AEROSPACE STANDARD	AS8025™	REV. A
	Issued 1988-02 Revised 1999-01 Reaffirmed 2021-08 Superseding AS8025	

Passenger Oxygen Mask

RATIONALE

AS8025A has been reaffirmed to comply with the SAE five-year review policy.

FOREWORD

Changes in this revision are format/editorial only.

1. SCOPE:

This standard covers oronasal type masks which use a continuous flow oxygen supply. Each such mask comprises a facepiece with valves as required, a mask suspension device, a reservoir, or rebreather bag (when used), a length of tubing for connection to the oxygen supply source, and a means for allowing the crew to determine if oxygen is being delivered to the mask. The assembly shall be capable of being stowed suitably to meet the requirements of its intended use.

1.1 Purpose:

This standard establishes the minimum requirements for the design, construction and performance of continuous flow oxygen masks for passenger cabin occupants in civil commercial aircraft.

1.2 Presentation:

When presented, the mask assembly's application shall be obvious. The mask shall be capable of quick and easy donning regardless of any special orientation requirements.

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1.3 Coding of Performance Classification:

An eight-digit performance classification number shall be assigned to each class of masks. This number shall correspond to the number assigned to the minimum performance curve established in 6.1.7.2.2 and shall represent the required minimum oxygen flow rates (NTPD) to the mask shown on curve “C” of Figure 1 at cabin pressure altitudes of 15 000, 25 000, 30 000 ft and the maximum approved altitude, respectively. Flow rates shall be to one decimal.

Typical Example - AS 8025-08233248-YY*-XX*

0.8 - required minimum oxygen flow, L/min, NTPD, at 15 000 ft
2.3 - required minimum oxygen flow, L/min, NTPD, at 25 000 ft
3.2 - required minimum oxygen flow, L/min, NTPD, at 30 000 ft
4.8 - required minimum oxygen flow, L/min, NTPD, at maximum approved altitude

*YY - Maximum approved altitude in thousands of feet
*XX - Additional coding which the mask manufacturer may desire to add

1.4 Interchangeability of Mask Assemblies:

1.4.1 Same Coding: Masks with the same coding shall be interchangeable.

1.4.2 Different Performance Classification Numbers (remainder of coding the same): Only those masks whose performance classification number shows that at all certified cabin altitudes, the required oxygen flow rates are equal to or less than the flow rates supplied to the mask from the airplane system shall be used on that airplane.

2. APPLICABLE DOCUMENTS:

2.1 Completely Applicable:

The following specifications, drawings, and publications of the issue in effect on the date of initiation of qualification tests, shall form a part of this specification:

MIL-P-7105	Pipe Threads, Taper, Aeronautical National Form, Symbol ANPT
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter
MIL-O-27210 or AS8010	Oxygen 99.5%, Gas and Liquid
BB-N-411	Nitrogen, Liquid and Gas

2.1 (Continued):

MIL-STD-889	Metals - Definition of Dissimilar
Federal Standard No. 595	Colors

2.2 Partially Applicable:

The following specifications, drawings, and publications of the issue in effect on the date of initiation of qualification tests shall form a part of this specification to the extent noted in this document:

AS916	Standard for Oxygen Flow Indicators
AIR1082	Fluid System Component Specification Criteria
A.T.A 100	Specification for Manufacturer's Technical Data
FAR PART 25	Federal Aviation Regulations Covering Airworthiness Standards for Transport Category Airplanes
MIL-STD-810	Environmental Testing, Aeronautical and Associated Equipment, General Specification
TSO-C64	Oxygen Mask Assembly, Continuous Flow, Passenger (For Air Carrier Aircraft)

3. GENERAL REQUIREMENTS:

3.1 Product:

The article furnished under this specification shall be capable of meeting the requirements specified herein.

3.2 Deviations:

Where the requirements of this specification differ from requirements of the specifications, drawings, and publications listed, the requirements of this specification shall govern.

3.3 Materials:

3.3.1 General: Materials shall be of type, grade, and quality, which experience or test or both have demonstrated to be suitable for the purpose intended. Materials which contaminate oxygen or are affected adversely by continuous service with oxygen shall not be used.

Materials shall have at least flame-resistant properties as specified in Federal Aviation Regulation Part 25.853.

3.3.2 Facepiece: The facepiece shall be free of objectionable odors. Materials in contact with the skin shall be selected to be non-allergenic and non-irritating.

3.3.3 Cleaning and Sterilizing: The mask shall be made of materials which permit cleaning and sterilization without adverse effects and without disassembly. The manufacturer shall recommend the method of cleaning and sterilizing.

3.3.4 Elastomer Components: All elastomer materials used in the mask shall have been manufactured not more than 12 months prior to the delivery date of the mask except those materials that a longer period has proven feasible. A tag or leaflet describing elastomeric components with service life limits and a suggested method for inspection and detection of deterioration in these components, which may adversely affect the performance of the mask, shall be attached to or included in the packaged mask prior to delivery to the user.

3.3.5 Fungus (Inert): Components shall be fungus proofed by selection to the greatest extent practicable of parts and materials that are non-nutrient to fungus, or by treatment of the parts and materials prior to their use. Treatment shall be non-allergenic and non-irritating with no objectionable odors and shall be consistent with the other material requirements in 3.3.

3.3.6 Dissimilar Metals: Unless suitably protected against electrolytic corrosion, dissimilar metals shall not be used in intimate contact with each other (Reference MS33586).

3.3.7 Material Specification: The material specification of all parts of this mask assembly shall be submitted for approval to the procuring activity if requested.

3.4 Workmanship:

The mask shall be fabricated and finished in accordance with the highest grade practice in the manufacture of this type equipment. The finished mask and all internal parts shall be cleaned throughout and be free of flashing, burrs, scale, and oils, or any other conditions or materials that might adversely affect the safe operation of the mask. All components shall be resistant to snags, breaks, tears, and other harmful actions which could lead to malfunction of the mask due to rough handling during its service life.

3.5 Finish:

All materials that are not inherently corrosion-resistant shall be finished with a protective treatment or coating to minimize the effect of exposure to the environmental conditions that may be encountered in the service for which the equipment is intended. The protective treatment or coating shall not chip, flake, or powder, or otherwise contaminate the mask.

3.6 Color:

The color of the facepiece shall be No. 13538 yellow of Federal Standard No. 595.

3.7 Interchangeability:

All parts having the same manufacturer's part number shall be directly and completely interchangeable with each other with respect to installation, performance and operation.

3.8 Deterioration:

Corrosion or deterioration, such as oozing of plasticizers, of any component that could in any manner make the mask unsuitable for use and prevent the mask from meeting operational requirements during its service life shall be cause for rejection of the mask.

3.9 Service Life:

The service life of the article after delivery to the using agency shall be not less than three years when normal storage and use conditions are observed. This includes subjecting the mask assembly to cleaning and sterilization treatments (see 5.4). At the end of and during the service life specified or established, or both, by the mask manufacturer, the mask assembly shall be operationally serviceable and capable of meeting the appropriate requirements specified herein. If the mask is deemed disposable by the mask manufacturer, its service life may be considered complete after the first normal use. Shelf life shall be considered separately and will be over and above service life. Shelf life shall be specified.

3.10 Reliability:

Reliable operation shall be a major consideration, even after long periods of inattention during stowage on the shelf or in the aircraft, or both.

3.11 Identification Markings:

The following information shall be marked on the outside of the article using materials or processes, or both, that shall ensure legibility during the expected life span of the article. The marking shall not cause smudging or discoloration of the article.

a. The words “Oxygen Mask”
b. Manufacturer’s Part Number
c. Manufacturer’s Name and Address
d. Performance Classification Number (see 1.3)
e. Elastomer Cure Date (see 3.3.4)
f. Picture (see 5.11)
g. Date of Manufacture
h. TSO Number (If Applicable)

4. DETAIL CONSTRUCTION REQUIREMENTS:

4.1 Facepiece Assembly:

4.1.1 Fit: The facepiece shall be of a sufficient resilience, size and shape to conform readily to extreme facial contours using no more pressure than supplied by the mask suspension device. The facepiece shall cover the airways of the nose and mouth. The main body of the mask shall be stiff enough to minimize deformation due to incorrect handling, which might result in reduction in operating performance.

4.1.2 Volume: The chamber formed between the face and the mask shall at all times be of a minimum volume.

4.1.3 Valve Design: Valves, where used, shall be designed to offer minimum resistance to inflow of oxygen and ambient air during inhalation, and to outflow of expiration gases during exhalation.

4.1.4 Provision for Attachment of Actuation Cord for Turning on Oxygen Supply: Provision shall be made where applicable for the attachment of a ribbon or a lanyard to the mask to turn on the oxygen supply. This lanyard and its attachment provision must be capable of withstanding a pull of 44.48 N (10 lbf) in any direction.

4.2 Mask Suspension (Holding) Device:

A simple mask suspension device shall be provided for holding the mask on the user's face during normal head movements. The attachment of the suspension device shall not restrict the orientation of the mask. The device shall have such dimensions and elastic properties that it can hold the mask to the face without adjustment and at the same time it shall present minimum discomfort to the wearer. A simple means for adjusting the tightness of the mask shall be provided.

The adjustment means shall be easily identifiable to the user by a visual or tactile recognition, such as tabs at the ends of elastic suspension straps.

The suspension device shall be stowed on the facepiece in a manner that shall not interfere with normal operation of the mask, with hand-held usage, or with automatic presentation of the mask assembly.

4.3 Gas Bag (Where Used):

The gas bag, where used, shall be attached to the facepiece and tubing with sufficient strength to withstand a pull force in any direction of 22.24 N (5 lbf) for at least three seconds and shall be made of flexible material which will collapse when not in use. The gas bag(s) shall have the following minimum and maximum capacity when inflated to 0.125 kPa (0.5 inches of water) positive pressure.

TABLE 1

Type	Minimum Volume (cm^3)	Maximum Volume (cm^3)
Reservoir	1000	1500
Rebreather	800	1000

4.4 Tubing:

The oxygen supply tube, which is to be used for connecting the mask assembly to the oxygen supply source, shall be light in weight, and shall be capable of being bent to a 12.7 mm (0.5 inch) radius measured to the center line of the tube for stowage purposes with less than a 5% restriction to flow during subsequent use. The tubing shall be fully flexible within a temperature range of -29 °C (-20 °F) to 71 °C (160 °F). For installations requiring tight radii, "anti-kink" devices are recommended.

4.5 Flow Indication:

4.5.1 There must be a means to allow the crew to determine whether oxygen is being delivered to each oxygen mask assembly.

4.5.2 Flow indication must comply with AS916 as applicable.

5. PERFORMANCE REQUIREMENTS:

Unless otherwise specified, all flow requirements refer to oxygen.

5.1 Environmental Conditions:

5.1.1 Stowage Configuration: The mask assembly including the supply tubing shall be capable of being stowed in such a manner as to be ready for its intended use. The mask shall remain serviceable in its stowed configuration until it is required for its specific application. The maximum stowage envelope shall be defined by the manufacturer in coordination with the buyer. Where the mask is to be automatically presented by a drop method, compliance shall be demonstrated by showing that the mask falls freely from an inverted rigid box with envelope dimensions representing the intended installation.

5.1.2 Temperature and Humidity: The assembly shall be capable of being stowed at temperatures of 71 °C (160 °F) for 120 hours at relative humidities varying from 5 - 95% and at -57 °C (-70 °F) for two hours, without adversely affecting subsequent performance after return to room temperature.

5.1.3 Condensation: Operation of the equipment shall not be adversely affected by moisture accumulated during use.

5.1.4 Vibration: In its stowed configuration, the equipment shall be capable of withstanding vibrations as follows:

5.1.4.1 Resonance: One million cycles or eight hours, whichever occurs first, at each resonance occurring within the frequency range of Figure 6. (Where several resonances are encountered the vibration periods may then be limited to those resonances considered most likely to produce failure.)

5.1.4.2 No Resonance: One million cycles in each of three mutually perpendicular directions, at 100 cycles per second and the corresponding amplitude of Figure 6.

5.2 Operational Serviceability:

5.2.1 Presentation: After exposure to any of the conditions of 5.1, the mask assembly, including supply tubing, shall be capable of being presented from its stowed configuration and meeting the performance requirements specified herein.

5.2.2 Altitude: Overall operation shall be satisfactory following sudden pressure changes from sea level to the maximum altitude for which approval is desired.

5.2.3 Low Temperature: After the temperature of the mask assembly in its stowed configuration has stabilized at approximately 21 °C (71 °F), the assembly shall be capable of immediate and satisfactory operation when exposed to -40 °C (-40 °F) for a minimum period of five minutes.

5.3 Endurance:

The mask assembly shall be capable of satisfactory operation for a minimum of 50 000 simulated breathing cycles at an approximate rate of 30 cycles per minute, essentially sinusoidal, at a delivery rate of 70 L/min ATPD for 10% of the inspiration time, and at least 30 L/min ATPD for 50% of the remaining inspiration time.

5.4 Sterilization:

Reusable mask assemblies shall be capable of being subjected to the cleaning and sterilization treatment recommended by the manufacturer, without disassembly and with no adverse effects.

5.5 Strength:

5.5.1 Assembly: When the supply tubing is connected to the outlet fitting, the mask assembly shall withstand a static tensile load of 88.96 N (20 lbf) applied to the facepiece for at least three seconds without damage to the assembly or disconnection from the outlet fitting. The load shall be applied as described in 6.1.4.1. Figures 3 and 4 show commonly used outlet fittings. When the mask assembly is used with these or other outlet fitting configurations, the manufacturer must show compliance using the appropriate fitting or fittings.

5.5.2 Assembly Connected to a Warm Outlet (Chemical Oxygen Generator): When the supply tubing is connected to the outlet fitting and the fitting temperature is 79 ± 3 °C (175 ± 5 °F), the mask assembly shall withstand a static tensile load of 22.24 N (5 lbf) applied to the facepiece for at least three seconds without damage to the mask assembly or disconnection from the outlet fitting. The load shall be applied as described in 6.1.4.1. Figure 3 shows a commonly used outlet fitting for chemical oxygen generators. When the mask assembly is used with this outlet or other outlet fitting configurations, the manufacturer must show compliance using the appropriate fitting or fittings if required by the buyer.

5.5.3 General: All components of the mask assembly shall be resistant to tears, snags, and all other defects leading to its malfunction, which might be caused by rough handling during its service life.

5.5.4 Gas Bag: The gas bag, when used, shall be capable of withstanding 1 lbf/in^2 internal gage pressure without damage or leakage.

5.6 Odor:

No objectionable odor shall be perceptible to the user of the mask.

5.7 Leakage:

5.7.1 Facepiece Total Leakage: The facepiece total leakage, including peripheral leakage when the mask is worn, shall be established as defined in 6.1.7. As a design objective, facepiece total leakage shall not exceed 100 cc/minute with differential pressures of 0 - 0.30 kPa (0 - 1.2 inches of water) inside the facepiece.

5.7.2 Gas Bag Leakage: Where used, the gas bag, including connections to the facepiece and supply tubing, shall have no detectable leakage when pressurized to 0.75 kPa (3.0 inches of water) and tested with bubble solution or by immersing in water.

5.8 Breathing Resistance:

5.8.1 Inward Flow Resistance: The suction within the mask shall not exceed 0.20 kPa (0.80 inches of water) when the inhalation flow rate is 30 L/min at ground level conditions. At an inhalation flow rate of 70 L/min the suction within the mask shall not exceed 0.50 kPa (2.0 inches of water).

5.8.2 Outward Flow Resistance: The pressure build-up within the mask shall not exceed 0.20 kPa (0.8 inches of water) when discharging a flow of 30 L/min at ground level conditions. At 70 L/min the pressure build-up shall not exceed 0.50 kPa (2.0 inches of water).

5.9 Mask Performance:

The mask assembly, when used by typical airline passengers, shall be able to maintain during inspiration mean tracheal oxygen partial pressures equal to or greater than those specified in 25.1443 of FAR Part 25 for passengers and cabin attendants when the mask is connected to an oxygen source that supplies oxygen at the flow rates which have been determined to be necessary for the particular mask assembly.

NOTE: When used by cabin crew members, physically active individuals with critical duties to perform, the performance of this equipment may be compromised when used in conjunction with facial hair that interferes with the seal between the mask and skin.

5.10 Flow Indicator:

A flow indicator shall indicate that oxygen is flowing to the mask assembly at oxygen flow rates as low as 0.5 L/min, NTPD.

5.11 Picture on Gas Bag:

A picture as shown in Figure 5 shall be permanently printed on each side of the gas bag in a color that shall contrast with the bag. The picture shall be oriented so that the head of the man is upright when the mask is presented to the user. The picture on one side shall be the mirror image of the picture on the opposite side.

6. QUALITY ASSURANCE PROVISIONS:

6.1 Qualification Test by the Manufacturer:

The manufacturer shall perform or cause to be performed the tests covered by this specification for initial qualification of the mask. Any of the tests required by this specification that have been performed on similar units may be omitted, provided the manufacturer submits proof of qualification by similarity. Tests called for in 6.1.2 - 6.1.4 inclusive shall be run on at least five different masks. Tests called for in 6.1.5, 6.1.6, 6.1.10 and 6.1.11 shall be run on at least one mask. For tests called for in 6.1.7, at least eleven masks shall be used. Each test mask shall be representative of production units and shall be individually identified. The FAA shall be given the option to perform a conformity inspection of the masks and test set-up prior to testing and shall be given the option to witness any or all testing.

If reworking of the mask or any component part should be required to complete any of the tests called for in this specification, the manufacturer shall repeat all tests previously run or certify that said rework does not affect prior results obtained. A statement of all rework performed on the mask or its components during qualification testing and the necessity for rework shall be included in the qualification test report. Whenever extensive rework is necessary to complete the test program, a rerun of the qualification test program using a mask assembly incorporating all rework features shall be required to obtain final approval from the procuring activity.

6.1.1 Test Conditions:

6.1.1.1 Gas: The gas used in testing the mask shall be either oxygen conforming to Specification MIL-O-27210, Type I, or AS8010; water pumped nitrogen conforming to Specification BB-N-411, Type I, Class I, Grade B; water pumped air equivalent in purity to Specification MIL-O-27210, Type I, oxygen. If nitrogen or air is used, appropriate density correction factors shall be applied to the flow meter used.

6.1.1.2 Pressure and Temperature: Whenever the pressure and temperature existing at the time of the test are not definitely specified, it shall be understood that the test shall be made at atmospheric pressure of approximately 101.3 kPa (29.92 inches of mercury) at a room temperature of approximately 21 °C (70 °F). All flow measurements shall be corrected to liters per minute NTPD.

6.1.1.3 Vibration and Noises: Excessive noise, vibration, flutter, or chatter of any part of the mask assembly during operation of the mask shall be cause for rejection of the mask.

6.1.2 Test for Leakage:

6.1.2.1 Gas Bag Leakage: Seal off the gas bag connection to the mask and apply at least 0.75 kPa (3.0 inches of H_2O) pressure to the gas bag and oxygen supply tubing. There shall be no detectable leakage when tested with bubble solution or alternatively when tested by water immersion.

6.1.3 Test for Flow Resistance:

6.1.3.1 Inhalation Flow Resistance: Seal the periphery of the facepiece of the mask to an appropriate fixture that is capable of producing suction within the mask and measuring this suction and the suction flow rate. Plug the oxygen supply tube. Adjust the suction flow rate to 30 L/min and measure the suction inside the facepiece. The suction shall not exceed 0.20 kPa (0.80 inches of water) pressure. The suction shall not exceed 0.50 kPa (2.0 inches of water) when the test is repeated with a suction flow rate of 70 L/min.

6.1.3.2 Exhalation Flow Resistance: Seal off the periphery of the facepiece of the mask. Connect the oxygen supply tube to the test gas source through an appropriate measuring device. Adjust the flow to 30 L/min and measure the differential pressure between the interior of the facepiece and the ambient. This differential pressure shall not exceed 0.20 kPa (0.80 inches of water).

Repeat test at 70 L/min flow. This differential pressure shall not exceed 0.50 kPa (2.0 inches of water).

6.1.4 Strength Tests:

6.1.4.1 Mask Assembly Strength Tests: Attach the mask assembly supply tubing inlet to an appropriate outlet fitting configuration. The mask assembly must be tested with all outlet configurations for which usage is intended. Apply a static tensile force of 88.96 N (20 lbf) to the facepiece for a period of at least three seconds. The test shall be conducted with the axis of the tubing and end fitting in line with each other, ± 30 degrees. The mask assembly must not disconnect from the outlet.

The mask assembly shall suffer no damage which will adversely affect subsequent operation.

6.1.4.2 Mask Assembly Strength with Warm Outlet: Repeat the above test with the outlet heated to 79 ± 3 °C (175 ± 5 °F) using a static tensile load of 22.24 N (5 lbf).

6.1.4.3 Mask/Reservoir Bag Assembly Tests: With the mask assembly supported by the inlet end of the oxygen supply tube, apply a static force of 22.24 N (5 lbf) to the reservoir bag for a period of three seconds. Support the mask assembly by the facepiece and apply a static force of 22.24 N (5 lbf) to the bag in an axial direction, and at 45 and 90 degree angle to the axial direction. The mask assembly must suffer no damage which will adversely affect subsequent operation.

6.1.4.4 Gas Bag Strength Tests: Seal off the passage between the gas bag and the facepiece of the mask, and apply a pressure of 6.89 kPa (1 lbf/in^2) to the bag, through the oxygen supply tube, for a period of three seconds. The gas bag must suffer no damage which will adversely affect subsequent operation.

6.1.5 Temperature Exposure Tests:

6.1.5.1 Low Temperature: With the gas bag folded and the tubing having at least one 180 degree bend of 12.7 mm (0.5 inch) radius, the mask shall be stabilized at a temperature of -57 °C (-70 °F) for a period of two hours and subjected to normal room ambient temperature for a further period of one hour. The mask shall then be tested at room temperature (see 6.1.2 - 6.1.4). Upon close visual inspection, the mask assembly shall show no signs of damage or deterioration and the flexible portions shall show no apparent change in flexibility. The tubing must straighten easily and must not crack, stick closed, or have an abnormal restriction to flow.

6.1.5.2 High Temperature: With the gas bag folded and the tubing having at least one 180 degree bend of 12.7 mm (0.5 inch) radius, the mask shall be stabilized at a temperature of 71 °C (160 °F) for a period of 120 hours and subjected to normal room ambient temperature for a further period of one hour. The mask shall then be tested at room temperature per 6.1.2 - 6.1.4. Upon close visual inspection, the mask assembly shall show no signs of damage or deterioration and the flexible portions shall show no apparent change in flexibility. The tubing must straighten easily and must not crack, stick closed, or have an abnormal restriction to flow.

6.1.6 Vibration Test: Set up the mask for a vibration test in a simulated in-flight stowage configuration with the hose coiled inside the mask unless the design of the mask dictates an alternate stowage configuration for the hose. In each of three mutually perpendicular directions, one being in line with the mask axis, make a slow frequency scan over the frequency range of Figure 6 for resonance. At each resonant frequency observed, vibrate for one million cycles or eight hours whichever occurs first, at the amplitudes shown in Figure 6, and in whichever direction the resonance was observed. If no resonances are found within the frequency range of Figure 6, vibrate the mask at 100 cycles per second and the corresponding amplitude of Figure 6, for one million cycles in each direction.

6.1.7 Performance Tests “A”: The performance of the mask shall be established by first determining a typical fit leakage value on representative human subjects, and then testing the mask on a breathing machine that can consistently produce the minute volumes and tidal volumes specified in Federal Aviation Regulation, FAR 25.1443. (c)(1) and (c)(2).

6.1.7.1 Human Subjects (Typical Fit Leak Value): A typical facial fit leak value shall be determined by testing masks on at least 75 randomly selected persons of both sexes who are inexperienced in the use of oxygen equipment. Selection of persons for test purposes shall be made from the public at random, with effort being made to ensure a wide variation in facial contours and to include both sexes and various age groups in approximately the following percentages:

TABLE 2

Age (Years)	Male (%)	Female (%)
5 - 15	3	3
15 - 25	9	7
25 - 45	39	12
Over 45	18	9

6.1.7.1.1 Briefing: Briefing shall simulate as closely as practical but no more detailed than that expected to be given passengers in air carrier operation. Such briefing should include at least the following instructions:

a. Grasp mask and place over nose and mouth.
b. Apply mask suspension device over the head.
c. Adjust mask manually to fit the face. Draft into eyes or onto other portions of the face during exhalation indicates a poor fit.

The subject shall not be given additional instructions, information, or aid of any kind other than to instruct the subject to inhale, hold his breath or breathe normally.

6.1.7.1.2 Test Method: Test at laboratory ambient conditions using a test rig capable of applying suction to the mask, and indicating pressures at the mask as well as providing data for determining any leakage flows arising from the fit of the mask to the face. The test rig should not significantly affect mask fit or performance.

Record mask pressures and leakage flow rates that existed while the subject was holding his breath, and then evaluate for 0.25 kPa (1.0 inch of water) suction pressure in the mask.

6.1.7.1.3 Test Results: The values obtained on all individuals must be reported and only one test per individual shall be permitted. The value of the mask leak rate, including mask peripheral leakage, below which 95% of the test results fall shall be the typical leak value for the mask and shall be reported in the test data and test report(s).

6.1.7.1.4 Alternate Dynamic Test Method:

6.1.7.1.4.1 Discussion: The objective of this test method is the same as that described in 6.1.7.1.2, that is to determine a typical mask fit value. The difference is that in the referenced paragraph the leakage rates are measured as volumetric flow rates, whereas in this dynamic test comparative levels of ambient trace gas shall be used to establish equivalent leakage for the breathing machine test in 6.1.7.2.

The advantage of the dynamic test is that it requires less subject discipline. It does not require him to hold his breath and the leakage values equivalents are obtained under dynamic breathing conditions. The test set-up, however, is more elaborate.

6.1.7.1.4.2 Test Set-up: A small sealed enclosure about the size of a telephone booth with large sealed windows is required in order to provide an ambient atmosphere of air with about 200 ppm of trace gas. The trace gas shall have high TLV (threshold limit value) such as n - Pentane or Freon - 12.

The chamber or enclosure shall be provided with a low velocity recirculation fan to mix the ambient chamber air. The chamber's design shall include an ambient chamber air purge system. The purge system shall consist of a vented hood exhaust fan to take the contaminated air out of the laboratory environment. An air inlet check valve or valves shall be provided in the chamber so that the laboratory air can be used to purge the chamber. The laboratory air can be used for the mask breathing media as long as it can be kept free of contamination and checked before and after each test.

6.1.7.1.4.2 (Continued):

A schematic of the test set-up is shown in Figure 7. A short breathing hose is connected from the mask inhalation valve or reservoir bag to a low pressure drop flow meter outside the chamber. The inlet of the flow meter is open to laboratory air. The flow meter shall provide a calibrated electrical output that is matched to a recorder to provide a continuous flow trace. A small hose sample tube shall be installed through the mask facepiece to provide for a continuous measurement of the trace gas leakage level. The tube shall be located so as to draw the sample at a point near the nostrils. Two other sample tubes shall also be provided to measure chamber ambient and laboratory ambient, respectively. The sample tubes shall be connected to a three-way manual sampling valve. The output from the three-way valve is connected to a continuous hydrocarbon detector with recorder. The recorded hydrocarbon level measurements shall be synchronized with the flow recorder. A two-way chamber communication system, while not mandatory, would be found useful.

6.1.7.1.4.3 Procedure: Test and calibrate instrumentation. The test chamber shall purge until there is no detectable level of trace gas from either the chamber or mask probe. Also check laboratory environment probe to make certain there is no detectable level of trace gas.

The subject shall then be briefed as defined in 6.1.7.1.1 and placed in the chamber. The subject shall be told to don the mask, and the chamber door is then closed and sealed. A quantity of n - Pentane (or other suitable hydrocarbon) shall be injected into the chamber at a point near the recirculation fan. The quantity injected should be sufficient to bring the trace gas level to approximately 200 ppm by volume. Following the subject's breathing pattern stabilization, the test shall be run for about three minutes.

6.1.7.1.4.4 Test Results: The values obtained on all individuals must be reported and only one test per individual shall be permitted. The data for each individual shall be evaluated for average flow rate, in L/min, and average trace gas level, in ppm. The trace gas level below which 95% of the other individual test subjects fall shall be the typical value.

The typical trace gas level also includes the typical flow rate which corresponds to the same individual average flow rate. The typical fit leakage value is then added to the breathing machine minute volume by repeating the typical chamber test with the breathing machine. The mask facepiece is hermetically sealed to the face of the breathing machine or to an adapter plate connected to the breathing machine outside the chamber.

The breathing machine is then set at the typical flow rate and a leakage orifice or other mechanism is then adjusted until the typical trace gas level is measured in the mask facepiece. The adjusted orifice is then locked and used in this position throughout the breathing machine testing.

6.1.7.1.5 Alternate Test Methods: An alternate test method to establish the typical mask fit leakage value is acceptable providing that it can be shown that the proposed method is equal to or better than the one described in 6.1.7.1.2.

6.1.7.2 Breathing Machine Tests with Typical Fit Leakage: Hermetically seal the facepiece of the test mask against the face of the breathing machine. Incorporate a mechanism to provide the typical fit leakage established in 6.1.7.1.3.

NOTE: The breathing machine shall have a simulated tracheal dead space of approximately 150 cm^3 and shall ensure a thorough mixing of the gases in the simulated lung. The respiratory rate and tidal volume shall be sufficiently adjustable to meet the requirements of this specification. The simulated respiratory flow shall essentially follow a sinusoidal pattern such as occurs in human respiration.

Figure 8 shows a recommended breathing machine schematic.

6.1.7.2.1 Performance Testing: For each mask tested, determine the added oxygen flow rates required to meet the required percentage total oxygen versus altitude curve (Curve B) Figure 1. Tests shall be conducted at a minimum of three different altitudes between 3048 m (10 000 ft) and 5639 m (18 500 ft) when the breathing machine minute volume is 15 L/min BTPS and the tidal volume is 700 cm^3 BTPS, and at 5639 m (18 500 ft) and the maximum altitude for which approval is desired plus a minimum of three additional approximately equally spaced intermediate altitudes when the breathing machine minute volume is 30 L/min BTPS and the tidal volume is 1100 cm^3 BTPS.

NOTE: For these tests, the percentage total oxygen may be estimated by measuring the percentage of O_2 in the simulated end tidal gases, or alternatively by subtracting the percentage of N_2 in the simulated expired end tidal gases from unity. All samples shall be taken during stabilized conditions.

6.1.7.2.2 Performance Analysis: Using the results obtained in 6.1.7.2.1 establish a mask performance curve as indicated for Curve C on Figure 1. In establishing this curve, a maximum of 5% of the values obtained may fall above the curve, provided these values appear to be randomly distributed with respect to the test conditions.

6.1.7.2.3 Establish Ground Level Performance: Select the mask from those tested per 6.1.7.2.1 whose performance most nearly coincides with the mask performance curve established per 6.1.7.2.2 at the maximum altitude for which approval is desired. Test this mask on a breathing machine having a minute volume of 15 L/min BTPS and a tidal volume of 700 cm^3 BTPS, at ground level, to determine the added oxygen flow rate required to maintain the percentage total oxygen corresponding to that required at the maximum altitude that approval is desired. Repeat this test but with a mask whose performance most nearly coincides with the mask performance curve established per 6.1.7.2.2 at 4572 m (15 000 ft). Determine the added oxygen flow rate required to maintain the percentage oxygen corresponding to that required at 4572 m (15 000 ft). The values of added oxygen flow rate versus percentage total oxygen thus obtained shall be the maximum permitted in the manufacturer's production performance test, per 6.4.3.

6.1.8 Performance Tests "B" (Human Subjects at Altitude): The validity of performance tests of 6.1.7 shall be demonstrated by testing 11 masks on at least 11 different randomly selected novice human subjects, except that only well indoctrinated subjects may be exposed to altitudes greater than 12 192 m (40 000 ft). Each subject shall be tested at increments of not more than 2286 m (7500 ft) altitude between 3048 m (10 000 ft) and the maximum altitude for which approval is desired with the mask held in place by the suspension device. Subject selection and briefing shall be made in accordance with 6.1.7.1. No test results may be discarded without adequate reason and full written explanation. For these tests, the subject shall wear the mask in an altitude chamber, and the oxygen flows to the mask at the various altitudes between 3048 m (10 000 ft) and the maximum altitude that approval is desired shall be as determined in 6.1.7.2.2. It is required that at some altitude no more than 1524 m (5000 ft) below the maximum altitude for which approval is desired at least three subjects reach a breathing rate of approximately 30 L/min BTPS. To achieve this rate, induced hyperventilation may be performed and established under close medical supervision. During the testing if the subject's arterial blood oxygen saturation falls below the base line established (Method of 6.1.8.2) or tracheal oxygen partial pressure falls below that required by applicable Federal Air Regulations (Method of 6.1.8.1), the oxygen flow to the mask shall be increased sufficiently to bring the blood oxygen saturation or the tracheal oxygen partial pressure to the required values. This oxygen flow value shall replace the previous value established for this altitude in 6.1.7.2.2 except that the flow schedule of only 10 of the 11 subjects need be included in the test results. Preoxygenation of the subjects prior to ascending to altitudes above 7620 m (25 000 ft) is considered desirable as a safety precaution. Either of the two following methods may be used to reaffirm that the mask shall deliver to the human the same percentage of oxygen as determined on a breathing machine.

NOTE: Where the validity of the results obtained under 6.1.7 has been previously established by comparisons with the results obtained under this paragrah, it is permissible to test only five subjects.

6.1.8.1 Gas Analysis Method (See Alternate Method, 6.1.8.2): For these tests, the percentage total oxygen in the inspired gases reaching the lungs may be estimated by adding the percentage of O_2 and the percentage of CO_2 in the expired end tidal gases, or alternatively by subtracting the percentage of N_2 in the expired end tidal gases from unity. All samples shall be taken during stabilized conditions.

Values so estimated must be equal to or in excess of that shown on the percentage total oxygen versus altitude curve of Figure 1. The minute volume of the subject, as estimated from measurements taken during the test, as well as the percentage total oxygen achieved shall be recorded at each interval of altitude at which a test is made.

6.1.8.2 Arterial Blood Oxygen Saturation Method (See alternate method, 6.1.8.1): For this test, the subject's arterial blood oxygen saturation shall be determined by use of the continuous recording oximeter. A base line of blood oxygen saturation shall be established for each subject as indicated below. Throughout the test, a drop below this base line shall not be allowed. The minute volume of the subject as estimated from measurements taken during the test, as well as the blood oxygen saturation values achieved, shall be recorded at each interval of altitude at which a test is made.

6.1.8.2.1 Establish Blood Oxygen Saturation "Base Line": When the method of 6.1.8.2 is used the blood oxygen saturation "base line" shall be established for each test subject prior to but as near as practical to the time of conducting the altitude tests. Insofar as possible, the test subject shall be exposed to the same conditions when the "base line" is being established as those, which he will be exposed during the altitude mask testing. This shall include such things as his sitting posture, degree of activity, instrumentation and other devices that might affect his blood oxygen saturation.

Affix the oximeter to the seated subject breathing ambient air in an altitude chamber and ascend to 3048 m (10 000 ft). Level off, and for a period of three minutes or until stabilized readings are achieved, establish his oxygen blood saturation. The resultant recorded percent saturation shall be the subject's 3048 m (10 000 ft) "base line", which shall be considered to correspond to 100 mm Hg mean tracheal oxygen partial pressure. Ascend to 4267 m (14 000 ft) and similarly establish the subject's 4267 m (14 000 ft) "base line" at this altitude with the subject breathing ambient air. This "base line" shall be considered to correspond to 83.8 mm Hg mean tracheal oxygen partial pressure.

6.1.8.2.2 Procedure: Ascend to 9144 m (30 000 ft) with the subject wearing a pressure demand type mask and breathing 100% oxygen. Level off and have the test subject put on the test mask. The oxygen supply to the test mask at this and subsequent levels shall be as determined in 6.1.7.2.2. Ascend to the maximum altitude that approval is desired, level off, remain at this altitude until the oxygen saturation has stabilized, but in no case remain for less than three minutes at this altitude. Record the minute volume and the lowest values for blood oxygen saturation obtained. The reading shall not fall below the required values. (See 6.1.8.) Should this happen, immediately increase the oxygen flow to the mask per 6.1.8 and make the required changes to 6.1.7.2.2 and repeat all tests from 6.1.7.2.2 - 6.1.8.2.2. Descend at 7500 ft intervals recording the blood oxygen saturation and the minute volume as above at each interval.

6.1.9 Guaranteed Minimum Performance: The performance curve data established in 6.1.7.2.2 and verified in 6.1.8.1 or 6.1.8.2 shall be included in the test report that is submitted for approval by the mask manufacturer. Individual mask assemblies and their performance shall be identified by appropriate coding as shown in 2.3.

6.1.10 Cold Tests (Ground Level Pressure): Ensure the mask temperature has stabilized to approximately 21 °C (70 °F), then on exposing the mask to an ambient temperature of -40 °C (-40 °F) for a minimum period of five minutes, test immediately on a human subject for a three minute period. The mask shall function in a satisfactory manner under these conditions, with a nominal supply of 3 L/min NTPD of oxygen flowing to the mask.

6.1.11 Endurance Test: The mask shall be subjected to a minimum of 50 000 simulated breathing cycles at an approximate rate of 30 cycles per minute. Oxygen delivery during the inspiration half cycle shall follow a smooth curve, essentially sinusoidal, in which flow is at least 70 L/min ATPD for 10% of the time, and at least 30 L/min ATPD for 50% of the remaining time. The mask must operate satisfactorily throughout this test. At the end of this test, the mask shall be tested in accordance with 6.1.7.2.1, and meet the minimum performance curve established for the mask per 6.1.7.2.2.

6.1.12 Test Omissions: Although specific tests are not called for to cover every requirement of this specification, this does not release the manufacturer from the responsibility of furnishing a mask that meets these requirements.

6.2 Left Blank Intentionally

6.3 Left Blank Intentionally

6.4 Manufacturer's Production Tests:

6.4.1 Strength Tests: Support the mask assembly by the inlet end of the oxygen supply tube and apply a static force of 88.96 N (20 lbf) to the facepiece for a period of three seconds. The mask assembly must not suffer damage or adverse effects.

6.4.2 Flow Resistance:

6.4.2.1 Inhalation Flow Resistance: Seal the periphery of the facepiece of the mask to an appropriate fixture that is capable of producing a suction within the mask and measuring this suction and suction flow rate. Plug the oxygen supply tube. Adjust the suction flow rate to 30 L/min. The suction inside the facepiece shall not exceed 0.20 kPa (0.80 inches of water). The suction shall not exceed 0.50 kPa (2.0 inches of water) when the suction flow rate is increased to 70 L/min.

6.4.2.2 Exhalation Flow Resistance: Seal off the periphery of the facepiece of the mask. Connect the oxygen supply tube to the test gas source through an appropriate measuring device. Adjust the flow to 30 L/min and measure the differential pressure between the interior of the facepiece and the ambient. This differential pressure shall not exceed 0.20 kPa (0.80 inches of water). Repeat test at 70 L/min flow. This differential shall not exceed 0.50 kPa (2.0 inches of water).

6.4.3 Performance Tests: Test each mask at ground level altitude at a breathing minute volume of 15 L/min BTPS and a tidal volume of 700 cm^3 BTPS and with the two oxygen flow rates established per 6.1.7.2.3. The percentage total oxygen values so obtained shall equal or exceed the respective values used in 6.1.9.

NOTE: This test shall be mandatory until such time as a reliable quality level is established. A reliable quality level shall have been established when 10 consecutive production masks have passed this test with no failures, following which, five consecutive production lots shall have passed test without any rejections. For this purpose, each lot shall not exceed 100 in number and 10 sample masks from each lot shall be tested as above.

On establishment of a reliable quality level, sample testing after production line inspection shall be made on four in every 250 production masks. When any sample mask fails to meet the test requirements, this sequence of testing shall be reinstated, beginning with the first mask of the lot then being tested, so that a reliable quality level can be established.

6.4.4 Other Tests: It shall be the manufacturer's responsibility to formulate and pursue a quality control program that will result in a high and stable quality level. The foregoing tests which have been stipulated should in no way be construed as establishing limits beyond which the manufacturer need not go in assuring compliance with all design requirements of the specified article. It is expected that the mask manufacturer will search for, and correct, those deficiencies which would decrease the usability and proper general function of the mask under the actual altitude conditions expected in service.

7. PREPARATION FOR DELIVERY:

7.1 Mask Sterilization:

Masks shall be in a clean and sterile condition when packaged for delivery.

7.2 Packaging:

Materials and methods used in packaging the mask assembly shall be suitable to ensure its protection from contamination, damage or deterioration.

7.3 Marking:

All containers including individual packages and outer cartons shall be marked with the following information:

a. Manufacturer's Name
b. Appropriate AS Standard Part and Coding
c. Name of Part
d. Manufacturer's Part Number (including dash number when used)
e. Manufacturing Date
f. Quantity in Container
g. Estimated Shelf Life
h. TSO Number (if applicable)

7.4 Instruction Tag:

Where the procuring activity is aware that the manufacturer's article requires special attention during receiving/inspection or installation or operation, the procuring activity shall make special request to the manufacturer to provide a removable instruction tag affixed to each article.

7.5 Special Handling Procedure:

Where the manufacturer is aware that certain non-obvious characteristics of his version of the specified article shall require special handling procedures, it shall be the responsibility of the manufacturer to notify the procuring activity to that effect and thereafter to affix an appropriate removable instruction tag to each production article delivered.

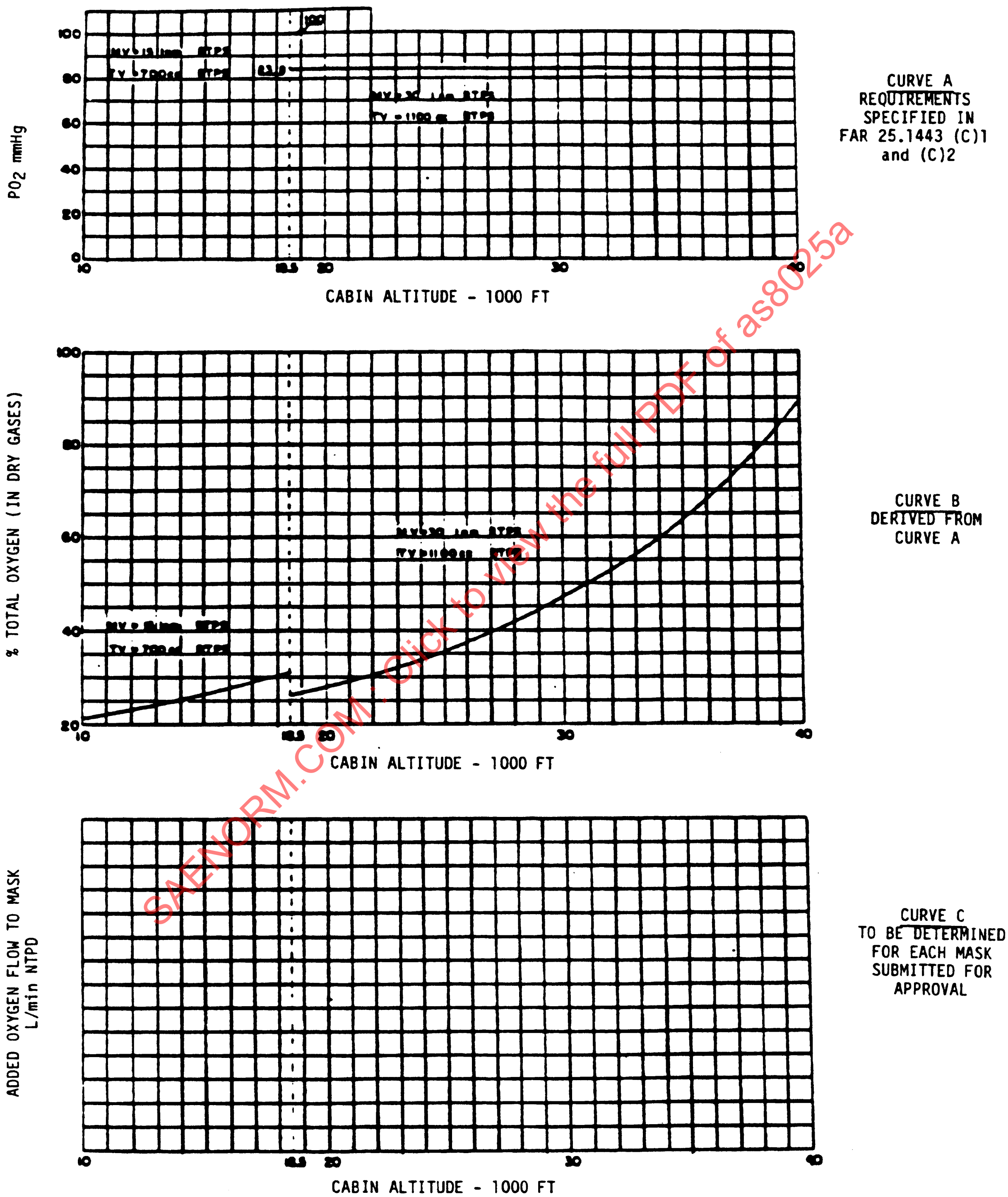

FIGURE 1 - Performance Testing Criteria

PO_2 = 100 mm Hg
MV = 15 lpm BTPS
TV = 700 cc BTPS

ALTITUDE FEET	% TOTAL O_2
10,000	21.02
11,000	21.94
12,000	22.91
13,000	23.94
14,000	25.02
15,000	26.17
16,000	27.39
17,000	28.68
18,000	30.05
18,500	30.77

PO_2 = 83.8 mm Hg
MV = 30 lpm BTPS
TV = 1100 cc BTPS

ALTITUDE FEET	% TOTAL O_2
18,500	25.78
19,000	26.40
20,000	27.70
21,000	29.08
22,000	30.55
23,000	32.12
24,000	33.81
25,000	35.60
26,000	37.52
27,000	39.59
28,000	41.81
29,000	44.20
30,000	46.78
31,000	49.57
32,000	52.59
33,000	55.87
34,000	59.43
35,000	63.33
36,000	67.59
37,000	72.25
38,000	77.33
39,000	82.88
40,000	88.98

Data based on "The ARDC Model Atmosphere, 1959"

FIGURE 2 - Coordinates for Curve B of Figure 1