Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE STANDARD

AS 1046A

Issued 11-15-67
Revised 2-16-76

MINIMUM STANDARD FOR PORTABLE GASEOUS, OXYGEN EQUIPMENT

1. PURPOSE

Ø This standard defines the general minimum standards for the design specifications, testing and packaging of portable oxygen breathing equipment, incorporating an integral compressed gas oxygen supply. (1)

2. SCOPE

This standard is intended to apply to that portable compressed gaseous oxygen equipment used for the administration of supplementary and/or first aid oxygen to one or more occupants of either private or commercial transport aircraft.

2.1 Types of Portable Units: This standard is applicable to the following types of portable oxygen equipment:

a) Continuous flow;

b) Demand flow;

1) Straight demand

2) Diluter demand

3) Pressure demand

c) Combination continuous flow and demand flow.

3. REQUIREMENTS

3.1 General Requirements: The requirements as set forth in AS 861, "Minimum General Standards for Oxygen Systems" shall be considered as part of this standard, except that in event of conflict, this standard shall take precedence.

3.1.1 Applicable Documents:

SAE

	AS 452	Oxygen Mask Assembly, Demand and Pressure Breathing
	AIR 822	Oxygen Systems for General Aviation
	AIR 825	Oxygen Equipment for Aircraft
	AS 861	Minimum General Standards for Oxygen Systems
	AIR 1059	Transfilling & Maintenance of Oxygen Cylinders
Ø	AS 1065	Quality & Serviceability Requirements for Aircraft Cylinder Assemblies
	AIR 1176	Oxygen System and Component Cleaning and Packaging
	AS 1219	Aircraft Oxygen Replenishment Coupling for Civil Transport Aircraft
	AS 1224	Continous Flow General Aviation Oxygen Masks
	AS 1248	Minimum Standard for Oxygen Pressure Reducers

(1) See AS 1303 for Portable Chemical Oxygen

3.1.1 Applicable Documents: (Cont'd)

Other

MIL-P-7105	Pipe Threads, Taper, Aeronautical National Form, Symbol ANPT
MIL-S-7742	Screw Threads Standard, Aeronautical
MIL-O-27210	Oxygen, Aviator's Breathing, Liquid and Gas
MIL-T-27730	Tape, Antiseize, Tetrafluoroethylene, with Dispenser
FAR PART 21	Certification Procedures for Products and Parts
FAR PART 25	Airworthiness Standards Transport Category Airplanes
FAR PART 37	Technical Standard Order (TSO) Authorizations
FED-STD-595	Federal Standard Colors
CGA S-1.1	Safety Relief Device Standards-Cylinders for Compressed Gases (Cylinder Gas Association)
DOT Tariff 27	Hazardous Materials Regulations of the Department of Transportation (DOT) 49CFR170.

3.2 Detail Requirements: Each portable unit shall consist of the following basic components:

a) Oxygen cylinder
b) Oxygen pressure reducer and/or flow regulator with necessary accessories
c) Mask(s)
d) Harness (optional)
e) Overall container (optional)

3.2.1 Oxygen Cylinder: The oxygen cylinder shall conform to Department of Transportation (DOT) Specifications 3A or 3AA or to any other DOT specifications for transportable cylinders for oxygen service. The cylinder shall be permanently marked to show the applicable DOT specification number, service pressure and most recent test date. Prior to assembling components to the cylinder, it shall be cleaned to those levels specified in AIR 1176, "Oxygen System and Component Cleaning and Packaging".

3.2.1.1 Filling Pressure: The filling pressure shall be prominently shown for the benefit of the user by a stencil, label or other durable marking and shall not exceed the DOT "service pressure" rating stamped near the neck of the cylinder. If the equipment meets the requirements for 10% overcharging, this shall be shown on the stencil (or other marking). For example, a cylinder manufactured to Specification DOT 3AA1800 will be marked "MAX. PRESSURE 1980 PSIG @ 70F (13.65 MPa @ 21.1C). This is equivalent to the noted service pressure X 110%.

3.2.1.1.1 Gas: The cylinder shall be filled with aviator's breathing oxygen conforming to MIL-O-27210 or AS 1065.

3.2.1.2 Size and Shape: The dimensions and shape of the cylinder shall be as required by, or acceptable to, the purchaser.

3.2.1.2.1 Protrusions: External tubing or other provisions which might be used as carrying or supporting handles must be designed to safely withstand the loads which might be imposed on them.

3.2.1.3 Capacity:

The gaseous volume of oxygen in LITERS (dm^3) NTPD, contained in the cylinder when charged to its rated pressure shall be indicated on the cylinder by stencil, label or other durable marking. For example, an acceptable marking is "CONTAINS XXXX LITERS, NTPD, WHEN CHARGED TO XXXX PSIG", or "CONTAINS XXXX dm^3 NTPD, WHEN CHARGED TO XXXX MPa". NTPD indicates Normal Temperature and Pressure, Dry; that is, at 21°C (70°F) and 760 mm Hg (.101325 MPa).

3.2.1.4 Duration: The rated altitude and the duration of oxygen in the cylinder when filled to its rated Ø pressure shall be indicated by a stencil, label or other durable marking. It shall show the duration of the supply when used at its rated altitude by one person. For continuous flow types of portable equipment, the duration shall be calculated based on the average flow at the rated altitude. For demand, diluter demand and pressure demand, the duration shall be based on a minute volume of 20 liters (dm^3) per minute, BTPS*, and using an average oxygen-air mixing ratio.

By nature, demand systems vary greatly in oxygen usage because of variations in user's vital capacity, rate of exercise, etc. Therefore, the above-rated duration should be considered average only and shall be noted as "average duration".

*BTPS - Body Temperature, Pressure, Saturated (37°C, ambient pressure, saturated with water vapor at 37°C. pH_2O at 37°C = 47 mm Hg (6.27 kPa))

3.2.1.5 Color: Color of the cylinder and other components shall be optional with the purchaser. Unless otherwise specified, cylinders shall be painted green per color No. 14187 of FED-STD-595.

3.2.1.5.1 The cylinder shall be prominently and durably marked "AVIATOR'S BREATHING OXYGEN".

3.2.1.6 Cylinder-to-Regulator Attachment: The attachment of the regulator, valve or other component to the Ø oxygen cylinder may be by means of either:

a) Taper pipe threads conforming to MIL-P-7105 and using as a thread sealant, teflon tape conforming to MIL-T-27730; or

b) Straight threads conforming to MIL-S-7742 with a gasket seal. The gasket material shall be compatible for use with high pressure oxygen.

3.2.2 Regulator: The regulator shall control the delivery of oxygen to the user(s) either through a continuous flow metering device, through a demand regulator, or both. The following accessories shall be deemed a part of the regulator, although they may not all be integral portions of a single unit, but may be arranged as separate components interconnected.

a) ON-OFF valve
b) Cylinder contents indicator (pressure gage)
c) High pressure safety relief device
d) Low pressure relief valve
e) Filler fitting
f) One or more continuous flow outlets and/or a demand type regulator
g) Flow indicator (optional)

3.2.2.1 Regulator Performance:

3.2.2.1.1 Pre-Set Continuous Flow Type: Unless otherwise specified by the purchaser, the mass flow of oxygen from each outlet shall be such that when used in combination with the mask recommended by the manufacturer (or selected by the user), the combination will deliver to the user sufficient oxygen to maintain the minimum tracheal oxygen partial pressure or mass flow rate specified in the appropriate paragraph(s) of FAR Part 25.1443, at the altitude or altitudes stipulated by the manufacturer. The highest altitude at which this requirement is met shall be clearly indicated by a permanent stencil, decal, label or other means as the maximum recommended altitude.

3.2.2.1.2 Adjustable Continuous Flow Type: The regulator may be provided with a means for varying the flow of oxygen either by adjustment of the regulator, adjustment of the constant flow outlet, or other means. When such adjustment is provided, its use shall be clearly explained in a permanent stencil, label, or other means. Unless otherwise specified by the purchaser, the flow of oxygen shall be adequate (when used in combination with the mask recommended by the manufacturer of selected by the user) to maintain a minimum tracheal oxygen partial pressures or mass flow rate specified in the appropriate paragraph(s) of FAR Part 25.1443, at the altitude(s) stipulated by the manufacturer.

3.2.2.1.3 Automatic Continuous Flow Type: The regulator shall be provided with an automatic mechanism which will vary the flow of oxygen in accordance with altitude. Its operation shall be clearly explained in a permanent stencil, label or other means. Unless otherwise specified by the purchaser, the flow of oxygen shall be adequate (when used in combination with the mask recommended by the manufacturer or selected by the user) to maintain the minimum tracheal oxygen partial pressures specified in the appropriate paragraph(s) of FAR Part 25.1443, at the altitude(s) stipulated by the manufacturer.

3.2.2.1.4 Demand Type: When a demand regulator is included in the equipment, either alone or in combination with one or more continuous flow outlets, the demand regulator shall deliver oxygen from the regulator in response to the inspiratory effort ("draft") of the user. The demand regulator shall meet the requirements of FAR 37.198, OXYGEN REGULATORS, DEMAND, TSO-C89.

3.2.2.1.5 Diluter-Demand Type: In response to the inspiratory effort of the user, the diluter-demand regulator shall deliver a mixture of air and oxygen. The concentration of oxygen in the mixture delivered to the mask shall be not less than that required to maintain a minimum tracheal partial pressure of oxygen of 122 mm Hg (16.3 kPa) at inspiratory flow rates of 10 to 120 LPM-BTPS (dm^3/min.) within the altitude range stipulated by the manufacturer. Where the equipment is to be used for passengers the tracheal partial pressures and flow rates must conform to FAR 25.1443 (C). The altitude to which the regulator will perform this function shall be clearly indicated by means of a stencil, label or other durable marking.

3.2.2.1.6 Pressure-Demand Type: The pressure-demand regulator shall deliver oxygen to the mask at a positive (above atmospheric) pressure at those altitudes or under other conditions where 100% oxygen is required. Such a pressure shall be sufficient:

a) To provide protection against smoke during firefighting by precluding inward mask leakage of the ambient atmosphere; and/or

b) To partially compensate for reduced barometric pressure at altitudes at which 100% oxygen at ambient atmospheric pressure is inadequate for physiological needs.

Ø The regulator outlet pressures shall comply with FAR 37.198, OXYGEN REGULATORS, DEMAND TSO-C89.

3.2.2.2 ON-OFF Valve: An ON-OFF valve shall be provided to control the delivery of oxygen from the cylinder. The valve may be:

a) A high pressure valve between the cylinder and the pressure reducer/regulator; or

b) A pressure reducer/regulator mechanism designed to serve as both an ON-OFF valve and a regulating control; or

c) A low pressure valve on the downstream side of the pressure reducer.

3.2.2.2.1 High Pressure Valve: The valve shall be a means of isolating the cylinder contents from all parts of the regulator except the cylinder contents gauge and the high pressure safety relief device.

3.2.2.2.2 Valve-Regulator Combination: A means shall be provided for mechanically controlling the regulating valve for the purpose of either preventing flow from passing the regulating valve or allowing flow to pass through the regulator and allowing it to function simultaneously as a pressure reducer.

3.2.2.2.3 Low-Pressure Valve: A low pressure valve on the downstream side of the pressure reducing regulator shall, by stopping the discharge of gas, cause the pressure reducer valve to close and prevent further entry of gas from the cylinder into the regulator.

3.2.2.3 Valve Design, Construction and Materials: The requirements and recommendations of AIR 825 shall be considered in the design of valves. Valve seats, seals or other non-metallic materials shall be compatible for use with oxygen at the maximum working pressure and temperature anticipated.

3.2.2.4 Valve Control: The valve control shall be clearly and durably marked to indicate the direction of movement to open or close the valve. The valve control may be of the rotating knob, rotating lever, or "push-pull" type. Rotating type controls shall be of ample size, properly contoured, and of sufficiently low torque to be easily turned "on" or "off" by a female cabin attendant. "Push-pull" type controls shall require not more than 44.5 N (10 lb) of force to either open or close the valve.

3.2.2.5 Cylinder Contents Indicator: The indicator shall at all times (regardless of whether the on-off valve is open or closed) indicate (in psi, unless otherwise specified) the pressure existing in the cylinder. If so specified by the customer, the indicator may show the maximum filling pressure and the pressure at which the cylinder should be refilled. The use of the color red in bands to signify fill levels shall be avoided.

3.2.2.6 High Pressure Safety Device: The safety device shall be of a type approved by the Bureau of Ø Explosives and shall comply with the requirements of CGA Pamphlet S-1.1. It shall serve to release the contents of the cylinder at some pressure not greater than 1.67 times the DOT rated service pressure of the cylinder. The outlet of the device shall be designed to minimize the propulsive effects of the escaping gas. It shall be safety wired where feasible.

3.2.2.7 Low Pressure Relief Valve: The low pressure relief valve shall release from the reduced pressure area of the regulator any pressure in excess of that which can be safely contained, or in excess of that which will permit safe performance of the regulator. The valve shall reclose after release of excess pressure.

3.2.2.8 Continuous Flow Oxygen Connection: The style and type of connection shall be optional with the Ø purchaser. On connections used with a pre-set regulator, the connection shall be marked to indicate the oxygen flow rate and rated altitude. Color coding (or other equivalent means), explained by a durable decal or label, is acceptable. The connection shall be designed to permit easy coupling by a female cabin attendant.

3.2.2.9 Filler Fitting: The equipment shall be provided with a fitting through which the oxygen cylinder can be Ø refilled from a source of gaseous oxygen under adequate pressure. The fitting shall be in accordance with Item A of Fig. 1. The filler fitting shall incorporate a filter of 125 micron (125 mm) nominal or better particle retention. The fitting shall be protected against damage or contamination by a removable cap or equivalent means. As an alternate, the filler fitting shall be in accordance with AS 1219, Oxygen Replenishment Coupling.

3.2.3 Flow Indicator: If required by the purchaser, an indicator may be provided to indicate to the user that oxygen is being delivered from the regulator.

3.2.4 Harness: When and as specified by the purchaser, the equipment may be provided with a harness whereby the equipment can either be conveniently carried or worn, either by a crew member of by a passenger using the equipment. When furnished with a shoulder strap, the equipment should also be provided with a waist belt or some type of restraint to minimize uncontrolled swinging of the unit when worn by an ambulatory crew member or passenger. Choice of material, color and design detail of the harness shall be at the option of the purchaser.

3.2.5 Overall Container: The equipment may be supplied in an overall enclosure or container so designed that either:

a) The equipment can be used without removal from the container; or

b) The container shall act as a protection and a means of stowing the equipment, and the equipment shall be readily removable for use.

The specific details of the container shall be optional with the purchaser.

3.2.6 Mask:

3.2.6.1 Continuous Flow: The choice of a rebreathing type versus a non-rebreathing type shall be at the Ø discretion of the purchaser using AS 1224, Para. 4.1.1 as a guide to determining the altitude limits for the various types of constant flow masks. The mask, hose and connector shall be compatible with the equipment with which it is used and if connected to the cylinder, shall be adequately protected from abuse, damage, tampering and contamination. This paragraph is not intended to exclude respiratory devices other than masks, such as a head hood, provided that its performance is at least equivalent to that of a mask.

3.2.6.2 Demand and Pressure-Demand: Masks shall conform to AS 452.

Ø 4. QUALITY ASSURANCE PROVISIONS

4.1 Classification and Scope:

4.1.1 Qualification Testing: Qualification testing by supplier shall consist of, but not necessarily limited to, Ø those tests of Paragraphs 4.3.1 through 4.3.7 and shall be documented by the supplier and retained for reference.

4.1.2 Acceptance Testing: Acceptance tests shall be defined by specification and shall include at least the Ø requirements of Para. 4.3.1 through 4.3.3.

4.2 Test Media: The testing media shall be one of the following:

Ø a) Oxygen per MIL-O-27210, Type 1.
b) Nitrogen equivalent in dryness and contamination levels to oxygen per MIL-O-27210, Type 1.
c) Air equivalent in dryness and contamination levels to oxygen per MIL-O-27210, Type 1.

4.2.1 If other than oxygen is used in testing, appropriate correction factors must be applied where necessary; Ø that is, in flow requirements.

4.2.2 If other than oxygen is used in testing, manufacturer must insure that oxygen per MIL-O-27210 is used for filling the unit prior to shipping.

Ø 4.3 Test Methods: All testing shall be conducted at temperatures of 25°C ± 10C (77°F ± 18F).

4.3.1 Product Examination: The unit shall be carefully examined to determine conformance to applicable Ø specification with respect to materials, workmanship, finish, dimensions, markings and cleanliness for oxygen service.

4.3.2 Leakage: With the unit in an OFF mode, external leakage shall not exceed 0.005 liters per hour. Ø There shall be no internal leakage as measured by no rise in regulated pressure during a 15-minute interval.

4.3.3 Performance Testing: Performance tests shall be performed to verify unit conformance to product Ø specifications with respect to pressures and flows.

4.3.4 High and Low Temperature Testing: Leakage and performance testing as defined in Para. 4.3.2 and Ø 4.3.3 shall be performed at temperatures at the limits and within the operating range of -30°C to 50°C (-22°F to 122°F).

4.3.5 High and Low Temperature Exposure Testing: Leakage and performance testing as defined in Para. Ø 4.3.2 and 4.3.3 shall be performed after a 12-hour exposure to -55°C (-67°F) and to 70°C (158°F). Tests shall be conducted separately after unit has been returned to and stabilized at temperatures within the operating range.