AEROSPACE STANDARD

AS8010™	REV. D

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Superseding AS8010C

Aviator's Breathing Oxygen Purity Standard

RATIONALE

The aim of this edition is to harmonize impurity requirements, of various oxygen supply technologies; like gaseous-, chemical-, liquid-, or in situ-generated oxygen. Limits included in this edition correspond from human physiology point of view to acknowledged data of American Conference of Governmental Industrial Hygienists (ACGIH) and National Institute for Occupational Safety and Health (NIOSH).

AS8010D has been reaffirmed to comply with the SAE Five-Year Review policy.

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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 and complies with the United States Pharmacopoeia (USP). In Europe, medical oxygen specification compiles with the European Pharmacopoeia monograph (Ph Eur 0417).

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

Copies of these documents are available online at http://quicksearch.dla.mil.

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

MIL-STD-3050 Aircraft Crew Breathing Systems using on-board Oxygen Generating System (OBOGS)

Copies of these documents are available online at https://www.gpo.gov/fdsys/browse/collectionCfr.action?collectionCode=CFR.

EPA 40 CFR Parts 50, 51, 52, 53 and 58 United States Environmental Protection Agency National Ambient Air Quality Standards for Particulate Matter

2.1.2 CGA Publications

Available from CGA, 14501 George Carter Way, Suite 103, Chantilly, VA 20151, Tel: 703-788-2700, www.cganet.com.

CGA G-4.3 Commodity Specification for Oxygen

2.1.3 Other References

ACGIH American Conference of Governmental Industrial Hygienists (http://www.acgih.org)

NIOSH National Institute for Occupational Safety and Health (https://www.cdc.gov/niosh)

2.2 Definitions

ACGIH: The American Conference of Governmental Industrial Hygienists is an association that establishes and recommends exposure limits for chemical substances and physical agents.

EPA: The United States Environmental Protection Agency is an agency of the federal government of the United States responsible for human health and environment protection.

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.

NIOSH: The National Institute for Occupational Safety and Health is the United States federal Agency responisble for the prevention of work-related injury and illness.

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.

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.

PM10: Respirable Particulate Matter with a diameter less than 10 micrometers (µm).

PM2.5: Respirable Particulate Matter with a diameter less than 2.5 micrometers (µm).

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.

REL: Recommended Exposure Limit is an exposure limit that is recommended by NIOSH considering safety and health over a working lifetime.

STEL: Short-Term Exposure Limit is the average exposure concentration limit that should not be exceeded during a 15 minute periode at any time.

TIME WEIGHTED AVERAGE: Averaged concentrations for periods not exceeding 5 minutes over the duration of operation.

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 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.

Historically, two categories of chemical oxygen were created to account for the possibility that some impurity might occur in chemically generated aviators breathing oxygen that was acceptable for brief exposures during an emergency descent, but was not advisable for prolonged or repeated use. As of this revision, no equipment is known to produce chemically generated oxygen in excess of 60 minutes. Accordingly Type III is not considered in this standard.

3.1.1 Gaseous Type Aviator's Breathing Oxygen (Type I).

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 specified in Table 4 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)

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 specified in Table 4 and minor constituents specified in Table 1, may be argon, nitrogen, or similar non-toxic inert gas.

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, including CO, discernible from background noise)	0.2 ppm	0.1 ppm

3.1.3 Chemically Generated Type Aviator's Breathing Oxygen (Type IV)

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 specified in Table 4 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.

Table 2 - Constituent maximum concentrations[1] for chemical oxygen

	Type IV - Chemical
Carbon Dioxide (CO_2), time weighted average[1)]	5000 ppm
Peak allowable concentration	30000 ppm[2)]
Chlorine and chlorine derivatives, time weighted average[1)]	0.2 ppm
Peak allowable concentration	1.0 ppm
Carbon Monoxide time weighted average[1)]	50 ppm
Peak allowable concentration	200 ppm[3)]
Solvents (Trichloroethylene, carbon tetrachloride, etc.)	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) CO_2 Limit Value according to STEL of NIOSH and ACGIH

3) CO Limit Value according to ceiling value of NIOSH

3.1.4 Aviator's Breathing Oxygen Produced by In Situ Concentration or Separation from Ambient Air (Type V)

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 3. The remainder, except for moisture specified in Table 4, nitrogen, argon, and minor constituents specified in Table 3, must be gases which can be shown to be physiologically innocuous at the levels encountered.

Systems where sources produce Type V Aviator's Breathing Oxygen at concentrations less than 99.5% by volume, on a dry basis (exclusive of moisture) shall provide evidence about oxygen concentration produced. The oxygen output concentration may be demonstrated by means of indication of maximum output established by design and qualification results.

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.

3.1.5 Aviator's Breathing Oxygen Produced by In Situ Electrolysis (Type VI)

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 3, may be argon, nitrogen, or similar inert gas or must be gases which can be shown to be physiologically innocuous at the levels encountered.

Table 3 - 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)	5000 ppm	10 ppm
Carbon Monoxide (CO)	15 ppm	10 ppm
Total Hydrocarbons (as methane, CH_4)	50 ppm	50 ppm
Aromatic Hydrocarbons	1 ppm	--
Ethyl Alcohol (C_2H_6O)[4)]	1000 ppm[4)]	--
Nitrous Oxide (N_2O)	25 ppm[5)]	4 ppm
Nitrogen Dioxide (NO_2)	1 ppm[5)]	--
Solvents (Trichloroethylene, carbon tetrachloride, etc.)	0.2 ppm	0.2 ppm
Ozone (O_3)[6)]	0.1 ppm	0.1 ppm
Hydrogen (H_2)	--	500 ppm

[4)] Applicable if air is tapped from cabin or cargo. Ethyl Alcohol Limit Value according REL from NIOSH.
[5)] N_2O and NO_2 Limit Value according REL from NIOSH.
[6)] O_3 concentration is increasing with altitude and causes adverse concentration and health effects. Threshold Limit Value according to ACGIH.

3.1.6 Oxygen Storage

Any device intended for oxygen storage shall be clean and unable to contaminate the oxygen stored therein with gases, liquids, solids or odors.

3.1.7 Conformity Markings

Oxygen supplies or sources which are to be marked as conforming to AS8010D shall indicate the Type in all such markings. Additional marking of concentration shall be provided, if the oxygen concentration is below 99.5%.