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AEROSPACE STANDARD

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Superseding AS8010B

Aviator's Breathing Oxygen Purity Standard

1. SCOPE:

This document defines the minimum degree of purity and maximum levels of certain deleterious impurities allowable for aviator's breathing oxygen at the point of manufacture or generation. It covers gaseous, liquid, and chemically generated oxygen, and oxygen supplied by in situ concentration and in situ electrolysis.

Different limits are established for oxygen from different sources, in recognition of differences in the ways the oxygen is stored, dispensed, and utilized, taking into account the safety of the user. These limits are not intended to specifically reflect upon the relative capabilities or merits of various technologies. Procurement documents may specify more stringent limits, where required for specific applications.

Medical oxygen is not covered by this standard. In the United States, medical oxygen is a prescription drug.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 U.S. Government Publications: Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-O-27210 Oxygen, Aviator's Breathing, Liquid and Gas

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (Inside USA and Canada)**
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

2.1.2 NATO Publications: Available from North Atlantic Treaty Organization, Military Agency for Standardization (MAS), 1110 Brussels, Belgium. Also available from Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

STANAG 3367 GGS	Characteristics Of Breathing Gas Supplied By Molecular Sieve Oxygen Concentrating Systems And Supply Equipment
STANAG 3545 GGS	Characteristics Of Breathable Liquid Oxygen
STANAG 3688 GGS	Characteristics Of Breathable Oxygen Supplied By Chemical Solid Generators

2.1.3 CGA Publications: Available from Compressed Gas Association, Inc., 1725 Jefferson Davis Highway, Suite 1004, Arlington, VA 22202.

CGA G-4.3 Commodity Specification for Oxygen

2.2 Definitions:

FIRST AID OXYGEN: Oxygen intended primarily for first aid treatment of aircraft cabin occupants who might require undiluted oxygen following descent from cabin pressure levels above 25,000 ft.

IMPURITY: Any constituent other than oxygen found in a sample of oxygen gas.

MEDICAL OXYGEN: Oxygen administered by, or under the guidance of a physician.

NTPD: Normal Temperature and Pressure, Dry. Conditions comprising a temperature of 21.1 °C (70 °F), an absolute pressure of 101.3 kPa (760 mm of Hg), and 0 partial pressure of water vapor.

PEAK ALLOWABLE CONCENTRATION: A concentration value which must not be exceeded at any time. As used in this document, a Peak Allowable Concentration is an additional requirement which must be met along with a time weighted average requirement.

PERCENT CONCENTRATION: Unit of concentration of constituent in a gaseous mixture, which is stated as the number of unit volumes of the constituent to be found in 100 unit volumes of the entire mixture. Also sometimes called "concentration by volume", "percent by volume", "percent (volume/volume)", or "volume percent". For the purposes of this Standard, concentrations expressed as a percentage are presumed to be consistent with this definition, unless otherwise stated.

PARTS PER MILLION CONCENTRATION (ppm): Unit of concentration of constituent in a gaseous mixture, which is stated as the number of unit volumes of the constituent to be found in one million unit volumes of the mixture. Also sometimes called "ppm by volume", "volume ppm", or "ppm (volume/volume)". For the purposes of this Standard, concentrations expressed as parts per million or ppm are presumed to be consistent with this definition, unless otherwise stated.

2.2 (Continued):

PURITY: The oxygen concentration found in a sample of oxygen. Also sometimes used in reference to the level of impurities found in a sample of oxygen.

SLIP: The quantity of a chemical constituent to which a user would be exposed, expressed as the equivalent volume of the pure constituent which would be encountered throughout the exposure. In this document, the concept of slip is used to deal with exposure to carbon monoxide, which has an accumulative exposure effect.

3. GENERAL REQUIREMENTS:

3.1 Types of Oxygen Supplies:

The types of oxygen supplies covered by this Standard include gaseous oxygen (Type I), liquid oxygen (Type II), chemically generated oxygen for routine use (Type III), chemically generated oxygen for emergency use (Type IV), oxygen concentrated in situ (Type V), and oxygen generated in situ by electrolysis (Type VI). Each type shall meet the composition requirements stated below.

3.1.1 Gaseous type Aviator's Breathing Oxygen (Type I) must contain not less than 99.5% oxygen by volume. The oxygen must contain no objectionable odor. The remainder, except for moisture and minor constituents specified in Table 1, may be argon, nitrogen, or similar non-toxic inert gas.

3.1.2 Liquid type Aviator's Breathing Oxygen (Type II) must contain not less than 99.5% oxygen by volume. The oxygen must contain no objectionable odor. The remainder, except for moisture and minor constituents specified in Table 1, may be argon, nitrogen, or similar non-toxic inert gas.

3.1.3 Chemically generated type Aviator's Breathing Oxygen for routine use (Type III) must contain not less than 99.5% oxygen by volume, on a dry basis (exclusive of moisture). The oxygen must contain no objectionable odor. The remainder, except for moisture and minor constituents specified in Table 2, must be gases which can be shown to be physiologically innocuous at the levels encountered. In addition, peak levels of certain minor constituents must meet the additional requirements given in Table 3.

3.1.4 Chemically generated type Aviator's Breathing Oxygen for emergency use (Type IV) must contain not less than 99.5% oxygen by volume, on a dry basis (exclusive of moisture). The oxygen must contain no objectionable odor. The remainder, except for moisture and minor constituents specified in Table 2, must be gases which can be shown to be physiologically innocuous at the levels encountered. In addition, peak levels of certain minor constituents must meet the additional requirements given in Table 3.

3.1.5 Aviator's Breathing Oxygen produced by in situ concentration or separation from ambient air (Type V) must not contain more than 0.5% impurities by volume, excepting moisture, nitrogen, and argon. The oxygen must contain no objectionable odor. Levels of minor constituents shall not exceed the values shown in Table 4. The remainder, except for moisture, nitrogen, argon, and minor constituents specified in Table 4, must be gases which can be shown to be physiologically innocuous at the levels encountered.

TABLE 1 - Constituent Maximum Concentrations for Gaseous and Liquid Oxygen

	Type I - Gaseous	Type II - Liquid
Carbon Dioxide (CO_2)	10 ppm	5 ppm
Methane (CH_4)	50 ppm	25 ppm
Acetylene (C_2H_2)	0.1 ppm	0.05 ppm
Ethylene (C_2H_4)	0.4 ppm	0.2 ppm
Ethane (C_2H_6) and heavier hydrocarbons	6 ppm (C_2H_6 equivalent)	3 ppm (C_2H_6 equivalent)
Nitrous Oxide (N_2O)	4 ppm	2 ppm
Halogenated Compounds (Refrigerants, CFC's, HCFC's, etc.)	2 ppm	1 ppm
Solvents (Trichloroethylene, carbon tetrachloride, etc.)	0.2 ppm	0.1 ppm
Other (Each compound discernible from background noise)	0.2 ppm	0.1 ppm

TABLE 2 - Constituent Maximum Concentrations[1] for Chemical Oxygen

	Type III - Chemical, for Routine[2] Use	Type IV - Chemical, for Emergency[3] Use
Carbon Dioxide (CO_2)	5000 ppm	5000 ppm
Chlorine and chlorine derivatives	0.2 ppm	0.2 ppm
Carbon Monoxide	50 ppm	50 ppm
Solvents (Trichloroethylene, carbon tetrachloride, etc.)	0.2 ppm	0.2 ppm

[1] The values shown in Table 2 for chemically generated oxygen are the time weighted average concentrations for periods not exceeding 5 min over the duration of operation.

[2] Routine use refers to systems which are intended to be used during normal operation of the aircraft. Such uses are likely to be of substantial duration and the same persons are likely to use oxygen from such systems on a frequent basis.

[3] Emergency use refers to systems which are intended to be employed only in an emergency, such as a loss of cabin pressure, failure of the primary system, first aid use following a loss of cabin pressure, cabin fires, and emergency evacuation or egress. Such uses are generally of limited duration and the same persons are not likely to use oxygen from such systems on a frequent basis.

TABLE 3 - Additional Constituent Requirements for Chemical Oxygen

	Type III - Chemical, for Routine Use	Type IV - Chemical, for Emergency Use
Carbon Dioxide (CO_2) Peak allowable concentration in ppm by volume	20,000 ppm	40,000 ppm
Chlorine and chlorine derivatives, Peak allowable concentration in ppm by volume	1.0 ppm	1.0 ppm
Carbon Monoxide (CO) Maximum permissible slip in ml, NTPD, to which an individual user may be exposed for single mission (Type III) or single use (Type IV)	100 ml	100 ml

TABLE 4 - Constituent Maximum Concentrations
for Oxygen Produced by In Situ Concentration or Electrolysis

	Type V - In Situ Concentration	Type VI - In Situ Electrolysis
Carbon Dioxide (CO_2)	5,000 ppm	10 ppm
Carbon Monoxide (CO)	15 ppm	10 ppm
Total Hydrocarbons (as methane, CH_4)	50 ppm	50 ppm
Aromatic Hydrocarbons	1 ppm	--
Nitrous Oxide (N_2O)	4 ppm	4 ppm
Nitrogen Dioxide (NO_2)	5 ppm	--
Solvents (Trichloroethylene, carbon tetrachloride, etc.)	0.2 ppm	0.2 ppm

3.1.5.1 Sources which produce Type V Aviator's Breathing Oxygen at concentrations less than 99.5% by volume, on a dry basis (exclusive of moisture) shall indicate or declare the oxygen concentration produced. If the system includes a sensor to measure the oxygen output concentration, this requirement can be satisfied by use of an indicator or display which is visible to the user. Alternatively, the minimum concentration supplied can be declared, whether this is controlled by internal mechanisms which respond automatically to a sensor signal or is established by design and qualification results.

3.1.5.2 Sources that produce Type V Aviator's Breathing Oxygen at concentrations less than 99.5% by volume, on a dry basis (exclusive of moisture) must be used only with dispensing devices which are designed to supply users with a volume of oxygen consistent with the use of that source concentration.

3.1.6 Aviator's Breathing Oxygen produced by in situ electrolysis (Type VI) must contain not less than 99.5% oxygen by volume on a dry basis (exclusive of moisture). The oxygen must contain no objectionable odor. The remainder, except for moisture and minor constituents specified in Table 4, may be argon, nitrogen, or similar inert gas or must be gases which can be shown to be physiologically innocuous at the levels encountered.

3.1.7 Oxygen supplies or sources which are to be marked as conforming to AS8010 shall indicate the Type in all such markings.

3.2 Moisture (Water Vapor):

3.2.1 Moisture in gaseous (Type I) or liquid (Type II) oxygen must not exceed 5 µg/L of gas at a temperature of 21.1 °C (70 °F) and a pressure of 101.3 kPa (760 mm of Hg). This corresponds to a dew point of -63.3 °C (-82 °F).

3.2.2 Moisture in chemically generated oxygen (Type III and Type IV), oxygen produced by in situ concentration (Type V), and oxygen produced by in situ electrolysis (Type VI), which is used as it is produced, shall not exceed 20 mg/L of gas at a temperature of 21.1 °C (70 °F) and a pressure of 101.3 kPa (760 mm of Hg). This corresponds to a dew point of 25 °C (77 °F). When oxygen from these sources is to be stored under pressure prior to use, the required moisture limit shall be determined by the actual application and stated by the procurement specification. In selecting an appropriate moisture limit, the possible effects of condensation, freezing, and corrosion must be considered.

3.3 Particles:

3.3.1 Liquid oxygen (Type II) must be filtered through a 10 µm nominal (40 µm absolute) filter located in the fill line to the shipping container.

3.3.2 Gaseous oxygen (Type I), chemically generated oxygen intended for routine use (Type III), oxygen produced by in situ concentration (Type V), and oxygen produced by in situ electrolysis (Type VI), shall not contain particles with any dimension in excess of 100 µm, nor fibers in excess of 40 µm x 600 µm, and total solids shall not exceed 1.0 mg/m^3 of oxygen.

3.3.3 Chemically generated oxygen intended for emergency use (Type IV) shall not contain particles with any dimension in excess of 500 µm, nor fibers in excess of 40 µm x 3000 µm, and total solids shall not exceed 100 mg/m^3 of oxygen.

4. ANALYTICAL METHODS:

4.1 Oxygen Content:

Oxygen content shall be measured by the methods described in MIL-O-27210, or by alternative methods giving equivalent precision and accuracy.

4.2 Constituent Concentration:

4.2.1 Concentrations of trace constituents shall be measured by methods which have appropriate detection limits for the maximum acceptable constituent concentration level.

4.2.2 Calibration methods employed in measurement of constituent concentrations shall encompass the same order of magnitude as the maximum acceptable level of the constituent being measured.

4.2.3 Sampling methods and materials shall be appropriately selected to insure that representative samples are obtained and to minimize interferences caused by chemical interactions between sample and sampling equipment.

4.3 Test equipment shall be calibrated using documented procedures and traceable standards, on a scheduled basis.

4.4 Test equipment shall be maintained in proper working order.

NOTE: Analytical methods found in the CGA and STANAG references cited in 2.1.2 and 2.1.3 shall not be applied in any manner contradictory to the constraints established in Section 4.

5. NOTES:

5.1 Keywords:

Oxygen, oxygen systems, aircraft oxygen, oxygen source, purity, impurity, breathing oxygen, aviator's breathing oxygen, oxygen purity

PREPARED BY SAE COMMITTEE A-10, AIRCRAFT OXYGEN EQUIPMENT