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(See 6.11)

MILITARY SPECIFICATION

PRODUCER, LIQUID OXYGEN AND LIQUID NITROGEN (SHIPBOARD TYPE – LOW PRESSURE)

This specification is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all departments and agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers a shipboard equipment which will produce liquid oxygen and liquid nitrogen by means of a low pressure air liquefaction and separation process. Only one classification of producer is covered.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extend specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 3655

SPECIFICATIONS

FEDERAL

BB-N-411	Nitrogen, Technical

MILITARY

MIL-C-104	Crates, Wood: Lumber and Plywood Sheathed, Nailed and Bolted
MIL-T-704	Treatment and Painting of Materiel
MIL-S-901	Shock Tests, HI (High Impact), Shipboard Machinery, Equipment and Systems, Requirements for
MIL-E-917	Electric Power Equipment, Basic Requirements (Naval Shipboard Use)
MIL-C-2212	Controllers, Electric Motor AC or DC and Associated Switching Devices
MIL-P-15024	Plates, Tags and Bands for Identification of Equipment
MIL-P-15024/5	Plates, Identification
MIL-E-15090	Enamel, Equipment, Light-Gray (Formula No. 111)
DOD-P-15328	Primer (Wash), Pretreatment (Formula No. 117 for Metals); (Metric)
MIL-S-16032	Switches and Detectors, Shipboard Board Alarm Systems
MIL-G-18997	Gauge, Pressure, Dial Indicating
MIL-V-22549	Valves, Angle, Relief, for Gas and Oxygen Service (Sizes 2-Inches IPS and Below), Naval Shipboard
MIL-H-22577	Heating Elements, Electrical: Cartridge, Strip and Tubular Type
MIL-P-24441	Paint, Epoxy-Polyamide, General Specification for
MIL-L-25567	Leak Detection Compound, Oxygen Systems; (Metric)
MIL-O-27210	Oxygen, Aviator's Breathing, Liquid and Gas
MIL-C-52211	Components and Assemblies for Industrial Gas Production, Storage and Transport Equipment, Packaging of

STANDARDS

MILITARY

MIL-STD-167-1	Mechanical Vibrations of Shipboard Equipment (Type I – Environmental and Type II – Internally Excited)
MIL-STD-278	Welding and Casting Standard
MIL-STD-461	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-471	Maintainability Verification Demonstration/Evaluation MIL-STD-740-1Airborne Sound Measurements and Acceptance Criteria of Shipboard Equipment
MIL-STD-740-1	Airborne Sound Measurements and Acceptance Criteria of Shipboard Equipment
MIL-STD-777	Schedule of Piping, Valves, Fittings, and Associated Piping Components for Naval Surface Ships
MIL-STD-781	Reliability Testing for Engineering Development, Qualification, and Production
MIL-STD-882	System Safety Program Requirements
MIL-STD-889	Dissimilar Metals
MIL-STD-1186	Cushioning, Anchoring, Bracing, Blocking and Waterproofing; with Appropriate Test Methods
MIL-STD-1330	Cleaning and Testing of Shipboard Oxygen, Nitrogen and Hydrogen Gas Piping Systems

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DRAWINGS

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

810-1385850	Piping, Gage for All Service

(Application for copies should be addressed to the Commander, Portsmouth Naval Shipyard, Naval Engineering Drawing Support Activity, Code 202.2, Portsmouth, NH 03804-5000.)

PUBLICATIONS

NAVSEA

0900-LP-001-7000 Fabrication and Inspection of Brazed Piping Systems

(Application for copies should be addressed to the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

B31 Code for Pressure Piping

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

Boiler and Pressure Vessel Code Section VIII Rules of Construction of Pressure Vessels

(Application for copies should be addressed to the American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D3951 Standard Practice for Commercial Packaging
F1166 Human Engineering Design Criteria for Marine Systems and Equipment; (DOD adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

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

2.3 **Order of precedence.** In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 **General requirements.** The producer shall receive compressed air and separate it into liquid oxygen and liquid nitrogen at minus 312 degrees Fahrenheit (°F) (minus 191 degrees Celsius (°C)) and 5 and 50 pounds per square inch (lb/in^2) gauge minimum respectively.

3.2 **First article.** When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.5) in accordance with 4.3.

3.3 **General characteristics.** The equipment shall be constructed for maximum reliability, and shall be operated, maintained, and repaired by personnel with a minimum of training. The equipment shall assure rapidity, safety, ease and economy of maintenance in normal, adverse and emergency maintenance environments. The producer shall be fail-safe, so that any component or equipment failure will not cause operator injury or damage to other components. In addition, the producer shall include automatic fail-safe controls to preclude equipment damage. The producer shall perform its functions in an ambient compartment temperature of 122 °F (150 °C) minimum. The producer shall reflect efficient arrangement of operation and maintenance workplaces, equipment, controls, and displays to ensure efficient task performance. Equipment shall provide for adequate physical, visual, auditory, and other communication links between personnel and the equipment under both normal and emergency conditions. Controls, displays, marking, coding, labeling, and arrangement schemes (equipment and panel layout) shall be uniform for common functions of all equipment. Where off-the-shelf equipment requires modification in order to interface with other equipment, the modification shall conform to the criteria contained in the standard. Detailed human engineering guidance covering the foregoing requirements are specified in ASTM F1166. The producer shall be constructed in accordance with the human engineering criteria of ASTM F1166 (see 6.3 and appendixes A, B, and F).

3.3.1 **Installation.** The producer shall be configured for installation in a shipboard compartment. After the producer has been manually started and product flow established, the producer operation shall be fully automated to maintain full-rated production. Producer operations including start-ups and shut-downs shall require only one operator. The maximum clearance needed around the producer for maintenance or operation shall be not greater than 3 feet. Manual control valves and indicators (pressure gauges, temperature gauges, tachometers, and so forth) shall be mounted on a single face of the producer. Visual displays and controls shall be in accordance with ASTM 1166. The manual controls and control indicators shall be arranged so that the indicators are readable from the control position. Generally, this shall require that the indicator be within 3 feet of the applicable control device. Removable panels shall be provided for quick and convenient access to the reversing valves, check valves, the turbo-expander, the producer vessel space, adsorbent filters, and for any other items which may require frequent maintenance attention (see 6.3 and appendix C).

3.4 Operating cycle. Air shall be supplied to the producer from a separate centrifugal air compressor, via an after cooler. Immediately after the air enters the producer it shall pass through a moisture separator to remove entrained liquid. A reversing type heat exchanger shall be used to cool the process air and remove water and carbon dioxide. A contaminant removal system shall be used to remove traces of moisture, carbon dioxide and hydrocarbons which may remain in the cold process air stream from the heat exchanger. The effluent from the removal system shall be split into two streams; one stream shall flow to a turbo-expander and the other stream to the distillation columns. The turbo-expander shall supply the refrigeration necessary to achieve liquefaction and separation of air and shall be self-contained in the cold box, non-lubricated, and closed-loop air loaded. The effluent from the turbo-expander shall flow through a superheater-liquefier and to the reversing heat exchanger to cool down the incoming process air. The fraction of the process air to the distillation columns shall flow via the superheater-liquefier (for heat exchange with the turbo-expander effluent) to a high pressure column (nitrogen column) or to a vapor-liquid separator and a low pressure column (oxygen column). Movement of process fluids shall be by differential pressure or by bubble-type pumps.

3.4.1 Capacity. The producer shall produce liquid oxygen (LOX) and liquid nitrogen (LIN) at a minimum of 250 pounds per hour (lb/hr) under normal operating conditions and 200 lb/hr under abnormal conditions (as in table I). Only one product is required at any one time.

TABLE I. *Performance criteria.*

Influent air conditions				Liquid product output
Condition	Flow	Pressure	Temperature	(LIN or LOX)
Normal	1625–1650 ft^3/min	90–110 lb/in^2 gauge	80–100 °F	250 lb/hr
Abnormal	1600–1624 ft^3/min	80–89 lb/in^2 gauge	101–110 °F	220 lb/hr

TABLE II. *Atmospheric contaminants.*

Contaminant	Concentration (max by volume)
Carbon dioxide (CO_2)	1000 p/m[1]
Water vapor (H_20)	Saturated
Nitrous oxide (N_20)	5 p/m
Carbon monoxide (CO)	20 p/m
Methane (CH_4)	3 p/m
Sulfur dioxide (SO_2)	1 p/m
Acetaldehyde (C_2H_4O)	1 p/m
Acetylene (C_2H_2)	2 p/m

[1]Parts per million (p/m).

3.4.2 Purity. The producer shall produce oxygen which meets the purity requirements of MIL-O-27210 type II and nitrogen which meets the purity requirements of BB-N-411, type II, grade B, at the quantities specified in 3.4.1 when the influent air contains all of the contaminants in the concentrations indicated in table II. Under conditions specified herein the producer shall operate continuously for a minimum of 720 hours before shutdown for defrost and before regeneration of any adsorption bed. The producer shall be capable, immediately after completion of a 720 hour run (cold plant), of being regenerated and defrosted and then operated so as to produce at specified rates and purities for additional 720 hour periods. The total time for shut-down, regeneration and defrost, and resumption of production shall not exceed 24 hours.

3.5 Utilities.

3.5.1 Electrical power. The producer shall require only one source of electric power. The electric power supply shall be 440 volts, 3-phase, 60 hertz (Hz). The maximum power demand rate of the producer shall not exceed 100 kilowatts (kW). The average power demand shall not exceed 75 kW. One main circuit breaker for the producer will be furnished by the installing activity. Other breakers or overloads shall be furnished with the producer and integrally mounted within the equipment. Shipboard installed wiring shall be kept to a minimum. Wiring and instrumentation shall be installed, prewired, and prepiped on the producer. If electric power of other characteristics is required, all equipment needed for the conversion shall be furnished as part of the producer. Control power shall be obtained from the main input power of the producer. Types of power other than electrical shall not be used.

3.5.2 Air. The producer shall require only one source of process air. Air shall be received from a separately installed centrifugal air compressor at the conditions specified in 3.4.1. If air is required for operation of control valves or other equipment, the air shall be taken from the process air. Necessary equipment for control of air pressures shall be provided with the producer.

3.5.3 Purge gas. The producer cold box enclosure shall be pressurized to at least 2 inches of water pressure with gaseous nitrogen. The maximum purge gas flow rate required to maintain this pressure shall not exceed 40 standard cubic feet per hour (ft^3/h).

3.5.4 Water. The producer shall not require water.

3.6 Dimensions and weight. The producer envelope dimensions shall not exceed the following: height: 108 inches, width (across front): 144 inches and depth (front to back): 108 inches. Total producer weight shall not exceed 20,000 pounds.

3.7 Shock and vibration. The producer shall meet the shock requirements of MIL-S-901, grade A, class I, deck-mounted equipment and the vibration requirements of MIL-STD-167-1, type I, frequency range 4 to 50 Hz. Structural supports shall have no local resonances in the range from 4 to 50 Hz.

3.8 Pitch, roll, and list conditions. The producer shall operate under specified pitch, roll, and list conditions when the largest (not diagonal) dimension of the producer is parallel with the fore and aft centerline of the ship.

3.8.1 Operation at rated capacity and purity. The producer shall operate at rated capacity and purity under the following conditions:

a. Pitch – 4 degrees for an 11-second period
b. Roll – 15 degrees for a 17-second period
c. List – 2.5 degrees.

3.8.2 Operation under increased list conditions. When operating at a list of 5.0 degrees to either side, the producer shall produce liquid oxygen or nitrogen at a minimum of 75 percent of rated capacity while maintaining minimum product purity levels specified in 3.4.2.

3.8.3 Loss of fluids or damage. The producer shall not lose fluids or be damaged under the following conditions:

a. Operating at a fixed incline of up to 15 degrees in any direction
b. Operating while pitching at a maximum of 10 degrees up or down from its normal horizontal plane
c. Operating while rolling a maximum of 30 degrees to either side of vertical.

3.9 Electromagnetic interferences. Unless otherwise specified herein, the producer shall conform to the electromagnetic emission requirements of parts 1 and 5 of MIL-STD-461.

3.10 Noise. Total produced airborne noise levels shall not exceed 80 decibels (dB) at any frequency when measured in accordance with MIL-STD-740-1. To conform to this requirement, the turbo-expander air load shall be closed-loop and muffled.

3.11 Thermal insulation. Surfaces, including the insulation jacket (see 3.14.6) except the outer end of sample lines and sample vaporizers, shall be so insulated that the surfaces will neither collect frost nor sweat when exposed to an atmosphere with a dry bulb temperature of 90 °F (32.2 °C) and a wet bulb temperature of 80 °F (26.7 °C). Surfaces, the temperature of which may exceed 120 °F (49 °C) during normal operation shall be insulated so that the resulting insulation surface temperature is below 120 °F (49 °C). Hydraulic setting types of insulation material shall not be used.

Either solid formed shapes, solid block type, or fibrous mineral blanket or loose fill type insulation shall be used. Fibrous mineral type insulation is permitted only as described in 3.14.6 for producer cold box. The solid formed shape and solid block type insulation shall not have friable fibers, produce dust, or contain asbestos, silica, or any other material which will cause lung disorders. Insulation material shall be non-flammable in temperatures up to 572 °F (300 °C). When burning, the insulation material shall not give off any toxic gas. The insulation manufacturer shall

certify that his insulation material conforms to the aforementioned flammability and toxicity requirements. The insulation material shall conform to the chemical requirements of appendix H. The hydrocarbon oil content of the insulation shall not exceed 0.175 percent by weight.

3.12 Electrical equipment. Electric equipment and wiring shall be in accordance with MIL-E-917.

3.12.1 Controllers. Controllers shall conform to MIL-C-2212 and the following:

Voltage rating and phase	–	440 volts, 3-phase, 60 Hz
Duty	–	Continuous
Type	–	As required
Insulation	–	Class B, except that coils may be class A
Operation	–	Magnetic
Performance	–	Automatic with automatic shut-down
Enclosures	–	Drip-proof or watertight
Protection features	–	Thermal overload relay or low voltage protection or both for each service. Protection feature shall be justified by the failure mode and effects analysis (FMEA) (see 6.3). The FMEA shall consider the maximum potential flow and Pressure from the compressor and the flows through safety valves and associated upstream and downstream pressure.

3.12.2 Wiring. Electrical and thermocouple wiring shall be clearly labeled and run through wire harnesses or conduit. Where possible, wiring and harnesses shall be run along tubing, piping or structural members for support and protection.

3.12.3 Electrical insulation resistance. With the exception of thermocouples, each independent electric circuit shall have a resistance to ground and to other independent circuits greater than 5 megohms (see 4.7.4).

3.13 Materials and fabrication.

3.13.1 Materials. Welding and associated inspections shall be in accordance with MIL-STD-278. Materials used within the O_2N_2 producer shall be suitable for the intended use. Piping, piping components, valves and process vessels shall be constructed for a 125 pounds per square inch gauge (lb/in^2) minimum pressure and a temperature range of minus 320 °F (minus 196 °C) to 300 °F (149 °C) for the maximum outlet temperature from the heater, whichever is higher. Design pressure and design temperature of pressure vessels and piping may be reduced to a lower value but not less than 25 lb/in^2 and 25 °F greater than the most severe conditions of coincident temperature and pressure based on the condition of at least two independent failures including operator error during all phases of producer operation including start-up, shut-down, and defrost. Unless otherwise specified (see 6.2), the materials used shall be limited to the 300 series corrosion-resisting steels, aluminum and aluminum alloys, copper and copper alloys, silicon-bronze, 70-30 brass, or monel. Pressure vessels fabricated and of the materials as specified herein, shall be

inspected in accordance with either ASME BPVC, section VIII or the requirements of MIL-STD-278 for A-3 pressure vessels. Radiography of closure welds of A-3 pressure vessels is not required. Piping fabricated in accordance with MIL-STD-278 of the materials specified herein shall require a radiographic sample of at least 10 percent of all butt-welded joints in lieu of the radiography test specified by MIL-STD-278 for class P-LT piping. Carbon steel alloys may be used for structural supports which are not subjected to low temperature from cryogenic vessels or piping. The use of dissimilar materials shall be minimized to preclude galvanic corrosion and shall be in accordance with MIL-STD-889 requirements for selection and protection of dissimilar metals. Materials including gaskets and valve packing shall be compatible with R-11 and R-113 cleaning solvents. Any materials subject to corrosion shall be treated to prevent corrosion. Vessels subject to corrosion shall include adequate corrosion allowance to insure a 20 year life. Aluminum shall be hard anodized after all welding and forming has been completed on the component or piping assembly. Component or piping material shall be selected to minimize dissimilar metal joints. Where dissimilar metal joints are used, the joint construction shall preclude metal-to-metal contact and moisture entrapment at the gasket. Within the producer insulation jacket, each piping line shall be separated by a minimum of 4 inches (measured radially from the closest point on the piping surface) from any item of dissimilar material.

3.13.1.1 Recovered materials. Unless otherwise specified herein, all equipment, material, and articles incorporated in the products covered by this specification shall be new and may be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

3.13.2 Brazing. Brazing of ferrous and non-ferrous piping shall conform to the requirements of NAVSEA 0900-LP-001-7000. No equipment shall be fabricated by riveting or soft soldering.

3.13.3 Pneumatic testing. Pneumatic testing may be substituted for hydrostatic testing specified in NAVSEA 0900-LP-001-7000, provided such testing and the method of lead detection are clearly specified on the manufacturer's drawing. Pneumatic pressure testing for pressure vessel and piping integrity shall be performed at 1-1/2 times maximum working pressure. Leak testing shall be performed at a pressure not less than the maximum working pressure.

3.13.4 Pressure vessel and piping construction. Piping for fluids listed in MIL-STD-777 shall conform to MIL-STD-777 unless otherwise approved. Tapered pipe threads will not be permitted. Pressure containing vessels shall be in accordance with the ASME BPVC section VIII for unfired pressure vessels MIL-STD-278. Piping and tubing shall be in accordance with ANSI B31 and welding shall be in accordance with ASME BPVC section VIII or MIL-STD-278.

3.13.5 Piping, valves, and fittings. Unless otherwise specified herein, all valves and fittings shall be in accordance with MIL-STD-777. Valves and all mechanical joints shall be of the soft seat design. Relief valves shall be union ended to facilitate removal for testing and calibration. Piping shall be configured to facilitate solvent cleaning and testing. There shall be no dead-ended piping.

One-half inch inner diameter (id) tubing or below shall be bundled or affixed to stronger members for support, temperature profile permitting. Bonded transition joints will not be permitted. Where it is necessary to join dissimilar materials, flanges with cryogenic compatible gaskets shall be used. Valve packing, gasket, and O-ring materials shall be compatible with cryogenic fluids as well as R-11 and R-113 cleaning solvents. Mechanical joints within the producer cold box shall be kept to a minimum.

3.13.6 Components. Whenever possible, producer pressure boundary components shall be made of type 300 series corrosion resisting steel or silicon bronze. Components shall be constructed for a working pressure of 125 lb/in^2 minimum.

3.13.7 Pressure vessels. Pressure vessels shall be made of type 300 series corrosion resisting steel or silicon bronze. Pressure vessels shall be constructed for a working pressure of 125 lb/in^2 minimum.

3.14 Producer. The producer shall consist of air drying and purification equipment, heat exchangers, distillation apparatus, turbo-expander, inlet air filter, silencers, an insulating jacket cold box provided with necessary operating instrumentation and controls integrally mounted, and other necessary components. A turbo-expander shall provide all refrigeration and cooling needed to produce the required amounts of oxygen or nitrogen. A tachometer, readout device, and overspeed shut-down shall be provided for the turbo-expander. No motor driven pumps or compressors shall be used in the producer. Oxygen clean pressure, liquid level, and flow instruments shall maintain the required level of accuracy for continued plant operation without recalibration during a 5-year period and a means shall be provided to verify the accuracy of the instruments without disconnecting the instrument piping.

3.14.1 Start-up time. After the air flow is started to it the producer shall produce at full rated capacity (see table I) within 12 hours of start-up at an ambient temperature of 122 °F (50 °C) minimum and within 2 hours after a shut-down of 2 hours.

3.14.2 Air drying and purification. Air drying and purification system shall be so that neither producer defrost nor adsorbent regeneration is required more frequently than every 720 hours. Equipment shall be provided to remove compressor lubricant, water, carbon dioxide, hydrocarbons, and other contaminants as necessary to ensure acceptable product purity, as specified when processing air containing the contaminants specified in table II. In addition to the above air drying and purification equipment, a secondary adsorption bed shall be provided to preclude contamination enrichment in the distillation columns. This secondary adsorption bed shall be external to the columns and the bed column shall be based on 0.003 cubic feet minimum per equivalent standard cubic feet per minute (ft^3/min) of flow to the distillation columns. Consumable chemicals shall not be used for contaminant removal. The purification equipment and the secondary adsorption bed shall be regenerated using a process gas which contains less than 22 volume percent oxygen. The process gas for regeneration shall be a by-product of the air separation process.

3.14.2.1 Electric thaw heater. Electric heaters required for heating gas for regeneration and thaw of the producer shall conform to MIL-H-22577, type III, with a corrosion-resisting steel or nickel-chromium-iron alloy sheath. The outlet gas temperature from the heaters shall be automatically controlled and heater burnout protection shall be provided. The warm air exhaust from the turbo-expander may be used to preheat the feed gas to the heaters. Adsorbent bed regeneration heaters shall heat beds to a minimum temperature of 400 °F. The total time to regenerate each adsorbent bed shall not exceed 6 hours, with a maximum heating cycle of 2 hours. Thaw heaters shall warm the producer piping and vessels to a minimum temperature of 125 °F. Thaw heaters shall be sized so that total producer thaw time does not exceed 12 hours.

3.14.3 Control valves. Valves shall be in accordance with MIL-STD-777 and as specified herein. For valves requiring fine adjustment, the handwheel shall indicate the degree to which the valve is opened. Gate valves shall not be used in any throttling service. Valves shall have replaceable seats and discs.

3.14.4 Automatic shut-off and safety valves. Electrically operated automatic shut-off valves shall be furnished with the O_2N_2 producer at the compressed air inlet and at the turbo-expander inlet for emergency shut-downs. The separation process shall be protected from abnormal pressures by safety valves. Safety valves shall be located in one region to facilitate inspection and shall be equipped with flanged or union type outlets connected to a single vent header. Safety valves shall conform to MIL-V-22549 or be approved by NAVSEA.

3.14.5 Pressure and temperature switches. Pressure and temperature switches shall meet the requirements of MIL-S-16032 with respect to size, type, and application.

3.14.6 Insulation jacket (cold box). Separation equipment operating at temperatures below 32 °F (0 °C) shall be enclosed in a jacket fabricated with a structural-metal frame and sheet-metal panels. Other components of the producer shall be mounted on the same baseplate outside the insulation jacket. The panels shall be easily removable, and no welding or cutting is to be required for access for maintenance of the enclosed equipment including the replacement of heat exchangers and columns. Instruments for control of the enclosed equipment shall be mounted on a panel in front of the jacket. The entire jacket shall have sufficient insulation and thermal isolation of structural members to prevent the formation of frost spots when temperature and humidity conditions are as specified in 3.11. The insulation shall function and be as specified in 3.11. The cold box insulation shall be solid block type insulating material except that mineral wool may be used within the interior and packed amid the process vessels and piping. Solid block insulation shall be used to the maximum depth possible in from the cold box exterior panels on all four sides and top and bottom. The block insulation shall be used around all maintainable components and in the way of the access from the cold box exterior to those components. The cold box shall be constructed so that during operation and during shut-downs there shall be a small continuous flow of nitrogen purge gas, 40 standard cubic feet per hour (ft^3/hr) (maximum), from the center of the cold box toward the outside for the purpose of excluding entry of moisture. Piping, rotometers, and valves shall be provided for both nitrogen purge gas tapped from the air separation process and nitrogen purge gas from an external source. The jacket shall be constructed to prevent any leakage in excess of 40 ft^3/hr maximum at 2 inches of water pressure.

3.14.7 Purity analyzers. One nitrogen and oxygen product purity analyzer and one waste gas analyzer shall be provided with the producer. Analyzers shall be Sybron Corporation model number X540AA10101-1 (517B) or equal and mounted on the producer. Product nitrogen, oxygen, and waste gas sample lines shall be run from the columns via two-stage pressure regulators to the analyzers. Sample gases are to be at room temperature prior to being sent to the analyzers. The electronic analyzers shall provide continuous readout of the purities. The electronic analyzers shall be accurate to within 0 ± 0.5 volume percent of the actual sample gas purity. The analyzers shall be attached to the producer. The producer shall have sample gas tubing, calibration gas tubing, gas flow manifolds, and electrical wiring so that the purity of the sampled process stream can be easily and accurately determined. The electronic analyzers shall have a warm-up period of 2 hours maximum, shall not require calibration more often than once in 24 hours, and shall not require consumables. If calibration gas is required for the electronic analyzer operation, the analyzers shall operate as specified herein utilizing either military gas (see 6.6) or gas for which certified composition analysis is not necessary. The analyzer shall not require calibration gas purity to be more than 99.99 percent.

3.14.8 Liquid product sampling. Means shall be provided for drawing samples of the liquid oxygen product and liquid nitrogen product for analysis by means other than the electronic analyzer. The sample lines shall be warmed in such a manner that the sample comes from the producer as a gas and correctly represents the composition of the fluid being sampled. A liquid oxygen sample valve shall be provided for obtaining liquid samples to monitor the product oxygen in the oxygen column.

3.14.9 Liquid traps. Any line which carries liquid oxygen or liquid nitrogen from the producer shall include traps in the line which prevent liquid from being in contact with the line's valve when the valve is closed.

3.15 Instrumentation. Instrumentation shall be mounted on a common panel located at the front of the producer, at between 4 and 6 feet from the base. Like instrumentation shall be clustered together along with applicable control devices.

3.15.1 Mechanical.

3.15.1.1 Pressure gauges. Pressure gauges shall be in accordance with MIL-G-18997 for oxygen service. Gauges shall be installed in accordance with Drawing 810-1385850 and mounted on a common instrumentation panel located at the front of the producer. Snubbers shall be used to protect gauges. Dedicated gauges shall be provided to measure, as a minimum, the following critical pressures:

a. Process air to cold box

b. Air from adsorbers

c. Air to adsorbers

d. Air to turbo-expander

e. Air from turbo-expander

f. Low pressure column

g. High pressure column

h. Low pressure column condenser/reboiler (if operated at different pressures than high and low columns

i. Waste gas from columns

j. Waste gas to reversing heat exchanger

k. Defrost air to low temperature section

l. Seal air to expander.

3.15.1.2 Flowmeters. Flowmeters shall be differential pressure type, employing a rupture-proof bellows design. Meters will read in inches of water and shall be accurate to within plus or minus 4 percent of actual flow measurements. Graduations shall be black on a white background. Normal operating readings shall be indicated within the middle one-third range of the indicator. A graph which provides a means to determine actual flows based on the type of fluid being measured and the temperature and pressure of the fluids shall be provided for each flowmeter. The flowmeters shall be installed on a common instrumentation panel and measure, as a minimum, the following critical flows:

a. Process air to reversing heat exchanger
b. Unbalance stream air to reversing heat exchanger
c. All process flow to all columns
d. Defrost air flow
e. Regeneration gas flow.

3.15.1.3 Liquid level indicators. Liquid level indicators employing a rupture-proof bellows design shall be provided to measure the process fluid levels. The scale of each liquid level indicator shall be equipped with a zero adjustment and shall be graduated in increments of water. Graduations shall be black on a white background. Normal operating readings should be indicated within the middle one-third range of the indicators. Indicators shall be mounted on a common instrumentation panel at the front of the producer. Loop seals will be used to prevent flow in the lower gauge line. Dedicated indicators shall measure, as a minimum, the following critical levels:

a. Crude oxygen in high pressure column
b. Crude oxygen in condenser and reboiler
c. Liquid in column feed separator
d. Liquid oxygen in low pressure column.

3.15.2 **Electronic.**

3.15.2.1 **Temperature indicating system.** A temperature indicating system shall be provided with the producer. The system shall consist of individually installed resistance temperature detectors (RTD's) which are connected to one common temperature indicating unit mounted on the front of the producer. The temperature indicating unit shall have a digital readout and a rotary switch with a position for each RTD installed. The system shall indicate a temperature at the following points in the producer:

a. Entering air
b. Main heat exchanger, air – in
c. Main heat exchanger, air – out
d. Main heat exchanger, waste gas – in
e. Main heat exchanger, waste gas – out
f. Turbo-expander inlet
g. Turbo-expander outlet
h. Low pressure distillation column top
i. Heat exchanger inlet and outlet streams
j. Column inlet and outlet streams
k. Thaw heater inlet and outlet streams
l. Low pressure distillation column reboiler
m. High pressure column condenser
n. High pressure column feed
o. Product temperatures
p. Superheater-liquefier, all flows in and out.

Temperatures c., d., f., and g. shall also be monitored separately from the others by a temperature indicating system accurate to within plus or minus 1 °F at the normal operating temperatures. At least three of these temperatures shall be continuously monitored and indicated by the readout system. On producers with an adjustable side bleed system, the main heat exchanger side bleed temperature shall have a continuous monitor and readout and shall also be recorded on a data logger. Each RTD and its piping well shall be immersed in the fluid stream.

3.16 Product filter. A product filter with adequate access for maintenance shall be provided to prevent any carryover of the producer's adsorbents. The filter shall be within the insulated portion of the producer cold box.

3.17 Outlet connections. Producer outlet connections from the producer shall be located in the front of the producer at approximately 8 feet from the base and 6 to 8 inches from the left side. The outlet connections shall be so that all shipboard interconnecting piping can be easily connected and any needed insulating material can be readily applied. No automatic valves, switches, or sensors associated with producer operation shall be required for the interconnecting piping.

3.18 Interchangeability. In no case shall parts be physically interchangeable or reversible unless such parts are also interchangeable or reversible with regard to function, performance, and strength.

3.19 Plates and placards.

3.19.1 Identification and information plates. Identification and information plates shall be in accordance with type A or B (plates of phenolic compounds will not be acceptable) of MIL-P-15024 and MIL-P-15024/5. Plates shall be attached with corrosion resistant screws, bolts, or rivets in conspicuous locations. An identification plate shall be attached to each producer. Identification plates which name the components to facilitate operation, shall be attached adjacent to or on each valve, pressure switch, liquid-level gauge, flowmeter, temperature gauge, pressure indicator, control switch, indicator lamp, safety valve, and sample line. The component names (and alpha-numeric designations, if used) on the plates shall be consistent with those used in the documentation (see 3.3 and appendix B).

3.19.2 Information plates, shall be provided which will illustrate the following:

a. A flow diagram of each individual process of the plant (for example, air refrigeration, air separation, reactivation gas flow) and the overall producer process

b. Electrical wiring schematic diagram of each individual circuit (for example, producer process monitors and controls) and the overall producer circuitry.

The plates for individual processes and circuits shall be attached near the appropriate controls and indicators. The plates for overall producer process and circuitry shall be attached to the front of the producer.

3.20 Lifting eyes. The producer shall have four lifting eyes to permit lifting by one overhead hoist.

3.21 Painting. External, exposed metal surfaces of the producer shall be painted, except surfaces such as valve extensions, identification plates, or surfaces which may be exposed to temperatures below minus 40 °F (minus 40 °C) in normal service. Metal surfaces of the structure, framework, and panels internal to the cold box shall be painted. Prior to painting, all fabricating operations, such as welding, machining, drilling, and tapping, shall be completed. Surface preparation and painting shall be accomplished in accordance with MIL-T-704 and as follows:

a. Remove all flux, loose mill scale, rust, and other visible corrosion products

b. Remove all grease, oil, and dirt by solvent wiping, vapor degreasing, caustic washing and rinsing, or other appropriate method

c. Apply one coat of wash-priming pretreatment, conforming to DOD-P-15328, plus two coats of semi-gloss light-gray enamel, conforming to MIL-E-15090, to external exposed metal surfaces

d. Apply two coats of epoxy priming paint, conforming to MIL-P-24441, formula 150, plus one top coat of epoxy paint, conforming to MIL-P-24441, formula and color optional, to cold box internal metal surfaces.

3.22 Workmanship. Parts, especially machined surfaces and passages, shall be kept clean and protected during fabrication and while in storage. Burrs and sharp edges shall be removed from producer parts. The producer shall be completely free of all foreign matter such as chips, shavings, refuse, dirt, scale, water, and hydrocarbons. Piping connections shall be aligned to within 1/8 inch laterally of mating center lines and 1/8 inch axially along mating center lines. This precludes pre-stressing of piping to effect connections. Producer surfaces which come in contact with process fluids shall be cleaned as specified in 4.8.

3.23 Human engineering. Unless otherwise specified herein, the producer shall meet the human engineering requirements specified in ASTM F1166. The producer shall be constructed for ease of operation and maintenance. The producer shall reflect efficient arrangement of operation and maintenance workplaces, and equipment, controls and displays shall ensure optimal task performance. Equipment shall provide for adequate physical, visual, auditory, and other communication links between personnel and the equipment under both normal and emergency conditions. Controls, displays, and marking, coding, labeling, and arrangement schemes (equipment and panel layout) shall be uniform for common functions of all equipment. Where off-the-shelf equipment requires modification in order to interface with other equipment, the modification shall conform to the criteria contained in the standard. The manual controls and control indicators shall be arranged so that the indicators are readable from the control position. Generally, this shall require that the indicator be within three feet of the applicable control device. Removable panels shall facilitate access to the following components: regenerator or reversing valves, check valves, turbo-expander, producer vessel space, adsorbent beds and filters, and for any other items which may require frequent maintenance attention.

3.24 Safety. When specified (see 6.2), the contractor shall implement a tailored system safety program (SSP) in accordance with Task 100 (SPP), Task 202 (preliminary hazard analysis), and Task 209 (safety assessment) of MIL-STD-882 (see 6.3). Safety design features shall be incorporated into the producer configuration to prevent damage to equipment and to ensure optimal personnel protection during operation, repair, or interchanging of any component. Safety design features shall include but not be limited to the following:

a. Posted caution or warning placards

b. Safety guards for moving machinery and high temperature (above 120 °F)

c. Emergency and high temperature cut-off switches

d. Overpressurization devices such as relief valves, burst discs, lift plate assemblies, and high pressure cut-off-switches.

The SSP shall interface with the human engineering (see 3.23) and reliability and maintainability (see 3.25) requirements to avoid duplication of efforts.

3.25 Reliability and maintainability. The producer shall have a mean-time-between-failure (MTBF) of not less than 2000 hours and a mean-time-to-repair (MTTR) of not greater than 8 hours (see 4.7.8.1 and 6.3).

3.26 Instruction placards. Instruction placards shall be of 8-1/2 by 11 inch heavyweight white paper with black print and laminated in plastic. Printing shall be on only one side. The data presented on the instruction placards shall be clear, concise, and include sufficient information to enable operation without damage to the producer or injury to personnel. Three complete sets of instruction placards shall be provided by the contractor. One set will be secured in a holding device that is attached to the producer. The holding device shall be so that the placards can be removed and replaced by personnel operating the producer. Each set of placards shall contain the following:

a. Flow and wiring diagrams identical to those on the information plates

b. Producer start-up procedure

c. Procedures for product change-over (that is, LOX-to-LIN, LIN-to-LOX)

d. Troubleshooting and controls adjustment procedures for low refrigeration and excess refrigeration conditions

e. Normal shut-down and thaw procedure

f. Emergency shut-down procedure

g. A table listing normal operating parameters and key valve settings.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of the manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

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

a. First article inspection (see 4.3)
b. Quality conformance inspection (see 4.4).

4.3 First article inspection. First article inspection shall consist of the examination and tests specified in 4.6 and 4.7 (see 6.3 and appendix D).

4.3.1 Sampling for first article inspection. The first producer manufactured under each contract or purchase order shall be subject to first article testing.

4.4 Quality conformance inspection. Quality conformance inspection shall consist of the examination and tests specified in 4.6, 4.7.1 through 4.7.4, 4.7.6, 4.7.9, 4.7.10, and 4.7.12 through 4.7.15 (see 6.3).

4.4.1 Sampling for quality conformance. Each producer shall be subject to quality conformance inspection.

4.5 ASME BPVC section VIII vessels. Presence of ASME official code U-symbol stamped or marked and a copy of ASME data sheet (form U-1) will be accepted as evidence that pressure vessels and connections conform to ASME rules for construction of pressure vessels.

4.6 Examination. The first producer of each contract or purchase order shall be thoroughly examined both during and after manufacturing to ensure total conformance to the requirements specified herein. Subsequent producers manufactured under each contract or purchase order shall be periodically examined to ensure conformance. Failure to conform in any respect with the requirements specified herein shall be grounds for rejection of a producer.

4.7 Testing. Testing shall be conducted as specified herein (see 6.3 and appendix G). Upon completion of each test, all parts damaged by that test shall be replaced.

4.7.1 Silver brazed and welded joint testing. Silver brazed joints shall be tested in accordance with NAVSEA 0900-LP-001-7000.

4.7.2 Leak testing. Leak testing shall be accomplished as specified in 4.7.2.1 and 4.7.2.2.

4.7.2.1 Tests during fabrication and assembly. At the time of their assembly, all vessels, piping, piping components and subassemblies thereof shall be pressure tested with dry oil-free air or nitrogen and examined for leaks. A leak detector solution in accordance with MIL-L-25567 shall be used to check for leaks. Tests shall be conducted so that all leaks which are detrimental to the operation of the equipment will be found. This includes leaks through the seats of valves as well as through the body of valves and other piping components. No leakage is permitted. Leaks shall be repaired prior to further testing.

4.7.2.2 Test of final assembly. After final assembly each producer shall be leak tested at normal operating pressure for a minimum of 4 hours. The pressure drop compensated for any temperature change shall not exceed 2 percent of the test pressure after compensating for ambient pressure and temperature changes.

4.7.3 Strength test. Each producer shall be tested to demonstrate its ability to safely withstand all internal pressure and vacuum conditions it would be expected to encounter in service. Pressure tests may be performed at atmospheric temperature conditions. Pressures used in testing shall be at least 50 percent greater than the design working pressure.

4.7.4 Electrical insulation resistance test. To determine conformance to 3.12.3 an insulation resistance test shall be performed for each producer using a 500 volt direct current insulation resistance indicating ohmmeter with an 0 to 100 megohm scale. The test shall be conducted between 50 and 90 °F.

4.7.5 Shock test. The first producer on each contract or purchase order shall be shock tested in accordance with MIL-S-901, grade A, class I, type A, deck mounted. During the test the producer shall be pressurized to normal operating pressures. After the test, the producer shall be subjected to post-shock examination and test. The producer shall meet the performance requirements of this specification except that the equipment need not pass the noise requirements prior to performance of minor maintenance (see 6.3).

4.7.6 Operational endurance testing. In addition to other tests, the first producer on each contract or purchase order shall be operated for a minimum of 2160 hours (plus defrost and regeneration time). During this test the producer prepared under a contract or purchaser order shall be operated in the manner outlined in the producer technical manual. The 2160 hours of operation may be subdivided into 720 hour periods. During this period of time the producer shall meet the capacity and purity requirements specified in 3.4.1 and 3.4.2 respectively (see 6.7).

4.7.7 Vibration testing. The first producer on each contract or purchase order shall undergo vibration testing in accordance with MIL-STD-167-1. During this test the producer shall be pressurized to normal operating pressures but need not be operating. After the test the producer shall be fully operational as specified herein.

4.7.8 Reliability and maintainability demonstration. Reliability and maintainability shall be demonstrated with the first producer of each contract or purchase order (see 6.3).

4.7.8.1 Reliability demonstration. A reliability demonstration in accordance with MIL-STD-781 shall be accomplished concurrently with the operational endurance test. The producer shall meet the MTBF criteria specified in 3.25. For the purpose of this demonstration a failure is defined as follows: (a) four minor malfunctions, each of which can be repaired within 4 hours without requiring access into the cold box and without interrupting product production for more than 4 hours and requires less than 24 hours actual repair time; (b) two major malfunctions each of which interrupts production for more than 4 hours and requires less than 24 hours actual repair time; (c) one critical malfunction which interrupts production for more than 4 hours and requires 24 hours or more of actual repair time. If either four minor, two major, or one critical malfunction occurs it shall constitute failure of the test and the test shall be terminated and retesting is required after corrective action has been taken.

4.7.8.2 Maintainability demonstration. A maintainability demonstration shall be conducted in accordance with MIL-STD-471, method 3, to demonstrate maintainability requirements. The Government will select 20 maintenance actions to be performed on the first producer to verify the actual repair time against the repair time identified in the maintainability prediction.

4.7.9 Noise testing. Each producer shall be tested to determine conformance to 3.10. Testing shall include all modes of operation of the producer. The producer may be tested without being mounted on resilient mounts (see 6.3). The background noise level during testing shall be at least 10 dB lower than the noise of the producer at each measuring location.

4.7.10 Electromagnetic interference testing. The first producer shall undergo an electromagnetic interference test in accordance with MIL-STD-462.

4.7.11 Capacity testing. Producer output shall be monitored once every 12 hours during the operation test to ensure that the capacity requirements of paragraph 3.4.1 are being met under normal operating conditions of table I. The first producer on each contract or order shall be tested for a minimum of 24 hours to demonstrate conformance requirements for operation under abnormal conditions. Producer product output shall be measured by tank accumulation.

4.7.12 Purity testing. The producers product shall be tested at least once every 8 hours during operation to ensure that the purity of liquid oxygen and liquid nitrogen produced is in accordance with 3.4.1. Additionally, during a continuous 30 day operating cycle, the first producer shall be subject to the combined contaminant levels noted in table II and the oxygen product shall be monitored to determine conformance to 3.4.2 at the start of the cycle, once per day, and at the end of the cycle. Upon completion of the 2160 hours of operation and without having been defrosted and regenerated for at least 720 hours of operation, the first producer shall again be operated in production for at least 24 hours while subjected to the table II contaminant levels and the product monitored (three samples at 8 hour intervals) to determine the degree of conformance

to 3.4.2. During the testing of each producer carbon dioxide, methane and acetylene contamination shall be checked at least once per day. Only the first producer on each contract or order shall be subjected to the contaminants listed in table II. Subsequent producers shall be tested on CO_2 and H_2O vapor.

4.7.13 Operational plant test. Each producer shall be tested for a minimum of 120 hours to determine conformance to capacity, purity (including contaminant removal), and start-up time requirements and shall be operated for 4 hours under each of the pitch, roll, and list conditions specified to demonstrate conformance to specified capacities.

4.7.14 Enclosure leak test. When fully assembled, the producer enclosure shall be tested to ensure that its leakage rate does not exceed 40 ft^3/hr at 2 inches water column pressure.

4.7.15 Hydrostatic testing. At the conclusion of all operational testing the producer shall be hydrostatically tested to 150 percent of design pressure. Because of differing component design pressures, the producer may be segregated as necessary to facilitate testing. The hydrostatic testing may be accomplished using the cleaning fluid in accordance with MIL-STD-1330 immediately prior to cleaning. The test shall demonstrate the isolation capabilities and integrity of the producer as a whole.

4.8 Cleaning. After all pressure and hydrostatic testing has been accomplished, the producer shall be thoroughly cleaned and flushed in accordance with MIL-C-52211 or MIL-STD-1330. Adsorbent, wet polymeric material, and other consumables shall be replaced after the cleaning and prior to shipping.

4.9 Inspection of packaging. Sample packs, and the inspection of the preservation packing, and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition. For the extent of applicability of the packaging or preparation for delivery requirements of referenced documents listed in section 2, see 6.9.)

5.1 Preservation and unit pack. Preservation and unit pack shall be level A, C, or commercial as specified (see 6.2).

5.1.1 Level A. Equipment shall be cleaned, dried, and purged using dry nitrogen gas in accordance with MIL-C-52211. The equipment shall be sealed and shipped under a nitrogen gas pressure of 5 lb/in^2 gauge to prevent the entry of any contaminants. The equipment shall be unit protected in accordance with method C (method IIa) of MIL-C-52211.

5.1.2 Level C. Equipment shall be preserved and unit packed as specified in 5.1.1, except that method B (method IA-16) shall apply.

5.1.3 Commercial. Equipment shall be processed as specified in 5.1.1, except that the unit pack shall be in accordance with ASTM D 3951.

5.2 Packing. Packing shall be level A, B, C or commercial as specified (see 6.2).

5.2.1 Level A, B, and C. Equipment shall be packed in crates conforming to type II, class 2, style at the contractor option of MIL-C-104. Cushioning, blocking and bracing shall be in accordance with MIL-STD-1186 and the appendix to MIL-C-104. Crates shall be provided with inspection doors for interim inspection and servicing of contents.

5.2.2 Commercial. Packing shall be in accordance with ASTM D 3951 and herein.

5.2.2.1 Container modification. Shipping containers exceeding 200 pounds gross weight shall be provided with a minimum of two, 3- by 4-inch nominal wood skids laid flat, or a skid- or sill-type base which will support the material and facilitate handling by mechanical handling equipment during shipment and storage.

5.3 Marking. In addition to any special marking required (see 6.2), shipping containers shall be marked in accordance with MIL-C-52211 and shall include the marking requirements of MIL-C-104. Commercial packs shall be marked in accordance with ASTM D 3951.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The liquid oxygen and liquid nitrogen producer covered by this specification is intended for shipboard use.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number and date of this specification

b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2)

c. When first article is required (see 3.2)

d. Materials to be used if other than as specified (see 3.13.1)

e. System Safety Program (SSP) requirement (see 3.24)

f. Levels of preservation and unit pack and of packing required (see 5.1 and 5.2)

g. Special marking required (see 5.3).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DOD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
3.3 and appendix A	DI-DRPR-80651	Engineering Drawings	
3.3 and appendix B	DI-MISC-80169	Still Photo Coverage	
3.3 and appendix F	DI-MISC-80652	Technical Information Report	
3.3.1 and appendix C	DI-MISC-80652	Technical Information Report	
3.12.1	DI-R-7085	Failure Mode, Effects, and Criticality Analysis Report	
3.24	DI-SAFT-80102	Safety Assessment Report	
3.25	UDI-R-23567	Report, Maintainability Prediction	
4.3 and appendix D	DI-MISC-80653	Test Reports	
4.4	DI-T-2072	Reports, Test	
4.7 and appendix G	UDI-T-23724	Report, Failure/ Malfunction	
4.7.5	DI-ENVR-80709	High-Impact Shock Test Procedures	
4.7.5	DI-ENVR-80708	Shock Test Report	

4.7.8	DI-RELI-80250	Reliability Test Plan
4.7.8	DI-RELI-80252	Reliability Test Reports
4.7.8	DI-R-2129	Plan, Maintainability Demonstration
4.7.8	DI-MNTY-80832	Maintainability/ Testability Demonstration Report
4.7.9	DI-HFAC-80271	Sound Test Failure Notification and Recommendations Report
4.7.9	DI-HFAC-80272	Equipment Airborne Sound Measurements Test Report

The above DID's were those cleared as of the date of this specification. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.4 Technical manuals. The requirement for technical manuals should be considered when this specification is applied on a contract. If technical manuals are required, military specifications and standards that have been cleared and listed in DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL) must be listed on a separate Contract Data Requirements List (DD Form 1423), which is included as an exhibit to the contract. The technical manuals must be acquired under separate contract line item in the contract. Technical content should include the requirements of appendix E, titled "Technical Manual Technical Content Requirements".

6.5 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a preproduction sample, a first article sample, a first production item, a sample selected from the first _____ production items, a standard production item from the contractor's current inventory (see 3.2), and the number of items to be tested as specified in 4.3. The contracting officer should also include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish

evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.6 Electronic analyzer calibration gas (see 3.14.7). The contracting officer should furnish a list of military gases applicable to the producer specified herein as contained in the Federal Supply Catalog, Department of Defense Section, Identification list C6800-IL for FSC group 6830.

6.7 Operational endurance test monitoring. During operation (see 4.7.6), all temperatures listed in 3.15.2.1 and the purity measured on the bulk purity analyzer should be continuously monitored on multiple channel strip chart records or data loggers throughout the endurance test. The dates and hours should be indicated on each chart. Additional producers should undergo similar testing for 240 hours minimum for each producer.

6.8 Provisioning. Provisioning Technical Documentation (PTD), spare parts, and repair parts should be furnished as specified in the contract.

6.8.1 When ordering spare parts or repair parts for the equipment covered by this specification, the contract should state that such spare parts and repair parts should meet the same requirements and quality assurance provisions as the parts used in the manufacture of the equipment. Packaging for such parts should also be specified.

6.9 Sub-contracted material and parts. The packaging or preparation for delivery requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.10 Subject term (key word) listing.

Air compressor
Cold box
Pressure vessel

6.11 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing activity:
Navy – SH
(Project 3655-N110)

APPENDIX A

ENGINEERING DRAWINGS TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers information that shall be included on the drawings when specified in the contract or order. This appendix is mandatory only when data item description DI-DRPR-80651 is cited on the DD Form 1423.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. DRAWING CONTENTS

30.1 Drawings. Drawings should be level 3. Drawings should illustrate the producer down to and including the lowest detail. Typically the drawings should consist of but not be limited to the following:

a. Outline drawings with a complete bill of material

b. Installation diagrams

c. Process flow diagrams

d. Wiring diagrams (connections made by the installer should be shown)

e. Piping arrangements (internal and external) should show the approximate location of all piping, valves, fittings, and components

f. Internal component arrangement

g. Valves, pressure relief devices, and pressure, temperature, flow, and liquid level indicators

h. Control diagram

i. Assembly and detail drawings of internal components of producer

j. Bulk purity analyzer installation(s)

k. List of the equipment manufacturers, CAGE's, names, addresses, phone numbers, part numbers, and complete bills of material.

APPENDIX B

PHOTOGRAPH TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers the technical requirements for photographs covered by this specification. This appendix is not a mandatory part of this specification. The information contained herein is intended for guidance only.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. PHOTOGRAPH CONTENTS

30.1 Photographs. The contractor should produce photographs which show the internal and external arrangement of the producer. Photographs of the internal arrangement should be taken throughout construction and after the producer is completely assembled, just prior to installing insulation and cover plates. Photographs should include all views (that is, top, front, sides, back and three-quarter) and clearly show the location of all producer components, piping, tubing and instrumentation. Components, piping, tubing, instrumentation, valves, thermal couple lines, fitting, and so forth, shall be identified on master glossies by means of arrows and leaders attached to alphanumeric symbols printed in the photographs' margins. A symbol list shall be prepared for the photographs.

APPENDIX C

MAINTENANCE PLAN TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers the technical requirements for the maintenance plan covered by this specification. This appendix is not a mandatory part of this specification. The information contained herein is intended for guidance only.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. MAINTENANCE PLAN CONTENTS

30.1 Maintenance plan. The contractor should prepare a complete maintenance plan for the producer. The maintenance plan will be considered in determining producer logistics requirements. As a minimum the maintenance plan should provide the following:

a. A complete narrative of all required maintenance actions
b. Frequency of each maintenance action
c. Level at which each action must be accomplished
d. Special tools or test equipment (if applicable) for each action
e. Parts requirements (if applicable) for each action
f. Technical documentation necessary to accomplish each action.

APPENDIX D

TEST REPORTS TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers the technical requirements for first article inspection reports covered by this specification. This appendix is mandatory only when data item description DI-MISC-80653 is cited on the DD Form 1423.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. REPORT CONTENTS

30.1 First article test reports. Reports shall contain the following data:

a. Statement regarding overall success or failure of each test

b. Number of failures

c. Description of each failure and its cause

d. Description of the effect of each failure

e. Description of actions required to correct each failure (including replacement parts required)

f. Amount of time required to correct each failure

g. Total downtime resulting from each failure

h. Copies of log sheets containing all test data

i. Calculations for temperature and pressure compensations.

30.2 First article test procedures. The contractor should develop detailed test procedures. Test procedures shall include the following:

a. Sequence of tests

b. Acceptance criteria

c. Brand names and numbers of all consumables (for example desiccants, filters, lubricants, and so forth) to be used in the testing

d. Brand names and model numbers of all test equipment to be used.

APPENDIX E

TECHNICAL MANUAL TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers the technical requirements for manuals covered by this specification. This appendix is not a mandatory part of this specification. The information contained herein is for guidance only.

20. APPLICABLE DOCUMENTS

20.1 Government documents.

20.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

MILITARY

MIL-M-15071	Manuals, Technical: Equipments and Systems Content Requirements
MIL-M-38784	Manuals, Technical: General Style and Format Requirements

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

30. DATA CONTENT

30.1 Manuals. A technical manual (preliminary for review and camera-ready copy for final printing) should be prepared in accordance with MIL-M-15071 and MIL-M-38784 and contain the following:

a. Detail repair parts, maintenance information, and inspection criteria for all controls and pressure indicators, flowmeters, temperature and liquid level indicators, turbo-expanders, turbo-expander tachometers, and bulk purity analyzers.

b. Detailed instructions on how to pressure test and solvent clean the producer to remove contaminants after shipboard installation or contaminants that would have accumulated in the producer after a period of operation and which would need to be removed for safety reasons or for achieving satisfactory performance of the producer.

c. Information on how to recognize the need for changing of adsorbent in driers, hydrocarbon adsorbers, and similar equipments and how to recognize the need for overhaul of components.

d. Detailed information on how to insulate equipment after the completion of repairs which have involved insulation removal.

e. A single table showing for each valve the normal function, normal size, type, position during various operating modes of the producer, location, normal operating temperature, packing material, number of the figure which gives detail information regarding the valve, and whether the valve packing is upstream or downstream of the valve seat.

f. Calibration curves for all flowmeters and liquid-level indicators.

g. Sample operating logs showing typical readings of pressures, flows, temperatures, and liquid levels that would be encountered when starting the producer, operating to produce oxygen, operating to produce nitrogen, defrosting, regenerating, and cold start-up. Also, log data representing conditions of low refrigeration, low air flow, poor product purities, and any other adverse or unsatisfactory condition that degrades producer performance (these should provide information to aid an operator to recognize when such an adverse or unsatisfactory condition is occurring). These logs should be based on actual producer operation by the contractor. The adverse or unsatisfactory conditions should be artificially induced and simulated as necessary for log data development.

h. Isometric drawings showing the approximate positions of major producer components and valves.

i. Procedures for warm and cold start-up, normal, cold, and emergency shut down, and defrosting and regenerating for each mode of operation.

j. Complete electrical wiring schematics. Each wire should be identified by means of a number that is consistent with the producer drawings.

k. Complete piping schematics. Each piping run should be identified by means of a number that is consistent with the producer drawings.

l. Complete process flow diagrams.

m. Complete identification (including original vendor's name, part number, and CAGE) of consumables such as fuses, adsorbents, insulation, lubricants, chemicals, and so forth.

n. Complete exploded view drawings of repairable components.

o. Dimensions on repairable components with appropriate wear and replacement criteria.

p. Special tools or test equipment for disassembly, assembly, and testing of producer components.

q. A table showing when maintenance is required (action and frequency) along with detailed procedures for maintenance accomplishment.

APPENDIX F

MILESTONE REPORT TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers the technical requirements for milestone reports covered by this specification. This appendix is not a mandatory part of this specification. The information contained herein is intended for guidance only.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. REPORT CONTENTS

30.1 Milestone reports. Bi-monthly progress reports should be prepared which state the degree of completion, work planned to achieve completion, and problems that could delay completion of the producer. Reports should include all items in the contract.

APPENDIX G

FAILURE/MALFUNCTION REPORT TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers the technical requirements for failure/malfunction reports covered by this specification. This appendix is not a mandatory part of this specification. The information contained herein is intended for guidance only.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. REPORT CONTENT

30.1 Failure/malfunction data. A report should be prepared to document each and every incident of failure/malfunction that occurs during component tests, subassembly tests, factory checkout tests (that is, contractor's tests accomplished prior to the quality assurance tests specified herein) of each producer, and the quality assurance tests specified herein.

APPENDIX H

CHEMICAL REQUIREMENTS FOR INSULATION MATERIAL

10. SCOPE

10.1 Scope. This appendix covers chemical requirements for mineral-based thermal insulation. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

20.1 Non-Government publications. The following document(s) form a part of this document to the extend specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 512 Standard Test Methods for Chloride Ion In Water; (DOD adopted)

E 60 Standard Practice for Photometric and Spectrophotometric Methods for Chemical Analysis of Metals; (DOD adopted)

E 62 Standard Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods)

E 120 Standard Methods for Chemical Analysis of Titanium and Titanium Alloys; (DOD adopted)

E 146 Standard Methods for Chemical Analysis of Zirconium and Zirconium Alloys; (DOD adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

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

30. CHEMICAL REQUIREMENTS

30.1 Analysis. The specific material supplied shall be analyzed for the following leachable ions: (1) Chloride, (2) sodium or silicate (if necessary to meet the acceptance requirement of figure 1, both sodium and silicate should be analyzed). The plot point of these analyses shall fall in the acceptable area of figure 1. The acceptance – rejection curve may be extrapolated, as necessary, to determine the acceptability of plot points which fall outside the area actually bounded by figure 1. However, the minimum allowable value of sodium plus silicate shall be 50 p/m.

30.2 Hydrogen-ion concentration. Leach water from the material shall have a hydrogen-ion concentration negative exponent (pH) not greater than 11.2.

40. QUALITY CONFORMANCE TESTS

40.1 Lot size and sampling. For the purpose of this specification a lot shall consist of one production batch produced at one time under the same conditions and from ingredients of the same kind, nature, and quality. A minimum of three samples shall be taken from each lot for the quality conformance test. The sample shall be fully representative of the cross section of the material. Samples shall be wrapped in clear polyethylene sheets or placed in polyethylene envelopes as is suitable to protect the sample from contamination. Cleaned rubber or plastic gloves shall be worn while taking and handling the sample to avoid chloride contamination from perspiration or other contamination. The gloves shall be of material which does not have chloride containing compounds such as neoprene, saran, or metallic chlorides in its formulation. Prior to use, the gloves shall be rinsed twice in separate lots of boiling water; each rinsing shall be followed by thorough draining. The gloves shall then be air dried and stored in a closed container.

40.2 Leaching procedure prior to chemical tests. Equipment, tools, and reagents used for specimen preparation and leaching shall be clean and sufficiently free of chlorides, silicates, sodium, or acidic or alkaline materials which might otherwise affect the chemical tests. Water used in leaching shall be demineralized water meeting the following specifications: 0.1 p/m maximum chlorides, 2.5 microsiemens per cubic centimeter ($\mu S/cm^3$) maximum conductivity, 6.0 minimum and 8.0 maximum pH (water shall not be stored in glass, ceramic, or any other container in which it could pick up chloride, silicate, or sodium ions).

40.2.1 Specimen preparation. Two 20 gram specimens shall be taken from each sample. The specimen shall be proportionally representative of the entire composition. The specimen shall be prepared as follows: The specimen shall be pulverized in a blender operated at high speed for 30 to 60 seconds. The sample shall contain no large lumps. Sample portions may be cut or broken into smaller pieces prior to pulverizing.

40.2.2 Water leaching. Place each specimen in an individual 800 milliliter pyrex beaker (or equal) and cover the specimen with 400 milliliters of water. Cover the beaker with a watch glass and heat for one-half hour at 95 to 100 °C, then remove heat. Allow the beaker and its contents to cool to a room temperature of 20 to 30 °C. Filter the leach solution through a prewashed number 41 Whatman, or equal, filter paper in a Buchners type funnel, transferring the specimen

to the funnel and using light suction as necessary. The beaker and the specimen shall be washed thoroughly using a minimum of 10 small washes to make up the filtrate to 500 milliliters. The filtrate shall be transferred to a polyethylene container and marked as solution A. This solution A shall be the source of aliquots for the chemical tests. Approximately 150 milliliters of solution A, from which aliquots for the sodium and silicate tests are to be taken, shall be refiltered through a 0.45 millipore filter.

40.3 Chemical tests. The chemical tests shall be performed on the duplicate leach solutions A obtained from the duplicate specimens. The chemical analyses for chlorine, sodium, and silicate ions shall be calculated on the basis of the weight of the specimen. The pH shall be reported as the pH of solution A.

40.3.1 pH. The pH shall be determined on the aliquot from solution A using a Beckman Zeromatic (or equal) pH meter. Aliquots shall be discarded after the determination. The pH shall be corrected to 25 °C.

40.3.2 Chemical analyses. The chemical analyses for the chloride, silicate and sodium ions shall be made by the method contained in this specification, or equal as approved in writing by the command or agency concerned. Request for approval of alternate chemistry procedures shall be accompanied by justification evidence of their accuracy, such as by measuring differences in test results when known amounts of chlorides, silicates, or sodium are added and comparing these differences with comparable results obtained when using the procedures contained in this specification on the same samples of insulation. The analyses shall be made on suitable aliquots from solution A.

40.3.2.1 Analysis for chloride. An aliquot of solution A shall be analyzed by either of the following methods:

a. *Amperometric-coulometric titrator method.* An amperometric-coulometric titrator method such as the Aminco-Cotlove Automatic Chloride Titrator method, or equal.

b. *Colorimetric method:*

(1) An optical density shall be measured on a prepared solution against a water reference solution in five centimeter cells by a Beckman model B spectrophotometer or equal at 470 millimicron and the chloride content read from a calibration curve made from aliquots of a standard chloride solution representing 20, 40, 60, 80, and 100 micrograms of chloride ion. Both a sample blank and a reagent blank shall be used and the reading obtained on solution A shall be corrected by subtracting the sum of the blank readings. Note: Sulphate and phosphate cause positive interference at concentrations exceeding 0.2 weight percent.

(2) Add in turn to a 50 milliliter volumetric flask: An aliquot of solution A which contains 20 to 60 micrograms of chloride ion (adjusted to pH 6 to 8 with 6 Normal

HNO_3 using indicating paper), 2 milliliters each of reagents a. and b., and water to 50 milliliters, mixing thoroughly at each addition. Read 15 minutes after preparation, mixing the solutions thoroughly just prior to reading.

(3) Reagents shall be of suitable analytical grade. Reagent solutions shall have the following composition:

(a) 99.7 grams of $Fe_2 (SO_4)_3 \cdot (NH_4)_2SO_4 \cdot 24H_2O$ per liter dissolved in 6 Normal nitric acid. Store in a brown bottle for at least 24 hours before use.

(b) 7.5 grams of $Hg(SCN)_2$ dissolved in methyl alcohol to a final volume of 500 milliliters after mixing at least one hour with a stirrer and filtering through Whatman number 41 paper (or equal).

(c) Water shall be distilled water containing less than 0.1 parts per million of chloride ion. Note: For reference, see method C of ASTM D 512.

40.3.2.2 Colorimetric method for silicate. An aliquot of millipore filtered solution A shall be analyzed photometrically (see ASTM E 60) for silicates by either of the following methods, modified as required to suit the leach water:

a. The molybdisilicic acid method in accordance with ASTM E 62
b. The molybdenum blue method in accordance with ASTM E 120 or ASTM E 146.

40.3.2.3 Analysis for sodium. A 100 milliliter aliquot of millipore filtered solution A shall be analyzed by either of the following methods:

a. *Spectrographic method.* The solution is reduced to dryness under infrared lamps in a tared platinum dish. The residue is then analyzed spectrographically for sodium.

b. *Flame photometric method.* The millipore filtered solution shall be used for the flame photometric analysis. Note: Corrections must be made if high concentrations of alkaline or alkaline earth metals such as calcium, potassium or magnesium are present.

40.3.3 Acceptance. If the average analysis of the two specimens taken from any sample fails to conform to the requirements of 3.1 and 3.2 the lot represented by that sample shall be rejected.

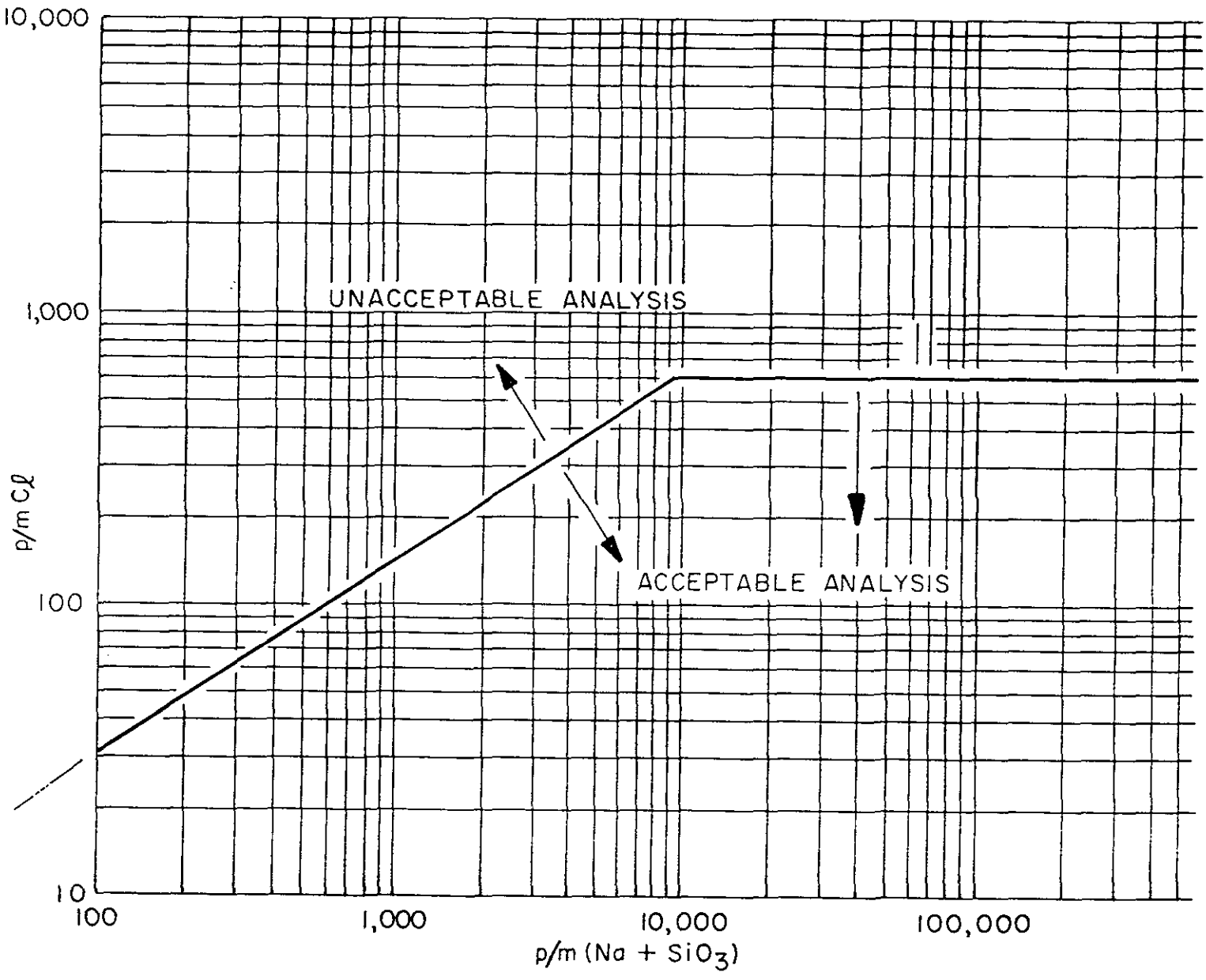

FIGURE 1. *Acceptability of insulation on the basis of the plot points of the chloride, sodium, and silicate ions.*

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
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NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD)
	MIL-P-24344C(SH)	2 January 1991

3. DOCUMENT TITLE
PRODUCER, LIQUID OXYGEN AND LIQUID NITROGEN (SHIPBOARD TYPE - LOW PRESSURE)

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE (Include Area Code) (1) Commercial	(2) AUTOVON
Technical Point of Contact(TPOC): Mr. A. Wagner (SEA 56Y14) PLEASE ADDRESS ALL CORRESPONDENCE AS FOLLOWS:	TPOC: 703-602-5585	8-332-5585
c. ADDRESS (Include Zip Code) Commander, Naval Sea Systems Command Department of the Navy (SEA 55Z3) Washington, DC 20362-5101	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	