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PERFORMANCE SPECIFICATION

PROPELLANT, OXYGEN

This specification is approved for use by all Departments and Agencies of the Department of Defense.

Comments, suggestions, or questions on this document should be addressed to DET 3, WR-ALC/AFTT, 2430 C Street, Bldg 70, Area B, Wright-Patterson AFB OH 45433-7632 or e-mailed to AFPET.AFTT@wpafb.af.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://assist.daps.dla.mil.

AMSC N/A FSC 9135

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1. SCOPE

1.1 Scope. This specification covers the requirements for three grades and two types of oxygen.

1.2 Classification. The oxygen shall be of the following types and grades as specified (see 6.2).

1.2.1 Types. The types of oxygen are as follows:

Type I – Gaseous

Type II – Liquid

1.2.2 Grades. The grades of oxygen are as follows:

Grade A – 99.6 percent pure, standard

Grade B – 99.5 percent pure, reduced standard

Grade F – 99.990 percent pure, fuel cell and breathing

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following standard forms a part of this document to the extent specified herein. Unless otherwise specified, the issues of this document are those cited in the solicitation or contract (see 6.2).

COMMERCIAL ITEM DESCRIPTION

A-A-58092	Tape, Antiseize, Polytetrafluorethylene

(Copies of this document is available online at http://assist.daps.dla.mil/quicksearch/ or http://assist.daps.dla.mil or by mail from the Standardization Document Order Desk, 700 Robbins Avenue, Bldg 4D, Philadelphia PA 19111-5094.)

2.3 Non-government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

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ASTM INTERNATIONAL (ASTM)

ASTM E 29	Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
ASTM F 307	Standard Practice for Sampling Pressurized Gas for Gas Analysis
ASTM F 310	Standard Practice for Sampling Cryogenic Aerospace Fluids

(Copies of these documents are available online at http://www.astm.org or by mail from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA, 19428-2959)

COMPRESSED GAS ASSOCIATION (CGA)

CGA G-4.3	Commodity Specification for Oxygen
CGA P-15	Filling of Industrial and Medical Nonflammable Compressed Gas Cylinders

(Copies of these documents are available online at http://www.cganet.com or by mail from the Compressed Gas Association, Inc., 4221 Walney Road, 5th floor, Chantilly, VA 20151-2923)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Grade requirements. The purity and impurity concentrations as applicable to each grade of oxygen shall conform to the limits of Table I when tested in accordance with the applicable test method also specified in Table I. Other limits and tests may be specified by the procuring activity (see 6.2).

3.2 Limiting values. The following applies to all specified limits in this specification. For purposes of determining conformance with these requirements, an observed value or a calculated value shall be rounded off “to the nearest unit” in the last right-hand digit used in expressing the specification limit according to the rounding-off method of ASTM E 29 Standard Practice for using Significant Digits in Test Data to Determine Conformance with Specifications.

3.3 Filter. A filter with no more than a 10-micrometer nominal and 40-micrometer absolute rating shall be installed between the manufacturer’s plant system and the manifold used to fill the gas or liquid containers for delivery.

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TABLE I. Grade limits for oxygen.

	Grade			Test Method
	A	B	F	
Purity, percent by volume, min	99.6	99.5	99.990	4.4.1
Impurities, ppm by volume, max	4000	5000	100	4.4.1
Total hydrocarbons as methane	50	67.7	20	4.4.2
Water	3	26.3	3	4.4.2
Methane	Note a	Note a	16	4.4.2
Ethane	Note a	Note a	2	4.4.2
Propane and higher hydrocarbons as propane	Note a	Note a	1	4.4.2
Nitrous oxide	Note a	Note a	1	4.4.2
Halogenated hydrocarbons	Note a	Note a	1	4.4.2
Carbon monoxide and carbon dioxide	Note a	Note a	1	4.4.2
Other (N, Ar, Kr, etc.)	Note a	Note a	75	4.4.2
Odor	Note a	Note a	None	4.4.2
Particulate[b], mg/L, max	1.0	1.0	1.0	4.4.3

a. No limit for this grade.
b. Applies to Type II product only. The particulate test requirement and limit may be deleted by the procuring activity (see 6.2).

3.4 Filled containers (Type I only).

3.4.1 Filling Pressure. The container filling pressure shall not differ from that required by the contract by more than 1.0% at 70°F when tested as specified in 4.5.1. In no case shall the filling pressure exceed the rated service pressure of the container. Pressure-Temperature Filling Charts in CGA P-15 may be used.

3.4.2 Leakage. Cylinders shall not leak when tested according to 4.5.2.

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4. VERIFICATION

4.1 Points of inspection (see 6.2). Unless otherwise specified, acceptance tests shall be conducted at the site of filling prior to shipment or departure.

4.2 Conformance inspection. Quality conformance tests shall consist of the following:

a. Individual tests (Type I only)	4.2.1
b. Sampling tests	4.2.2

4.2.1 Individual tests (Type I only). Each container (cylinder or tube) shall be subjected to the following tests as described under 4.5.

a. Filling pressure	4.5.1
b. Leakage	4.5.2

4.2.2 Sampling test. The number of oxygen containers shall be selected in accordance with Table II and subjected to the tests required by Table I.

Table II. Sampling for test.

Number of containers in lot	Number of containers to be sampled
1	1
2 – 40	2
41 – 70	3
71 – over	4

4.2.3 Lot and Container Definitions

4.2.3.1 Lot: A lot shall be defined as one of the following

a. All of the oxygen supplied in one or more containers filled from one manifold at the same time.

b. All of the oxygen filled from a single storage tank that is homogenous at the time of withdrawal and is not added to while being withdrawn. After each addition to the storage tank, the contents shall constitute a separate lot.

4.2.3.2 Container: A container is defined as a shipping conveyance consisting of one cylinder or tube, or multiple cylinders or tubes that are interconnected by a single manifold that equalizes the pressure across all the cylinders or tubes to form one unit.

4.2.4 Sample. Each sample shall be of sufficient size to conduct all the quality conformance tests as specified herein. Unless otherwise specified, the quality conformance tests shall be performed on each required sample (see 6.2). When required, an equivalent sample shall be forwarded to a laboratory designated by the procuring activity for testing.

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4.2.4.1 Sampling methods. All apparatus used shall be made of suitable materials. Each sample taken for analysis shall be representative of the entire contents of the container being sampled. Unless otherwise specified in the acquisition requirements (see 6.2), sampling may be accomplished by the following methods.

a. Type I, gaseous oxygen may be sampled in accordance with ASTM F 307, for Type II, liquid oxygen may be sampled in accordance with ASTM F 310. It is critical that the outlet of the sampling port and the other equipment used in this process meet oxygen system cleanliness standards. Use an oxygen compatible cleaning solvent in accordance with local procedures for oxygen cleanliness.

b. By connecting the shipping container being sampled directly to the analytical equipment using suitable pressure regulation as required. It is critical that the outlet of the sampling port and the other equipment used in this process meet oxygen system cleanliness standards. Use an oxygen compatible cleaning solvent in accordance with local procedures for oxygen cleanliness.

4.2.5 Non-bulk Containers. Non bulk containers are defined as containers with a water capacity of 400 liters, or less. The number of non-bulk containers Type I (gaseous) or Type II (liquid) oxygen will be in accordance with Table II. Containers to be sampled may be selected at random.

4.2.6 Bulk Containers. Bulk containers are defined as having a water capacity in excess of 400 liters. Each bulk container filled with Type I (gaseous) and Type II (liquid) oxygen constitutes a lot and shall be sampled.

4.2.6.1 Continuous service. (see 6.4.1) Unless otherwise specified by the procuring activity, the following sample option for oxygen shall be used for storage and transport tanks engaged in continuous oxygen service (see 6.2). Contractor shall sample the contents of each transport tank engaged in continuous oxygen service at least once every seven days at uniform intervals of time. Samples shall be taken from the filled transport tanks. Contractor shall sample the contents of each transport tank when entering continuous service and when the transport tank has remained empty for a period greater than 24 hours. When empty, all ports and vents shall remain closed to the atmosphere. While in continuous service, compliance with quality conformance tests specified herein shall be determined by sampling the filling point storage tank after each addition or, in case of continuous production, at established intervals not less frequent than once every 24 hours. When a storage tank is being filled during a change of duty shift, sampling shall be performed after filling.

4.3 Rejection. When any sample tested in accordance with 4.4 fails to conform to the requirements specified herein, the entire lot represented by the sample shall be rejected.

4.4 Analytical procedures. Unless otherwise specified, samples shall be analyzed according to the procedures described below (see 6.2). Calibration gas standards may be required to calibrate (zero and span) analytical instruments used to determine the purity and impurity contents of the oxygen. The accuracy of the calibration gas standards is to be traceable to the National Institute of Standards and Technology (NIST). A suggested procedure for infrared analysis is provided in 6.7.

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4.4.1 Purity. Methods shall be selected from CGA G-4.3 except for grade F. The purity of grade F shall be determined by difference as follows:

$$\%O_2 = 100 - 10^4 \sum l$$

where $\sum l$ equals the sum of the water content, total hydrocarbons, nitrous oxide, carbon dioxide, carbon monoxide, and inert gases in ppm by volume.

4.4.2 Gaseous impurities. Methods shall be selected from those of CGA G-4.3.

4.4.3 Particulate content. A filter holder assembly (Pall Life Sciences part No. 2220) or equivalent, modified as shown in Figure 1, shall be attached to the withdrawal line of the vessel to be utilized to fill the tanks. A preweighed filter paper (47 mm glass fiber paper, type A/E or equivalent) shall be placed on top of another filter of the same kind. The filters shall then be placed on the porous filter support, which, in turn, shall be placed in the filter holder as shown in Figure 1. The male threads of the filter holder shall be wrapped with thin, nonadhesive-backed polytetrafluorethylene tape A-A-58092, or technical equivalent, to prevent galling of the threads. The holder shall be tightened by hand as tight as possible to prevent bypassing of the filter element. The discharge liquid from the filter housing shall be collected in a clean, uninsulated, ambient temperature vessel marked to indicate when 5 liters of liquid have been collected. The liquid flow shall be terminated when 5 liters of liquid have been collected. The filter holder shall be removed from the line and permitted to reach ambient temperature. The warmup to ambient temperature may be expedited by use of an oven or other heat source. Care shall be exercised to ensure that any airflow which enters the unit will be directed through the inlet of the assembly to prevent displacing and particles from the surface of the filter. Upon warmup, the other side of the holder shall be wiped with a clean cloth and the holder then disassembled. The filter paper shall be closely inspected. The test shall be repeated if evidence of either (a) the filter not being securely clamped by uniform depression of its edge; (b) the filter having been cut by the holder; or (c) when dirt particles are detected in the clamped area indicating bypassing had been encountered. The test shall also be repeated when either the bottom filter shows any discoloration or when leakage of liquid from the filter holder is detected. Upon completion of a valid test the filter shall be removed from the housing and weighed to the nearest 0.1 mg.

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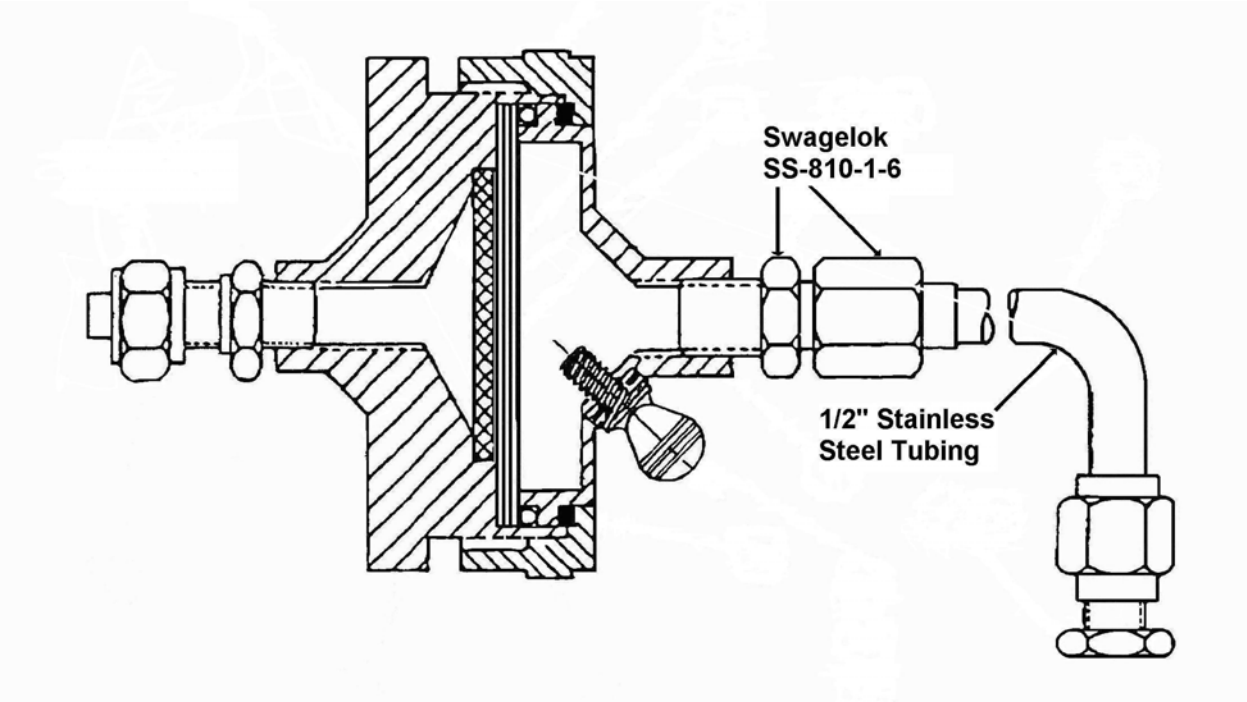

Figure 1. Filter Cryogenic Liquids

4.5 Containers of Type I oxygen.

4.5.1 Filling pressure. Containers shall be tested for proper filling pressure by attaching a calibrated Bourdon-tube gauge or equivalent to the valve outlet and by attaching either a thermocouple or thermometer to the container wall. The gauge shall have scale divisions not greater than 100 kPa (15 psi). If a thermometer is used, tape or putty shall be applied to the bulb to protect if from extraneous temperatures. Putty shall not be applied between the bulb and the container wall. The thermometer shall have scale divisions not greater than 1°C (2°F). The containers shall be stabilized to ambient temperature. The valve shall then be opened and the internal pressure observed on the gauge.

4.5.2 Leakage. Each Type I oxygen container shall be tested for leaks at the neck threads, stem packing, and safety device of the valve with leak-detection fluid. Valve seat leakage shall be tested by means of a tube from the valve outlet to a container of liquid.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

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6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The propellant covered by this specification is intended for use as follows.

a. Grade A, type I – Purging and pressurization of propellant systems and rocket engines.

b. Grade A, type II – Oxidizer.

c. Grade B, type II - Oxidizer.

d. Grade F, types I and II – Fuel cell grade that may be used for crew breathing in subsystems utilizing a common storage for both functions.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.

b. Type and grade of oxygen required (see 1.2).

c. If required, the specific issue of individual documents referenced (see 2.2.1).

d. When other limits or tests are required (see 3.1).

e. When the particulate test is not required (see Table I).

f. When a variation in the points of inspection is required (see 4.1).

g. When a variation of the quality conformance tests to be performed on each sample is required (see 4.2.4).

h. When a variation to the sampling method is required (see 4.2.4.2).

i. When a variation to the continuous service option is required (see 4.2.6.1).

j. When a variation to the 400 liter criteria for sampling is required (see 4.2.7).

k. When a variation of the analytical procedures is required (see 4.4).

l. Packaging requirements (see 5.1 and 6.3).

6.3 Packaging requirements. Guidance for cylinders may be found in the following documents.

a. RR-C-901	Cylinders, Compressed Gas: Seamless Shatterproof, High Pressure DOT 3AA Steel, and 3AL Aluminum
b. MIL-DTL-2/39	Valve, Cylinder, Gas: Oxygen Outlet 540
c. MIL-STD-101	Color Code for Pipelines and for Compressed Gas Cylinders

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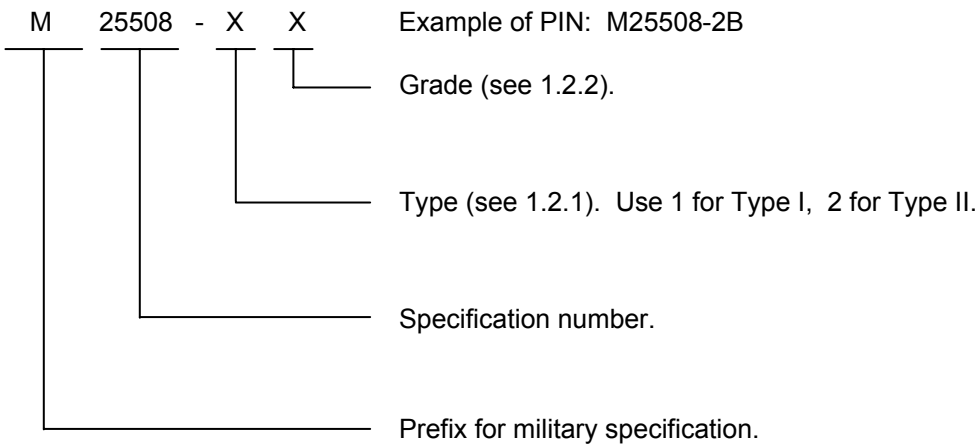
d. MIL-STD-1411 Inspection and Maintenance of Compressed Gas Cylinders

e. 49 CFR 171 – 199 Code of Federal Regulations

6.4 Definition.

6.4.1 Continuous service. Continuous service applies to continuous deliveries under Government contract of oxygen complying with the quality conformance tests specified herein.

6.5 Part or identifying number (PIN). The PIN's to be used for oxygen acquired to this specification are created as follows:



6.6 Subject term (key word) listing.

Aerospace
Breathing
Cryogenic
Cylinders
Fuel cell
Space vehicle

6.7 Infrared analysis. Procedures for calibration and analysis may be found in MIL-STD-1564, Procedure for Calibration and Analysis of Trace Contaminants in Aviator's Breathing Oxygen by Infrared Spectroscopy.

6.8 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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Custodians:
Army – MI
Navy – AS
Air Force – 68
DLA – PS

Preparing activity:
Air Force – 68
(Project 9135-2005-007)

Review activities:
Air Force – 19
DLIS – LS

Civil Agencies:
NASA

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