MIL-D-85520(AS)
10 March 1983

MILITARY SPECIFICATION

DESIGN AND INSTALLATION OF ON BOARD OXYGEN GENERATING SYSTEMS IN AIRCRAFT, GENERAL SPECIFICATION FOR

This specification is approved for use by the Naval Air Systems Command, Department of the Navy, and is available 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 on board oxygen generating systems (OBOGS) in military aircraft.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

BB-N-411	-	Nitrogen Technical.

MILITARY

MIL-E-5007	-	Engine, Aircraft, Turbojet and Turbofan, General Specification for.
MIL-V-9050	-	Valve, Oxygen, Cylinder, High Pressure.
MIL-E-18927	-	Environment Systems, Pressurized Aircraft, General Requirements for.
MIL-L-25567	-	Leak Test Compound, Oxygen Systems.
MIL-G-27617	-	Grease, Aircraft and Instrument, Fuel and Oxidizer Resistant.
MIL-S-81018	-	Survival Kit Container, Aircraft Seat, With Oxygen, General Specification for.
MIL-C-81302	-	Cleaning Compound, Solvent, Trichlorotrifluoroethane.
MIL-B-81365	-	Bleed Air Systems, General Specification for.

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

MIL-T-81533	-	1,1,1 Trichloroethane (Methyl Chloroform), Inhibited, Vapor Degreasing.
MIL-H-81581	-	Hose Assemblies, Breathing Oxygen and Air, General Specification for.
MIL-S-83427	-	Survival Kit Containers, CNU-129(V)/P and CNU-130/P.
MIL-C-85521	-	Concentrator, Oxygen.
MIL-M-85522	-	Monitor, Oxygen.
MIL-R-85523	-	Regulator, Chest Mounted, Positive Pressure.

STANDARDS

MILITARY

MIL-STD-411	-	Aircrew Station Signals.
MIL-STD-704	-	Electrical Power, Aircraft, Characteristics and Utilization of.
MIL-STD-810	-	Environmental Test Methods.
MIL-STD-889	-	Dissimilar Metals.

2.1.2 Other Government documents. The following other Government document forms a part of this specification to the extent specified herein.

PUBLICATIONS

NAVAL AIR SYSTEMS COMMAND

01-1A-20	-	Aviation Hose and Tube Manual.

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

2.1.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Design. The installation of an aircraft on board oxygen generating system (OBOGS) shall comprise two major subsystems: the oxygen enriched air system (OEAS) and the airframe installed components for the bleed air and oxygen delivery system.

3.1.1 Oxygen enriched air system. The oxygen enriched air system shall comprise the oxygen concentrator, oxygen monitor and the aircrew oxygen regulator. The system shall connect with the aircrewmember personal oxygen mask and hose assembly.

3.1.2 Bleed air and oxygen delivery system. The bleed air oxygen delivery system airframe installed components shall comprise, as required, bleed air shut-off valves, heat exchangers, overtemperature sensors, check valves, test connections, plenums, emergency oxygen assemblies, tubing, fittings, hoses, cabling, wiring and all other items specified herein and required for a complete installation.

3.1.2.1 Selection of components. Components used in the bleed air and oxygen delivery system which operate at high temperature or high pressure shall have been tested to indicate suitability of design. These tests shall be conducted in accordance with the airframe contractor's acquisition specifications. The airframe contractor's tests shall include the following tests:

a. Leakage tests.

b. Pressure decay test.

c. Burst pressure test.

d. Proof pressure test.

e. Pressure cycling test.

f. Thermal cycling test.

g. Valve "close-open-close" cycling test.

h. Flow resonance test.

Burst pressure, proof pressure, pressure cycling, and flow resonance tests shall be conducted in accordance with MIL-B-81365.

3.1.2.2 Environmental tests of bleed air and oxygen delivery system. The bleed air and oxygen delivery system components shall have been subjected to the following environmental tests conducted in accordance with the applicable aircraft specification, or if not provided therein, in accordance with MIL-STD-810, whichever is more severe:

a. High temperature test.

b. Low tempeature test.

c. Humidity test.

d. Altitude test.

e. Salt spray test.

f. Vibration test.

g. Fungus resistance test.

h. Sand and dust test.

i. Acceleration test.

j. Shock test.

k. Acoustic susceptability.

3.2 Enriched air systems.

3.2.1 Systems utilizing oxygen mask. Pressurized fighter, patrol, training, attack and transport aircraft having cabin altitudes 42,000 feet and below, and the capability of descending from a maximum indicated altitude of 50,000 feet to 42,000 feet within 5 minutes after a rapid decompression, shall have an enriched air system providing concentrated oxygen to crewmembers. The aircraft shall have an enriched air system of sufficient capacity to supply the entire crew for the period of any of the specified design missions.

3.2.2 Emergency oxygen.

3.2.2.1 Escape oxygen supply. An escape oxygen supply as specified in MIL-S-83427 or MIL-S-81018 shall be provided. The escape oxygen supply provided shall remain with the aircrewmember during his descent following aircraft abandonment. For aircraft equipped with ejection seats, provision shall be made for the automatic actuation of the escape oxygen supply during ejection seat operation.

3.2.2.2 OBOGS back-up oxygen supply. An emergency oxygen supply shall be incorporated to provide 200 liters at 14.7 psia, 70°F to each crew station as a back-up source of oxygen in the event of an OBOGS failure. This supply shall be separate from that required in 3.2.2.1 and may be a single source for all crewmembers. This supply shall be manually actuated. The interface of the emergency oxygen supply shall be designed in such a manner that upon actuation of the emergency oxygen supply all flow of enriched air to the aircrewmember will be blocked and only emergency oxygen can flow to the aircrewmember.

3.3 Size and number of concentrators. The number and size of OEAS concentrators installed on an aircraft shall be based upon the ability of the concentrator to support the specified number of crewmembers. Adequate space shall be provided in the aircraft for the number of concentrators required. If two or more concentrators are installed in the aircraft, they shall be separated as much as practicable to minimize combat vulnerability. Sufficient space shall be available to replace concentrators and perform maintenance on all parts.

3.4 System layout. Typical OBOGS configurations are shown in Figures 1 through 5 for military aircraft utilizing engine bleed air as input air for the concentrator. These figures represent the general arrangement of the system; the actual number, location and application of components are determined by the aircraft characteristics and the requirements specified herein. Alternate sources of input air for the concentrator may be used, provided that the requirements of 3.6.1.1 are fulfilled.

3.4.1 Location. The enriched air equipment, tubing, and fittings shall be located as remotely as practicable from fuel, oil, hydraulic, electrical, radio, and insulating materials. Insofar as practical, enriched air lines shall not be grouped with lines carrying flammable fluids. Where necessary, deflector plates shall be used to keep flammable fluids away from enriched air lines, fittings, and equipment.

3.5 Major system components.

3.5.1 Concentrator. Each OBOGS installation shall incorporate an oxygen concentrator. The concentrator shall process input conditioned air to provide a moisture reduced, low contamination, oxygen enriched breathing gas. The remaining gas shall be exhausted. When a vent line is used to exhaust the remaining gases it shall have a resistance to air flow not to exceed that caused by a smooth base straight tube 0.56 inch inside diameter and four feet long. The design, construction and performance of the concentrator is defined by MIL-C-85521.

3.5.1.1 Installation. The concentrator shall be capable of being removed and replaced from the aircraft in less than 15 minutes. With the concentrator installed, plumbing and electrical connections shall be accessible by maintenance personnel using standard hand tools. The concentrator compartment dimensions shall be determined from the concentrator dimensions provided in MIL-C-85521.

3.5.1.1.1 Preinstallation tests. The concentrator shall have passed the sea level, pressure and voltage variation operational tests of MIL-C-85521 within 30 days of installation in the aircraft.

3.5.2 Monitor. Each OBOGS installation shall incorporate an oxygen monitor. The monitor provides an electrical output signal whenever the partial pressure of oxygen in the enriched air from the concentrator drops below the signal alarm range specified in MIL-M-85522. The electrical output signal shall initiate a visual indicator at each crew station in the cockpit and shall initiate an audible indicator. The design, construction and performance of the monitor is defined by MIL-M-85522. The press-to-test plunger on the monitor shall be accessible to the pilot or designated aircrewmember while seated.

3.5.2.1 Installation. The monitor shall be capable of being removed and replaced from the aircraft in less than five minutes. With the monitor installed, plumbing and electrical connections shall be accessible to maintenance personnel using standard hand tools. To minimize the volume of the interconnecting plumbing, the monitor shall be located as close as is practical to the enriched air line.

3.5.2.1.1 Preinstallation tests. The monitor shall have passed the sea level, altitude and voltage variation operational tests of MIL-M-85522 within 30 days of installation in the aircraft.

3.5.3 Regulator. A breathing gas regulator shall be utilized for each crewmember that will be required to wear an oxygen mask. The design, construction and performance of the regulator is defined by MIL-R-85523.

3.5.4 Plenum. If required, the airframe shall incorporate a plenum to assure an adequate supply of breathing gas to the aircrew during periods of peak breathing demand. The plenum shall be located near the regulator end of the aircraft plumbing that carries the enriched air from the concentrator to the cockpit.

3.5.5 Heat exchanger. Systems shall incorporate a heat exchanger in the airframe, if necessary, to ensure proper cooling of the air supplied to the concentrator as specified in 3.6.1.1. The heat exchanger shall be in accordance with MIL-B-81365.

3.5.6 Overtemperature sensor. An overtemperature sensor shall be installed in the air input line for the concentrator if there is the possibility of an overtemperature condition due to a system component failure. The overtemperature sensor shall activate a visual indicator in the cockpit to alert the pilot of an overtemperature condition in the concentrator input line. Location of the visual indicator(s) shall be in accordance with MIL-STD-411.

3.5.7 Shut-off valves. In systems utilizing engine bleed air, a bleed air shut-off valve which is capable of stopping bleed air flow shall be installed on the engine, located as close as possible to the engine bleed air source. Each bleed air shut-off valve shall be individually activated by a cockpit mounted switch. Engine bleed air shut-off valves shall be in accordance with MIL-B-81365. A shut-off valve shall be provided for each air source in systems which utilize other than engine bleed air.

3.5.8 Check valves.

3.5.8.1 Engine bleed air check valves. In aircraft with more than one source of bleed air, check valves shall be installed to preclude loss of air through an inoperative source or as a result of input air tubing failure. Engine bleed air check valves shall be in accordance with MIL-B-81365.

3.5.8.2 Test port check valve. A check valve shall be incorporated in the test port to prevent air from escaping in the event the closure cap is left off or comes loose.

3.5.9 Tubing.

3.5.9.1 Enriched air tubing. Tubing used in the enriched air portion of the OBOGS installation shall conform to Publication 01-1A-20 requirement for material, flaring and bending, mounting, marking and torquing for oxygen line tubing. Tubing lengths shall be kept to a minimum while allowing for expansion, contraction, vibration and component replacement.

3.5.9.2 Air supply tubing.

3.5.9.2.1 Tubing design. All rigid tubing shall be designed to withstand repeated simultaneous applications of pressure, temperature and velocity of air as well as thermal expansion, thermal shock, structural deflections and severe environment to the maximum values attainable under flight operating conditions. All rigid engine bleed air tubing shall be in accordance with MIL-B-81365.

3.5.9.2.2 Flexible connectors. Tubing flexible connectors shall be designed to withstand axial compression or tension, radial deflection or offset movement, or both, as may be required to prevent failure of the ducting system due to vibration or stresses caused by variations in loading or temperature. The amount of deflection (compression, tension or bending) for which the flexible connectors shall be designed is the maximum value resulting from the imposition of accelerations and temperatures by the system and environment under flight operating conditions. All flexible connectors that are a component of engine bleed air tubing shall be in accordance with MIL-B-81365.

3.5.10 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.

3.5.11 Test connection. A self-sealing (checking) test connection shall be installed in the OBOGS air supply line to allow organizational level personnel to provide auxiliary air to the concentrator for a systems test.

3.5.12 Crewmember's regulator hose. The crewmember's regulator hose shall connect the crewmember's chest mounted regulator to the manifold hose of the ejection seat survival container. The hose shall be of such a length that the user's movements are not restricted during his normal duties at his station by short length, excessive bulkiness or resistance to breathing. Hose assemblies shall be in accordance with MIL-H-81581.

3.5.13 Ejection seat oxygen supply assembly. For aircraft equipped with ejection seats, the manifold assembly shall be mounted on the aircraft crewmember's seat or survival kit and shall be separated from the aircraft by an automatic disconnect fitting upon ejection or emergency ground egress of the crewmember from the aircraft. The hose lengths from the disconnect fitting to the ejection seat oxygen manifold and from the manifold to the aircrewmember's disconnect fitting shall be of the shortest practicable length to minimize hose weight, bulk and resistance to breathing.

3.5.14 Pressure relief valve. If required, a pressure relief valve, in accordance with MIL-V-9050, Type II, shall be incorporated in the enriched air system that shall limit enriched air pressure to that specified for the oxygen regulator. The pressure relief valve, if required, shall be located as close as is practical to the oxygen regulator.

3.6 Aircraft resources.

3.6.1 Concentrator requirements.

3.6.1.1 Air supply. The air supply to each concentrator shall be provided at temperatures, pressures and mass flow rates in accordance with the ranges specified in MIL-C-85521. Contaminants in the supply air shall not exceed those limits specified in MIL-E-5007.

3.6.1.2 Electrical power. The concentrator shall be provided with a nominal 28 VDC in accordance with MIL-STD-704 with a voltage range for operation of 18.0 to 31.5 volts. Electrical requirements shall be in accordance with MIL-C-85521.

3.6.2 Oxygen monitor requirements.

3.6.2.1 Electrical power. Each monitor shall be provided with a nominal 28 VDC in conformance with MIL-STD-704, with a voltage range for operation of 18.0 to 31.5 VDC. Electrical requirements shall be in accordance with MIL-M-85522.

3.6.3 Other electrical requirements. Electrical power will be required for the operation of bleed air shut-off valves, overtemperature warning lights, if required, the OBOGS master switch and the low oxygen warning signal light.

3.7 Performance. The pressures at the inlet to the oxygen regulator during all flight conditions shall be not less than the minimum pressure requirements in Figure 6. The pressure at the inlet to the oxygen regulator during all ground idle conditions shall be not less than 15 psig. The flowrate at the inlet to the oxygen regulator shall be not less than the minimum flowrate requirements in Table

I. The maximum pressures at the inlet to the oxygen regulator shall not exceed the limits specified in MIL-R-85523. The temperature of the breathing gas shall be within ± 5°F of the temperature of the cockpit (cabin) ambient air around the aircrewmen at waist level.

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

3.7.2 Pressure decay. The OBOGS, when tested as specified in 4.5.3, shall not have a pressure decay from the charged pressure in excess of 5 psig.

3.7.3 Functional tests.

3.7.3.1 Press-to-vent switch. The monitor press-to-vent plunger, when tested as specified in 4.5.4.1, shall cause an oxygen partial pressure drop that activates the MASTER CAUTION light and the advisory panel OXY-LOW warning light within 15 seconds. When the plunger is released, closing the valve, the warning light shall extinguish within 30 seconds.

3.7.3.2 Oxygen concentration. When tested as specified in 4.5.4.2, the OBOGS shall provide oxygen concentrations conforming to the level specified in Table II.

3.7.3.3 Breathing. When tested as specified in 4.5.4.3, verify that the oxygen regulator provides air upon demand and shut-off without excessive back pressure when breathing normally. Verify also that heavy demand breathing does not require excessive effort nor cause the regulator to block air flow.

3.7.4 Enriched air pressure. When tested in accordance with 4.5.5, the pressure of the enriched air system at each crew station shall be not less than the values specified in Table III.

3.7.5 Enriched air flowrates. The minimum flowrate of enriched air at each crew station shall be provided at the flowrates specified in Table IV at each of the corresponding oxygen regulator inlet pressures. When tested in accordance with 4.5.6, the regulator outlet pressures shall be within the range specified in Table IV at each corresponding oxygen regulator flowrate.

3.7.6 Flight test. When specified in the contract, flight tests of the OBOGS shall be conducted to determine the proper functioning of all the OBOGS equipment in the aircraft. In addition, a determination shall be made of the suitability of the arrangement to the items from the standpoint of accessibility and convenience to all crewmembers during their flight duties.

3.8 System cleanliness. The completed installation shall be free of oil, grease, fuel, water, dust, dirt, objectionable odors or any other foreign matters, both internally and externally prior to introducing enriched air or 100 percent oxygen into the system.

3.8.1 Closures. If the location of the concentrator within the aircraft is such that enriched air lines are required to be disconnected during aircraft maintenance checks or overhaul, suitable closures shall be provided for each exposed connection to prevent materials which are incompatible with oxygen from entering the system. 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 and 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.

3.8.2 Degreasing. Parts of the enriched air 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. Ultrasonics may be used for the cleaning of components. When MIL-C-81302 cleaning compound is used, a final rinse in clean, fresh solvent is required. When vapor degreasing is used, the item shall finally be immersed in the cool, clean condensate reservoir and then held in the vapor zone until all condensation has ceased before removal. After completion of the cleaning and when assembled, General Electric Type H Leak Detector, or equal Halide testing apparatus, shall be used to determine the absence of the cleaning compound.

3.8.3 Purging. After initial assembly of the OBOGS, hot dry nitrogen conforming to BB-N-411, Type I, Class 1, Grade B, shall be used to purge the OBOGS between the concentrator and the survival kit manifold. The temperature at the inlet to the system shall not exceed 250^{o}F during purging. The purging procedure shall be conducted until the distribution terminals in the cockpit are noticeably warm to the touch (150^{o}F) and then continue to purge for an additional period of 10 minutes.

3.8.4 Lubricants. Lubricants qualified to MIL-G-27617 may be used sparingly on seals and straight threads if assembly difficulty is encountered.

3.9 Maintenance and replacement. All parts of the enriched air system shall be installed to permit ready removal and replacement without the use of special tools. All tubing connections, fittings, regulators, concentrators, and other items shall be readily accessible for leak testing with leak test compound and for tightening of fittings without removal of surrounding parts. Flexible hoses shall be used to connect shock mounted equipment to permit easy maintenance.

3.10 Clearance requirements. Enriched air lines, fittings and equipment shall be installed above and at least 0.5 inch away from fuel, oil and hydraulic systems to avoid contamination. Deflector plates shall be used where necessary to keep hydraulic fluids away from enriched air 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 0.5 inch of clearance between the enriched air system and flexible moving parts of the aircraft. There shall be at least 0.5 inch clearance between the OBOGS components and rigid parts of the aircraft, except at clamp areas. The enriched air tubing, fittings and equipment shall be separated at least 0.5 inch from all electrical wiring, heat conduits and heat emitting equipment in the aircraft.

3.10.1 Exceptions from clearance requirements. When barriers such as ribs, webs, frames, channels, extrusions and stringers exist between enriched air 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 be not applicable. Shields shall be acceptable to the acquiring activity. Where electrical wires lead into enriched air equipment due to an electrical item being a component of the enriched air equipment, the requirements for separation, mounting and covering are not applicable, except that they shall be secured against chafing. Exceptions other than specified herein shall be approved by the acquiring activity.

3.12 Workmanship. The enriched air 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.

4.2 Classification of inspection. The inspection requirements specified herein are classified as quality conformance inspection.

4.3 Quality conformance inspection. Quality conformance inspection shall consist of design tests and installation tests as specified in Table V.

4.3.1 Design tests. Design tests shall be performed on one or more OBOG systems (see 6.2.1b).

4.3.2 Installation tests. Each OBOG system shall be subjected to the installation tests.

4.4 Test conditions.

4.4.1 Oxygen regulator. The oxygen regulator used for the OBOGS quality conformance inspection shall have passed the outlet pressure and leakage tests of MIL-R-85523 within 30 days of the OBOGS quality conformance inspection.

4.4.2 Test supply gas. Filtered compressed air shall be used to functionally test the OBOGS. The air shall be filtered to allow passage of a maximum particle size of 20 microns and shall not exceed one part per million (ppm) of oil. The air supply shall be capable of providing the pressures and flow rates required to test the system. Technical nitrogen gas conforming to BB-N-411 shall be used to leak test, clean and purge all enriched air tubing. Oil pumped nitrogen shall not be used.

4.4.3 Electrical power. Aircraft electrical power shall be provided by a ground power unit (GPU) capable of supplying a nominal 28 VDC to the aircraft.

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

4.4.5 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 test data, where required, to normal temperature and pressure (NTP) conditions. NTP conditions are 70°F and 29.92 inches of mercury. Test instruments shall be calibrated or adjusted according to their required usage in conducting individual tests.

4.5 Inspection methods.

4.5.1 Visual examination. The OBOGS shall be examined visually to determine conformance to this specification and applicable drawings with respect to all the requirements not covered by tests.

4.5.2 Leakage test. All tubing joints and connections shall be coated with leak test compound specified in 4.4.4. External electrical power shall be supplied to the aircraft and the OBOGS master switch energized. The heat exchanger vent (if applicable) and the closest disconnect to the aircraft air supply shall be capped and the maximum specified OBOGS supply air pressure applied to the aircraft external air port. Verify that exhaust gas is venting from the concentrator. Visually inspect the bleed air delivery system for signs of leakage. The system shall pass the requirements specified in 3.7.1.

4.5.3 Pressure decay test. The enriched air delivery system, from the concentrator outlet to the survival kit manifold, shall be charged with gaseous oxygen to the system operating pressure. After system pressure has been stabilized for five (5) minutes, isolate gaseous oxygen source and record oxygen system pressure, time and distribution line temperature. The oxygen pressure and distribution line temperature shall again be recorded after 30 minutes and shall pass the requirements specified in 3.7.2.

4.5.4 Functional tests. Functional tests shall be performed for each crew station of each aircraft with the oxygen mask hose assembly. External electrical power and an external air source shall be applied to the aircraft. Energize the system with the OBOGS master switch and allow two minutes to warm up. Adjust the external air source to 12 psig. Verify that enriched air is flowing from the oxygen mask hose assembly.

4.5.4.1 Press-to-vent switch. With the oxygen regulator attached to the manifold-to-regulator hose and the flow of breathing gas 5 slpm to 10 slpm, depress the press-to-vent button and hold until the aircraft LOW OXYGEN warning lamp and the MASTER CAUTION lamp illuminate. Release the press-to-vent button. Activation and extinguishing of the LOW OXYGEN warning lamp shall be in accordance with the requirements of 3.7.3.1.

4.5.4.2 Oxygen concentration. With the enriched air flowing at the rates specified in Table II, the percent oxygen, when measured at any one aircrewmember station, shall meet the requirements of 3.7.3.2.

4.5.4.3 Breathing test. Adjust external air source to 25 psig. Don oxygen mask hose assembly and breathe normally. Breathing requirements shall conform to 3.7.3.3.

4.5.5 Enriched air pressure test Ground testing of the system shall be conducted with the aircraft providing the air supply. With the aircraft operating at rest on the ground, the system shall provide the pressures specified in 3.7.4. Enriched air pressures supplied to the oxygen regulator at the specified aircraft altitudes can be extrapolated from the ground tests using the air source pressure specification at altitude, the concentrator pressure regulator schedule (MIL-C-85521) and the cabin pressurization schedule (MIL-E-18927).

4.5.6 Enriched air flowrate. This test must be conducted with a regulator (MIL-R-85523) connected to the OBOGS via all required interface hoses and connections as per the final design configuration. A breathing machine shall be connected to the outlet of the oxygen regulator. The breathing machine shall be used to generate a sinusoidal flow demand on the oxygen regulator. With compressed air connected to the OBOGS supply air inlet and supplying sufficient air pressure to achieve the enriched air pressures at the oxygen regulator inlet as specified in 3.7.5, and the breathing machine set to the corresponding specified flowrate and cycle flowrates, the pressure at the oxygen regulator shall remain within the range specified in 3.7.5. This test shall be performed at each crew station.

4.5.7 Flight test. When specified in the contract (see 6.2.1c), flight tests shall be conducted and the OBOGS shall meet the requirements specified in 3.7.6.

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

6. NOTES

6.1 Intended use. The design and installation requirements specified herein are intended for use in incorporating OBOGS into new aircraft designs as well as in replacing liquid oxygen systems and gaseous oxygen systems in aircraft currently in use.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification.

b. Whether design tests are required on more than one aircraft (see 4.3.1).

c. Whether flight tests are required (see 4.5.7).

d. Items of data required (see 6.3).

6.3 Data requirements. For the information of contractors and contracting officers, any of the data specified in subparagraphs below, applicable documents contained herein, or referenced lower-tier documents need not be prepared for the Government and shall not be furnished to the Government unless specified in the contract or order. The data to be furnished shall be listed on DD Form 1423 (Contractor Data Requirements List) which shall be attached to and made a part of the contract or order. NAVAIR Form 4200/30 (Drawings, Lists, and Specifications Required) shall be attached where applicable.

6.3.1 Design data. Drawings and substantiating engineering data in accordance with MIL-D-8706 shall show the location, capacity, identity (including manufacturer and part number) and function of all components and equipment used in the OBOGS. Schematic type drawings, depicting and explaining airflow circuits and operation of controls shall be included. Engineering data shall include the system design analysis, all equipment acquisition specifications, equipment test requirements and a weight breakdown for the complete system. The system design analysis should contain a brief description of how the overall system functions and how the controls are operated.

6.3.2 Drawings. Drawings should be in accordance with DOD-STD-100 and should include the following:

6.3.2.1 Pre-engineering information. At least 60 days prior to the preparation of the installation drawings, a schematic diagram of the oxygen system should be submitted to the acquiring activity for approval. The symbols used on all schematic drawings should be in accordance with Figures 1 - 5 of this specification.

6.3.2.2 Installation drawings. All installation drawings for oxygen equipment should be submitted to the acquiring activity for approval in accordance with NAVAIR Form 4200/30. Installation drawings should show the position of the equipment in the aircraft and the possible stations in the aircraft. Installation drawings should also show accessibility of the concentrators and monitors.

6.3.3 Schematic drawing. A schematic drawing of the oxygen system should be provided as required in the Pilot's Flight Operating Instruction Handbook in conformance with MIL-M-7700 and MIL-M-38800. The drawing should include a plan view of the aircraft and should include all items for which there is a symbol in MIL-STD-17, Part 2. The drawing should include the symbol key listing, where applicable, and the type number of the items. Each concentrator on the drawing should be numbered to correspond with a number placed in a readily visible place by each concentrator in the aircraft. The symbols used on all schematic drawings shall be in accordance with Figures 1 - 5 of this specification.

Preparing activity:
Navy - AS

(Project 1660-N475)

TABLE I. Oxygen regulator pressure flowrate requirements.

Maximum pressure of enriched air supplied to oxygen regulator (psig)	Enriched air flowrate (liters/minute, NTP) 1/	
	Average	Peak
15.0	30	90
23.0	50	150
30.0	60	180
35.0	66	200

1/ Normal temperature and pressure; 70°F, 14.7 psia

TABLE II. Oxygen concentrations at sea level.

Concentrator input pressure (psig)	Concentrator output 1/ flowrate (lpm, NTP)	O_2 concentration (percent)
27.0 ± 2.0	3 - 5	94.2 ± 0.4
	10 - 13	89.0 ± 2.0
	18 - 20	74.0 ± 3.0

1/ Steady state flow established at one crew station.

TABLE III. Enriched air pressures.

Operating condition	Minimum enriched air pressure at oxygen regulator inlet (psig)	Aircraft altitude (ft)
Ground idle	15	Sea level
Flight idle descent	20	Sea level
	20	25,000
	15	40,000
All other flight conditions	35	Sea level
	35	24,000
	23	40,000

TABLE IV. Enriched air flowrate. 1/

Maximum pressure of enriched air supplied to oxygen regulator (psig)	Enriched air flowrate at the oxygen regulator outlet (liters/minute, NTP) 2/		Breathing machine cycle rate 3/ (Cycles/minute)	Oxygen regulator outlet pressure 4/ (Inch H_2O)
	Average	Peak		
15.0	30	90	15	0.0 to +1.5
23.0	50	150	25	-1.5 to +3.0
30.0	60	180	35	-2.0 to +4.0
35.0	66	200	35	-4.0 to +5.0

1/ This test shall be conducted for 2 minutes at each regulator supply pressure.

2/ 70°F, 14.7 psia.

3/ A complete cycle includes the flow period during breathing machine inhalation and the no flow period during breathing machine exhalation.

4/ These values are based on a normal human breathing waveform.

TABLE V. Quality conformance inspection.

Examination or test	Requirement paragraph	Examination or test paragraph
Installation tests:		
Visual examination	-	4.5.1
Leakage test	3.7.1	4.5.2
Pressure decay test	3.7.2	4.5.3
Functional tests	3.7.3	4.5.4
Design tests:		
Enriched air pressure test	3.7.4	4.5.5
Enriched air flowrate	3.7.5	4.5.6
Flight test	3.7.6	4.5.7

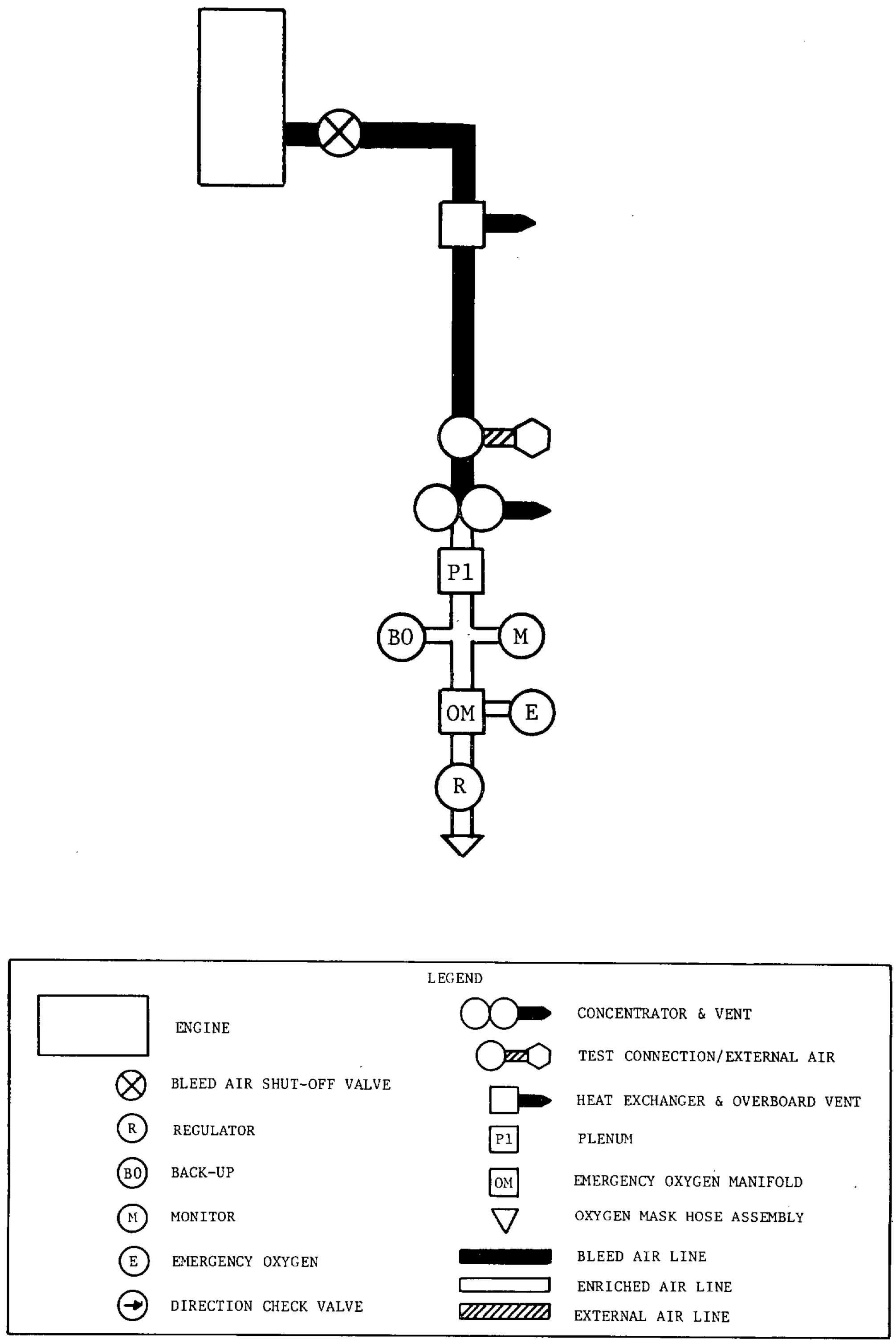
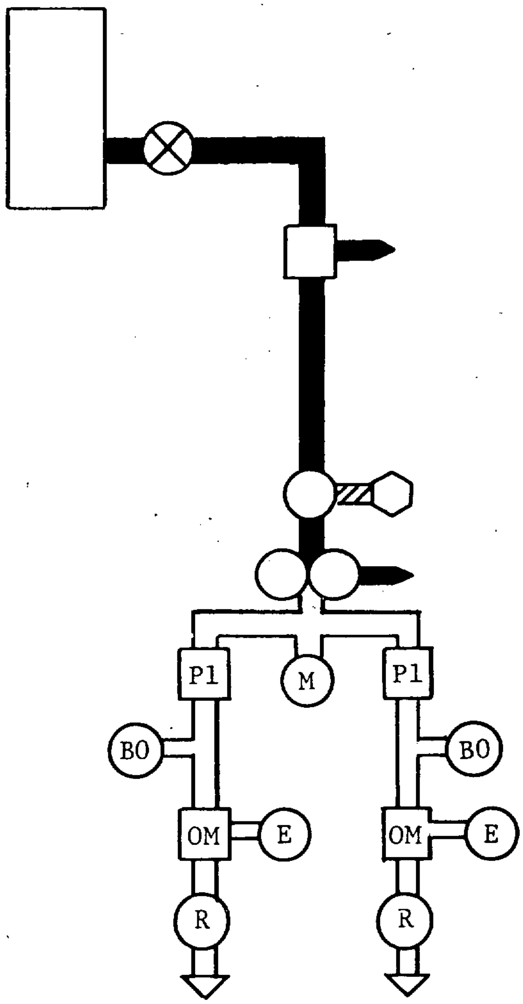


FIGURE 1. Single concentrator, single engine, single place aircraft.



1/ A single plenum may be used in lieu of two plenums as long as system pressure and flowrate requirements are fulfilled.

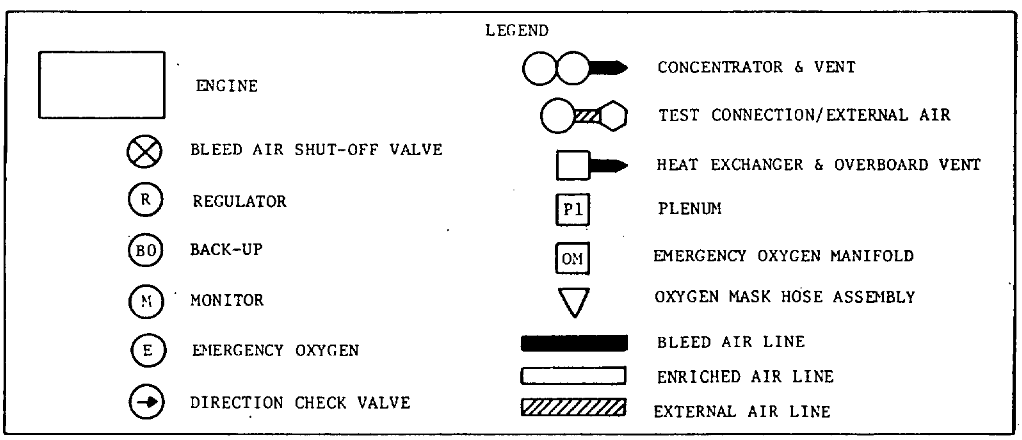
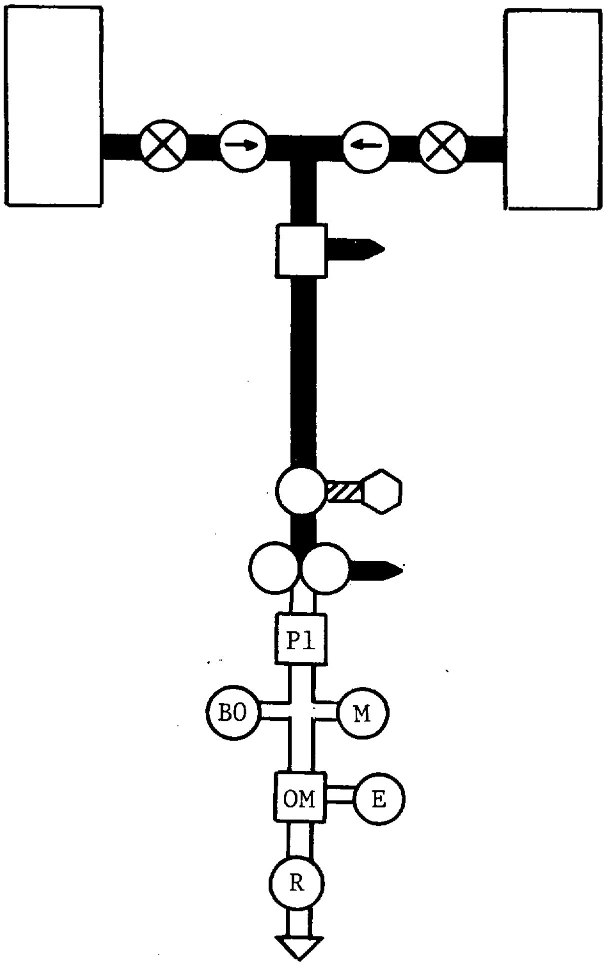


FIGURE 2. Single concentrator, single engine, dual place aircraft.



1/ A dual bleed air system may be provided to the concentrator.

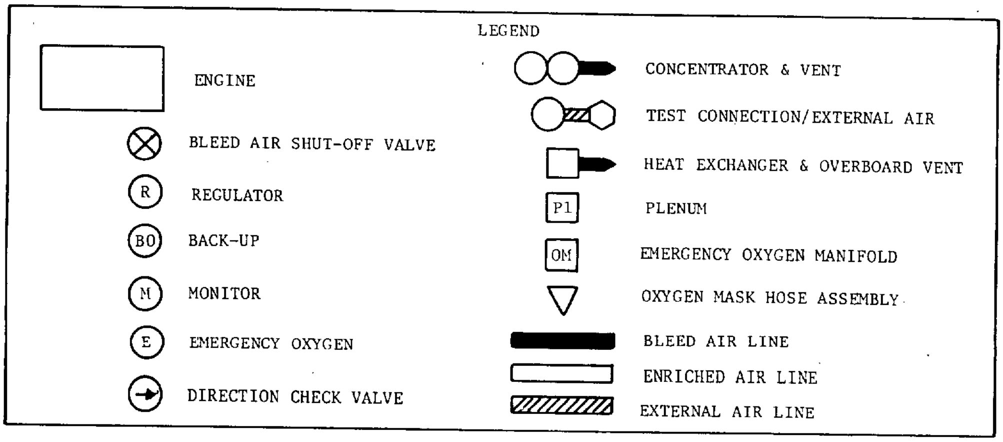
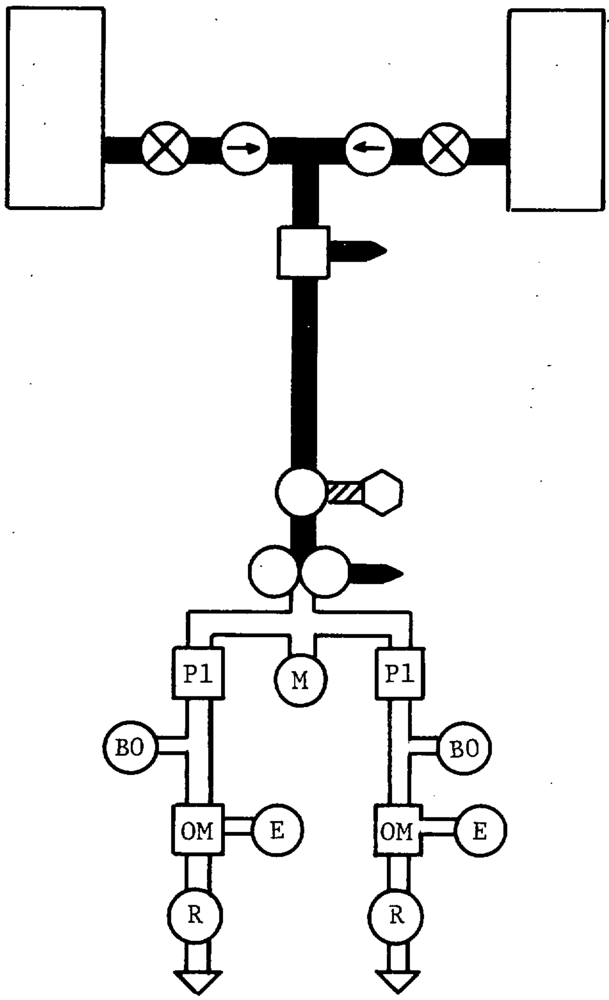


FIGURE 3. Single concentrator, twin engines, single place aircraft.



1/ A dual bleed air system may be provided to the concentrator.

2/ A single plenum may be used in lieu of two plenums as long as system pressure and flowrate requirements are fulfilled.

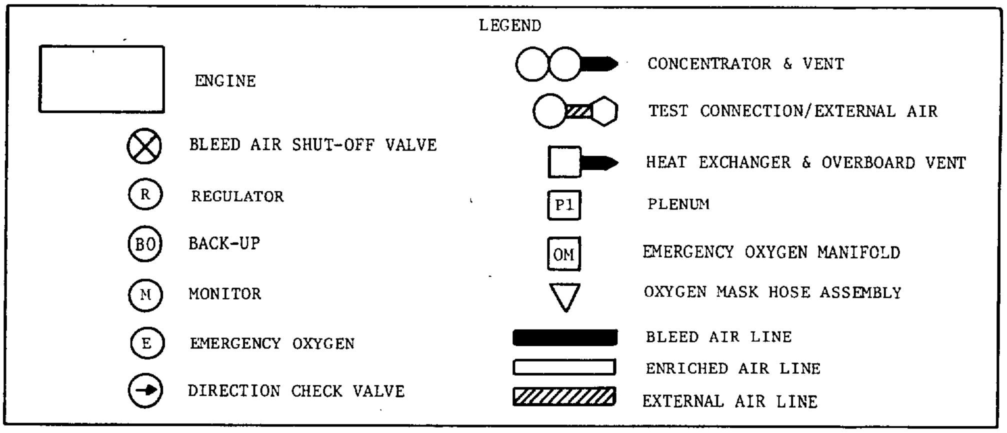
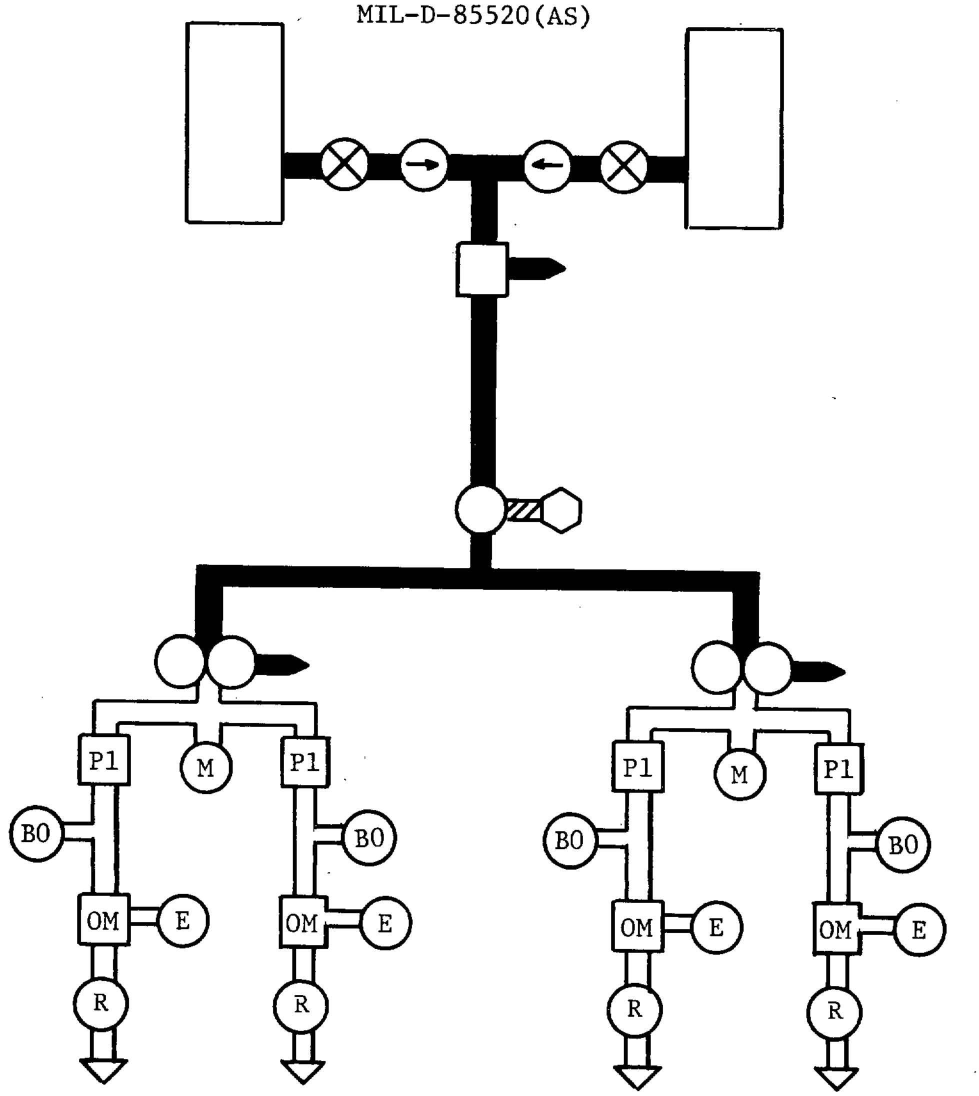


FIGURE 4. Single concentrator, twin engines, dual place aircraft.



1/ Dual bleed air systems may be provided to the concentrator.

2/ Fewer plenums may be used as long as system pressure and flowrate requirements are fulfilled.

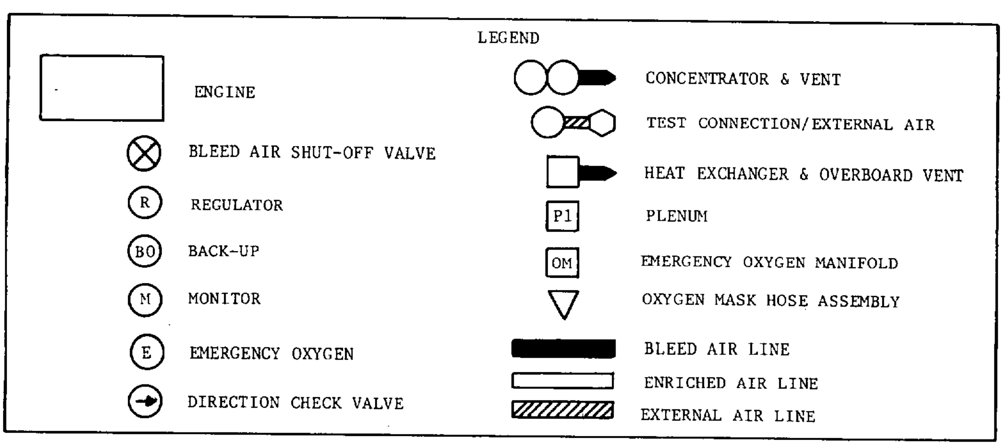


FIGURE 5. Dual concentrators, twin engines, multiple place aircraft.

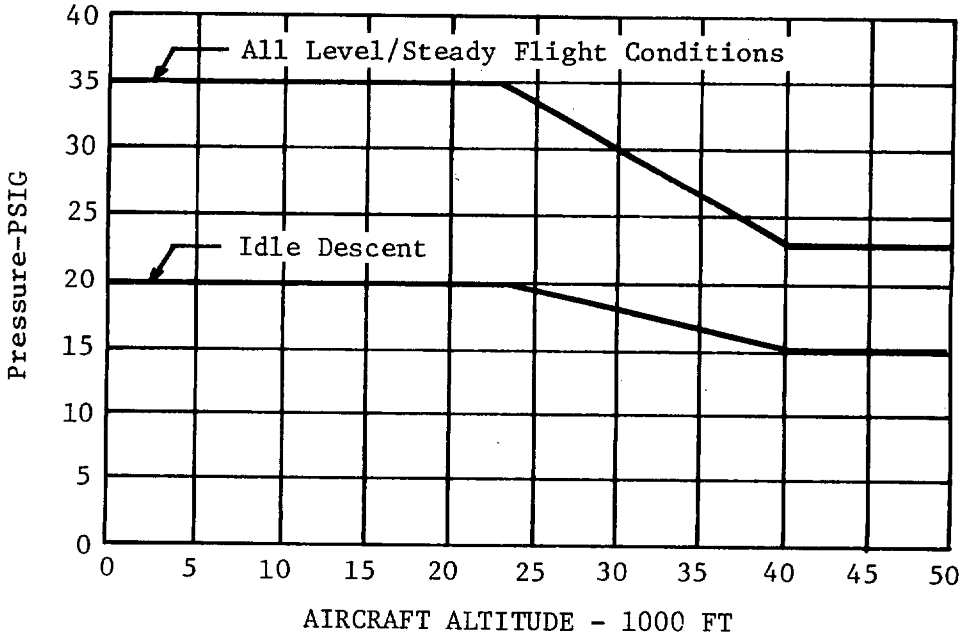


FIGURE 6. Enriched air pressure requirements of the oxygen regulator.

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