonroutine, emergency, or rescue use. It would not be desirable, for example, to select respirators that are heavy or that offer high resistance to breathing for routine wearing for many hours each day.

4.2.5 Respirator Characteristics. The physical characteristics, the functional capabilities, and the performance limitations of the various types of respirators shall be considered in selecting a respirator.

4.2.6 Respirator Protection Factors. A respirator protection factor is an experimentally determined measure of protection afforded by a respirator under conditions of use. It is defined as the ratio of the concentration of airborne contaminant outside the respirator to the concentration inside the respirator. Multiplying the permissible exposure limit concentration or ceiling concentrations, whichever is applicable, by the respirator protection factor gives the maximum concentration of the contaminant for which the respirator should be used.

A protection factor is a selection and use guide, and should only be used in conjunction with the selection criteria outlined in this standard and the advice of the Respiratory Protection Administrator. (See Appendix I for list of respirator protection factors.)

4.2.7 Approved Respirators. Approved respirators shall be used when they are available. Any modification that is not authorized by the approval agencies of an approved respirator voids the approval.

4.2.8 Workplace Environmental Measurements. Selection of a proper respirator should be based on the concentration of the respiratory hazard as measured in the work area. Air samples should be collected periodically during respirator use to ensure that continued use of the selected respirator remains appropriate.

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4.3 Training. The supervisor, the person issuing respirators, and the respirator wearers shall be given adequate training by a qualified person(s) to ensure the proper use of respirators.

4.3.1 Training Content. To ensure the proper and safe use of a respirator, the minimum training of each respirator wearer shall include the following elements:

- (1) The reasons for the need of respiratory protection.
- (2) The nature, extent, and effects of respiratory hazards to which the person may be exposed.
- (3) An explanation of why engineering controls are not being applied or are not adequate and of what effort is being made to reduce or eliminate the need for respirators.
- (4) An explanation of why a particular type of respirator has been selected for a specific respiratory hazard.
- (5) An explanation of the operation, and the capabilities and limitations of the respirator selected.
- (6) Instruction in inspecting, donning, checking the fit of, and wearing the respirator.
- (7) An opportunity for each respirator wearer to handle the respirator, learn how to don and wear it properly, check its seals, wear it in a safe atmosphere.
- (8) An explanation of how maintenance and storage of the respirator is carried out.
- (9) Instructions on how to recognize and cope with emergency situations.
- (10) Instructions as needed for special respirator use.
- (11) Regulations concerning respirator use.

4.3.2 Refresher Training. The length of time between training sessions is dependent upon the frequency of use and the complexity of the respiratory protection equipment. Minimum frequency of retraining for infrequent use of nuisance dust respirators should be every two years.

4.4 Medical Evaluation. A physician shall determine what physiological conditions are pertinent for the wearing of different types of respirators. The respirator program administrator or his designee, using guidelines established by the physician, shall determine whether or not a person may be assigned to a task requiring the use of a respirator. This determination should be reviewed annually.

4.5 Fit-Testing. Each wearer of a negative pressure respirator shall pass a qualitative or quantitative fit-test to assure satisfactory fit. Each respirator wearer shall be required to check the seal of the respirator by appropriate means prior to entering a potentially hazardous atmosphere.

4.5.1 Test Method. A qualitative or quantitative respirator-fitting test shall be used to determine the ability of each individual respirator wearer to obtain a satisfactory fit with a negative-pressure respirator. The results of qualitative or quantitative respirator-fitting tests shall be used to select specific types, makes, and models of negative-pressure respirators for use by individual respirator wearers. Respirator-fitting tests are not required for positive-pressure respirators.

Qualitative Respirator-Fitting Test - A person wearing a respirator is exposed to an irritant smoke, an odorous vapor, or other suitable test agent. An air-purifying respirator must be equipped with an air-purifying element(s) which effectively removes the test agent from inspired air. If the respirator wearer is unable to detect penetration of the test agent into the respirator, the respirator wearer has achieved a satisfactory fit with the respirator.

Quantitative Respirator-Fitting Test - A person wears a respirator in a test atmosphere containing a test agent in the form of an aerosol, vapor, or gas. Instrumentation, which samples the test atmosphere and the air inside the respiratory-inlet covering of the respirator, is used to measure quantitatively the penetration of the test agent into the respiratory-inlet covering.

When carrying out a qualitative or quantitative respirator-fitting test, the respirator wearer shall carry out a series of exercises which simulate work movements.

4.5.2 Facial Hair. A respirator equipped with a facepiece shall not be worn if facial hair comes between the sealing periphery of the facepiece and the face or if facial hair interferes with valve function.

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4.6 Respirator Maintenance. Respirator maintenance and inspection shall be performed regularly. Maintenance shall be carried out on a schedule which ensures that each respirator wearer is provided with a respirator that is clean and in good operating condition.

4.6.1 Cleaning and Sanitizing. Each respirator shall be cleaned and sanitized to ensure that the respirator wearer is provided with a clean and sanitized respirator at all times. A respirator issued for other than continuous personal use by a particular worker, such as with routine, non-routine, emergency, or rescue use, shall be cleaned and sanitized after each use.

4.6.2 Inspection. Each respirator shall be inspected routinely before and after use. A respirator shall be inspected by the user immediately prior to each use to ensure that it is in proper working condition. After cleaning and sanitizing, each respirator shall be inspected to determine if it is in proper working condition, if it needs replacement of parts or repairs, or if it should be discarded.

Each respirator stored for emergency or rescue use shall be inspected at least monthly. Respirator inspection shall include a check for tightness of connections; for the condition of the respiratory-inlet covering, head harness, valves, connecting tubes, harness assemblies, filters, cartridges, canisters, end-of-service life indicator, and shelf life date(s); and for the proper function of regulators, alarms, and other warning systems.

Each rubber or other elastomeric part shall be inspected for pliability and signs of deterioration. Each air and oxygen cylinder shall be inspected to ensure that it is fully charged according to the manufacturer's instructions.

A record of inspection dates, findings, and remedial actions shall be kept for each respirator maintained for emergency or rescue use.

4.6.3 Repair. Replacement of parts or repairs shall be done only by persons trained in proper respirator assembly and correction of possible respirator malfunctions and defects. Replacement parts shall be only those designed for the specific respirator being repaired. Reducing or admission valves, regulators, and alarms shall be returned to the manufacturer or to a trained technician for repair or adjustment. Instrumentation for valve, regulator, and alarm adjustments and tests must be approved by the valve, regulator, or alarm manufacturer.

4.6.4 Storage. Respirators shall be stored in a manner that will protect them against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. Respirators shall be stored to prevent distortion of rubber or other elastomeric parts. Respirators shall not be stored in such places as lockers and tool boxes unless they are protected from contamination, distortion, and damage. Emergency and rescue-use respirators that are placed in work areas shall be quickly accessible at all times, and the storage cabinet or container in which they are stored shall be clearly marked.

4.7 Recordkeeping. Records shall be maintained by the Respiratory Protection Administrator or their designee as part of the overall respiratory protection program.

4.7.1 Types of Records. Recordkeeping requirements will vary greatly with the complexity of a location's use of respirators. The following represents a minimum requirement:

- (1) Employee training session outlines and attendance records.
- (2) Results of fit-test.
- (3) Medical acceptance or rejection of an employee's use of respirators on his/her job.
- (4) Reports of monthly inspections of emergency use respirators.

4.7.2 Record Retention. Records required under this section shall be maintained for at least 40 years, or for the duration of employment plus 20 years.

4.8 Written Respiratory Protection Program. The Respiratory Protection Administrator shall prepare a written respiratory protection program which shall include, at the least, all of the provisions described in section 4 of this standard.

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5. QUALITY OF RESPIRABLE AIR

5.1 Specifications for Respirable Air. Compressed air and liquid air, used for respiration shall be of high purity. 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-7.1-1973. This currently requires that the carbon monoxide level not exceed 20 ppm, the carbon dioxide content not exceed 1000 ppm, the condensed hydrocarbons (oil mist) not exceed 5 mg/m, and there be no pronounced odor.

5.2 Compressed Air. Breathing air may be supplied to respirators from cylinders or air compressors.

A breathing-air type compressor shall be used. A compressor shutoff alarm and suitable in-line air purifying sorbent bed and filters to assure breathing air quality shall also be incorporated into the system. An air-storage receiver shall also be provided to furnish the wearer with an adequate supply of escape air if the compressor fails to operate. In addition, compressor air intakes shall be situated so as to avoid the entry of contaminated air into 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 ensure that it meets the specifications for respirable air.

The contents of compressed air cylinders used to provide the air supply for an airline respirator shall be tested for oxygen concentration and carbon monoxide content. The air supply in the cylinder shall be sufficient to permit completion of the work and escape.

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TABLE I
RESPIRATOR PROTECTION FACTORS^a

Type Respirator	Facepiece ^b Pressure	Protection Factor
I. Air-Purifying		
A. Particulate ^c removing		
Single-use, ^d dust ^e	-	5
Quarter-mask, dust ^f	-	5
Half-mask, dust ^f	-	10
Half- or Quarter-mask, fume ^g	-	10
Half- or Quarter-mask, High-Efficiency ^h	-	10
Full-Facepiece, High-Efficiency	-	50
Powered, High-Efficiency, all enclosures	+	1000
Powered, dust or fume, all enclosures	+	X ⁱ
B. Gas and Vapor-Removing ^j		
Half-Mask	-	10
Full-Facepiece	-	50
II. Atmosphere-Supplying		
A. Supplied-Air		
Demand, Half-mask	-	10
Demand, Full-Facepiece	-	50
Hose Mask Without Blower, Full-Facepiece	-	50
Pressure-Demand, Half-Mask ^k	+	1000
Pressure-Demand, Full-Facepiece ^l	+	2000
Hose Mask With Blower, Full-Facepiece	-	50
Continuous-Flow, Half-Mask ^k	+	1000
Continuous-Flow, Full-Facepiece ^l	+	2000
Continuous-Flow, Hood, Helmet, or Suit ^m	+	2000
B. Self-Contained Breathing Apparatus (SCBA)		
Open-Circuit, Demand, Full-Facepiece	-	50
Open-Circuit, Pressure-demand Full-Facepiece	+	10 000 ⁿ
Closed-Circuit, Oxygen Tank-type, Full-Facepiece	-	50
III. Combination Respirator		
A. Any combination of air-purifying and atmosphere-supplying respirator.		Use minimum protection factor listed above for type of mode of operation.
B. Any combination of supplied-air respirator and an SCBA.		

Exception: Combination supplied-air respirators, in pressure-demand or other positive pressure mode, with an auxiliary self-contained air supply, and a full facepiece, should use the PF for pressure-demand SCBA.

Note: Table I is not to be reproduced without the accompanying footnotes.



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Footnotes for Respirator Protection Factor Table I

^aThe overall protection afforded by a given respirator design (and mode of operation) may be defined in terms of its protection factor (PF). The PF is a measure of the degree of protection afforded by a respirator, defined as the ratio of the concentration of contaminant in the ambient atmosphere to that inside the enclosure (usually inside the facepiece) under conditions of use. Respirators should be selected so that the concentration inhaled by the wearer will not exceed the appropriate limit. The recommended respirator PFs are selection and use guides, and should only be used when the employer has established a minimal acceptable respirator program as defined in Section 3 of the ANSI Z88.2-1969 Standard.

^bIn addition to facepieces, this includes any type of enclosure or covering of the wearer's breathing zone, such as supplied-air hoods, helmets, or suits.

^cIncludes dusts, mists, and fumes only. Does not apply when gases or vapors are absorbed on particulates and may be volatilized or for particulates volatile at room temperature. Example: Coke oven emissions.

^dAny single-use dust respirator (with or without valve) not specifically tested against a specified contaminant.

^eSingle-use dust respirators have been tested against asbestos and cotton dust and could be assigned a PF of 10 for these particulates.

^fDust filter refers to a dust respirator approved by the silica dust test and includes all types of media, that is, both nondegradable mechanical type media and degradable resin-impregnated wool felt or combination wool-synthetic felt media.

^gFume filter refers to a fume respirator approved by the lead fume test. All types of media are included.

^hHigh-efficiency filter refers to a high-efficiency particulate respirator. The filter must be at least 99.97% efficiency against 0.3- μ m DOP to be approved.

ⁱTo be assigned, based on dust or fume filter efficiency for specific contaminant.

^jFor gases and vapors, a PF should only be assigned when published test data indicate the cartridge or canister has adequate sorbent efficiency and service life for a specific gas or vapor. In addition, the PF should not be applied in gas or vapor concentrations that are: (1) immediately dangerous to life, (2) above the lower explosive limit, and (3) cause eye irritation when using a half-mask.

^kA positive pressure supplied-air respirator equipped with a half-mask facepiece may not be as stable on the face as a full facepiece. Therefore, the PF recommended is half that for a similar device equipped with a full facepiece.

^lA positive pressure supplied-air respirator equipped with a full facepiece provides eye protection but is not approved for use in atmospheres immediately dangerous to life. It is recognized that the facepiece leakage, when a positive pressure is maintained, should be the same as an SCBA operated in the positive pressure mode. However, to emphasize that it basically is not for emergency use, the PF is limited to 2000.

^mThe design of the supplied-air hood, suit, or helmet (with a minimum of 170 liters/min of air) may determine its overall efficiency and protection. For example, when working with the arms over the head, some hoods draw the contaminant into the hood breathing zone. This may be overcome by wearing a short hood under a coat or overalls. Other limitations specified by the approval agency must be considered before using in certain types of atmospheres.

ⁿThe SCBA operated in the positive pressure mode has been tested on a selected 31-man panel and the facepiece leakage recorded as <0.01% penetration. Therefore, a PF of 10 000+ is recommended. At this time, the lower limit of detection 0.01% does not warrant listing a higher number. A positive pressure SCBA for an unknown concentration is recommended. This is consistent with the 10 000+ that is listed. It is essential to have an emergency device for use in unknown concentrations. A combination supplied-air respirator in pressure-demand or other positive pressure mode, with auxiliary self-contained air supply, is also recommended for use in unknown concentrations of contaminants immediately dangerous to life. Other limitations, such as skin absorption of HCN or tritium, must be considered.

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