

**BB-O-925a**

August 22, 1961

**SUPERSEDING**  
**Fed. Spec. BB-O-925**  
**September 16, 1954**  
**(See 6.1)**

**FEDERAL SPECIFICATION****OXYGEN, TECHNICAL, GAS AND LIQUID**

*This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.*

**1. SCOPE AND CLASSIFICATION**

**1.1 Scope.** This specification covers oxygen for industrial uses.

**1.2 Classification.**

**1.2.1 Types.** The oxygen shall be furnished in the following types, as specified (see 6.2):

Type I—Gas (industrial or technical).

Type II—Liquid (industrial or technical).

**2. APPLICABLE SPECIFICATIONS, STANDARDS, AND OTHER PUBLICATIONS**

**2.1 Specifications and standards.** The following standards, of the issues in effect on date of invitation for bids, form a part of this specification to the extent specified herein:

*Federal Standards:*

Fed. Std. No. 102—Preservation, Packaging and Packing Levels.

Fed. Std. No. 123—Marking for Domestic Shipment (Civilian Agencies).

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications, Standards, and Handbooks and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge at the General Services Administration Regional Offices in Boston, New York, Atlanta, Chicago, Kansas City, Mo., Dallas, Denver, San Francisco, Los Angeles, Seattle, and Washington, D. C.)

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications, Standards, and Handbooks from established distribution points in their agencies.)

*Military Standards:*

MIL-STD-101—Color Code for Pipeline and for Compressed Gas Cylinders.

MIL-STD-129—Marking for Shipment and Storage.

MIL-STD-147—Palletized Unit Loads (40" × 48") 4-Way Partial and 4-Way Pallets.

(Copies of Military specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

**2.2 Other publications.** The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issues in effect on date of invitation for bids shall apply.

## National Bureau of Standards

Miscellaneous Publication M-191 (1948).

(Application for copies should be addressed to the National Bureau of Standards, Washington 25, D. C.)

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*Code of Federal Regulations:*

49 CFR 71-78—Interstate Commerce Commission Rules and Regulations for the Transportation of Explosives and Other Dangerous Articles.

(The Interstate Commerce Commission regulations are a part of the Code of Federal Regulations (Revised 1956) available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Orders should cite "49 CFR 71-78 (Rev. 1956).")

**3. REQUIREMENTS****3.1 Purity.**

**3.1.1** Type I, oxygen gas shall contain not less than 99.5 percent by volume oxygen, when tested as specified in 4.3.1.

**3.1.2** Type II, liquid oxygen, when gasified, shall meet the requirements of type I, oxygen gas (see 4.3.1).

**3.2 Impurities.** Oxygen shall be odorless (see 4.3.2) and free from all contaminants. (No specific test is recommended for drying agents, due to the many agents which might be used. Whenever the oxygen gas has been in contact with drying agents, the gas shall be tested by a method approved by the Government and shall be free of such agents to the extent required by the use to which the gas is to be put.)

**3.3 Moisture.** Type I oxygen shall contain not more than 5 milliliters of separated water per cylinder at room temperature when tested as specified in 4.3.3.

**3.4 Filling pressure.** The gage pressure of each sample cylinder shall be checked in accordance with 4.3.4. Cylinders shall be filled to the necessary pressure at the filling temperature to assure that the net contents are as specified (see 6.2). Table I, which is based on Miscellaneous Publication M-191, shall be used to make necessary conditions.

TABLE I—Table of temperatures and gage pressures (p. s. i. g.)

Temperature °F.	Filling pressures at 70°F.		
	1800	2015	2200
-50	1239.5	1369.8	1479.1
-48	1248.9	1380.7	1491.2
-46	1258.3	1391.6	1503.4
-44	1267.8	1402.5	1515.6
-42	1277.3	1413.5	1527.9
-40	1286.8	1424.5	1540.2
-38	1296.2	1435.3	1552.4
-36	1305.6	1446.1	1564.6
-34	1315.1	1457.0	1576.8
-32	1324.6	1467.9	1589.1
-30	1334.1	1478.8	1601.2
-28	1343.5	1489.6	1613.3
-26	1352.9	1500.4	1625.3
-24	1362.3	1511.3	1637.3
-22	1371.7	1522.2	1649.4
-20	1381.1	1533.0	1661.5
-18	1390.5	1543.8	1673.7
-16	1399.9	1554.5	1685.9
-14	1409.3	1565.2	1698.1
-12	1418.7	1576.0	1710.4
-10	1428.1	1586.8	1722.6
-8	1437.4	1597.6	1734.6
-6	1446.8	1608.4	1746.6
-4	1456.2	1619.3	1758.6
-2	1465.6	1630.2	1770.7
0	1475.0	1641.1	1782.8
2	1484.3	1651.9	1794.8
4	1493.6	1662.6	1806.8
6	1503.0	1673.3	1818.8
8	1512.4	1684.1	1830.9
10	1521.8	1694.9	1842.9
12	1531.1	1705.6	1854.8
14	1540.4	1716.3	1866.6
16	1549.7	1727.0	1878.4
18	1559.1	1737.8	1890.3
20	1568.4	1748.6	1902.2
22	1577.7	1759.2	1914.2
24	1587.0	1769.8	1926.1
26	1596.3	1780.5	1938.2
28	1605.6	1791.2	1950.2
30	1614.9	1801.9	1962.3
32	1624.2	1812.6	1974.3
34	1633.5	1823.3	1986.3
36	1642.8	1834.0	1998.3
38	1652.1	1844.8	2010.4
40	1661.4	1855.6	2022.4
42	1670.7	1866.2	2034.3
44	1679.9	1876.9	2046.1
46	1689.2	1887.5	2057.9
48	1698.4	1898.2	2069.7
50	1707.7	1908.9	2081.6

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TABLE I—Table of temperatures and gage pressures (p. s. i. g.) (cont'd.).

Temperature °F.	Filling pressures at 70°F.		
	1800	2015	2200
52	1716.9	1919.5	2093.4
54	1726.1	1930.0	2105.2
56	1735.4	1940.5	2117.0
58	1744.6	1951.1	2128.9
60	1753.9	1961.7	2140.8
62	1763.1	1972.3	2152.6
64	1772.3	1982.9	2164.4
66	1781.5	1993.6	2176.2
68	1790.7	2004.3	2188.1
70	1800.0	2015.0	2200.0
72	1809.2	2025.5	2211.9
74	1818.4	2036.0	2223.8
76	1827.6	2046.5	2235.7
78	1836.8	2057.0	2247.6
80	1846.1	2057.6	2259.6
82	1855.3	2078.2	2271.5
84	1864.4	2088.9	2283.3
86	1873.6	2099.6	2295.0
88	1882.9	2110.4	2306.6
90	1892.1	2121.1	2318.3
92	1901.2	2131.6	2330.1
94	1910.4	2142.1	2341.9
96	1919.6	2152.7	2353.7
98	1928.8	2163.2	2365.6
100	1938.0	2173.8	2377.5
102	1947.1	2184.3	2389.3
104	1956.3	2194.8	2401.1
106	1965.4	2205.3	2412.9
108	1974.6	2215.8	2424.7
110	1983.8	2226.3	2436.4
112	1992.9	2236.8	2448.1
114	2002.0	2247.3	2459.8
116	2011.2	2257.8	2471.4
118	2020.3	2268.3	2483.1
120	2029.5	2278.8	2494.8
122	2038.6	2289.3	2506.6
124	2047.7	2299.8	2518.4
126	2056.8	2310.4	2530.2
128	2066.0	2320.9	2542.0
130	2075.1	2331.4	2553.8
132	2084.2	2341.9	2565.5
134	2093.3	2352.4	2577.1
136	2102.4	2362.9	2588.8
138	2111.5	2373.4	2600.4
140	2120.6	2383.9	2612.1
142	2129.7	2394.4	2623.7
144	2138.8	2404.9	2635.3
146	2147.9	2415.5	2647.0
148	2157.0	2426.0	2658.6
150	2166.1	2436.6	2670.3

3.5 Cylinders and valves installed therein shall not leak when tested as specified in 4.3.5.

3.6 **Drying.** Internal drying of the cylinders, when required, shall be accomplished by heating in an oven or water bath, or by passing hot, dry, waterpumped nitrogen through the cylinder. Each cylinder dried shall be tested for moisture content after filling.

#### 4. SAMPLING, INSPECTION, AND TEST PROCEDURES

4.1 The supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own or any other inspection facilities and services acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

#### 4.2 Sampling.

4.2.1 When cylinders are filled by compression of gaseous oxygen by the manufacturer, each set of cylinders charged on a manifold at one time shall make up one lot. The number of samples shall conform to table II for the lot size or fraction thereof.

TABLE II.—Inspection samples<sup>1</sup>.

Number of samples	Lot size
1	1-10
2	11-40
3	41-70
4	71 and up

<sup>1</sup> Each cylinder selected for testing shall have approximately 1 cubic foot of gas withdrawn before sampling for all tests except for the separated water test.

4.2.1.1 In cases where gaseous oxygen is compressed into cylinders from the vaporization of liquid oxygen, the following alternate procedure for sampling shall be followed: From the initial filling of the liquid storage system each

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day, or upon addition of new portions of liquid oxygen to the system, cylinders from the first manifold charged shall be sampled in accordance with table II. Therefore during that day, or until new amounts of liquid are added to the storage system, one cylinder shall be taken at random for test from each 20 filled.

**4.2.2 Type II, liquid oxygen.** A sample shall be drawn from each liquid container. The sample may be drawn from the liquid and vaporized completely in the sampling line or may be drawn from the vapor space of the container. Sufficient gaseous oxygen shall be permitted to flow through the sampling line in order to completely displace the air before coupling to the test equipment. Samples shall be tested for purity in accordance with 4.3 and 4.3.1, and odor in accordance with 4.3.2.

**4.3 Test procedures.** All chemical tests shall be made with analytical reagent grade chemicals and distilled water. Samples, taken in accordance with 4.2, shall be tested for purity (see 4.3.1.1, or other method approved by the procuring activity); for odor, in accordance with 4.3.2; for moisture, in accordance with 4.3.3; for pressure, in accordance with 4.3.4; and for leakage, in accordance with 4.3.5.

**4.3.1 Purity.** All type I, oxygen gas selected as specified in 4.2.1 and type II, liquid oxygen selected as specified in 4.2.2 shall be tested for purity in accordance with 4.3 or 4.3.1.1.

**4.3.1.1 Purity test, types I and II oxygen.** The test for purity shall be conducted as follows: Place a sufficient quantity of mercury in a 100-cubic centimeter calibrated gas measuring burette provided with a two-way stopcock and a two-way outlet, and properly connected with a liquid leveling tube. Connect one of the outlet tubes of the burette with a gas pipette of suitable capacity. Place in the pipette a coil of copper wire which extends to the uppermost portion of the bulb, and add about 125 c. c. of ammonium chloride-ammonium hydroxide test solution (made by mixing equal volumes of water and 27 percent concentrated ammonia; then saturate with ammonium chloride). Draw

the liquid (free from air bubbles) through the capillary opening connection and stopcock opening in the burette by reducing the pressure in the burette tube and opening the stopcock controlling connection with the gas pipette. Then close the stopcock. Having completely filled the burette, the other stopcock opening, and the other intake tube with mercury, draw into the burette exactly 100 c. c. of oxygen by reducing the pressure in the tube. Close the stopcock. Increase the pressure on the oxygen in the burette tube, and open the stopcock controlling the connection with the gas pipette. Force the entire volume of gas into the pipette. Close the stopcock, and rock the pipette gently, providing frequent contact of the liquid, gas, and copper spiral. At the end of 15 minutes most of the gas will have been absorbed by the liquid. At this time, to facilitate absorption of the last portion of the oxygen, draw some of the liquid into the burette tube, and force the residual gas back upon the surface of the liquid in the gas pipette. Again rock the pipette until no further diminution in the volume of the gas occurs. Draw the residual gas, if any, into the burette tube, and measure its volume. The volume of gas remaining undissolved shall not exceed  $\frac{1}{2}$  c. c. The ammonium chloride-ammonium hydroxide solution may be used for leveling purposes if desired.

**4.3.2 Odor.** Type I and type II cylinder or liquid containers selected as specified in 4.2.1 and 4.2.2 shall be subjected to the following test: The cylinder valve shall be cracked and the escaping gas smelled. Pure oxygen is odorless and tasteless. Cylinders received for refill which have an odor present shall be treated in accordance with 3.6 before filling. Filled cylinders having an odor shall be rejected.

**4.3.3. Moisture.** Type I oxygen cylinders selected as specified in 4.2.1 and 4.2.1.1 shall be tested for separated water by supporting the cylinder at room temperature in an inverted position for 5 minutes. Then allow the gas to leak out very slowly into a suitable dry 25-milliliter graduated container for 1 minute. (Caution: Rapid escape of gas will cause dispersion of water.) Collection of 5 or more milliliters of water shall be cause for rejection.

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**4.3.4 Filling pressure.** The filling pressure shall be determined by means of a suitable gage installed on the manifold or by means of a gage attached to each cylinder. The filling temperature shall be determined by means of a suitable thermometer, the bulb of which is in contact with the outside wall of the cylinder. The temperature need be determined on only one cylinder from each manifold filling. The same temperature shall be used for all cylinders filled from that manifold at the same time.

**4.3.5 Leakage.** For type I oxygen, each filled cylinder shall be tested for leakage by brushing a soap solution over the cylinder and all portions of the valve. Bubbling indicates leakage.

**4.4 Inspection of preparation for delivery.** Inspection of the packaging, packing, and marking shall be performed to determine conformance with the requirements specified in 5.1 and 5.2.

## 5. PREPARATION FOR DELIVERY

(For Civil agency procurement, Federal Standard No. 102 should be referred to for definitions and applications of the various levels of packaging protection for supplies and equipment.)

**5.1 Packaging and packing (levels A, B, and C).** All filled cylinders and liquid oxygen containers, whether Government-owned or contractor-furnished, shall be packaged and packed in accordance with the Interstate Commerce Commission Regulations. Cylinders shall not be filled if the date of the last hydrostatic test is more than five years before the date of filling. The contractor shall perform his usual inspection and cleaning to assure that all containers are free from contamination and suitable for shipment and storage.

**5.1.1** When specified (see 6.2), the cylinders shall be palletized in accordance with Military Standard MIL-STD-147, except that the unit quantity on the pallet shall not exceed a maximum weight of 2100 pounds.

**5.2 Marking.** All cylinders shall be marked in accordance with the Interstate Commerce

Commission Regulations. When specified (see 6.2), each cylinder shall also be marked with a complete description of the contents as specified in the contract or order under which the shipment is made. This information shall be marked on a suitable tag firmly wired to the cylinder cap.

**5.2.1 Military agencies.** In addition to the marking specified in 5.2, all cylinders shall be marked in accordance with Military Standard MIL-STD-129. The requirements of Military Standard MIL-STD-101 shall apply for Government-owned cylinders.

**5.2.1.1** All Government-owned cylinders for type I, oxygen gas shall be painted in accordance with Military Standard MIL-STD-101.

**5.2.2 Civil agencies.** In addition to the marking specified in 5.2, shipping containers shall be marked in accordance with Federal Standard No. 123.

## 6. NOTES

**6.1** Oxygen covered by this specification is intended for use in industrial applications such as welding. Oxygen for medical use should be purchased under the requirements of the U. S. Pharmacopoeia (current revision). Aviator's breathing oxygen should be purchased in accordance with Military Specification MIL-O-21749 or MIL-O-27210. Liquid technical oxygen for missile use is covered by Military Specification MIL-P-25508.

**6.2 Ordering data.** Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Type required (see 1.2).
- (c) Net content of filled cylinders (see 3.4).
- (d) Whether the cylinders will be furnished by the contractor without cost to the Government for return when empty; whether the Government will furnish the cylinders for charging; or whether cylinders will be furnished by the contractor and remain the property of the Government.



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- (e) When cylinders should be palletized (see 5.1.1).
- (f) When cylinders should be marked with description of contents (see 5.2).

**6.3** Oxygen should be purchased on the basis of the cubic foot or the U. S. gallon at 70°F. and 760 mm. Hg. Oxygen is commercially available in cylinders having rated capacities of 55, 110, 200, 210, 244, and 300 cubic feet. Type II oxygen may also be purchased by the pound or the ton. The following conversion factors for liquid oxygen shall be used:

<i>Unit</i>	<i>Cubic feet of gaseous oxygen at 70°F. and 760 mm. Hg.</i>
Gallon (liquid)	115.2
Pound	12.08

**6.4 Transportation descriptions.** Transportation descriptions and minimum weights applicable to this commodity are:

*Type I, Gas, oxygen, other than liquid.*

Rail: Carload minimum weight 30,000 pounds.

Motor volume minimum weight 30,000 pounds.

*Type II, Oxygen, gas, liquid.*

Rail: Carload minimum weight 60,000 pounds.

Motor volume minimum weight 60,000 pounds.

**Notice.** When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

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