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MILITARY SPECIFICATION

DESIGN AND INSTALLATION OF GASEOUS OXYGEN SYSTEMS IN AIRCRAFT, GENERAL SPECIFICATION FOR

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 general requirements for the design and installation of gaseous oxygen (450 and 1800 pounds per square inch gage (psig) (3.1 MPa and 12.4 MPa) systems in aircraft.

1.2 Classification. Aircraft oxygen systems shall be of the following types:

Type I - High pressure system 1800 psig (12.4 MPa)
Type II - Low Pressure system 450 psig (3.1 MPa)

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specification, standards, and handbooks. The following specifications, standards and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Systems Engineering and Standardization Department (Code 93) Naval Air Engineering Center, Lakehurst, NJ 08733-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC-N/A FSC 1660

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SPECIFICATIONS

MILITARY

DOD-D-1000	-	Drawings, Engineering and Associated Lists
MIL-B-5087	-	Bonding, Electrical, and Lighting Protection, for Aerospace Systems.
MIL-T-8506	-	Tubing, Steel, Corrosion-Resistant, (304), Annealed, Seamless and Welded.
MIL-A-8625	-	Anodic Coatings, for Aluminum and Aluminum Alloys.
MIL-V-18318	-	Valve, Pressure Regulating, Oxygen System.
MIL-A-23121	-	Aircrew, Environmental, Escape and Survival Cockpit Capsule System; General Specification For.
MIL-R-25410	-	Regulator, Oxygen, Diluter-Demand, Automatic Pressure Breathing.
MIL-L-25567	-	Leak Detection Compound, Oxygen Systems.
MIL-C-25969	-	Capsule Emergency Escape Systems, General Specification For.
MIL-T-26069	-	Trailer, Compressed Gas Cylinder AF-M32R-3, High Pressure, 2 Wheel 6 Cylinder Capacity.
MIL-O-27210	-	Oxygen, Aviator's Breathing, Liquid and Gas.
MIL-O-27335	-	Oxygen System, Survival Container-Oxygen Kit, General Specification For.
MIL-G-27617	-	Grease, Aircraft and Instrument, Fuel and Oxidizer Resistant.
MIL-T-27730	-	Tape, Antiseize, Tetrafluoroethylene, With Dispenser
MIL-S-81018	-	Survival Kit Container, Aircraft Seat, With Oxygen, General Specification For
MIL-C-81302	-	Cleaning Compound, Solvent, Trichlorotriflouroethane
MIL-T-81533	-	Trichloroethane 1, 1, 1, (Methyl Chloroform)
MIL-H-81581	-	Hose Assembly, Breathing Oxygen and Air, General Specification For Inhibited, Vapor Degreasing.
MIL-H-81581/5	-	Hose Assembly, Breathing Oxygen, Low Pressure, Connector to Regulator.
MIL-R-83178	-	Regulator, Oxygen, Diluter-Demand, Automatic Pressure-Breathing, General Specification For.
MIL-M-87163	-	Mask, Oxygen, MBU-12/P
MIL-H-87961	-	Hose and Hose Assemblies, Air Duct, Air Breathing Oxygen System, General Specification For.

STANDARDS

MILITARY

MIL-STD-17-2	-	Mechanical Symbols For Aeronautical Aerospacecraft and Spacecraft Use.

DOD-STD-100	-	Engineering Drawing Practices
MIL-STD-143	-	Specifications and Standards, Order of Precedence for the Selection of.
MIL-STD-203	-	Aircrew Station Controls and Displays For Fixed Wing Aircraft.
MIL-STD-889	-	Dissimilar Metals.
MIL-STD-1247	-	Marking, Functions and Hazard Designation of Hose, Pipe, and Tube Lines for Aircraft, Missile, and Space Systems.
MIL-STD-1359	-	Cleaning Methods and Procedures for Breathing Oxygen Equipment.
MIL-STD-45662	-	Calibration System Requirements.
MS21211	-	Valve, Check, Aircraft Low Pressure Oxygen Systems.
MS21227	-	Cylinder, Oxygen, Low Pressure.
MS22012	-	Valve, High-Pressure Oxygen-Cylinder, Automatic Opening.
MS22032	-	Recharger Assembly, Portable Oxygen.
MS22035	-	Valve, Check, Oxygen, High Pressure, Filler Connection.
MS22055	-	Hose Assemblies, Oxygen-Breathing Connector to Regulator.
MS22059	-	Oxygen System, Portable, 295 Cu. In. High Pressure, Aircraft
MS22061	-	Oxygen System, Portable, 96 Cu. In. High Pressure, Aircraft.
MS22062	-	Regulator, Oxygen, Diluter Demand, Automatic, Pressure Breathing.
MS26545	-	Cylinder-Compressed Gas, Non-Shatterable.
MS27599	-	Regulator, Oxygen, Diluter Demand.
MS33583	-	Tubing End, Double Flare, Standard Dimensions For.
MS33584	-	Tubing End, Standard Dimensions For Flared.
MS33611	-	Tube, Bend Radii.
MS90338	-	Valve, High Pressure Oxygen Check, Flareless Ends.

AIR FORCE-NAVY AERONAUTICAL

AN780	-	Nipple - Union.
AN806	-	Plug - Flared Tube.
AN929	-	Cap Assembly, Tube, Pressure Seal.
AN6009	-	Coupling - Automatic Oxygen.
AN6011	-	Gage-Panel Mounting, High Pressure Oxygen.
AN6012	-	Valve, High Pressure Oxygen Line.
AN6014	-	Valve-High Pressure Oxygen Check, Style A.
AN6015	-	Valve-High Pressure Oxygen Check, Style B.
AN6016	-	Valve-High Pressure Oxygen Check, Style C.
AN6017	-	Valve-High Pressure Oxygen Check, Style D.
AN6018	-	Valve-High Pressure Oxygen Check, Style E.
AN6021	-	Gage-Panel Mounting, Low Pressure Oxygen.
AN6024	-	Valve-Low Pressure Oxygen Filler.
AND10089	-	Fitting End, Standard Dimensions For Cone Connection.

2.1.2 Other Government documents, drawings and publications. The following other Government documents, drawings and publications, form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

DRAWINGS

AIR FORCE

44A25450	-	Sleeve, Oxygen Coupling.
46A16236	-	Clip-Recharger, Low Pressure Oxygen System.
53C3794	-	Cylinder and Regulator, Breathing Oxygen, Portable.
53D3970	-	Mask-Cylinder-Regulator, Oxygen, Portable, Aircraft, Firefighters.
55B3878	-	Dustcap-High Pressure Oxygen Filler Valve-Assembly.
60D3570	-	Cylinder and Regulator, Breathing Oxygen, Portable A/U26S-3, Assembly of.

(Copies of specifications, standards, handbooks, drawings, publications and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the nongovernment documents which is current on the date of solicitation.

SOCIETY OF AUTOMOTIVE ENGINEERS

AMS 4071	-	Aluminum Alloy Tubing, Hydraulic, Seamless, Drawn, Round 2-5Mg-0.25 Cr (5052-O) Annealed.

(Applications for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Selection of specifications and standards. Specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143.

3.2 Design. The installation of an aircraft gaseous oxygen system shall comprise, as required: cylinders, tubing, fittings, filler valves, relief valves, check valves, gages, regulators, portable units, adapters, mask to regulator hoses, brackets, shutoff valves, and all other necessary items specified herein and required for a complete installation. The installation shall provide for replenishing the oxygen supply by connecting an external filling source directly to the filling valve which shall be located such that filling from a portable servicing trailer can easily be accomplished by servicing personnel standing on the ground outside of the aircraft.

3.3 Oxygen systems.

3.3.1 Systems utilizing oxygen delivery equipment. Aircraft having flight ceilings over 10,000 feet (3048 metres), but not over 50,000 feet (15,240 metres) of altitude and aircraft that have the capability of descending from altitudes above 50,000 feet (15,240 metres) to 42,000 feet (12,801 metres) or lower immediately following a decompression shall be provided with an installed oxygen system. This oxygen system shall have supply, necessary delivery, and crew station equipment to support all aircraft occupants.

3.3.1.1 Fighter and attack aircraft supply. Fighter and attack aircraft shall have an oxygen system of sufficient capacity to supply the entire crew for the total duration of any specified design mission. The oxygen supply system shall be sized to ensure mission completion in the event of loss of cabin pressure enroute to or at the combat zone. If applicable, the oxygen system shall be sized to include range extension due to auxiliary fuel stores and/or aerial refueling.

3.3.1.2 Bomber aircraft supply. Bomber aircraft shall have an oxygen system of sufficient capacity to supply breathing oxygen to the entire crew for 75 percent of the duration of the longest specified design mission, or to the entire crew for the total time the cabin altitude is above 10,000 feet (3048 metres), whichever condition establishes the largest amount. The oxygen supply system shall be sized to ensure mission completion in the event of loss of cabin pressure enroute to or at the target. If applicable, the oxygen system shall be sized to include range extension due to auxiliary fuel stores and/or aerial refueling.

3.3.1.3 Transport aircraft supply. Transport aircraft shall have an oxygen system of sufficient capacity to supply all the primary crew members and all of the passengers with breathing oxygen whenever the cabin altitude exceeds 10,000 feet (3048 metres). In the event of loss of cabin pressure, the oxygen system shall provide the full primary aircrew with breathing oxygen for at least 50 percent of the design mission duration. The passenger oxygen supply shall be dispensed from a continuous flow system and shall have sufficient capacity to provide breathing oxygen to a full passenger load for 50 percent of the design mission duration or for a shorter period if so specified by the acquiring activity, but in no case for less than 15 minutes.

When therapeutic oxygen capability is specified, a supplemental quantity shall be included within the passenger oxygen supply. Therapeutic oxygen usage shall be independent from passenger oxygen usage and the quantity shall be adequate for 100 percent of the design mission duration plus two hours to allow for patient loading and unloading.

* 3.3.1.4 Mission specialist and training aircraft supply. Mission specialist and training aircraft shall have an oxygen system of sufficient capacity to supply the entire flight crew, mission specialist trainees, and any passengers (if applicable) with breathing oxygen whenever the cabin altitude exceeds 10,000 feet (3048 metres). The flight crew may need additional oxygen supply for flight above 35,000 feet (10,668 metres), inflight refueling, and night flight. The oxygen system shall support all aircraft occupants during depressurization at cabin altitudes and durations as specified by the acquisition activity.

3.3.2 High altitude aircraft supply. Aircraft having a sustained flight capability above 50,000 feet (15,240 metres), or the requirement to remain above 42,000 (12,801 metres) for a period over 5 minutes, but not equipped with emergency pressurization capsule provisions, shall be provided with an installed oxygen system design to support high altitude pressure suits and helmets, or pressure breathing masks and counter pressure garments, as appropriate. The quantity shall be adequate to provide for 100 percent oxygen for the entire mission, including, if appropriate, a period of oxygen breathing at ground level prior to flight. In addition, provisions shall be made for the use of pressure breathing masks during flight operations at lower altitudes.

3.3.3 Systems utilizing capsules. The pressurization requirements and the oxygen requirements shall be as specified in MIL-C-25969 or MIL-A-23121, as applicable. The system to be installed shall be capable of meeting the specified mission profile.

3.3.4 Portable oxygen systems. When crew mobility within the aircraft is required, as is normally the case in bomber and cargo aircraft, portable oxygen systems shall be provided in a ratio not less than one system for two crew-members. In those aircraft, at least one portable oxygen system shall be provided in each compartment of the aircraft, including lavatories. Smoke masks suitable for respiratory and eye protection shall be available for use by the pilot and any other critical crew member and be usable with the crew station regulator as well as with the portable systems. Portable oxygen systems shall be selected in accordance with 3.6.13.

3.3.5 Emergency oxygen. Aircraft equipped with a seat pan or back pack emergency oxygen supply, as specified in MIL-O-27335 or MIL-S-81018 or an equivalent emergency oxygen supply, shall be completely independent of the aircraft oxygen supply system. The emergency oxygen supply system will normally remain with the crewmember in the event of departure from the aircraft and subsequent descent via parachute. When the emergency oxygen is attached to the seat, separation from the seat shall not occur above an altitude of 15,000 feet (4572 metres).

3.4 Oxygen quantity determination.

3.4.1 Oxygen flow requirements.

3.4.1.1 Respiratory provisions. The oxygen supply requirement shall be based on an inspiratory minute volume (volume of gas per minute) of 15 litres per minute (LPM) (250 cu.cm/s) per crewmember determined at BTPS conditions; i.e., body temperature 98.6° F (37° C), body pressure (cabin altitude), and saturated with water vapor, 47 mm Hg (6.27 kPa). At normal conditions (NTPD) of sea level altitude, 760 mm Hg (101.3 kPa), 70 degrees F (21.1 degrees C), and dry, the baseline minute volume per crewmember is 13.35 LPM (223 cu. cm/s) (NTPD). For oxygen system design, the baseline oxygen requirements given in Table I shall apply to all aircraft containing 6 or more aircrew members. For intermediate altitudes not listed in Table I, the oxygen requirements may be calculated from Figure 8. For aircraft which contain less than 6 aircrew members, the design oxygen quantity shall be increased by the multipliers given in Table II, which is estimated to cover the 90th percentile of normal aircrew populations.

3.4.1.2 Flight and demand provisions. Where aircrew duties impose more than routine flight demand on the crew, the baseline oxygen quantity after adjustment for aircrew size shall be increased by applicable percentages extrapolated from those given in Table III. Some of these situations will not exist throughout the design mission and they shall be applied only to the crewmember or members directly affected and only for that period during which the increased demand is anticipated.

3.4.1.3 Oxygen regulator air dilution. The oxygen added to air ratio depicted in Figure 8 as curve B is typical of the performance achieved with the CRU-73 oxygen regulator. When significantly different dilution performance is provided by the selected oxygen regulator, as established by cyclic test results approved by the acquiring activity, the applicable oxygen added curve shall be substituted for curve B and appropriate oxygen usage rates calculated for use in lieu of those given in Table I under "Air dilution"

3.4.1.4 Design oxygen requirement. The oxygen system supply capacity shall be calculated from the requirements given in Table I with applicable adjustments for the crew size and provisional factors given in Tables II and III. In passenger aircraft, it shall be assumed that, in the event of loss of cabin pressure, the pilot will descend immediately to an altitude not requiring oxygen for passenger stabilization, and then, if necessary for fuel conservation, climb to a more economical cruise altitude which shall not exceed 25,000 feet (7620 metres). Determine the oxygen quantity required for passengers by using the design flow rates given in Table IV. The oxygen shall be dispensed from constant flow masks selected for their suitability for use up to the maximum cruise altitude expected to occur in the event of a decompressed cabin. Therapeutic oxygen flow is normally adjustable from two to twelve ambient cabin litres per minute (33 cu.cm/s to 200 cu.cm/s). Unless otherwise specified, use an average design flow of 6 NTPD litres per minute (100 cu.cm/s) from three fourths of the outlets, but in no case assume less than four outlets will be in use. Passengers designated to be receiving therapeutic oxygen can be excluded from the calculations of required passenger oxygen quantity.

3.4.2 Size and number of cylinders. Unless otherwise specified, all cylinders in an oxygen system shall be the same size; however, it may be acceptable to provide different cylinder sizes for crew and passenger systems. Q is the design volume of oxygen available in cubic feet at NTP conditions from each listed cylinder. The pressure drop to obtain the volume Q given in Table V is 1600 psi (11.03 MPa) while at a temperature of 70 degrees F (21.1 degrees C). The pressure drop to obtain the volume given in Table VI is 350 psi (2.41 MPa) while at a temperature of 70 degrees F (21.1 degrees C).

3.4.2.1 Maximum number of cylinders. In the event the aircraft performance is such that the number of cylinders required becomes so excessive that the installation becomes impractical, the acquiring activity shall specify the maximum number of cylinders (see 6.2.1b).

3.5 System layout. Typical oxygen systems for various types of pressurized or nonpressurized aircraft are shown in Figures 2 through 7, inclusive. These figures represent the general arrangement of the systems; the actual number, location, and application of these items are determined by the aircraft characteristics and the requirements specified herein. Figure 7 shows manifolding arrangement for three or more cylinders for an individual manifold.

3.5.1 Single-place combat aircraft. The single-place aircraft oxygen system shall be in accordance with Figure 3.

3.5.2 Multiplace combat aircraft. Except for training and transport aircraft, the multiplace aircraft oxygen system shall be in accordance with Figure 4.

3.5.3 Transport aircraft. The oxygen system for transport aircraft shall be in accordance with Figure 5. The crew of the aircraft shall be provided with a demand regulator while the passengers shall be provided with an automatic, continuous-flow regulator system. A line valve shall be provided as specified herein. The crew and passenger systems shall be manifolded on the filler line side into one filler valve. Check valves shall not be used except for the crew cylinders as shown in Figure 5 to separate the crew system into two parts, one for the pilot and the other for the co-pilot; the remaining crewmembers shall be divided between the two parts. Chemical oxygen generators may be used to supply oxygen to passengers subject to approval of the acquiring activity (see 6.2.1c).

3.5.4 Indicating instruments. Indicating instruments shall be provided as shown in Figure 5 at those crew stations not equipped with panel mounted regulators. Both pilot and co-pilot shall have complete indicating instruments while the other crewmembers shall have only flow indicators. Mask, helmet or chest mounted regulators that provide obvious evidence and sensorial perception of oxygen flow do not require flow indicators. Each additional crew compartment shall have a pressure gage. A pressure gage shall be provided for the passenger compartment as shown in Figure 5 and shall be mounted in such a manner as to be readily visible to a crewmember. The instruments shall be located together in the crewmember's normal field of vision so that they can readily be seen with a minimum of head turning and not interfere with flight duties.

3.5.4.1 Training aircraft. The training aircraft oxygen system shall be in accordance with Figure 6. In installations of this type, a common manifolded system without check valves shall be used. The entire system shall be recharged from one common filling point.

3.5.4.2 Two-place aircraft. Two-place aircraft, in which there is no crew movement, shall be provided with complete indicating instruments for both stations.

3.5.4.3 Multiplace aircraft. Multiplace aircraft, in which there is crew movement, shall be provided with complete indicating instruments and portable apparatus for the pilot and for at least one station in each compartment of the aircraft.

3.5.5 Location. The oxygen equipment, tubing, and fittings shall be located as remotely as practicable from fuel, oil, hydraulic, water injection, storage battery systems, exhaust stacks and manifolds, electrical and radio systems. Insofar as practicable, oxygen lines shall not be grouped with lines carrying flammable fluids. Where necessary, deflector plates shall be used to keep flammable fluids away from oxygen lines, fittings, and equipment. Whenever possible, cylinders shall not be in line with the plane of rotation of a turbine or propeller. Components of the oxygen system shall not be installed where they will be subjected to temperatures in excess of that specified in the individual component specifications, and no part of the system shall be installed in an area which will be subjected to a temperature of 250 degrees F (121 degrees C) or greater. Oxygen cylinders shall not be located near equipment that dissipates a high quantity of heat.

* 3.5.6 Drawings and data.

3.5.6.1 Drawings. Drawings shall be in accordance with DOD-D-1000 and DOD-STD-100 (see 6.2.2).

3.5.6.2 Pre-engineering information. At least 60 days prior to the preparation of the installation drawings, a schematic diagram of the oxygen system and oxygen duration calculation, for specified mission profiles, shall be submitted to the acquiring activity. The oxygen duration calculation shall include data to show that the number of cylinders provided per crew station is sufficient for the performance of the aircraft. The symbols used on all schematic drawings shall be in accordance with Figure 1 (see 6.2.2).

3.5.6.3 Installation drawings. All installation drawings for oxygen equipment shall be submitted to the acquiring activity for approval. Installation drawings shall show the position of the equipment in the aircraft and the possible stations in the aircraft. Installation drawings shall also show accessibility for replaceable cylinders and filler valves (see 6.2.2).

3.5.6.4 Pilot's flight operating handbook data (for Air Force use). A schematic drawing of the oxygen system and oxygen duration tables shall be provided as required in the Pilot's Flight Operating Instructions Handbook in conformance with Manual, Technical, Organizational Maintenance Instructions. The drawing shall include a plan view of the aircraft and shall include all items for which there is a symbol in MIL-STD-17, Part 2. The drawing shall include the symbol key listing, where applicable, and the type number of items. The symbols used on all schematic drawings shall be in accordance with Figure 1 (see 6.2.2).

3.6 Major system components.

3.6.1 Cylinder selection and installation. The cylinder selected shall be based upon the cylinder's capability to support the specified number of crewmembers. Space shall be provided in the aircraft based on the maximum cylinder specification envelope dimensions. If two or more cylinders are installed in the aircraft, they should be separated as much as practicable to minimize combat vulnerability. Sufficient space shall be available to replace cylinders and perform maintenance on all parts. The installation shall also provide for replenishing the oxygen supply by connecting an external filling source directly to the filling valve. The filling point shall be located such that the time for gaining access for connecting the external filling source shall not exceed one man minute and shall not create a hazard for servicing personnel.

3.6.1.1 High pressure systems. The high pressure oxygen cylinders shall be in accordance with MS26545 and shall be equipped with an MS22012 automatic opening valve. The size of the cylinders shall be chosen so that a minimum of two are used, where possible. Pressure reduction valves, when required (see 6.2.1.d), shall be located as close to the cylinder as practicable and shall be in accordance with MIL-V-18318, Type I, for 70 psi service, or Type II for 400 psi service.

3.6.1.2 Low pressure systems. The low pressure oxygen cylinders shall be in accordance with MS21227. The size of the cylinder for individually manifolded systems shall be chosen so that there is a minimum of two cylinders per individual manifold. In single-place aircraft, two or more cylinders shall be used.

3.6.2 Regulators.

* 3.6.2.1 Panel mounted. An automatic diluter demand-pressure breathing regulator, in accordance with MIL-R-25410 (MS22062) or MIL-R-83178 (MS27599), as applicable (see 6.2.1e), shall be installed at each permanent and temporary crew station in the aircraft. The pilot's panel mounted regulator shall be located in accordance with MIL-STD-203. The crewmember's regulator shall be in the crewmember's field of vision so that he can readily read the regulator without more than turning his head and with minimum interference with his flight duties. The regulators shall be located as close to the stations as is required to reach the regulator by normal extension of the crewmember's arm. The regulators shall be located so that they cannot be damaged by movement of personnel around them and may be mounted vertically or horizontally. The panel mounted breathing regulator shall be installed with flexible hose for both inlet ports, so that the regulator may be front serviced for both installation and removal.

* 3.6.2.2 Non-panel mounted. A manual shut-off valve shall be provided at each crewmember station where a seat, chest, or head mounted regulator is to be used. This valve shall control the oxygen flow to the regulator and provide means for stopping the flow from a defective quick disconnect or a damaged supply hose. Stowage provisions shall be made for chest mounting regulators to prevent damage or contamination during servicing and ingress-egress actions. Non-panel mounted regulators shall be installed as specified by the acquiring activity (see 6.2.1f).

* 3.6.2.3 Preinstallation tests. All regulators shall receive a leakage and flow test in accordance with the applicable specifications prior to installation in aircraft. The test shall be conducted not more than thirty days before installation of the regulator.

3.6.3 Filler valve.

3.6.3.1 High pressure system. The filler valve, to which the ground servicing connection is made in recharging the system, shall be a checking filler connection, MS22035, or a line valve, AN6012, with a cone fitting such as AN780-3. A dust cap and retaining chain, in accordance with Drawing 55B3878, shall be provided with the filler valve. All the cylinders shall be filled from a single filler valve.

3.6.3.2 Low pressure systems. The filler valve, to which the ground servicing connection is made in recharging the system, shall be in accordance with AN6024. All the cylinders shall be filled from a single filler valve.

3.6.3.3 Location. The filler valve shall be located inside the fuselage within a closed box behind a cover plate with a dirt and oil-tight seal, at a convenient height from the ground. The filler valve shall be located forward and above any potential sources of hydrocarbon contamination. The filler valve shall be readily accessible from the outside of the aircraft. It shall be possible to make connections for recharging with an oxygen servicing trailer conforming to MIL-T-26069, and to manipulate the valve with a heavily gloved hand without entering the aircraft. The cover plate shall be designed for quick access and hinged from the leading edge of the plate.

3.6.4 Line valve.

3.6.4.1 High pressure systems. Line valves shall not be used except for filling purposes as described in 3.6.3.1 and 3.5.3.

3.6.4.2 Low pressure systems. A line valve conforming to AN6012 shall be provided in transport aircraft, as shown in Figure 5. the valve shall be installed in a location easily accessible to crewmembers during flight. The line valve shall provide for the filling of the crew system alone or for filling the entire system as a whole. With this valve closed, only the cylinders for the crew shall be filled when recharging. The line valve, when open, shall also permit the use of the passenger oxygen by the crew.

3.6.4.2.1 Passenger cylinder removal. When passenger cylinders are removed, the line valve shall be closed and the tubing disconnected from the fittings in the passenger cylinders. The tubing shall be plugged with plugs conforming to AN806 and the fittings in the cylinders shall be capped with caps conforming to AN929. A sufficient number of these plugs and caps for the disconnect lines and cylinders shall be provided in a suitable, clean, dry box or compartment that is readily visible and clearly marked in accordance with 3.12.2h.

3.6.5 Check valves. Check valves for low pressure systems shall be selected in accordance with MS21211. For high pressure systems, check valves conforming to AN6014 through AN6018 are designed for the AND10089 cone connections while the MS90338 check valve is designed for a flareless connection. The valves shall be installed where they are effective in preventing additional loss of oxygen in the event any one oxgyen cylinder or line is destroyed by gunfire. The check valves shall be installed as shown in Figures 3 through 7, as applicable.

3.6.5.1 Installation. When more than one cylinder is installed in the aircraft, each cylinder or the tubing to and from each cylinder shall be equipped with check valves. A check valve shall be installed where a line from a cylinder or group of cylinders is connected to a main distribution line. When a group of cylinders exceeds three, sufficient lines shall lead from the cylinders to the main distribution line so that there is a single line of tubing from each of subgroups of three cylinders or less. This paragraph shall not apply for transport and training type airplanes.

* 3.6.6 Low pressure relief valve. A pressure relief valve that opens for pressure relief at 500 $\pm$ 25 psig (3.4 $\pm$ 0.17MPa) shall be provided on low pressure gaseous
aircraft oxygen systems to prevent overpressurization of the system during ground servicing and maintenance. The valve shall have been tested to indicate suitability of design. These tests shall include leakage, pressure cycling and gas flow, low and high temperature, vibration, and proof pressure. The valve shall open at 500 $\pm$ 25 psig (3.4 $\pm$ 0.17MPa) with increasing pressure and with
decreasing pressure the valve shall be fully closed at an inlet pressure of not less than 425 psig (2.93MPa). The valve shall permit oxygen gas to flow at a rate of not less than 220 standard cubic feet per minute 0.1cum per sec) and shall not permit the system pressure to exceed 700 psig (4.8MPa) at that flow rate. The pressure relief valve shall be installed such that gas is vented to the exterior for small aircraft installations or in safe regions for larger aircraft installations. Venting shall be nearby the filler valve and an indication of overpressurization shall be detectable by servicing personnel.

3.6.7 Tubing.

3.6.7.1 High pressure systems. All tubing shall be seamless steel tubing, corrosion resistant (304), annealed, conforming to MIL-T-8506. The outside diameter of the tubing shall be 3/16 inch (4.76 mm) and the wall thickness shall be 0.035 inch (.89 mm). Larger tubing sizes shall be used when necessary to assure adequate flow capacity.

* 3.6.7.2 Low pressure systems. The tubing shall be of aluminum alloy conforming to AMS 4071. It shall have a nominal outside diameter of 5/16 inch (7.9 mm) and a wall thickness of 0.035 inch (.89 mm). An anodic film conforming to MIL-A-8625 or an alodine coating shall be used when a protective coating is required. In portions of systems where high flows will occur, 3/8 or 1/2 inch (9.53 or 12.70 mm) outside diameter tubing shall be used as required to limit the pressure drops to acceptable levels.

3.6.7.3 Tubing flaring and bending. Aluminum alloy tubing of 5/16 and 3/8 inch (7.94 and 9.53 mm) outside diameters shall be double flared to conform with MS33583. Aluminum alloy tubing of 1/2 inch (12.7 mm) outside diameter and all sizes of corrosion resistant steel tubing may be single flared to conform with MS33584. As an alternative, corrosion resistant steel tubing may be welded, brazed, or swaged using methods and quality controls that produce leakproof joints, providing there is no undue degradation of tubing strength, corrosion resistance or fatigue life. Tubing systems having these permanent type joints shall be designed for ease of fabrication, inspection, and installation in the aircraft. The system layout shall provide for rapid in-service repair and component replacement. Tubing bends shall be uniform, without kinks, and fit the span between fittings without tension. The minimum bend radius to tube center lines shall be in accordance with MS33611.

* 3.6.7.4 Oxygen coupling sleeve. The oxygen coupling sleeve for flared tubing shall be in accordance with Drawing 44A25450.

3.6.7.5 Tubing routing and mounting. In routing the tubing, the general policy shall be to keep total length to a minimum. Allow for expansion, contraction, vibration, and component replacement. In all installations of two or more cylinders, where check valves are used, there shall be a minimum of tubing lengths in that portion of the system between the regulator and nearest check valve in the distribution line. To further reduce vulnerability to gunfire, the tubing lengths between this check valve and the cylinders shall be separated as much as possible. The separation between these tubing lengths shall not be less than 12 inches (.305 mm). All tubing shall be mounted to prevent vibration and chafing. This shall be accomplished by the proper use of rubberized or cushion clips installed at no greater than 20-inch (.508 m) intervals for 5/16 inch (7.94 mm) tubing and 15-inch (.381 m) intervals for 3/16 inch (4.76 mm) tubing and as close to the bends as possible. The tubing, where passing through or supported by the aircraft structure, shall have adequate protection against chafing by the use of flexible grommets. The tubing shall not strike against the aircraft during vibration and shock encountered during normal use of the aircraft. All tubing shall be electrically bonded in accordance with MIL-B-5087.

3.6.7.6 Markings. All tubing shall have markings in accordance with MIL-STD-1247.

3.6.8 Fittings. All fittings shall be in accordance with applicable standards. Unless suitably protected against electrolytic corrosion, dissimilar metals shall not be used in intimate contact with each other. Dissimilar metals are defined in MIL-STD-889.

* 3.6.9 Torque requirements for joints. Tightening of flared tube and pipe connection shall be accomplished in accordance with the best commercial practice. Torque wrenches shall be used, and the torque applied shall be within the limits specified in Tables VII and VIII. The torque limits specified in Table VII apply to double flared AMS 4071 aluminum tubing or MIL-T-8506 corrosion resistant annealed steel tubing. Table VIII applies only to tapered pipe thread connections with MIL-T-27730 tape applied.

* 3.6.10 Breathing oxygen masks.

* 3.6.10.1 Pressure demand masks. When a demand breathing system is used, a pressure demand breathing oxygen mask in accordance with MIL-M-87163 shall be used. The mask shall be used by flight crewmembers and by other crewmembers and mission specialists, as applicable. The mask shall have integral communication equipment and devices to connect to a helmet or a suspension device, as applicable. In transport aircraft, a commercial equivalent pressure demand breathing quick donning oxygen mask that incorporates a suspension device, smoke goggles with breathing air that purge smoke from the goggles, and communication equipment compatible with the aircraft equipment may be used (see 6.2.1 g).

* 3.6.10.2 Continuous flow oxygen masks. When a continuous flow breathing system is used, continuous flow breathing oxygen masks shall be used. A commercial equivalent continuous flow breathing oxygen masks that has a visual flow device and adjustable head strap may be used (see 6.2.1h). For permanent installations, these masks shall be installed out of the way to preclude damage. Storage containers that drop the mask automatically on emergency decompression shall be used.

* 3.6.11 Hoses. Unless otherwise specified, hoses shall be in accordance with MIL-H-81581.

3.6.11.1 Breathing hose. Unless otherwise specified, the breathing hose shall be in accordance with MIL-H-81581/5 and the applicable part number of MS22055.

* 3.6.11.2 Applicable to the Air Force. The breathing hose shall be in acccordance with MIL-H-81581/5 and the applicable part number of MS22055, or MIL-H-87961. (See 6.2.1i).

3.6.12 Personal services. Crewman's personal services connecting him to the aircraft shall be separated from the aircraft upon ejection by an automatic disconnection system. The disconnection force shall not be applied to the crewman. For disconnection forces, refer to applicable component specification. The installation of the personal services and the lengths chosen shall be such that the user's movement will not be restricted during normal duties at his station. However, excessive lengths, with resultant bulkiness and resistance to breathing, shall be avoided. Suitable stowage provisions shall be provided in the aircraft for protection of personal services when not in use.

* 3.6.12.1 Flow requirement. For each panel mounted regulator installation, the combination of breathing hose, fittings, and disconnects between the regulator and the mask connector at the end of the MS22055 hose shall not exhibit a flow resistance in excess of 2 inches of water (497.6 Pa) with a flow of 80 litres per minute (1333 cu.cm/s) of oxygen at NTP conditions. If a hose in accordance with MIL-H-87961 is used, the same flow resistance requirement shall apply.

3.6.13 Portable oxygen system.

3.6.13.1 Portable oxygen system 1800 psi (12.4 MPa). When a portable oxygen breathing system is required but refilling during use is not contemplated, the oxygen assembly shall be selected in accordance with MS22059, MS22061, or Drawing 60D3570. A substitute may be utilized if the above assemblies are unsuitable for the application, subject to approval of the acquiring activity. (See 6.2.1j).

3.6.13.2 Portable oxygen systems 450 psi (3.1 MPa). When a portable oxygen breathing system is required along with refilling during flight, the oxygen assembly shall be in accordance with Drawing 53C3794 for crew use with their pressure breathing oxygen masks, or in accordance with Drawing 53D3970 if the full face pressure breathing smoke mask is to be included. Each assembly shall be secured in a bracket which will retain the assembly under flight conditions and provide for rapid removal for use. The secured assembly shall be convenient to the crew duty stations and to each toilet. Recharging hoses in accordance with MS22032 shall be accessible from crew duty stations and toilets and have the filler valve and hose secured by Drawing 46A16236 clip in a vertical, valve down position.

3.6.14 Emergency oxygen. An emergency oxygen system shall be provided. Provisions shall be made for the automatic opening of the oxygen bail-out supply during ejection seat operation. Position of the emergency oxygen supply shall be determined by the type of seat configuration.

3.6.15 Indicating instruments.

3.6.15.1 Pressure gage. Pressure gages shall be in accordance with AN6021 for low pressure oxygen and in accordance with AN6011 for high pressure oxygen. The pressure gage shall indicate the actual pressure in the system. Pressure gages shall be installed at each permanent and temporary crew station in the aircraft only when non-panel mounted regulators are installed. A pressure gage for the passenger oxygen system shall be provided for a crewmember.

3.6.16 Automatic coupling. The oxygen outlets for the passengers in transport aircraft shall be automatic couplings in accordance with AN6009. One automatic coupling shall be provided for each passenger station as shown on Figure 5. The automatic coupling shall be mounted in a readily accessible location so that it will be possible to connect the mask easily while in flight. The coupling end shall be mounted flush with the aircraft interior lining. The automatic coupling shall not be installed more than 42 inches (1.07 m) away from the passenger when in his seat and sitting erect or reclined. The automatic coupling shall be installed so that the outlets point downward and no more than 90 degrees off the vertical. Temporary passenger stations, such as toilets, shall have automatic couplings in addition to the above, connected to the passenger manifold.

3.7 Performance.

3.7.1 Leakage. The oxygen system, when tested as specified in 4.5.2, shall not show any evidence of system leaks.

3.7.2 Pressure decay. The completed aircraft oxygen system shall not have a pressure decay from the fully charged pressure in excess of one-half percent per hour when tested as specified in 4.5.3.

3.7.3 Functional tests.

3.7.3.1 Panel mounted regulator.

* 3.7.3.1.1 Flow indicator. The oxygen system, when tested as specified in 4.5.4.1.1, shall permit a free flow of oxygen and the flow indicator of the panel mounted regulator shall function freely with each breath.

* 3.7.3.1.2 Emergency switch. The oxygen system, when tested as specified in 4.5.4.1.2, shall permit a free continuous flow of oxygen through the mask.

* 3.7.3.2 Non-panel mounted regulator. The oxygen system, when tested as specified in 4.5.4.2, shall permit a flow of oxygen through the mask without any appreciable resistance to breathing.

3.7.4 Flight test. When specified, flight tests on the oxygen systems shall be conducted to determine the proper functioning of all the oxygen equipment in the aircraft by actual crew use and functional measurements. In addition, a determination may be made of the suitability of the arrangement of the items from the standpoint of accessibility and convenience to all crewmembers during their flight duties.

3.8 Antiseize tape. Antiseize tape shall be used on all tapered male pipe thread fitting. Antiseize tape shall conform to and shall be applied as specified in MIL-T-27730. Antiseize tape shall not be used on flare tube fitting; straight threads, coupling sleeves, or on the outer side of the tube flares. None of the tape shall be allowed to enter the inside of a fitting.

* 3.9 System cleanliness. The completed installation shall be cleaned to a specified level by the removal of contaminants such as oil, grease, fuel, water, dust, dirt, objectionable odors, or any other foreign matters, both internally and externally, prior to introducing oxygen in the system. The internal surface of the system shall not exceed a maximum of non-volatile residue of 3.0 milligrams per square foot of surface area. MIL-STD-1359 can be used as a guide for system cleaning.

* 3.9.1 Filter. A replaceable filter shall be provided in the oxygen system where it will be effective in minimizing the accumulation of contaminants in critical components. The filter shall permit bypass of the element should the flow through the element drop below safe levels. Type, size, and location of the filter shall be determined by the manufacture.

3.9.2 Closures. Lines which are required to be disconnected during aircraft maintenance checks or overhaul shall be provided with suitable closures for each exposed connection to prevent materials which are incompatible with oxygen from entering the system when the system integrity is broken. Caps which introduce moisture and tapes that leave adhesive deposits shall not be used for these purposes. The closures shall remain with the aircraft at all times and shall be stored, when not in use, in close proximity to the connections in such a manner as not to become contaminated. All openings of lines, fittings, valves, and regulators shall be kept securely capped until closed within the installation.

* 3.9.3 Degreasing. The oxygen distribution system or parts of the oxygen system not covered by cleaning procedures shall be degreased using a cleaning compound, MIL-C-81302, or using vapor phase degreaser in accordance with MIL-T-81533 as specified in MIL-STD-1359. After cleanliness verification and when assembled, a halide testing apparatus having a sensitivity of at least 3 x 10^{-4} standard cc/sec shall be used to determine the absence of the cleaning compound.

* 3.9.4 Purging. The oxygen system shall be capable of being purged to remove any contaminants. The purging procedure shall be as specified in MIL-STD-1359 with a final purge using oxygen conforming to MIL-O-27210, Type I.

3.9.4.1 Oxygen distribution system. Purge the aircraft oxygen distribution system separate from the cylinders by establishing a flow from each oxygen station of at least 0.18 cu. ft. per minute (85 cu.cm/s) for a period of not less than 30 minutes. In large aircraft, it may be necessary to divide the system, as determined by feeder lines, and purge each separately.

* 3.9.5 Lubricants. Lubricants in accordance with MIL-G-27617 may be used sparingly on seals when pressure and friction may damage the sèal during assembly.

3.10 Maintenance and replacement. All parts of the oxygen system shall be installed to permit ready removal and replacement without the use of special tools. All tubing connections, fittings, regulators, brackets for indicating instruments, and other items shall be readily accessible for the leak testing with test compound and for tightening of fittings without removal of surrounding parts. Flexible hoses shall be used to connect panel mounted indicating instruments to permit easy maintenance.

3.11 Clearance requirements. Oxygen lines, fittings, and equipment shall be installed above and at least six inches away from fuel, oil and hydraulic systems to avoid contamination. Deflector plates shall be used where necessary to keep hydraulic fluids away from oxygen lines, fittings, and equipment. Open ends of cleaned and dried tubing shall be plugged with impermeable caps at all times except during attachment or detachment of parts. There shall be at least 2 inches (50.8 mm) of clearance between the oxygen system and flexible moving parts of the aircraft. There shall be at least 1/2 inch (12.7 mm) clearance between the oxygen system and rigid parts of the aircraft, except at clamp areas. The oxygen system tubing, fittings, and equipment shall be separated by at least 6 inches (152.4 mm) from all electrical wiring, heat conduits, and heat emitting equipment in the aircraft. Insulation shall be provided on the hot ducts, conduits, or equipment to prevent heating of the oxygen system. Adequate servicing clearance shall be provided around all valves and disconnects. The minimum clearance around the filler valve shall be a 5 inch (127 mm) diameter circle having its center concentric with the longitudinal axis of the valve.

3.11.1 Deviations from clearance requirements. When barriers such as ribs, webs, frames, channels, extrusions, and stringers exist between oxygen lines and electrical wires in such a manner that there is no danger of such lines contacting each other, the above requirements for separation, mounting, and covering shall not be applicable. Shields shall be acceptable to the acquiring activity. Where electrical wires lead into oxygen equipment due to an electrical item being a component of the oxygen equipment, the above requirements for separation, mounting, and covering are not applicable, except that they shall be secured against chafing. Deviations other than specified herein must be approved by the acquiring activity.

3.12 Aircraft marking requirements. The aircraft shall be permanently and legibly marked in the locations specified below, using a minimum letter height of 1/4 inch (6.35 mm). Color of the letter to be black on a white background.

3.12.1 High pressure systems.

a. On the outside surface of the filler valve box cover:

1800 psi, 12.4 MPa
HIGH PRESSURE OXYGEN
FILLER VALVE

b. On a plate inside the recess near the filler valve:

HIGH PRESSURE OXYGEN
FILL TO 1800 PSIG
DO NOT EXCEED 1850 PSIG
CAUTION
KEEP CLEAN, DRY, AND FREE OF ALL OILS

3.12.2 Low pressure systems.

a. On the outside of the filler valve box cover plate:

450 psi, 3.12 MPa
LOW PRESSURE OXYGEN
FILLER VALVE

b. On a plate inside the recess near the filler valve:

LOW PRESSURE OXYGEN
FILL TO 450 PSIG
DO NOT EXCEED 475 PSIG
CAUTION
KEEP CLEAN, DRY, AND FREE OF ALL OILS

c. In a readily visible location in the aircraft near the valve:

OXYGEN LINE VALVE
(OPEN FOR FILLING PASSENGER SYSTEM)
CLOSE FOR FILLING CREW SYSTEM ONLY
CLOSE WHEN PASSENGER CYLINDERS ARE REMOVED

d. On a plate inside the filler valve box recess:

SEE OXYGEN LINE VALVE LOCATED
OPEN TO FILL PASSENGER SYSTEM IN ADDITION
TO CREW SYSTEM
CLOSE TO FILL CREW SYSTEM ONLY
CLOSE WHEN PASSENGER CYLINDERS ARE REMOVED

e. In a readily visible location in the aircraft near each automatic coupling or near each coupling manifold.

PASSENGER OXYGEN

f. On the face of the portable unit brackets in a clearly visible location:

PORTABLE OXYGEN LOCATION
REFILL BEFORE REPLACING

g. In a readily visible location in the aircraft near the recharger clip:

PORTABLE OXYGEN RECHARGER

h. On a suitable, clean, dry box or compartment, as defined in 3.6.4.2.1:

(QUANTITY) PLUGS, AN806D5
(QUANTITY) CAPS, AN929-5
FOR PLUGGING OPEN ENDS WHEN
PASSENGER CYLINDERS ARE REMOVED
KEEP CLEAN, DRY, AND FREE FROM OIL

3.13 Workmanship. The oxygen system shall be uniform in quality and shall be free from irregularities, defects, or foreign matter which could adversely affect safety, performance, reliability, or durability.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. 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.

* 4.1.1 Responsibility for compliance. All items must meet all requirements of Section 3. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.2 Classification of inspection. The inspection requirements specified herein are classified as follows:

a. Quality conformance inspection. Quality conformance inspection consists of examinations and tests performed on individual products or lots to determine conformance of the products or lots with the requirements set forth in this specification (see 4.3).

4.3 Quality conformance inspection. All the examinations and tests of this specification shall be conducted on each gaseous oxygen system.

4.4. Test conditions.

4.4.1 Oxygen. Unless otherwise specified, the oxygen used in testing the oxygen system shall conform to MIL-O-27210, Type I.

4.4.1.1 Transfer equipment. A standard gaseous oxygen trailer, conforming to MIL-T-26069 shall be used. Transfer equipment shall mate with fittings provided for filling.

* 4.4.2 Pressure gage. The aircraft pressure gages shall not be used when testing the oxygen systems. A master oxygen test gage, maintained in accordance with MIL-STD-45662, shall be used in determining the pressure for each system. The master test gage for the low pressure system shall be calibrated in increments not greater than 5 psi (34.47 kPa), and an accuracy within one percent of scale increments not greater than 25 psi (172.35 kPa) and an accuracy of one percent scale reading. The aircraft oxygen gages shall read within its functional specification tolerance of the master test gage pressure.

4.4.3 Leak test compound. The leak test compound employed in testing the system shall conform to MIL-L-25567.

4.4.4 Temperature and pressure. Unless otherwise specified, tests shall be conducted at local ambient temperature and barometric pressure. The temperature and barometric pressure shall be recorded at the time of inspection. This information shall be available for computation of the test data, where required, to normal temperature and pressure (NTP) conditions. NTP conditions are 70 degrees F (21.1 degrees C) and 29.92 inches of mercury (101.3 kPa). Test instruments shall be calibrated or adjusted according to their required usage in conducting individual tests.

4.4.4.1 Temperature correction. During pressure decay testing it will be necessary to calculate the portion of the pressure change which was due to temperature change. The temperature of the oxygen storage cylinders shall be determined at the start and at the end of testing per 4.5.3. The pressure change, calculated from the following formula, shall be algebraically added to the initial pressure to obtain the corrected initial pressure.

P_1 = initial pressure + 14.7 (psia)

$T_1 = t_1 + 460$ (°R)

t_1 = initial temperature (°F)

t_2 = final temperature (°F)

Δt = change in temperature (°F)

Δp = change in pressure due to Δt

$$\Delta p = P_1 \times \frac{\Delta t}{T_1}$$

Sample calculations:

1. If $P_1 = 450 + 14.7 = 464.7$ psia

$\Delta t = t_2 - t_1 = +5$ °F

$T_1 = 70 + 460 = 530$ °R

$$\Delta p = 464.7 \times \frac{5}{530} = +4.38 \text{ psi}$$

2. If $P_1 = 1800 + 14.7 = 1814.7$ psi

$\Delta t = t_2 - t_1 - 5$ °F

$T_1 = 70 + 460 = 530$ °R

$$\Delta p = 1814.7 \times \frac{-5}{530} = -17 \text{ psi}$$

4.5 Inspection methods.

* 4.5.1 Visual examination. The oxygen system shall be examined visually to determined conformance to this specification and applicable drawings with respect to all the requirements not covered by tests. MIL-STD-1359 may be used as a guide for visual inspection for cleanliness verification.

4.5.2 Leakage test. The complete oxygen system, excluding the cylinders, personal mounted regulator, seat pan, mask, and hard line relief valve shall be subjected to a gaseous oxygen pressure equal to its operating pressure. While that test pressure is maintained, all fittings and connections shall be examined for leaks by application of leak test compound conforming to MIL-L-25567. The oxygen system shall pass the requirements specified in 3.7.1. Care shall be taken to remove all traces of the leak test compound from the system after this test is performed.

4.5.3 Pressure decay. The complete system shall be charged with gaseous oxygen to the system operating pressure. The oxygen pressure, temperature, and time shall be recorded. At least 4 hours, but less than 12 hours, after the start of the check period, the final system pressure shall be recorded along with the final oxygen cylinder temperature. The difference between the initial corrected system pressure (see 4.4.4.1) and the final pressure shall pass the requirement specified in 3.7.2.

4.5.4 Functional test. The following functional test shall be performed for each station of each aircraft, where applicable, after filling the system with oxygen to the designed operating pressure.

4.5.4.1 Panel mounted regulator.

* 4.5.4.1.1 Flow indicator. Connect a pressure breathing oxygen mask and hose assembly to the oxygen system. Move the diluter lever on the regulator to the "100 - percent oxygen" position. Breathe oxygen normally through the mask for a period of one minute and observe the flow indicator of the regulator. The oxygen system shall pass the requirements specified in 3.7.3.1.1.

* 4.5.4.1.2 Emergency switch. Connect a pressure breathing oxygen mask and hose assembly to the oxygen system. Move the diluter lever to the "normal" postion. Set the regulator emergency switch to the emergency position for a period of 10 to 20 seconds. The oxygen system shall pass the requirements specified in 3.7.3.1.2. After the test, the emergency switch shall be returned to the normal position.

* 4.5.4.2 Non-panel mounted regulator. Connect an oxygen mask assembly incorporating a pressure breathing regulator and regulator-to-aircraft hose to the oxygen system. Move the oxygen supply valve to the "ON" position. Breathe deeply through the mask several times. The oxygen system shall pass the requirements specified in 3.7.3.2.

4.5.5 Flight test. When specified (see 6.2.1k), flight tests shall be conducted and the oxygen system shall pass the requirements specified in 3.7.4. Upon completion of the flight test, the oxygen system shall then be subjected to and pass the tests specified in 4.5.2 and 4.5.4.

5. PACKAGING. This section is not applicable to this specification.

6. NOTES

6.1 Intended use. The installation requirements specified herein are intended for use in designing and installing gaseous oxygen systems in aircraft.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specifiy the following:

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

b. Maximum number of cylinders required (see 3.4.2.1).

c. Whether chemical oxygen generators may be used to supply oxygen to passengers (see 3.5.3).

d. Whether pressure reduction valves are required (see 3.6.1.1).

e. Type of panel mounted regulator required (see 3.6.2.1).

f. Installation of non-panel mounted regulators (see 3.6.2.2).

g. Whether alternate pressure demand breathing oxygen masks are required (see 3.6.10).

h. Whether alternate continuous flow breathing oxygen masks are required (see 3.6.10.2).

i. Type of breathing hose for Air Force acquisitions (see 3.6.11.2).

j. Whether alternate portable oxygen systems are required (see 3.6.13.1).

k. Whether flight tests are required (see 4.5.5).

* 6.2.2 Data requirements. When this speification is used in an acquisition and data are required to be delivered, the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contracts Data Requirements List (CDRL), incorporated into the contract. When the provisions of DOD FAR Supplement, Part 27, Sub-Part 27.410-6 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification are cited in the following paragraphs.

Paragraph No.	Data requirement title	Applicable DID no.	Option
3.5.6.1 thru 3.5.6.3	Drawings, Engineering and Associated Lists	DI-E-7031	- -
3.5.6.4	Characteristics and Performance Data	DI-E-3135	- -

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DOD 5000.19L, Vol. II, AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.3 Subject term (key word) listing.

Adapters
Check valve
Cylinders
Degreasing
Emergency oxygen
Filler valve
Fittings
Gages
Gaseous oxygen system
High pressure system
Indicating instruments
Leakage
Line valve
Low pressure system
Mask to regulator hoses
Portable units
Pressure decay
Purging
Regulator
Relief valve
Shutoff valve
Tubing

6.4 International system of units (SI). The ASTM Standard E 380-74, Metric Practice Guide - A Guide to Use of SI, the International System of Units, was used for the conversion to the SI units in this document. The following conversion factors are applicable to this specification.

Cubic feet x 2.832×10^{-2}	=	Cubic metres (m^3)
Feet X .3048	=	Metres (m)
Cubic feet per hour X 7.87×10^{-6}	=	Cubic metres per sec (m^3/s)
Cubic feet per hour X 7.87	=	Cubic centimetres per sec (cm^3/s)
Pounds per square inch (psi) X 6.894	=	Kilopascals (kPa)
Degrees Fahrenheit (F) to degrees Celcius (C)	=	Degrees $\frac{F-32}{1.8}$
Inches X 25.4	=	Millimetres (mm)
Inch-pounds X 0.1130	=	Newton - metres (n.m)
Litres per minute X 16.667	=	Cubic centimetres per sec (cm^3/s)
Millimetres of Hg X .1333	=	Kilopascals (kPa)
Inches of water X 248.18	=	Pascals (Pa)

* 6.5 International standardization. Certain provisions of this specification are the subject of international standardization agreement (ASCC 25/3, STANAG 3056, and STANAG 3296, and ASCC 25/34). When an 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.

6.6 Marginal notations. The margins of this specification are marked with an asterisk to indicate where changes from the previous issue were made. This marking was done as a convenience only, and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the past previous issue.

Custodians:
Navy - AS
Air Force - 11
Army - AV

Preparing activity:
Navy - AS

Project (1660-0576)

TABLE I. Baseline oxygen for each crewmember. 1/

Cabin altitude		Flow rate at 14.7 psig & 70 degrees F (101.3 kPa & 21.1 degrees C)			
		100% Oxygen		Air dilution 2/	
X1000 Feet	Metres	cu.ft./hr	cu.cm./s	cu.ft./hr	cu.cm./s
0	0	28.3	222.5	8.4	66.7
5	1524	23.2	182.8	6.1	47.8
8	2438	20.5	161.4	5.3	41.9
10	3048	18.9	148.6	5.1	39.7
15	4572	15.1	119.2	4.9	38.9
20	6069	12.0	94.4	5.6	44.2
25	7620	9.3	73.6	6.8	53.9
28 & above	8534 & above	7.9	62.5	7.9	62.5

1/ Oxygen values calculated on the basis of 15 LPM (250 cu.cm/s) requirement BTPS.

2/ Based on dilution performance of typical CRU-73 oxygen regulator.

TABLE II. Oxygen requirement adjustment for number in aircrew.

Aircrew number	Multiplier
1	1.20
2	1.10
3	1.06
4	1.03
5	1.02

TABLE III. Oxygen requirement multiplier for specific flight ativities.

Specific flight activity	Multiplier
Breathing safety pressure	1.10
Wearing pressure suit	1.20
Terrain following	1.25
Take off and landing	1.35
Carrier launch and landing	1.50
Aerial combat and threat	1.75

TABLE IV. Oxygen supply requirement for each passenger continuous flow mask.

Cabin altitude		Flow rate at 14.7 psig and 70 degrees F (101.3 kPa and 21.1 degrees C)	
X1000 Feet	Metres	cu.ft./hr.	cu.cm./s
10	3048	1.4	11.7
15	4572	1.4	11.7
20	6096	4.2	33.3
25	7620	6.1	48.3
30	9144	7.6	60.3
35	10688	9.0	70.8
40	12192	9.9	78.3

TABLE V. Available oxygen for each size of cylinder (high pressure).

Type of cylinder	Free gas at sea level Q (Cyl) cu. ft	cu. m.
MS26545AX0205	13.7	.38
MS26545AX0295	19.6	.56
MS26545AX0386	25.6	.72
MS26545AX0514	34.2	.97
MS26545AX0646	42.9	1.21

TABLE VI. Available oxygen for each size of cylinder (low pressure).

Type of cylinder	Free gas at sea level Q (Cyl) cu. ft.	cu. m.
MS21227-1	3.8	.11
MS21227-2	3.8	.11
MS21227-3	6.9	.20
MS21227-4	13.8	.39
MS21227-5	13.8	.39
MS21227-6	29.0	.82
MS21227-7	248.0	7.02

TABLE VII. Torque requirements for tube connections. 1/

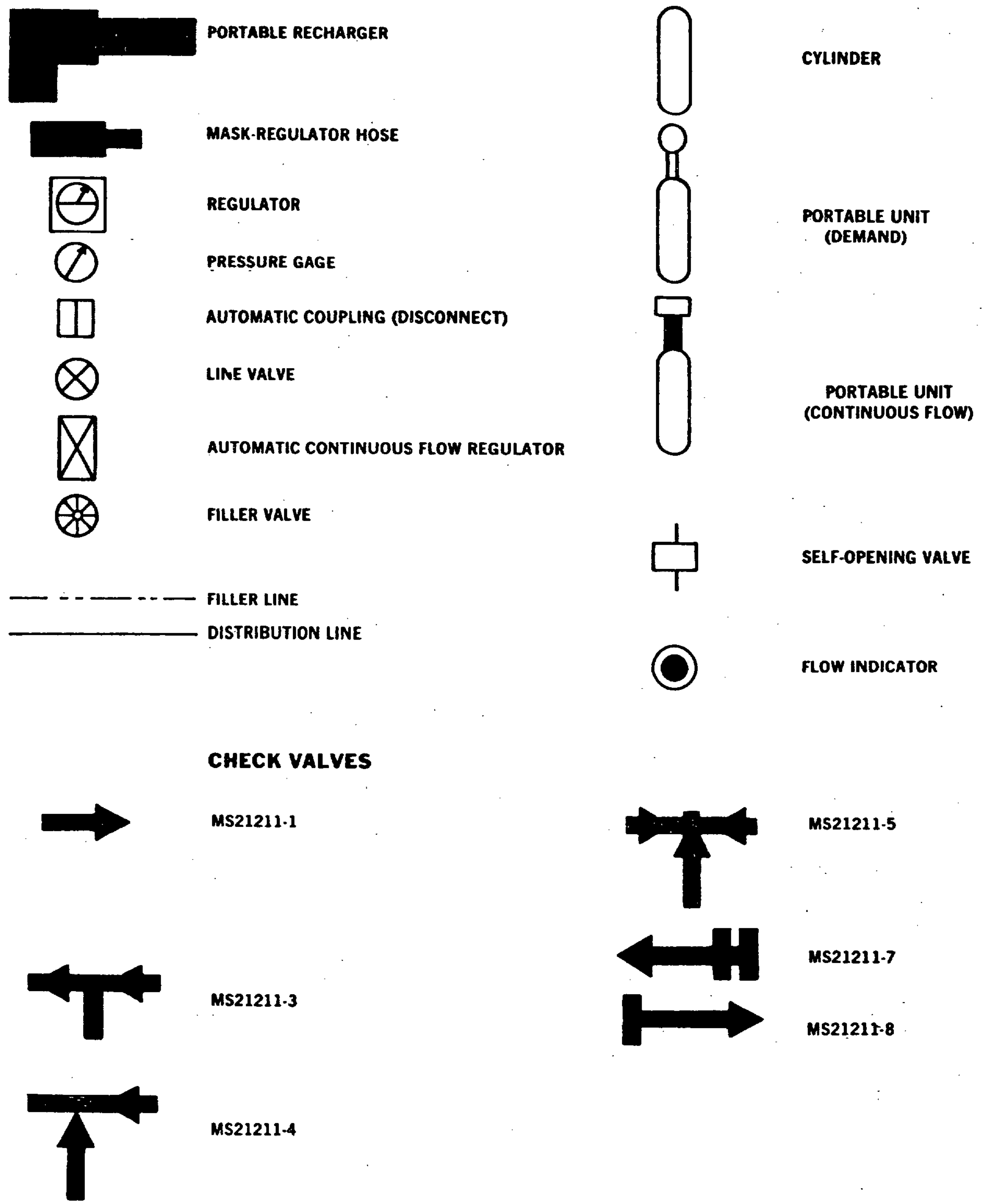
Tubing O.D		Minimum torque		Maximum torque	
Inches	mm	In.-lbs	N.m	In.-lbs	N.m
3/16	4.69	50	5.65	70	7.91
5/16	7.94	100	11.30	125	14.12

1/ Same as for Table VIII.

TABLE VIII. Torque requirements for pipe connections. 1/

Nominal pipe size		Minimum torque		Maximum torque	
Inch	mm	In. -lbs	N.m	In.-lbs	N.m
1/8	3.18	40	4.52	150	16.95
1/4	6.35	60	6.78	200	22.60
3/8	9.53	100	11.30	400	45.19

1/ Torque to specified minimum value and check for leakage. If additional torque is required to stop leakage, torque may be applied up to specified maximum value.



NOTES:
1/ The pressure gage and flow indicator may be an integral part of the regulator.

FIGURE 1. Oxygen symbols

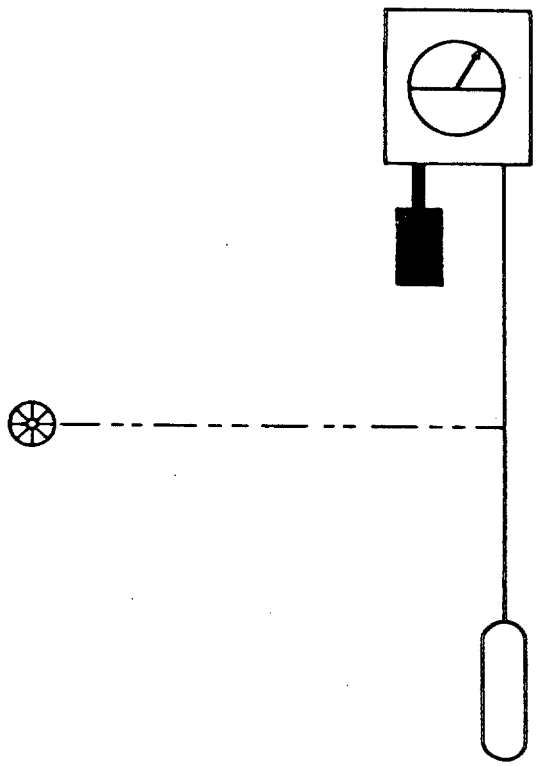


FIGURE 2. Typical one cylinder installation.

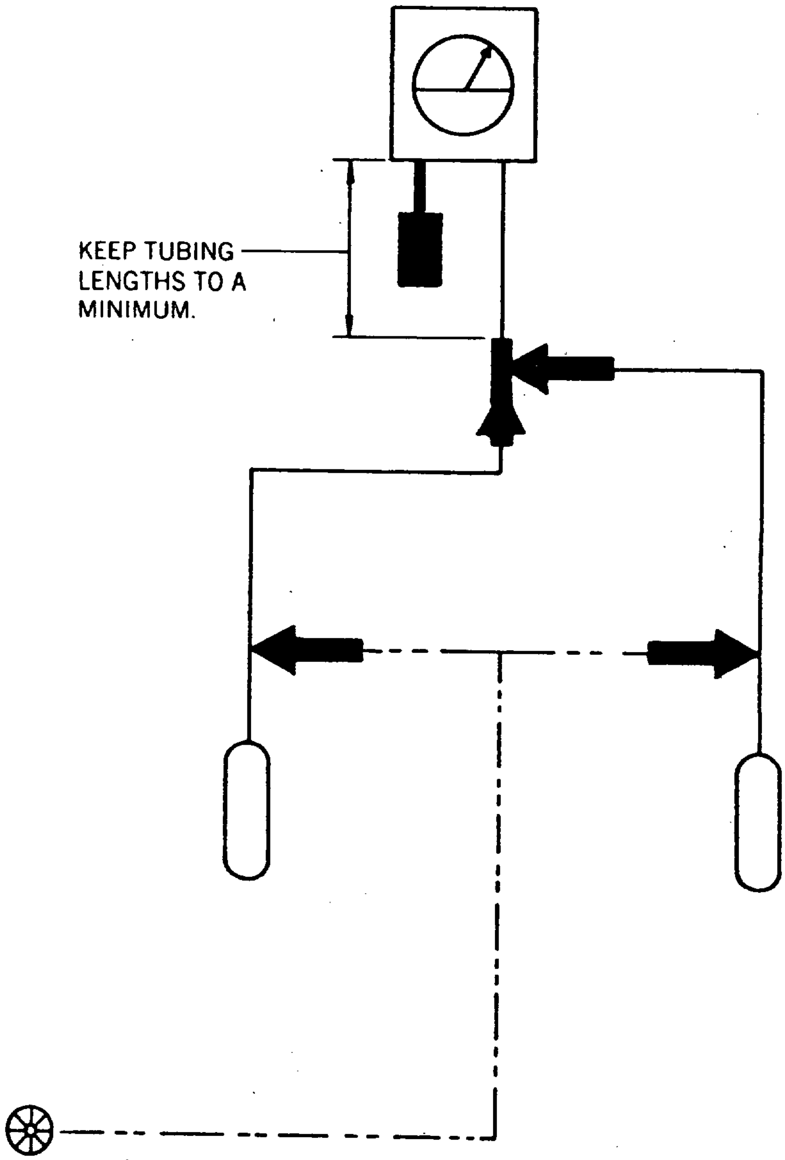
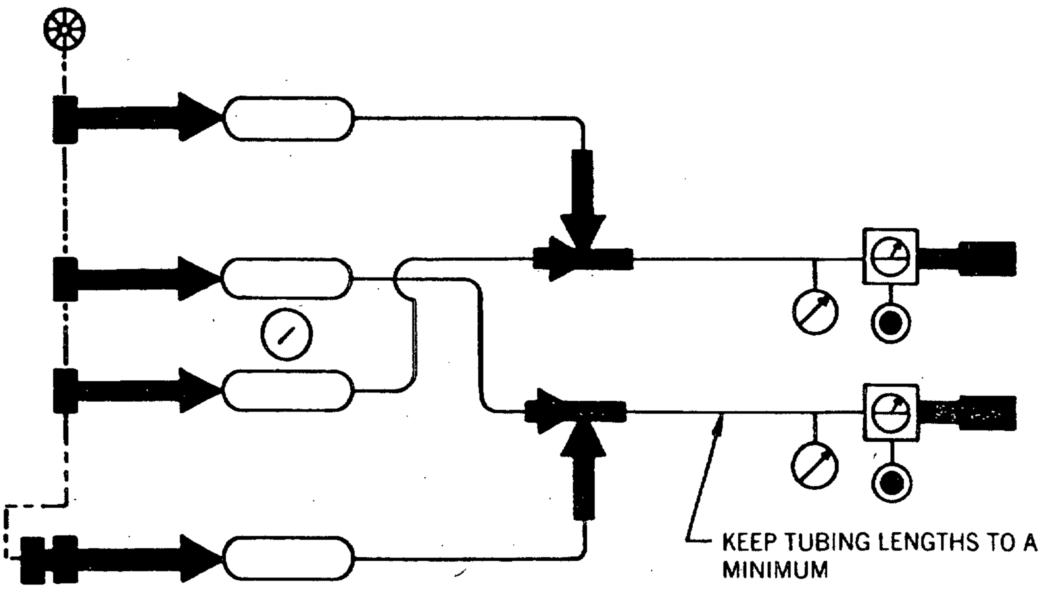
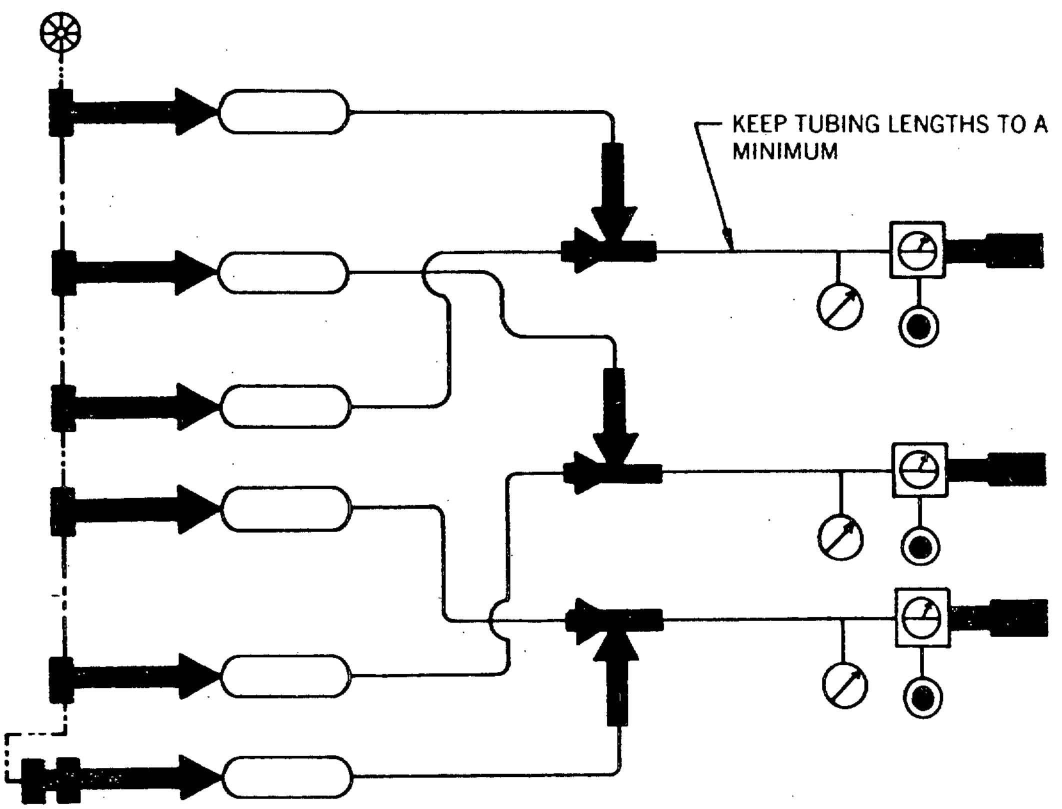


FIGURE 3. Typical two or more cylinder installation.



INSTALLATION IN DUAL PLACE AIRCRAFT



INSTALLATION IN THREE-PLACE AIRCRAFT

NOTES:
1/ Above installations illustrate separation of cylinders to individual stations.

FIGURE 4. Typical oxygen systems in dual and three place aircraft.

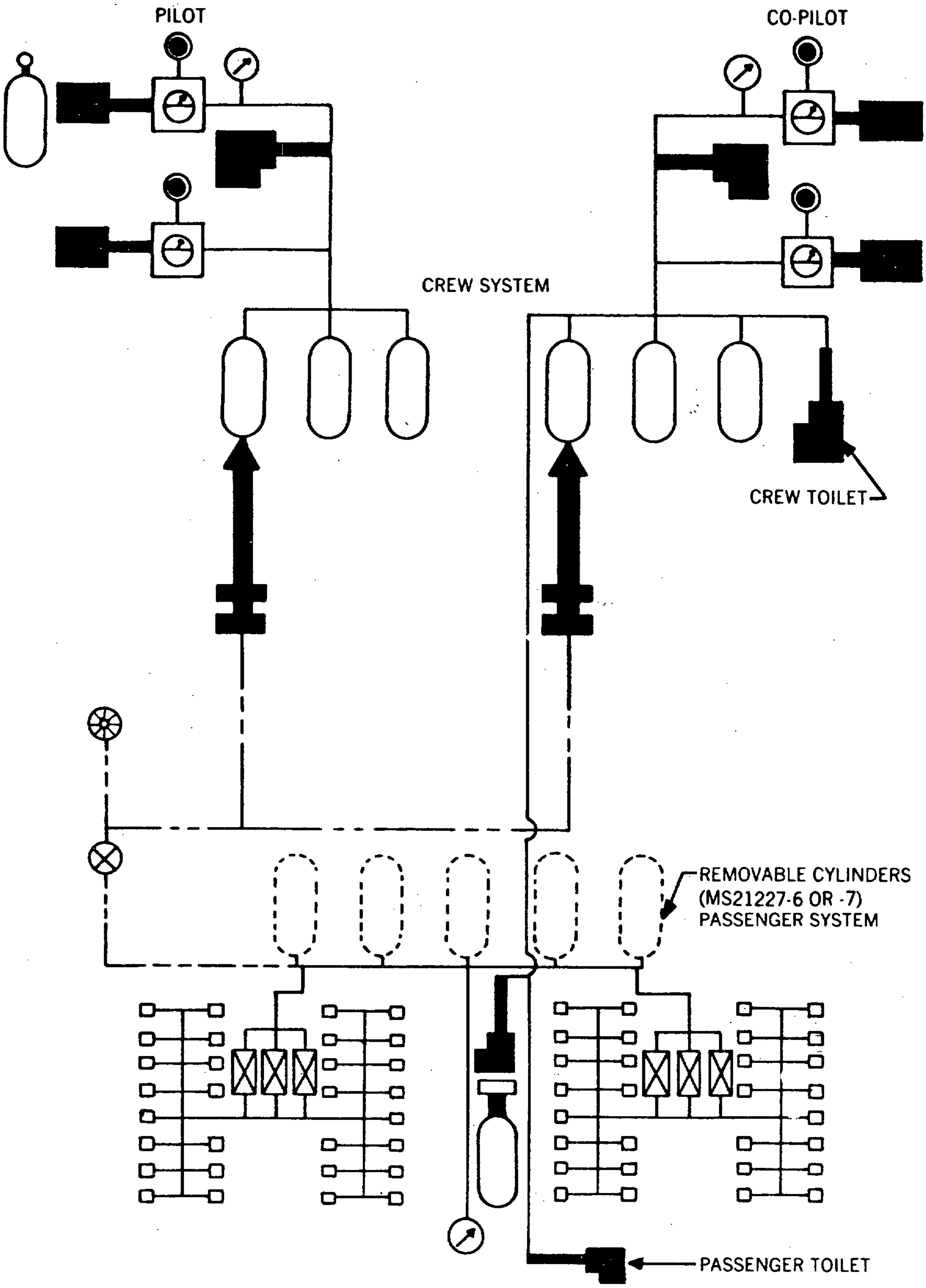


FIGURE 5. Typical installation in transport aircraft.

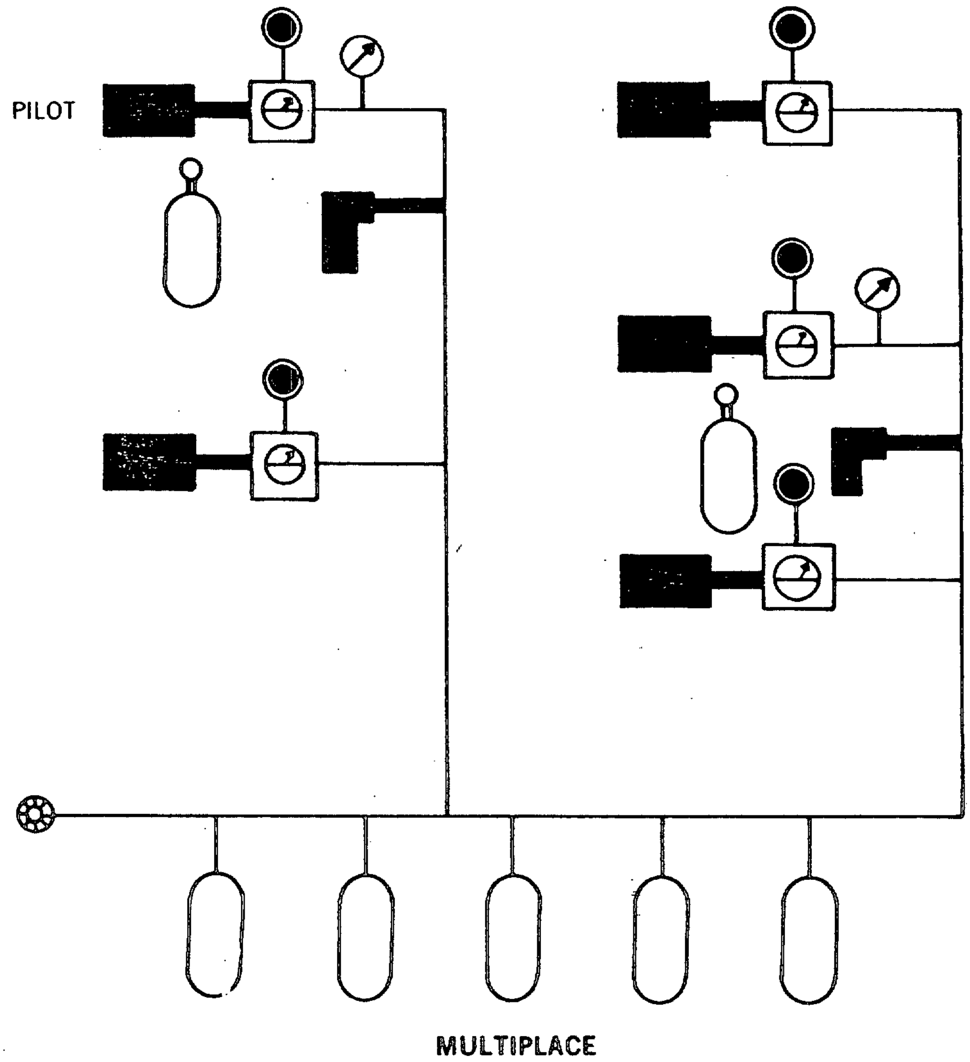


FIGURE 6. Typical installation in training aircraft.

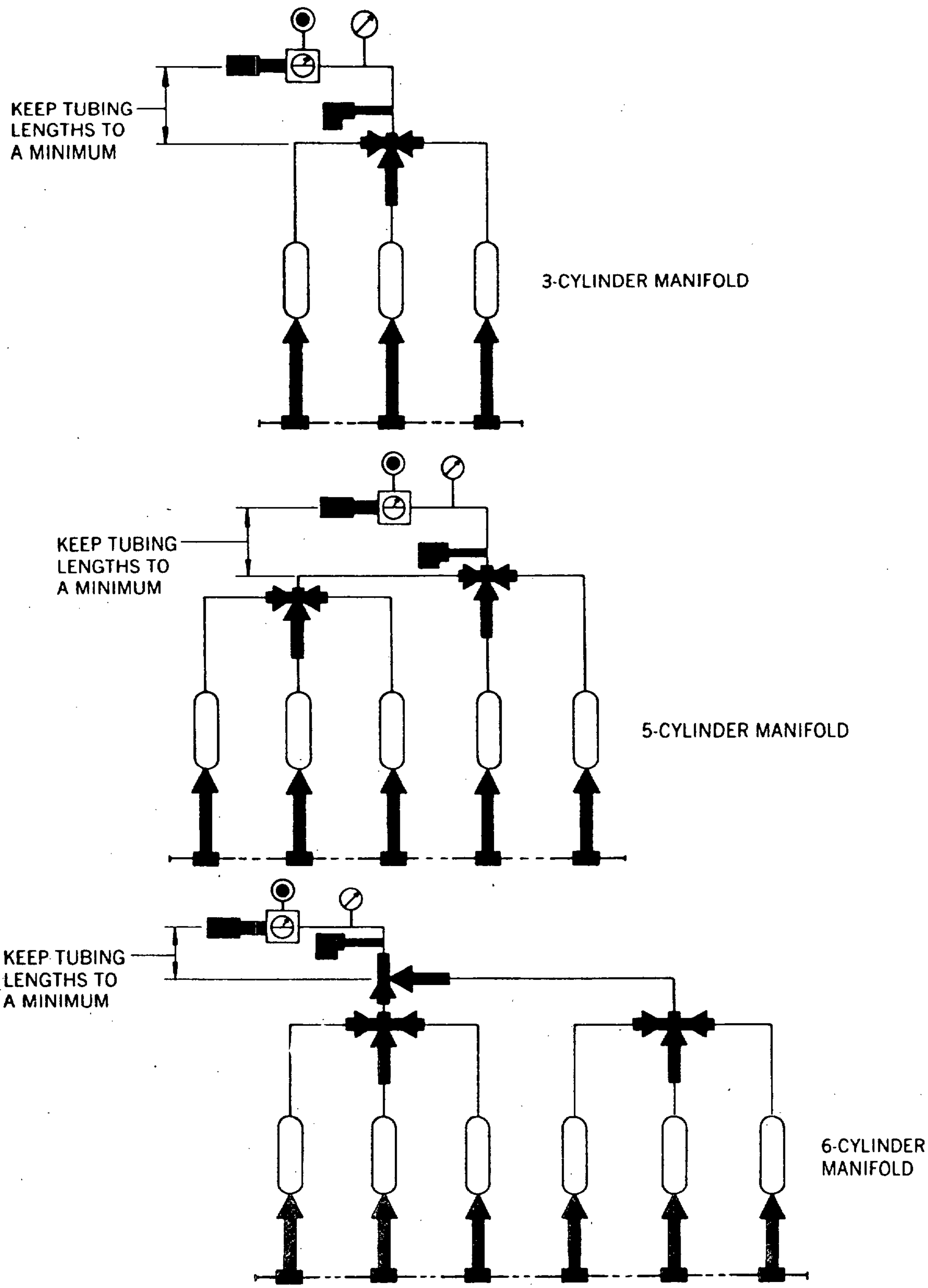


FIGURE 7. Typical individual manifold portion installation.

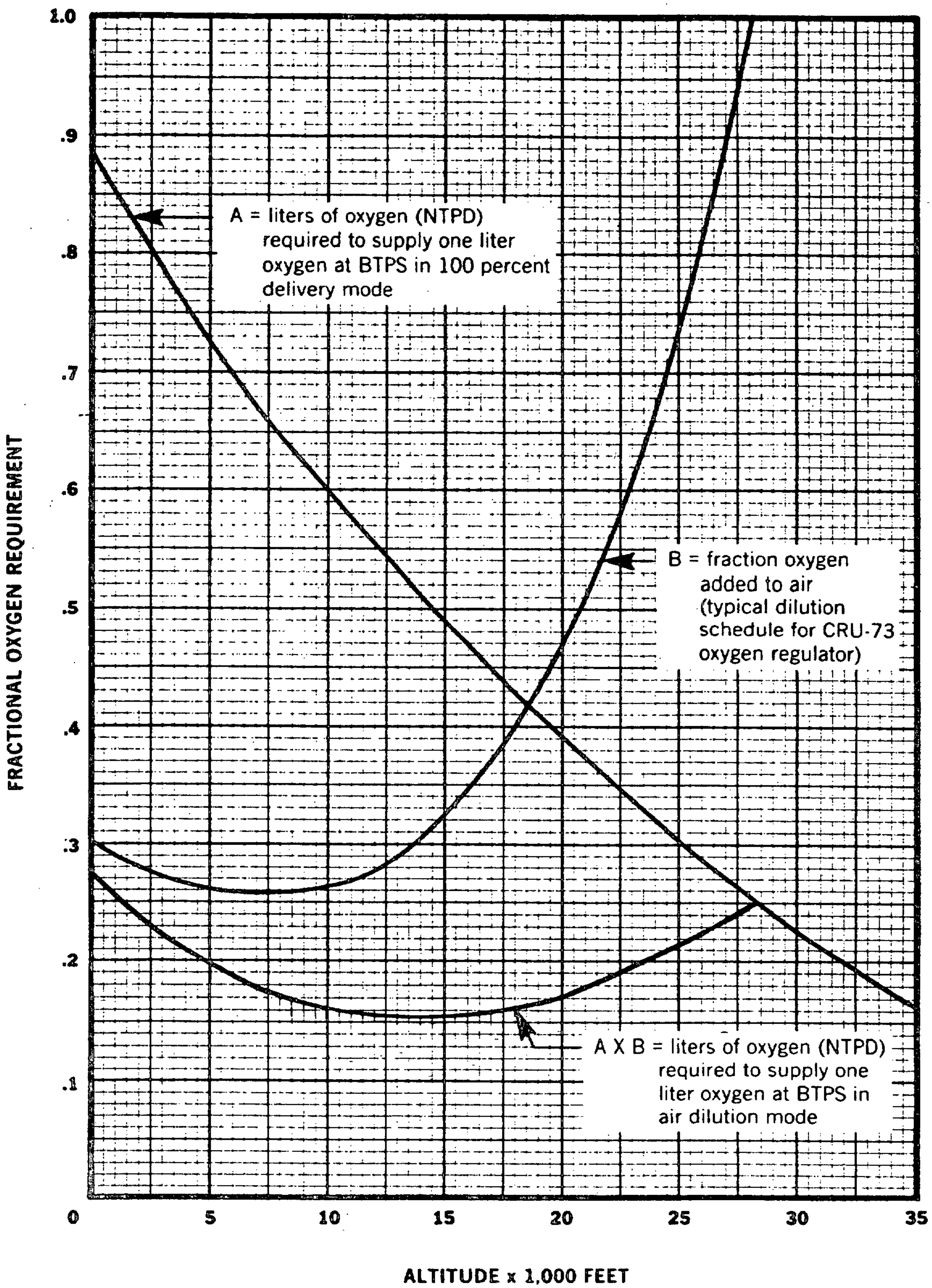


FIGURE 8. Fractional oxygen requirement versus cabin altitude.

INDEX

Contents	Paragraph	Page
AIRCRAFT MARKING REQUIREMENTS	3.12	18
High pressure systems	3.12.1	18
Low pressure systems	3.12.2	18
ANTISEIZE TAPE	3.8	16
APPLICABLE DOCUMENTS	2	1
CLASSIFICATION OF INSPECTION	4.2	20
Quality conformance inspection	4.2(a)	20
CLEARANCE REQUIREMENTS	3.11	17
Deviations from clearance requirement	3.11.1	17
DESIGN	3.2	5
DRAWINGS AND DATA	3.5.6	9
Drawings	3.5.6.1	9
Installation drawing	3.5.6.3	9
Pre engineering information	3.5.6.2	9
Pilot's flight operating handbook data (for Air Force use)	3.5.6.4	9
FIGURES (1 TO 8)		29 to 36
INSPECTION METHODS	4.5	21
Flight test	4.5.5	22
Functional test	4.5.4	22
Non-panel mounted regulator	4.5.4.2	22
Panel mounted regulator	4.5.4.1	22
Emergency switch	4.5.4.1.2	22
Flow indicator	4.5.4.1.1	22
Leakage test	4.5.2	21
Pressure decay	4.5.3	22
Visual examination	4.5.1	21
INTENDED USE	6.1	22
INTERNATIONAL STANDARDIZATION	6.6	24
INTERNATIONAL SYSTEM OF UNITS (SI)	6.5	24
MAINTENANCE AND REPLACEMENT	3.10	17

INDEX (Continued)

Content	Paragraph	Page
MAJOR SYSTEM COMPONENTS	3.6	10
Automatic coupling	3.6.16	15
Breathing oxygen masks	3.6.10	13
Continuous flow oxygen masks	3.6.10.2	14
Pressure demand masks	3.6.10.1	14
Check valves	3.6.5	12
Installation	3.6.5.1	12
Cylinder selection and installation	3.6.1	10
High pressure systems	3.6.1.1	10
Low pressure systems	3.6.1.2	10
Emergency oxygen	3.6.14	15
Filler valve	3.6.3	11
High pressure systems	3.6.3.1	11
Location	3.6.3.3	11
Low pressure systems	3.6.3.2	11
Fittings	3.6.8	13
Hoses	3.6.11	14
Applicable to the Air Force	3.6.11.2	14
Breathing hose	3.6.11.1	14
Indicating instruments	3.6.15	15
Pressure gage	3.6.15.1	15
Line valve	3.6.4	11
High pressure systems	3.6.4.1	11
Low pressure systems	3.6.4.2	11
Passenger cylinder removal	3.6.4.2.1	11
Low pressure relief valve	3.6.6	12
Personal services	3.6.12	14
Flow requirements	3.6.12.1	14
Portable oxygen system	3.6.13	14
Portable oxygen systems (1800 psi) (12.44 MPa)	3.6.13.1	15
Portable oxygen systems (450 psi) (3.1 MPa)	3.6.13.2	15
Regulators	3.6.2	10
Preinstallation tests	3.6.2.3	11
Non-panel mounted	3.6.2.2	10
Panel mounted	3.6.2.1	10
Torque requirements for joints	3.6.9	13
Torque requirements for tube connections	Table VII	28
Torque requirements for pipe connections	Table VIII	28
Tubing	3.6.7	12
High pressure systems	3.6.7.1	12
Low pressure systems	3.6.7.2	12
Markings	3.6.7.6	13
Oxygen coupling sleeve	3.6.7.4	13
Tube flaring and bending	3.6.7.3	12
Tube routing and mounting	3.6.7.5	13

INDEX (Continued)

Content	Paragraph	Page
MARGINAL NOTATIONS	6.6	25
ORDERING DATA	6.2	22
Acquisition requirements	6.2.1	23
Data requirements	6.2.2	23
OXYGEN QUANTITY DETERMINATION	3.4	6
Oxygen flow requirements	3.4.1	6
Baseline oxygen for each crew member	Table I	26
Design oxygen requirement	3.4.1.4	7
Flight demand provisions	3.4.1.2	7
Oxygen regulator air dilution	3.4.1.3	7
Oxygen requirement adjustment for number in aircrew	Table II	26
Oxygen requirement multiplier for specific flight activities	Table III	27
Oxygen supply requirements for each passenger continuous flow mask	Table IV	27
Respiratory provisions	3.4.1.1	7
Size and number of cylinders	3.4.2	7
Available oxygen for each size of cylinder (high pressure)	Table V	27
Available oxygen for each size of cylinder (low pressure)	Table VI	28
Maximum number of cylinders	3.4.2.1	8
OXYGEN SYSTEMS	3.3	5
Emergency oxygen	3.3.5	6
High altitude aircraft supply	3.3.2	6
Portable oxygen systems	3.3.4	6
Systems utilizing capsules	3.3.3	6
Systems utilizing oxygen delivery system	3.3.1	5
Bomber aircraft supply	3.3.1.2	5
Fighter and attack aircraft supply	3.3.1.1	5
Mission specialist and training aircraft supply	3.3.1.4	6
Transport aircraft supply	3.3.1.3	5
PERFORMANCE	3.7	15
Flight test	3.7.4	16
Functional test	3.7.3	16
Non-panel mounted regulator	3.7.3.2	16
Panel mounted regulator	3.7.3.1	16
Emergency switch	3.7.3.1.2	16
Flow indicator	3.7.3.1.1	16
Leakage	3.7.1	15
Pressure decay	3.7.2	15

INDEX (Continued)

Content	Paragraph	Page
QUALITY CONFORMANCE INSPECTION	4.3	20
RESPONSIBILITY FOR INSPECTION	4.1	19
Responsibility for compliance	4.1.1	19
SCOPE	1.	1
SELECTION OF SPECIFICATIONS AND STANDARDS	3.1	5
SUBJECT TERM (KEY WORD) LISTING	6.3	24
SYSTEM CLEANLINESS	3.9	16
Closures	3.9.2	16
Degreasing	3.9.3	17
Filter	3.9.1	16
Lubricants	3.9.5	17
Purging	3.9.4	17
Oxygen distribution system	3.9.4.1	17
SYSTEM LAYOUT	3.5	8
Indicating instruments	3.5.4	8
Multiplace aircraft	3.5.4.3	9
Training aircraft	3.5.4.1	8
Two-place aircraft	3.5.4.2	9
Location	3.5.5	9
Multiplace combat aircraft	3.5.2	8
Single place combat aircraft	3.5.1	8
Transport aircraft	3.5.3	8
TEST CONDITIONS	4.4	20
Leak test compound	4.4.3	20
Oxygen	4.4.1	20
Transfer equipment	4.4.1.1	20
Pressure gage	4.4.2	20
Temperature and pressure	4.4.4	20
Temperature correction	4.4.4.1	21
WORKMANSHIP	3.13	19

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