

METRIC

MIL-PRF-27210H

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SUPERSEDING

MIL-PRF-27210G

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PERFORMANCE SPECIFICATION

OXYGEN, AVIATOR'S BREATHING, LIQUID AND GAS



Comments, suggestions, or questions on this document should be addressed to HQ AFPET/PTPT, 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>.

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

1. SCOPE

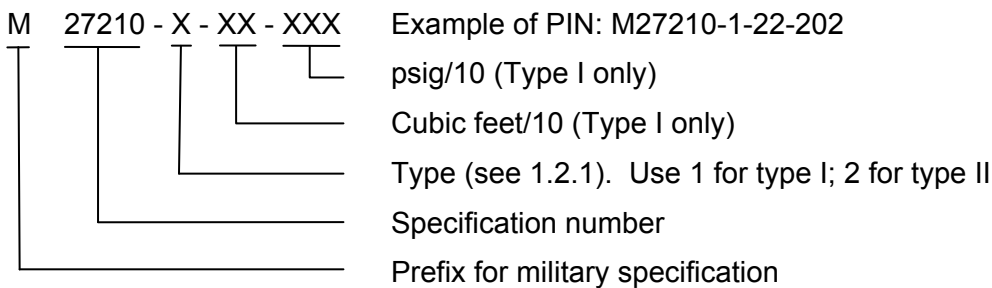
1.1 Scope. This specification covers the requirements for two types of aviator's breathing oxygen.

1.2 Classification. Oxygen is classified as the following types, as specified (see 6.2).

Type I - Gaseous

Type II - Liquid

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



2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4 and 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 specifications, standards and handbooks 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.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-2	Valves, Cylinder, Gas (for Compressed or Liquefied Gases), General Specification For
MIL-STD-101	Color Code for Pipelines and for Compressed Gas Cylinders
MIL-STD-1411	Inspection and Maintenance of Compressed Gas Cylinders

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094)

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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.

ASTM INTERNATIONAL (ASTM)

ASTM E29	Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
ASTM F307	Standard Practice for Sampling Pressurized Gas for Gas Analysis
ASTM F310	Standard Practice for Sampling Cryogenic Aerospace Fluids

(Copies of these documents are available online at <http://www.astm.org> or the 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 the Compressed Gas Association, Inc., 4221 Walney Road, 5th floor, Chantilly, VA 20151-2923)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, 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 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

3.2 Purity. The oxygen (Type I and II) shall contain not less than 99.5 percent oxygen by volume when tested in accordance with 4.5. The remainder, except for moisture and minor constituents specified in Table I, shall be argon and nitrogen.

3.3 Impurities. The oxygen shall be free from all contaminants of known toxicity to the maximum practicable extent. Limitations on specific impurities shall be as follows:

3.3.1 Odor. The oxygen (Type I and II) shall contain no odor when tested as specified in 4.5.

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TABLE I. Constituent concentrations

Constituent	Maximum concentration in parts per million (by volume)	
	Type I	Type II
Carbon Dioxide (CO ₂)	10	5
Methane (CH ₄)	50	25
Acetylene (C ₂ H ₂)	0.1	0.05
Ethylene (C ₂ H ₄)	0.4	0.2
Ethane (C ₂ H ₆) and other hydrocarbons as ethane equivalents	6	3
Nitrous Oxide (N ₂ O)	4	2
Refrigerants and Similar Solvents¹: Hydrochlorofluorocarbons (HCFC) Hydrofluoroethers (HFE) Chlorofluorocarbons (CFC)	2	1
Other Solvents: Trichloroethylene, n-Propyl Bromide, Trichloroethane, Carbon Tetrachloride, Perchloroethylene, Dichloromethane, Perfluoro-n-Butyl-Iodine (PFBI)	0.2	0.1
Other Compounds: (each discernable from background noise on infrared spectrophotometer or gas chromatograph)	0.2	0.1
Note 1 Examples of Refrigerants and Similar Solvents include, but are not limited to the following compounds: HCFC: HCFC-225 (all isomers), HCFC-141b, HFE: HFE-7100, CFC: Freons		

3.3.2 Minor constituents. Minor constituents of Types I and II shall not exceed the quantity specified in Table I.

3.3.3 Moisture. Moisture in Types I and II shall not exceed 7 ppm of water vapor or a maximum dew point of -63.3°C (-82°F) when tested as specified in 4.5.

3.4 Materials. There is no requirement included herein which should be interpreted to exclude the use of reclaimed materials in the manufacture of this commodity.

3.5 Filter. When required, Type II oxygen shall be passed through a filter as specified in 4.6.

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3.6 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 E29.

3.7 Gas Cylinders (Type I only).

3.7.1 Pressure. The container filling pressure shall not differ by more than 1.0% at 21°C (70°F) when tested as specified in 4.4.1. Cylinders shall be filled to within 99 to 100 percent of their rated service pressure when tested as specified in 4.4.1. 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.

3.7.2 Leakage. Cylinders shall not leak when tested according to 4.4.2.

3.7.3 Inspection and maintenance. Compressed gas cylinders shall be inspected, maintained and charged according to 4.4.3.

4. VERIFICATION

4.1 Classification of inspections. A cross reference between the individual inspections and test methods is provided in Table II. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.2).
- b. Periodic inspection (see 4.2).
- c. Quality conformance inspection (see 4.2).

TABLE II. Test requirements

Characteristic	First Article Inspection	Periodic Inspection	Quality Conformance Inspection	Inspection Paragraph	Test Method Paragraph
Purity – Type I	Required	Required	Required	3.2	4.5
Purity – Type II	Required	Required	Required	3.2	4.5
Odor	Required	Required	Required	3.3.1	4.5
Minor Constituents	Required	Required	Not Required	Table I	4.5
Moisture	Required	Required	Required	3.3.3	4.5
Filled Containers (Type I)					
Pressure	Required	Required		3.7.1	4.4.1
Leakage	Required	Required	Required	3.7.2	4.4.2

4.2 First article, periodic, and quality conformance inspections.

4.2.1 First article inspection. First article inspection shall be defined as a preproduction sample. Prior to initial delivery of Type I or Type II oxygen, a representative product specimen shall be obtained as specified in 4.3.1.1 (Type I) or 4.3.1.2 (Type II) and forwarded to the designated laboratory (6.2). The product shall meet the requirements in 3.2 and 3.3.

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4.2.2 Periodic inspection. A representative product specimen of oxygen shall be obtained as specified in 4.3.1.1 (Type I) or 4.3.1.2 (Type II) and shall be taken once every 60 calendar days for the duration of the contract. This sample shall be shipped to the specified laboratory (6.2) for testing to determine compliance with requirements specified in Table II. The specified laboratory shall also test for purity and moisture if there is sufficient sample. The purity and moisture results shall be reported for correlation purposes and shall not be used to determine compliance to requirements of 3.2 or 3.3.3.

4.2.3 Conformance inspection. Quality conformance inspection shall consist of the following:

- a. Individual container / cylinder inspection (see 4.2.3.2).
- b. Sampling inspection per lot (see 4.2.3.3).

4.2.3.1 Place of inspection. Quality inspection shall be performed at source.

TABLE III. Sampling particulars

Sampler	Oxygen type	Method	Recommended final pressure (gauge)
≈ 1 liter size or larger Gas Cylinder	I	ASTM F307	≈12,500 kPa (≈ 1800 psi)
TTU-131/E, Cosmodyne LLC	II	ASTM F310	2750 to 3450 kPa (400 to 500 psi)
FCS 2001, CV International	II	ASTM F310	5500 to 8300 kPa (800 to 1200 psi)

4.2.3.1.1 Type I oxygen. Quality conformance inspection on cylinders filled with Type I oxygen shall be performed at the site of filling (see 6.2).

4.2.3.1.2 Type II oxygen. Quality conformance inspection shall be performed on samples taken from Type II oxygen transport container prior to leaving the site of filling. The transport container shall not be permitted to take on further liquid oxygen between inspection at the filling point and arrival at its destination, unless all quality conformance inspections are performed on the contents after such filling.

4.2.3.2 Individual container / cylinder inspection. Individual inspection will be as follows.

4.2.3.2.1 Type I Individual Inspection. Each cylinder filled with Type I oxygen shall be subjected to the tests in Table IV.

4.2.3.2.2 Type II individual inspection. After filling the shipping container, two product specimens shall be drawn from each container. One specimen shall be in liquid state and subjected to the odor test specified in 4.5. The other specimen shall be vaporized and subjected to the purity and moisture tests as specified in 4.5 (see table IV).

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4.2.3.3 Sampling inspection per lot. Randomly selected samples of Type I oxygen as specified in Table V shall be subjected to the following inspection:

Odor test	4.5
Fill pressure	4.4.1
Purity	4.5
Moisture	4.5

The fill pressure shall be performed prior to the odor, purity, and moisture tests. The cylinder pressure shall be checked after completion of all tests. If the sample cylinder pressure is below the minimum acceptable value, the cylinder shall be filled to within the acceptable range.

4.2.3.4 Lot definition. Each set of Type I oxygen cylinders filled on the same manifold at the same time shall constitute a lot.

TABLE IV. Individual inspection

TEST	TYPE I	TYPE II
Leak test	4.4.2	---
Odor test	---	4.5
Purity test	---	4.5
Moisture test	---	4.5

TABLE V. 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

4.3 Sampling. Samples required by 4.2.1 and 4.2.2 shall be delivered to the designated Government Laboratory (see 6.4), another designated laboratory, or other laboratories authorized by HQ AFPET/PTPT, 2430 C Street, Bldg 70, Area B, Wright-Patterson AFB OH 45433-7632.

4.3.1 Sampling point. The sampling point will be as follows:

4.3.1.1 Type I oxygen. Samples shall be taken from the manifold during filling operations.

4.3.1.2 Type II oxygen. Samples shall be taken from Type II oxygen storage tanks at the manufacturing site or any distribution facilities. If a distribution facility is supplied from more than one storage or manufacturing facility, each facility shall be checked as specified above.

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4.3.2 Sampling method. Unless otherwise specified (see 6.2), oxygen shall be sampled according to the methods of Table III. Sample size shall be sufficient to provide the analyzer with 7 liters of oxygen at 10 atmospheres of pressure.

4.3.2.1 Sample identification. The following data shall be provided on each sample sent to a Government laboratory for analysis: Item name, specification number, Type (I or II), sample number, sampler serial number, contractor's name, address, phone number and return shipping address for sampler, Government representative's name, address, and phone number, reason for analysis (first atricle, periodic, or resample), contract number, and date sample taken.

4.4 Gas Cylinder of Type I oxygen.

4.4.1 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 it from extraneous temperatures. Putty shall not be applied between the bulb and the cylinder wall. The thermometer shall have scale divisions not greater than 1°C (2°F). The containers shall be stabilized to ambient temperature. Then the valve shall be opened and the internal pressure observed on the gauge. If the internal pressure differs from the applicable pressure value by more than 100 kPa (15 psi), the container, and all other containers filled from the same manifold at the same time will be rejected.

4.4.2 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 after filling has been completed by connecting a hose to the valve outlet and placing the other end of the hose under the surface of a liquid.

4.4.3 Inspection and maintenance. Compressed gas cylinders shall be inspected, maintained and charged according to MIL-STD-1411.

4.4.3.1 Valves. Valves shall conform to MIL-DTL-2.

4.4.3.2 Color coding. Government-owned cylinders shall be color coded according to MIL-STD-101.

4.4.3.3 Identification tag. An identification tag impervious to climatic conditions shall be wired to the outlet port of each container and shall contain the following information: Product name, specification number with revision letter, type designation, National Stock Number (NSN), quantity, name of manufacturer, name of contractor (if different from manufacturer), date of manufacture, and lot identification number.

4.5 Analytical procedures. Unless otherwise specified, samples shall be analyzed according to the procedures described in CGA G-4.3 (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).

4.5.1 Documentation of procedures. Written procedures that detail the sampling and testing program and the analytical and measuring equipment calibration program shall be maintained.

4.5.2 Test reports. Test reports shall accompany each shipment and may be provided on the contractor's internal form, a letter of transmittal, the product DD Form 250, or Wide Area WorkFlow (WAWF) electronic form. For Type I, the reports shall include the values obtained from the odor, fill pressure, purity and moisture tests. For Type II, the reports shall include the values obtained from the odor, purity, and moisture tests.

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4.6 Filtration of Type II Oxygen. When required, Type II oxygen shall be passed through a filter with a rating of at least 10-micrometer nominal (40-micrometer absolute) located in the fill line to the shipping container.

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.

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 oxygen covered by this specification is intended for use in military aircraft breathing oxygen systems.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. First article inspection will be performed as specified in 4.2.
- c. The name and address of the laboratory to which the representative product specimen is to be submitted (see 4.2, 6.4, and Table VI).
- d. When variation in points of inspection are granted (see 4.2.3.1).
- e. When variation in sampling method is granted (see 4.3.2).
- f. When a variation in analytical procedures is granted (see 4.5).
- g. Packaging requirements (see 5.1 and 5.2).
- h. When cleaning and repair schedule is required for leased or Government owned containers.
- i. Method of shipment.
- j. Type (see 1.2).
- k. A hydrostatic and/or ultrasonic testing, cleaning, and repair schedule for cylinders that meets current DOT requirements.

6.2.1 Inspection at source. Defense Energy Support Center (DESC) awarded contracts will delegate Contract Quality Assurance (CQA) to DESC QARs.

6.3 Over-packing. Samplers for transport should be suitably packaged in accordance with ATA and DOT regulations to protect them during shipment. The packaging should be inspected and those with large amounts of wear or damage should be replaced to ensure prompt shipment to and from the laboratory.

6.4 Government laboratories. Laboratories perform tests on first article and periodic samples using the procedures in MIL-STD-1564. These laboratories also participate in the Air

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Force Aviator's Breathing Oxygen Correlation Program. Contracting officers may obtain a list of approved Government laboratories by contacting to the HQ AFPET/ PTPT, 2430 C Street, Bldg 70, Area B, Wright-Patterson AFB OH 45433-7632. See also Table VI.

TABLE VI. Laboratories

CALIFORNIA	Aerospace Fuels Laboratory HQ AFPET /PTPLE 1747 Utah Ave, Bldg 6670 Vandenberg AFB CA 93437-5220	JAPAN (KADENA AB)	Aerospace Fuels Laboratory HQ AFPET/PTPLG Bldg 854 Kadena Air Base, Okinawa JA APO AP 96368-5162
FLORIDA	Aerospace Fuels Laboratory HQ AFPET/PTPLH 15251 Scrub Jay Street Bldg 54800 Cape Canaveral AFS FL 32920-7519	OHIO	Aerospace Fuels Laboratory HQ AFPET/PTPLA 2430 C St, Bldg 70, Area B WPAFB OH 45433-7632
UNITED KINGDOM (RAF MILDENHALL)	Aerospace Fuels Laboratory HQ AFPET/PTPLF Bldg 725, RAF Mildenhall UK APO AE 09459-5025		

6.5 Particulate contamination. Particulate matter may be introduced and accumulate during transfer and storage of oxygen. Recommend that users control particulate matter by the installation of filters in oxygen transfer lines.

6.6 Subject term (key word) listing.

Code, Color
 Contaminant
 Cryogenic
 Cylinder
 Filling pressure
 Solvent
 Infrared spectroscopy
 Valve

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6.7 International standardization agreements. Certain provisions of this specification are the subject of international standardization agreements ASIC AIR STD 15/14, and NATO STANAG 7106. When amendment, revision, or cancellation of this specification is proposed which will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels, including departmental standardization offices, to change the agreement or make other appropriate accommodations.

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.

CONCLUDING MATERIAL

Custodians:

Army – AV
Navy – AS
Air Force – 68
DLA – PS

Preparing activity:

Air Force – 68
(Project 6830 - 2009 - 003)

Review activities:

DLA – GS
Air Force – 11
Air Force – 71

Civil Agencies:

NASA – NA

Note: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information using the ASSIST Online database at <http://assist.daps.dla.mil>.