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PROCUREMENT SPECIFICATION	TITLE	CLASSIFICATION
	OXYGEN MASK ASSEMBLY, PASSENGER	SPECIFICATION
		NAS 1179 SHEET 1 OF 15

APPROVAL DATE Dec. 1959 REVISION (1) 15 Feb. 1961 (2) 31 March 1961 (3) 15 Sept. 1975 (4) 30 April 1977

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LIST OF ABBREVIATIONS AND DEFINITIONS

SYMBOL	
O_2	Oxygen
CO_2	Carbon dioxide
N_2	Nitrogen
I.D.	Inside diameter
O.D.	Outside diameter
lpm	Liters per minute
F	Added oxygen
TV	Tidal volume (volume of one inhalation)
MV	Respiratory minute volume (volume breather per minute)
STPD	Standard temperature and pressure dry. [0°C (32°F) and 760 mm Hg]
BTPS	Body temperature and pressure saturated. [37°C (98.6°F) and ambient pressure]
NTPD	Normal temperature and pressure dry. [21°C (70°F) and 760 mm Hg]
Total Oxygen	Added oxygen plus oxygen in dry air
% Total Oxygen	Percentage of oxygen by volume contained in dry gases
PO_2	Mean tracheal partial pressure of oxygen in the inspired gases reaching the lungs
Gas Bag	A container used to store supply oxygen or a mixture of supply oxygen and exhaled gases.
ATA	Air Transport Association
CAR	Civil Air Regulations
FAA	Federal Aviation Agency

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PROCUREMENT SPECIFICATION	TITLE	CLASSIFICATION SPECIFICATION
	OXYGEN MASK ASSEMBLY, PASSENGER	NAS 1179 SHEET 2

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1. SCOPE

1.1 PURPOSE - This specification defines the minimum requirements for the design, construction, and performance of continuous flow oxygen masks for passengers in civil aircraft.

1.2 DESCRIPTION - The mask shall be an oronasal type utilizing a continuous supply of oxygen and comprising a facepiece with valves as required, a mask suspension device, a reservoir bag (when used) and a length of tubing for connection to the oxygen supply source. The assembly shall be capable of being stowed suitably to meet the requirements of its intended use.

1.3 PRESENTATION - When presented, its immediate application shall be as obvious as possible. The mask shall be capable of quick and easy application. It shall be usable without special orientation.

1.4 CODING OF PERFORMANCE CLASSIFICATION - A performance classification number shall be assigned to each class of masks. This number shall correspond to the number assigned to the minimum performance curve on the NAS Standard Drawing and shall appear in the part call-out as the first dash number following the NAS Standard Part number. Where the performance of a mask differs appreciably from any of the minimum performance curves existing on the NAS Standard Drawing, the proven performance curve for this mask may be added to the appropriate NAS Standard Drawing. This mask would then be assigned a performance classification number corresponding to this new performance curve on the NAS Standard Drawing.

Example: NAS XXXX-XX - - - Additional codings as may be desirable

- Performance Classification
- Appropriate NAS Standard Part

1.5 INTERCHANGEABILITY OF MASK ASSEMBLIES -

1.5.1 Same Coding - Masks with the same coding shall be interchangeable.

1.5.2 Different Performance Classification Numbers (remainder of coding the same) - All masks with performance classification numbers which require oxygen flow rates less than the flow rates supplied to the mask from the airplane system at all certificated cabin altitudes are interchangeable on that airplane.

X 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 test, shall form a part of this specification:

MIL-P-7105	Pipe Threads, Taper, Aeronautical National Form, Symbol ANPT
MIL-S-7742	Screw Threads, Standard Aeronautical
BB-O-925	Oxygen 99.5 per cent, Gas and Liquid
MIL-N-6011	Nitrogen, Liquid and Gas
MS33586	Metals - Definition of Dissimilar
Federal Standard No. 595	Colors

(2) (Deleted)

NOTE: Additional NAS Standard Part numbers will be added, if required, to cover newly approved masks or class of masks.

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:

A.T.A. 100	Specification for Manufacturer's Technical Data
MIL-E-5272	Environmental Testing, Aeronautical and Associated Equipment, General Specification

3. REQUIREMENTS

3.1 GENERAL DESIGN REQUIREMENTS

X 3.1.1 Product - The article furnished under this specification shall be a product which is capable of meeting the appropriate requirements specified herein.

X 3.1.2 Deviations - Where the requirements of this specification differ from the requirements of the specifications, drawings, and publications listed, the requirements of this specification shall govern.

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3.1.3 Materials -

3.1.3.1 General - Materials shall be of type, grade, and quality which experience and/or tests have demonstrated to be suitable for the purpose intended. Materials shall not be used which contaminate oxygen or are affected adversely by continuous service with oxygen. Materials shall have ~~at least flame~~-resistant properties as specified in the applicable Civil Air Regulations.

3.1.3.2 Facepiece - The facepiece shall be free of objectionable odors. Materials in contact with skin shall be selected to be nonallergenic and nonirritating.

3.1.3.3 Cleaning and Sterilizing - The mask shall be made of materials which will permit cleaning and sterilization without adverse effects and without disassembly. The method of cleaning and sterilizing shall be recommended by the mask manufacturer.

3.1.3.4 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 for which a longer period has proven feasible. The date (quarter and year) the elastomer was cured shall be permanently and legibly stamped on each part with a suitable ink. The life expectation of the elastomer which has the shortest remaining serviceable life shall govern the life expectancy of the mask assembly.

3.1.3.5 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.

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

3.1.3.7 Material Specification - The material specification of all parts of this mask assembly shall be submitted for approval to the procuring activity.

3.1.4 Workmanship - The mask shall be fabricated and finished in accordance with the highest grade practice in the manufacture of this type of equipment. The finished mask and all internal parts shall be clean throughout and free of fins, burrs, scale, oils, and all materials which might adversely affect the safe operation of the mask.

3.1.5 Finish - All materials which are not inherently corrosion resistant shall be finished with a protective treatment or coating to minimize the effect of exposure to the environmental conditions which 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.

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

3.1.7 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 safety.

3.1.8 Weight - The weight of the mask assembly shall not exceed the value shown on the appropriate NAS Standard Drawing.

3.1.9 Deterioration - Deterioration or corrosion of any component which could in any manner prevent the equipment from meeting operational requirements during service life shall provide reason to consider the equipment as having failed to meet the requirements of this specification.

3.1.10 Service Life - The service life of the article after delivery to the procuring agency shall not be less than the value specified by the manufacturer of the mask.

3.1.11 Reliability - Reliable operation shall be a major consideration, even after long periods of inattention during stowage in aircraft and/or during its shelf life.

3.1.12 Identification Markings - The following information shall be marked on the outside of the article using materials and/or processes that will 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. The notation "NAS XXXX-XX" (with appropriate NAS Standard Part Number and dash numbers)

e. Elastomer cure date (see Paragraph 3.1.3.4)

f. Picture (see Paragraph 3.3.12)

g. Date of manufacture

h. Service life (months)

i. TSO number (optional)

3.2 DETAIL CONSTRUCTION REQUIREMENTS -

3.2.1 Dimensions - The mask assembly shall meet the dimensional requirements shown on the appropriate NAS Standard Drawing.

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3.2.2 Facepiece Assembly -

3.2.2.1 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.

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

3.2.2.3 Resilience - 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.

3.2.2.4 Valve Design - Valves, where used, shall be designed to offer negligible resistance (Reference Paragraph 3.3.8) to inflow of oxygen and ambient air during inhalation, and to outflow of used air during exhalation.

3.2.2.5 Attachment of Mask Suspension Device - Provisions shall be made on the facepiece for attaching a mask suspension device, the attachment of which shall not restrict the orientation of the mask.

3.2.2.6 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 cord to turn on the oxygen supply. This cord must be capable of withstanding a pull of 10 pounds.

3.2.3 Mask Suspension Device - A simple mask suspension device shall be provided for holding the mask on the user's face. 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 suspension device shall be stowed on the facepiece in a manner such that it will not interfere with automatic presentation of the mask assembly where so presented, with hand-held usage, or with normal operation of the mask. The mask shall remain serviceable in its stowed configuration until it is required for its specific application.

3.2.4 Actuation Cord For Turning On Oxygen Supply - The actuation cord, when used, shall conform to the applicable part of the appropriate NAS Standard Part.

(2) 3.2.5 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 5 pounds for three seconds and 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 0.5 inch of water positive pressure:

Type	Minimum Volume (cc)	Maximum Volume (cc)
Reservoir	1,000	1,500
Rebreather	800	1,000

3.2.6 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 adequate for its intended use. The tubing shall be fully flexible within a temperature range of -29°C (-20°F) to 71°C (160°F). The tubing shall be capable of being bent to a 0.5 inch mean radius for stowage purposes with less than a 5% restriction to flow.

3.3 PERFORMANCE REQUIREMENTS - Unless otherwise specified, all flow requirements refer to oxygen.

3.3.1 Environmental Conditions -

3.3.1.1 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 maximum stowage envelope shall be as shown on the applicable NAS Standard Drawing. Where mask is to be automatically presented, the mask shall fall freely from an inverted rigid box of the envelope dimensions to demonstrate compliance.

3.3.1.2 Temperature and Humidity - The assembly shall be capable of being stowed at temperatures of 71°C (160°F for 120 hours and -55°C (-67°F) for 2 hours, at relative humidities varying from 5% to 95%, without adversely affecting subsequent performance after return to normal temperature.

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

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

3.3.1.4.1 Resonance: One million cycles or 8 hours, whichever occurs first, at each resonance occurring within the frequency range of Figure 1. (Where several resonances are encountered the vibration periods may then be limited to those resonances considered most likely to produce failure.)

3.3.1.4.2 No Resonance: One million cycles in each of three mutually perpendicular directions, at 100 cycles per second and the corresponding amplitude of Figure 1.

3.3.2 Operational Serviceability -

3.3.2.1 Presentation - After exposure to any of the conditions of Paragraph 3.3.1 the mask assembly, including supply tubing, shall be capable of being presented from its stowed configuration and meeting the performance requirements specified herein.

3.3.2.2 Altitude - Over-all operation shall be satisfactory following sudden pressure changes from sea level to at least the maximum altitude for which approval is desired.

3.3.2.3 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 suddenly exposed to -40°C (-40°F) for a minimum period of 5 minutes.

3.3.3 Endurance - The mask assembly shall be capable of satisfactory operation to a minimum of 50,000 simulated breathing cycles at an approximate rate of 30 cycles per minute, at a peak delivery rate of 70 lpm STPD for 10% of the inspiration time, and at 30 lpm STPD for 90% of the inspiration time.

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3.3.4 Sterilization - The article shall be capable of being subjected to the cleaning and sterilization treatment recommended by the manufacturer, without disassembly and with no adverse effects.

3.3.5 Strength -

3.3.5.1 Assembly - When supported at the inlet end of the oxygen supply tubing, the assembly shall withstand, without damage, a static load of 20 pounds applied at the facepiece for a period of three seconds.

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

3.3.5.3 Gas Bag - The gas bag when used shall be capable of withstanding 1 psi internal gage pressure without damage.

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

3.3.7 Leakage -

3.3.7.1 Facepiece Total Leakage - The facepiece total leakage, including peripheral leakage when the mask is worn, shall be a minimum.

3.3.7.2 Gas Bag Leakage - Where used, the gas bag including connections to the facepiece and supply tubing shall have no detectable leakage when pressurized to 3.0 inches of water.

3.3.8 Breathing Resistance -

3.3.8.1 Inward Flow Resistance - The suction within the mask shall not exceed 0.60 inches of water when the inhalation flow rate is 30 lpm STPD at ground level conditions and for all expected oxygen supply flow rates. At an inhalation flow rate of 70 lpm the suction within the mask shall not exceed 1.2 inches of water.

NOTE: Values up to 0.80 and 2.0 inches of water may be used in place of 0.60 and 1.2 inches of water respectively where test data for an individual mask indicates these values to be satisfactory from the user's standpoint.

3.3.8.2 Outward Flow Resistance - The pressure build-up within the mask shall not exceed 0.80 inch of water when discharging a flow of 30 lpm STPD at ground level conditions. At 70 lpm the pressure build-up shall not exceed 2.0 inches of water.

3.3.9 Mask Performance - It is the intent of this specification that the mask assembly, as used by unindoctrinated airline passengers will be able to maintain during inspiration mean tracheal oxygen partial pressures at least as great as those specified in the appropriate Civil Air Regulations, when the mask is connected to an oxygen source which supplies oxygen at the flow rates which have been determined to be necessary for the particular mask assembly. These required minimum flow rates are specified on the appropriate NAS Standard Drawing.

3.3.10 Service Life - At the end of and during the service life specified and/or established by the mask manufacturer, the mask assembly shall be operationally serviceable and capable of meeting the appropriate requirements specified herein.

3.3.11 Technical Data -

3.3.11.1 Certified Test Reports - The manufacturer or his authorized representative shall submit four (4) copies of a certified test report showing compliance with this specification for approval to the procuring activity. Qualification data shall be furnished prior to or concurrently with the delivery of the first mask.

3.3.11.2 Bid Data Drawings - Manufacturer's drawings showing the detail design of the mask assembly being proposed in accordance with this specification shall be furnished by the manufacturer with his bid. In addition, schematic drawings of the mask operation shall be furnished with adequate descriptive material to facilitate the installation of the mask.

3.3.11.3 Engineering Data - A mask outline drawing for installation shall be submitted for approval to the procuring activity.

3.3.11.4 Manuals - The manufacturer shall furnish to the procuring activity a reproducible master to cover maintenance, operation, and parts per ATA No. 100, with data to cover overhaul procedure and servicing.

3.3.11.5 Test Program - A test program based on the tests and testing sequence specified by the specification and planned to demonstrate compliance with the requirements of the applicable specification shall be prepared by the manufacturer. The test program shall consist of a summary of the tests to be conducted, an itemized list of tests and testing sequences to be performed, schematics of test set-up for each specific test and a complete list of test equipment to be utilized showing manufacturer, part number, and accuracy and response time of unit. Specification tests which the manufacturer intends to omit on the basis of similarity with previous tests shall be noted. Copies of the test program shall be submitted for approval to the procuring activity.

3.3.11.6 Installation Approval - The manufacturer shall be required to give written approval of the mask installations in the airplane. This written approval is to assure the Engineering Departments of the user that the manufacturer is familiar with the installation and the masks, so installed, will operate as required by this specification.

3.3.12 Picture on Gas Bag - A picture as shown in Figure 4 shall be permanently printed on each side of the gas bag in a color which will contrast with the bag. The picture shall be oriented so that the head of the man is toward the end of the bag which is farthest from the facepiece. The picture on one side shall be the mirror image of the picture on the opposite side.

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4. QUALITY ASSURANCE PROVISIONS

4.1 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 which have been performed on similar units may be omitted, provided that the vendor shall show in the test report qualified proof of similarity and of performance of such tests, including applicability of such tests. Tests called for in Paragraphs 4.1.2 through 4.1.4 inclusive shall be run on at least five different masks. Tests called for in Paragraphs 4.1.5, 4.1.6, 4.1.10 and 4.1.11 shall be run on at least one mask. For tests called for in Paragraph 4.1.7 at least ten masks will be used. Each test mask shall be representative of production units and shall be individually identified.

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.

4.1.1 Test Conditions -

4.1.1.1 Gas - The gas used in testing the mask shall be either oxygen conforming to Specification BB-O-925 Grade A, or water pumped nitrogen conforming to Specification MIL-N-6011, or water pumped air equivalent in dryness to Specification MIL-N-6011 nitrogen. If nitrogen or air is used, appropriate density correction factors shall be applied to the flow meter used.

4.1.1.2 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 will be made at atmospheric pressure of approximately 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 STPD.

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

4.1.2 Test for Leakage -

4.1.2.1 Gas Bag Leakage - Seal off the gas bag connection to the mask and apply at least 3.0 in. 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.

4.1.3 Test for Flow Resistance -

4.1.3.1 Inward Flow Resistance - Seal the periphery of the facepiece of the mask to an appropriate fixture which is capable of producing suction within the mask and measure this suction and the suction flow rate. Plug the oxygen supply tube. Adjust the suction flow rate to 30 lpm and measure the suction inside the facepiece. The suction shall not exceed 0.60 inch of water. The suction shall not exceed 1.2 inches of water when the test is repeated with a suction flow rate of 70 lpm.

NOTE: Values up to 0.80 and 2.0 inches of water may be used in place of 0.60 and 1.2 inches of water respectively where test data for an individual mask indicates these values to be satisfactory from the user's standpoint.

4.1.3.2 Outward 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 lpm and measure the differential pressure between the interior of the facepiece and the ambient. This differential pressure shall not exceed 0.8 inch of water. Repeat test at 70 lpm flow. This differential pressure shall not exceed 2.0 inches of water.

4.1.4 Strength Tests -

(2) 4.1.4.1 Mask Assembly Strength Tests - Support the mask assembly by the inlet end of the oxygen supply tube and apply a static force of 20 pounds to the facepiece for a period of three seconds. With the mask assembly supported by the inlet end of the oxygen supply tube, apply a static force of 5 pounds to the reservoir bag for a period of three seconds. Support the mask assembly by the facepiece and apply a static force of 5 pounds to the bag in an axial direction, and at 45° and at 90° angle to the axial direction. The mask assembly must suffer no damage which will adversely affect subsequent operation.

4.1.4.2 Gas Bag Strength Tests - Seal off the passage between the gas bag and the facepiece of the mask, and apply a pressure of 1 psi 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.

4.1.5 Temperature Exposure Tests -

4.1.5.1 Low Temperature - With the gas bag folded and the tubing having at least one 180° bend of 0.5 inch radius, the mask shall be stabilized at a temperature of -55°C (-67°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 per Paragraphs 4.1.2 through 4.1.4. 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.

4.1.5.2 High Temperature - With the gas bag folded and the tubing having at least one 180° bend of 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 Paragraphs 4.1.2 through 4.1.4. 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.

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4.1.6 Vibration Test - Set up the mask for a vibration test with the mask in the appropriate rigid box stowage configuration shown on the appropriate NAS Standard Drawing. 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 1 for resonance. At each resonant frequency observed, vibrate for one million cycles or eight hours, whichever occurs first, at the amplitudes shown in Figure 1, and in whichever direction the resonance was observed. If no resonances are found within the frequency range of Figure 1, vibrate the mask at 100 cycles per second and the corresponding amplitude of Figure 1, for one million cycles in each direction.

4.1.7 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 which can consistently produce the minute volumes and tidal volumes specified in the appropriate Civil Air Regulations.

4.1.7.1 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:

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

4.1.7.1.1 Test Methods: 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.

4.1.7.1.2 Briefing: Briefing shall simulate as closely as practical but be 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

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 and hold his breath.

4.1.7.1.3 Test Results: Record mask pressures and leakage flow rates which existed while the subject was holding his breath, and then evaluate for 1.0 inch of water suction in the mask. The values obtained on all individuals must be reported and only one test per individual shall be permitted. Mask leak value including mask peripheral leakage determination shall be made in accordance with commonly accepted procedures. The value of the leak rate 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).

4.1.7.2 Breathing Machine Tests with Typical Fit Leakage - When using a breathing machine for test purposes, 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 Paragraph 4.1.7.1.3.

NOTE: The breathing machine shall have a simulated tracheal dead space of approximately 150 cc 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 sinusodial pattern such as occurs in human respiration.

4.1.7.2.1 Performance Testing: For each mask tested, determine the added oxygen flow rates required to meet the percentage total oxygen vs. altitude curve (Curve B) Figure 2. Tests shall be conducted at a minimum of three different altitudes between 10,000 feet and 18,500 feet when the breathing machine minute volume is 15 lpm BTPS and the tidal volume is 700 cc BTPS, and at 18,500 feet 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 lpm BTPS and the tidal volume is 1100 cc BTPS. (2)

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.

4.1.7.2.2 Performance Analysis: Using the results obtained in Paragraph 4.1.7.2.1, establish a mask performance curve as indicated for Curve C of Figure 2. In establishing this curve, a maximum of 5 per cent of the values obtained may fall above the curve, provided these values appear to be randomly distributed with respect to the test conditions.

4.1.7.2.3 Establish Ground Level Performance: Select the mask from those tested per Paragraph 4.1.7.2.1 whose performance most nearly coincides with ~~the mask performance curve established per Paragraph 4.1.7.2.2~~ at the maximum altitude for which approval is desired. Test this mask on a breathing machine having a minute volume of 15 lpm BTPS and a tidal volume of 700 cc 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 for which approval is desired. Repeat this test but with mask whose performance most nearly coincides with the mask performance curve established per Paragraph 4.1.7.2.2 at 15,000 feet. Determine the added oxygen flow rate required to maintain the percentage oxygen corresponding to that required at 15,000 feet. The values of added oxygen flow rate vs. percentage total oxygen thus obtained will be the maximum permitted in the manufacturer's production performance test, per Paragraph 4.3.3.

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4.1.8 Performance Tests "B" (Human Subjects at Altitude) - The validity of performance tests of Paragraph 4.1.7 shall be demonstrated by testing ten masks on at least ten different randomly selected novice human subjects, except that only well indoctrinated subjects may be exposed to altitudes greater than 40,000 feet. Each subject shall be tested at increments of not more than 7500 feet altitude between 10,000 feet 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 4.1.7.1. 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 10,000 feet and the maximum altitude for which approval is desired shall be as determined in Paragraph 4.1.7.2.2. It is required that at some altitude no more than 5,000 feet below the maximum altitude for which approval is desired at least three subjects reach a breathing rate of approximately 30 lpm 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 4.1.8.2) or the tracheal oxygen partial pressure falls below that required by applicable Civil Air Regulations (Method of 4.1.8.1), 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 4.1.7.2.2. Pre-oxygenation of the subjects prior to ascending to altitudes above 25,000 feet is considered desirable as a safety precaution. Either of the two following methods may be used to reaffirm that the mask will deliver to the human the same percentage of oxygen as determined on a breathing machine.

NOTE: Where the validity of the results obtained under Paragraph 4.1.7 has been previously established by comparisons with the results obtained under this paragraph, it is permissible to test only five subjects.

4.1.8.1 Gas Analysis Method (See alternate method, Paragraph 4.1.8.2) - 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 vs. altitude curve of Figure 2. 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.

4.1.8.2 Arterial Blood Oxygen Saturation Method (See alternate method, Paragraph 4.1.8.1) - 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.

4.1.8.2.1 Establish Blood Oxygen Saturation "Base Line": When the method of Paragraph 4.1.8.2 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. In so far as possible the test subject shall be exposed to the same conditions when the "base line" is being established as those to 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 which might affect his blood oxygen saturation.

Affix the oximeter to the seated subject breathing ambient air in an altitude chamber and ascend to 10,000 feet. 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 10,000 feet "base line" which shall be considered to correspond to 100 mm Hg mean tracheal oxygen partial pressure. Ascend to 14,000 feet and similarly establish the subject's 14,000 feet "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.

4.1.8.2.2 Procedure: Ascend to 30,000 feet with the subject wearing an A-13A (or similar 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 Paragraph 4.1.7.2.2. Ascend to the maximum altitude for which 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 4.1.8. Should this happen, immediately increase the oxygen flow to the mask per 4.1.8 and make the required changes to 4.1.7.2.2 and repeat all tests from Paragraph 4.1.7.2.2 through Paragraph 4.1.8.2.2. Descend at 7,500 feet intervals recording the blood oxygen saturation and the minute volume as above at each interval.

4.1.9 Guaranteed Minimum Performance - The performance curve data established in Paragraph 4.1.7.2.2 and verified in Paragraph 4.1.8.1 or 4.1.8.2 shall be included in the test report which is submitted for approval by the mask manufacturer. Upon approval of the report this performance data shall be incorporated as a part of the relevant NAS Standard Drawing. Individual mask assemblies and their performance will be identified by appropriate coding of the relevant NAS Standard part number.

4.1.10 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) 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 lpm NTPD of oxygen flowing to the mask.

4.1.11 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 lpm for 10% of the time, and over 30 lpm 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 Paragraph 4.1.7.2.1, and meet the minimum performance curve established for the mask per Paragraph 4.1.7.2.2.

4.1.12 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 which will meet these requirements.

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4.2 INSPECTION BY USER - Upon completion of manufacturer conducted qualification tests, the masks which have been tested shall be delivered with the qualification test report for inspection. Cost of qualification tests shall be borne by the manufacturer.

4.3 MANUFACTURER'S PRODUCTION TESTS -

4.3.1 Strength Tests - Support the mask assembly by the inlet end of the oxygen supply tube and apply a static force of 20 pounds to the facepiece for a period of three seconds. The mask assembly must not suffer damage or adverse effects.

4.3.2 Flow Resistance -

4.3.2.1 Inward Flow Resistance - Seal the periphery of the facepiece of the mask to an appropriate fixture which 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 lpm. The suction inside the facepiece shall not exceed 0.60 inch of water. The suction shall not exceed 1.2 inches of water when the suction flow rate is increased to 70 lpm.

NOTE: Values up to 0.80 and 2.0 inches of water may be used in place of 0.60 and 1.2 inches of water respectively where test data for an individual mask indicates these values to be satisfactory from the user's standpoint.

4.3.2.2 Outward 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 lpm and measure the differential pressure between the interior of the facepiece and the ambient. This differential pressure shall not exceed 0.8 inch of water. Repeat test at 70 lpm flow. This differential shall not exceed 2.0 inches of water.

4.3.3 Performance Tests - Test each mask at ground level altitude at a breathing minute volume of 15 lpm BTPS and a tidal volume of 700 cc BTPS and with the two oxygen flow rates established per Paragraph 4.1.7.2.3. ~~The percentage total~~ oxygen values so obtained shall equal or exceed the respective values used in Paragraph 4.1.9.

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 ten 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 ten 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.

4.3.4 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 which might be expected in service.

4.3.5 Approval - A production test procedure document shall be submitted for approval to the procuring activity.

5. PREPARATION FOR DELIVERY

5.1 MASK STERILIZATION - Masks shall be in a clean and sterile condition when packaged for delivery.

5.2 GENERAL INSTRUCTIONS - Where size or other consideration result in more than one unit being packaged within a shipping carton, the individual units shall be individually packaged within the shipping carton. This requirement is mandatory in order to provide suitable protection and identification during storage and handling after removal of the individual units from the major shipping carton. Whenever practicable, each unit shall be packaged with the supply hose wound within the facepiece. The hose shall be so wound that when pulled out of the facepiece it will not cause the gas bag to twist or otherwise restrict the flow of oxygen into the facepiece. It is suggested that one-half of the hose be wound clockwise and the other half counterclockwise.

5.3 DEVIATION - Any deviation from the above required individual packaging requirement must in all cases be approved by the procuring activity prior to shipment of the parts from the manufacturer's factory.

5.4 CONTAINERS - Individual containers shall be so constructed as to allow removal of the mask for inspection purposes without damaging the container or labels.

5.5 PACKAGING - Materials and methods used in packaging the article shall be suitable to ensure protection of the article from damage or deterioration.

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

a. Manufacturer's Name

b. Appropriate NAS 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. TSO Number (optional)

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5.7 INSTRUCTION TAG - Where the procuring activity is aware that the manufacturer's article will require special attention during receiving-inspection or installation or operation, the procuring activity will make special request to the manufacturer to provide a removable instruction tag affixed to each article.

5.8 SPECIAL HANDLING PROCEDURE - Where the manufacturer is aware that certain nonobvious characteristics of his version of the specified article will 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 removal instruction tag to each production article delivered.

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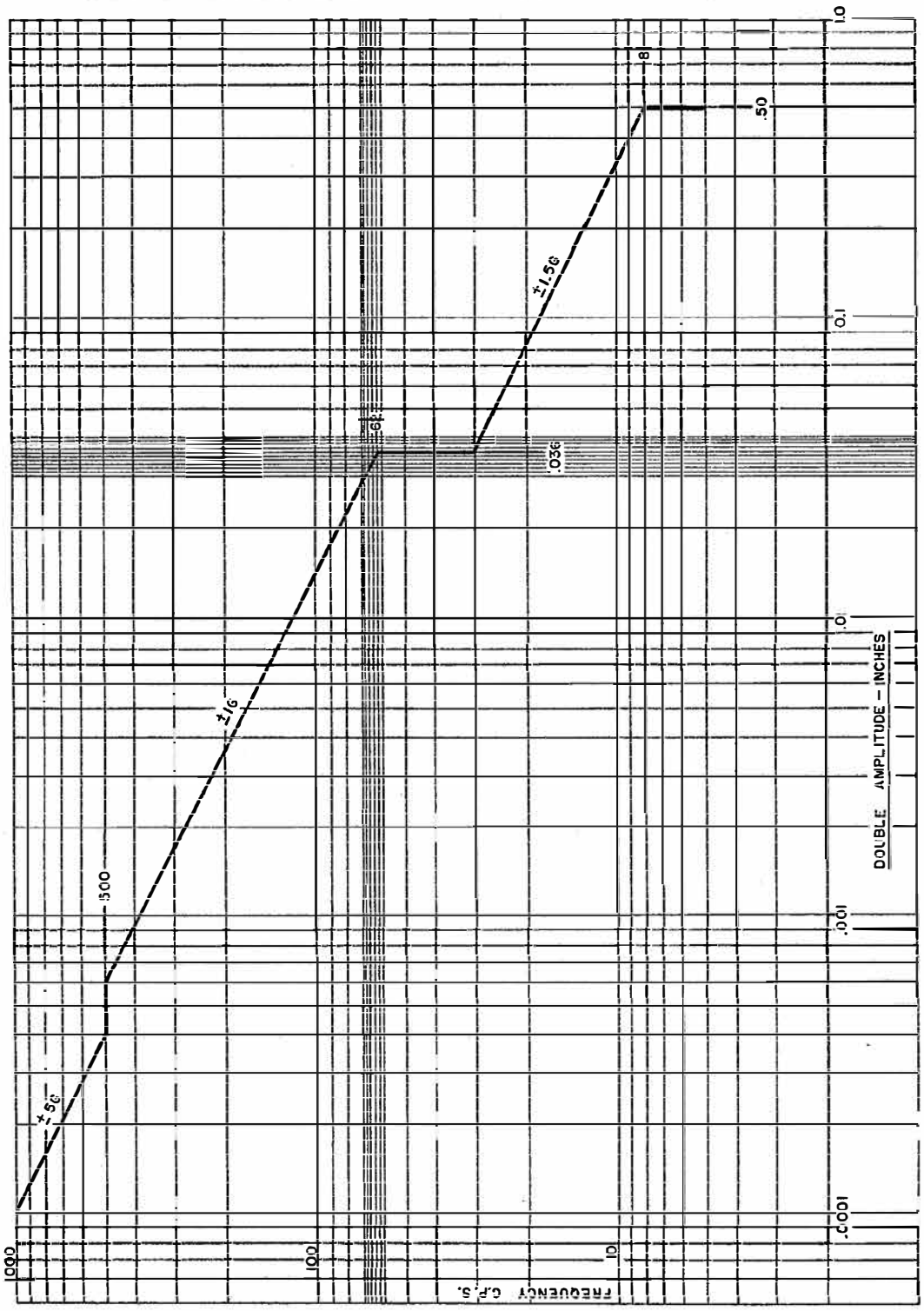

FIGURE 1
VIBRATION ENVELOPE

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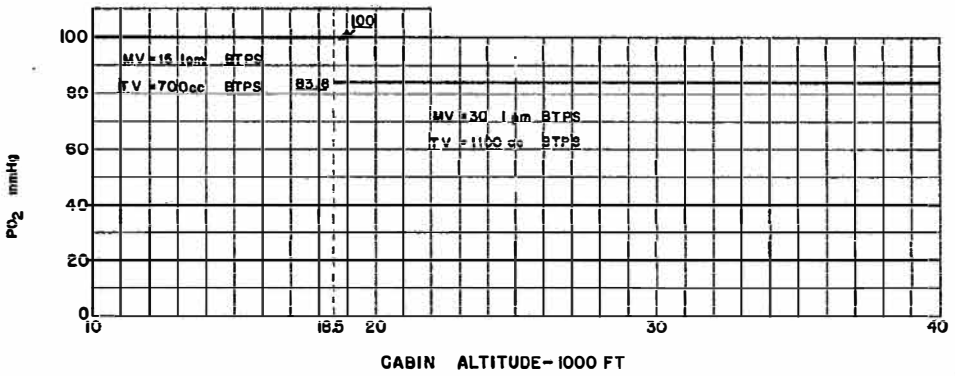
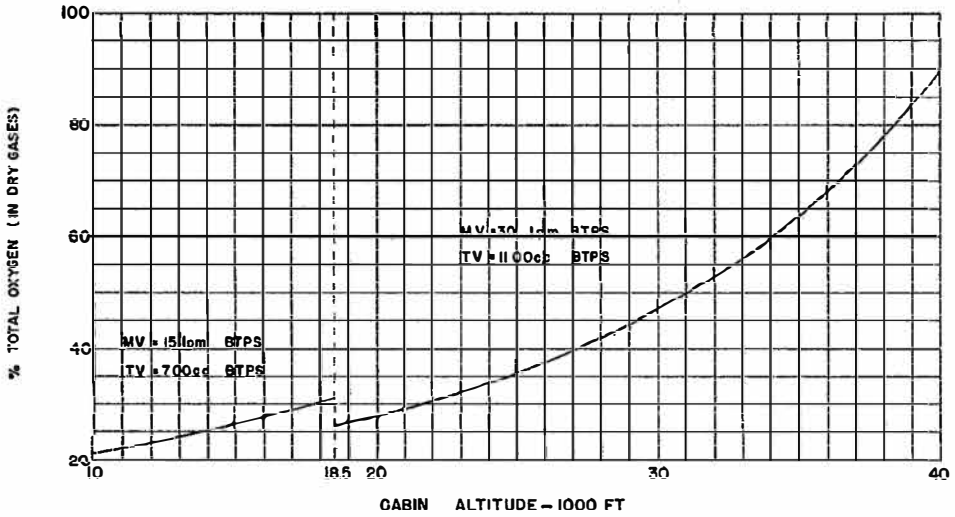


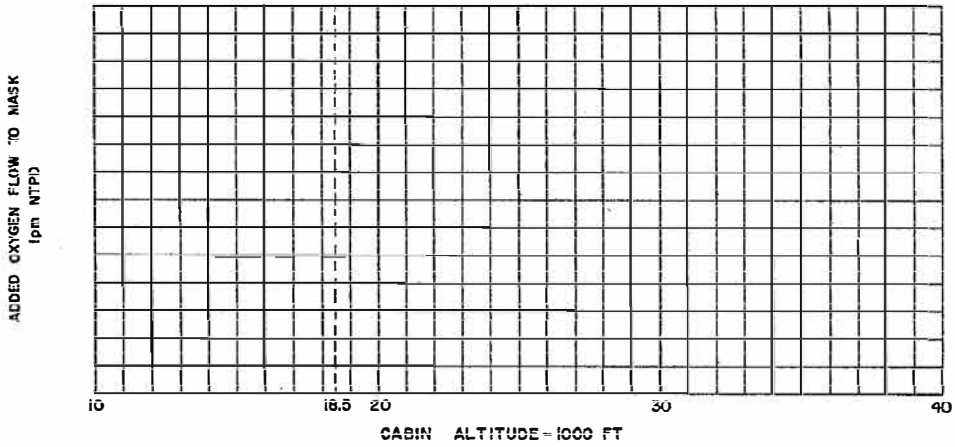
CURVE A

REQUIREMENTS SPECIFIED IN CAR 4b.651



CURVE B

DERIVED FROM CURVE A



CURVE C

TO BE DETERMINED FOR EACH MASK SUBMITTED FOR APPROVAL

FIGURE 2
PERFORMANCE TESTING CRITERIA

(1) COMPLETELY REVISED

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PROCUREMENT SPECIFICATION	TITLE OXYGEN MASK ASSEMBLY, PASSENGER	CLASSIFICATION SPECIFICATION NAS 1179 SHEET 13

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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 3

COORDINATES FOR CURVE B OF FIGURE 2

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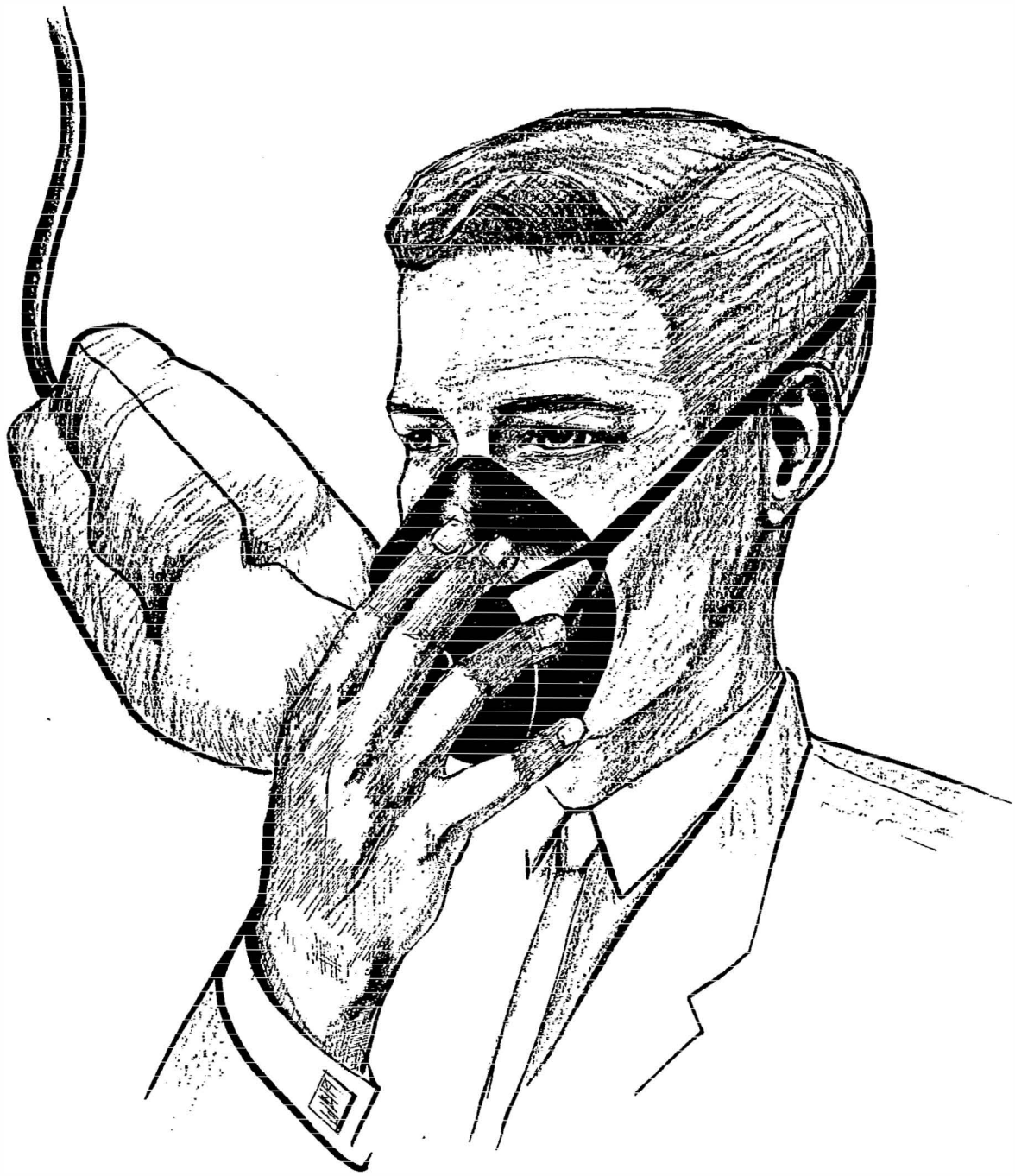

FIG 4

(1) COMPLETELY REVISED

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