SH700-A2-MMC-010

0910-LP-105-9927 **REVISION 1**

TECHNICAL MANUAL

OPERATION AND MAINTENANCE MANUAL FOR THE EMERGENCY EVACUATION HYPERBARIC STRETCHER (EEHS)

DESCRIPTION, OPERATION, MAINTENANCE,
AND ILLUSTRATED PARTS BREAKDOWN

GPC, A Joint Venture
Contract N00024-01-D4018

SUPERSEDURE NOTICE: THIS PUBLICATION SUPERSEDES NAVSEA SH0700-A2-MMC-010, 07 FEBRUARY 2003.

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SAFETY SUMMARY

S-1 INTRODUCTION.

This Safety Summary is divided into two parts. The first part consists of general safety rules and precautions; the second consists of WARNINGS and CAUTIONS appearing elsewhere in this manual. Should situations arise that are not covered by the general and specific safety precautions, the Commanding Officer or other authority will issue orders, as deemed necessary, to cover the situation.

S-2 GENERAL SAFETY RULES FOR EEHS.

Rules listed below shall be followed:

a. Clothing containing oil, grease, or volatile substances of any kind shall not be worn or used in or near the EEHS.
b. Matches, cigarette lighters, lighted cigarettes, cigars, pipes, or any open flame shall not be carried into the EEHS at any time.
c. Shoes shall not be worn inside the EEHS.
d. No electrical appliances, with the exception of approved medical monitors, are to be used in the EEHS while the flexible tube or the oxygen system to the BIBS manifold is pressurized.
e. EEHS clothing and towels shall be made of 100% cotton. The only exception to this is that Diver swim trunks made of 35% cotton and 65% polyester may be worn.
f. Do not use oil or other flammable or volatile substances on any oxygen fitting, air fitting, or other piece of equipment associated with the EEHS.
g. Do not permit products within the EEHS that may contaminate or off-gas into the EEHS atmosphere (e.g., mercury, batteries other than alkaline batteries, etc.).
h. Acrylic domes shall not be cleaned with glass cleaners, ammonia, solvents, or other volatile liquid as crazing or etching of the acrylic domes may result. Cleaning agents other than those specified in PMS shall not be used on acrylic plastic.
i Ensure that the EEHS is free of fire hazards.

S-3 GENERAL SAFETY PRECAUTIONS.

The following are general safety precautions that are not unique to a specific procedure. They will not appear elsewhere in the text. These are general recommended precautions that all personnel should know and understand. These precautions should be applied during all phases of operation and maintenance.

Extensive guidance for safety can be found in the *OPNAV 5100 Series Instruction Manual, Navy Safety Precautions* and the *U.S. Navy Diving Manual.*

S-3.1 Adhesives. Avoid skin contact with adhesives. Certain adhesives with rapid bonding properties will firmly bond to any skin surface that contacts the adhesive and parts during a bonding process. Do not attempt to pull bonded skin surfaces away from parts. Use the recommended solvents or call for medical assistance.

S-3.2 Toxins. Cleaning solvents, fuels, oils, adhesives, and catalysts must be used in a well-ventilated area. Vapor concentrations and skin contact can be harmful. Death may result if the vapors are inhaled for lengthy periods. Protective glasses should be worn and skin contact avoided. Body surfaces contacting the fluids must first be washed in hot water**;** eyes must be rinsed with water, and then examined by a doctor.

S-4 WARNINGS. A WARNING identifies an operating or maintenance procedure, practice, condition, or statement, which, if not strictly observed, could result in injury to or death of personnel. The following warnings appear in this manual and are repeated here for emphasis followed by the page number on which they can be found.

WARNING

When installing or removing the external door, do not use the pressure gauge or vent screw as a handle; use the appropriate knobs. Failure to do so may result in injury or death to personnel and damage to equipment (Page 1-3).

The control box bypass adaptor is provided solely to allow air to be supplied to the BIBS mask when the control box is being bypassed. Use for any other purpose is expressly forbidden and may result in injury or death to personnel (Page 1-6).

Do not exceed the cylinder rated pressure when filling the oxygen bottles (Page 1-6).

Obey all safety requirements involving the use of oxygen (Page 2-1).

Before the patient is placed into the stretcher, make certain that he is conscious, has an unobstructed airway, is breathing, and has a pulse (Page 2-2).

Do not hold or push against the flexible tube (Page 2-7).

When transporting the EEHS onboard an unpressurized aircraft, the operator runs the risk of lifting the stretcher relief valve. The relief valve will lift at approximately 9,250 ft altitude. If this occurs, the safety shut-off valve should be closed to prevent the stretcher from losing pressure (Page 2-9).

WARNINGS (Continued)

In the unlikely event of failure of one of the umbilical hoses, loss of pressure in the stretcher may be averted by removal of the corresponding quick-connect coupling on the penetrator plate, as this incorporates a non-return valve. Other pressure losses may be averted by closing the relevant valve on the control panel or supply cylinder (Page 2-9).

Repair or replace worn or damaged components immediately with authorized replacement components. Failure of equipment during operation may result in injury or death to personnel (Page 3-1).

Do not disassemble diving system components while a breathing gas circuit is pressurized. Failure to depressurize the system may result in injury or death to personnel and damage to equipment (Page 3-1).

Cleanliness is imperative in maintaining and handling the EEHS. All tools and parts must be kept free of oil, grease, rust, or other contamination. Foreign substances within an assembly may result in equipment failure and possible injury or death to personnel (Page 3-4).

Keep all sharp objects away from the stretcher. Objects may puncture or otherwise damage the stretcher (Page 4-5).

Do not tighten leaking connections while under pressure. A system that was previously gas tight and now leaks indicates a change in system hardware that over tightening may aggravate and which could prove hazardous (Pages 5-2, 5-3, 5-7, 5-9, and 5-10).

Do not repair the stretcher if there is any damage to the fibers as the integrity of the stretcher may have been impaired; contact NAVSEA 00C3 to determine the proper course of action (Page 6-2).

Each EEHS is supplied with four regulators; two for air and two for oxygen. They must not be interchanged because the oxygen regulators are supplied "Oxygen Clean." Failure to heed this warning may result in serious malfunction of the equipment or injury or death of personnel (Page 6-5).

Only oxygen-approved antiseizing tape may be used on oxygen system threaded connections (Page 6-21).

S-5 CAUTIONS. A CAUTION identifies an operating or maintenance procedure, practice, condition, or statement, which, if not strictly observed, could result in damage to or destruction of equipment, loss of mission effectiveness, or long-term health hazard to personnel. The following CAUTIONS appear in this manual and are repeated here for emphasis followed by the page number on which they can be found.

CAUTION

In view of the block and bleed system incorporated in the control box, it is essential that the air supply pressure exceeds the oxygen supply pressure by at least 30 psig (Page 1-6).

Care should be taken to ensure that the end domes do not fall in on the patient (Page 2-9).

The storage cases are heat sensitive above 140°F (60°C). Cover the cases to keep them out of direct sunlight, especially when stored in a non-ventilated, enclosed area behind glass (e.g., in a car) (Page 4-4).

Do not remove the protective fabric cover unless there is suspected damage to the surface of the tube. Replacing the cover is quite difficult; therefore, it should only be removed when absolutely necessary (Page 6-2).

When disassembling or reassembling regulator, use only plastic or brass O-ring picks to remove or install the O-rings. Every precaution shall be taken to prevent scratching the O-ring seating surface, as any damage to the sealing surface will result in leaks (Pages 6-8 and 6-14).

If at any time during testing the test pressure gauge exceeds 14 bar (206 psig), then there is a high pressure leak with the regulator. Shut the air supply valve and investigate the cause of the internal leak (Page 6-13).

During removal, disassembly, repair, and replacement every precaution shall be taken to maintain oxygen component cleanliness as stated in MIL-STD-1330. (Page 6-16)

If at any time during testing the test pressure gauge exceeds 11 bar (162 psig), then there is a high pressure leak with the regulator. Shut the air supply valve and investigate the cause of the internal leak (Page 6-20).

FOREWORD

This manual has been prepared to provide the U.S. Navy and Air Force with the technical information and operational instructions required to safely and effectively employ the Emergency Evacuation Hyperbaric Stretcher (EEHS) in support of worldwide peacetime and combat diving operations.

To ensure that a fully supportive logistics base is maintained, and this manual is kept up to date, it is imperative that all personnel associated with the EEHS submit recommended changes and improvements to this manual. Change recommendations to this manual should be submitted directly to COMNAVSEASYSCOM (Attn: Code 00C3) on NAVSEA Technical Manual Deficiency / Evaluation Report (TMDER), NAVSEA Form 4160/1 found in the back of this manual.

This manual contains the NAVSEA-approved standard Operating Procedures (OPs) and Emergency Procedures (EPs) for the EEHS. These represent the single approved set of OPs and EPs for operation of the EEHS**;** the original copies contained in Appendix A and B shall be used to make additional working copies. Changes to the OPs and EPs will be issued as changes to this manual.

Mailing Address:
Naval Sea Systems Command
ATTN: 00C3
1333 Isaac Hull Ave., SE, Stop 1073
Washington Navy Yard, DC 20376-1073

(Voice Phone, 202-781-0934; DSN, 326-0934; Fax, 202-781-4588)

LIST OF ACRONYMS AND ABBREVIATIONS

ACRONYM	DEFINITION
AGE	Arterial Gas Embolism
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Material
BIBS	Built-In Breathing System
CAGE	Commercial and Government Entity code
CGA	Compressed Gas Association
COMNAVSEASYSCOM	Commander Naval Sea Systems Command
CPR	Cardiopulmonary Resuscitation
DCS	Decompression Sickness
DLSS	Divers Life Support System
DT/DG	Divers Timer/ Depth Gauge
EPs	Emergency Procedures
EEHS	Emergency Evacuation Hyperbaric Stretcher
FAR	Failure Analysis Report
FCA	Field Calibration Activity
fpm	Feet per minute
fsw	Feet sea water
HP	High pressure
IROAN	Inspect, Repair Only As Needed
LP	Low pressure
MIPs	Maintenance Index Pages
MRCs	Maintenance Repair Cards
NAVOSH	Navy Occupational Safety and Health
NAVSEA	Naval Sea Systems Command
NSN	National Stock Number
NSTM	Naval Ships’ Technical Manual
OPNAVINST	Office of the Chief of Naval Operations Instruction
OPs	Operating procedures

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

ACRONYM	DEFINITION
PMS	Planned Maintenance System
PVHO	Pressure Vessel for Human Occupancy
psi	pounds per square inch
psig	pounds per square inch – (gauge pressure)
REC	Re-entry Control
RPL	Repair Parts List
SCA	System Certification Authority
scf	standard cubic feet
SPMIG	Standard PMS Materials Identification Guide
SCUBA	Self-Contained Underwater Breathing Apparatus
TBD	To be determined
TFBR	Technical Feedback Report
TMDER	Technical Manual Deficiency/ Evaluation Report

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CHAPTER 1 – SYSTEM DESCRIPTION

1-1 INTRODUCTION

The Emergency Evacuation Hyperbaric Stretcher (EEHS) is intended to be used to transport a diving or disabled submarine casualty from an accident site to a treatment facility while under pressure. The EEHS was tested and adopted to fulfill needs generated by the U.S. Navy and the USAF for providing hyperbaric treatment in austere settings on the ground, in submarines, and in diving situations, and during ground, air, and sea transport. It can be used for treatment of decompression sickness (DCS), arterial gas embolism (AGE), blood loss, ischemic injuries, burns, carbon monoxide (CO) poisoning, cyanide poisoning, smoke inhalation, crush injuries, and many other emergency conditions. The EEHS is not intended to replace or be used instead of a recompression chamber, only to be used in conjunction with a chamber. The EEHS is small enough to allow transfer of a patient, under pressure, into or out of many shore-based recompression chambers, owned by both the DOD and civilian medical organizations.

1-1.1 Purpose. The purpose of this manual is to provide the information required to operate and maintain the EEHS. This chapter provides a general description of the EEHS and its characteristics.

1-1.2 Scope. This manual provides the information required to mobilize, transport, set up, operate, and demobilize the EEHS.

a. For detailed operating and emergency procedures see Appendices A and B of this manual, which contains the NAVSEA approved standardized Operating Procedures (OPs) and Emergency Procedure (EPs) for the EEHS.

b. Where a conflict arises between this manual and other sources of guidance, the following order of precedence is assigned:

c. Planned Maintenance System (PMS)/Maintenance Requirement Cards (MRC) takes precedence.

1) If PMS/MRC is inadequate or found to be incorrect, applicable guidance in this manual or other applicable military technical manuals takes precedence. **Report** inadequate or incorrect PMS via a PMS technical feedback report (TFBR) in accordance with current PMS instructions.

2) If PMS and applicable military technical manual(s) are in conflict, PMS takes precedence. For this manual, report deficiencies directly to COMNAVSEASYSCOM (Code 00C3) using TMDER in back of manual.

1-2 STANDARD MILITARY USAGE

This manual utilizes standard military usage as pertains to permissive, advisory, and mandatory language. Word usage and intended meaning in this manual are as follows:

a. **"Shall"** has been used only when application of a procedure is mandatory.

b. "**Should**" has been used only when application of the procedure is recommended.

c. "**May**" and "**need not**" have been used only when application of a procedure is discretionary.

d. "**Will**" has been used only to indicate futurity, never to indicate any degree of requirement for application of a procedure.

1-3 GENERAL DESCRIPTION.

The EEHS consists of a flexible stretcher tube, two acrylic end domes, a control box, an umbilical, and a gas supply as shown in Figure 1-1. The stretcher tube is made of composite material consisting of para-aramid fiber strands encased in a silicone shell. The stretcher tube can be folded and put into its storage box for easy transportation. One clear acrylic end dome fits at each end of the stretcher to provide a pressure seal and to allow light into the stretcher for the patient. One of the end domes contains a medical lock and the other contains the penetrator plate. The control box is attached to the penetrator end dome by an umbilical comprised of four separate hoses that attach at each end with quick disconnect fittings. Included in the control box are the valves, fittings, and gauges that control and monitor the system. The compressed air and oxygen cylinders used to operate the EEHS must be DOT-certified, and where applicable, approved for Navy use.

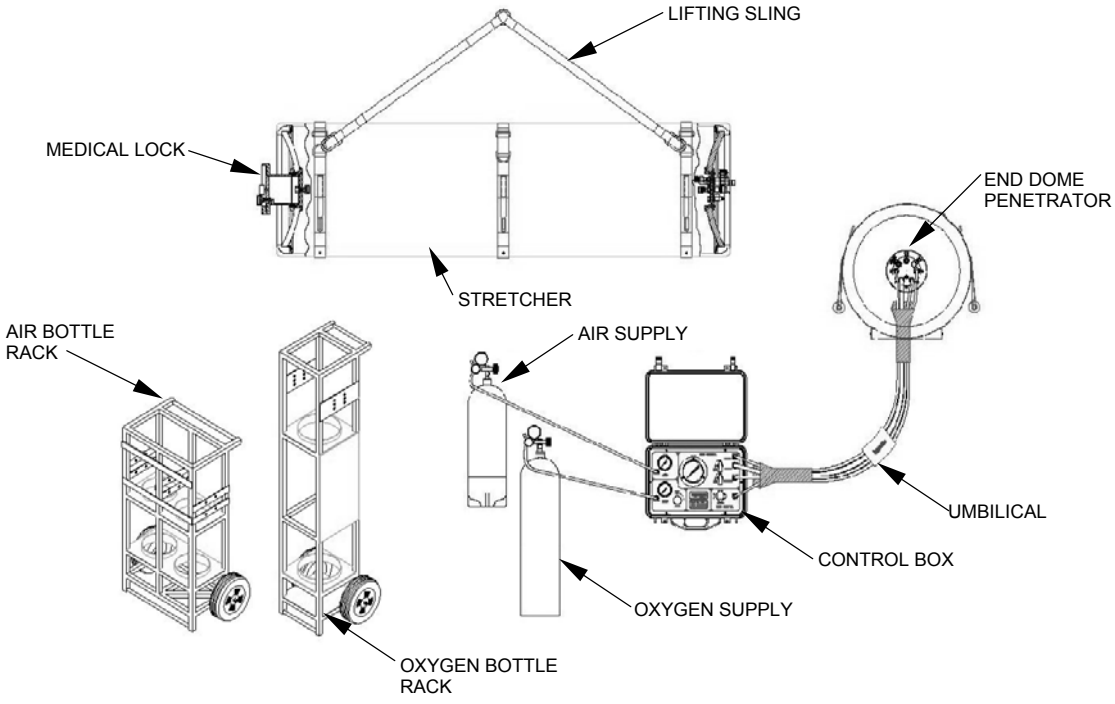

Figure 1-1. EEHS Component Overview

1-4 COMPONENT DESCRIPTION.

The EEHS is comprised of the following major components:

1-4.1 Stretcher Tube. The flexible tube is manufactured by winding para-aramid fiber strands and binding them in silicone matrices. Both the inside and outside surfaces are covered with an abrasion-resistant silicone. At each end of the tube there are sealing surfaces onto which the acrylic end domes fit. These surfaces should be smooth and be kept clean. Sharp objects must be kept away from the tube at all times. In the event that any damage to the surface of the tube appears, the tube should not be used until repairs have been completed.

1-4.2 End Domes. The stretcher has two transparent acrylic end domes that fit onto the inside of the wound tube at each end. The convex sides of the dome face inwards into the stretcher. One end dome contains a medical lock, which is used to transfer small items into and out of the stretcher. The penetrator end dome carries quick disconnects from the umbilical to the external control box, the emergency safety valves, and overboard dump. The Built-In Breathing System (BIBS) mask and microphone connections and the stretcher remote air inlet connections are on the inside of the penetrator end dome as well.

1-4.3 Medical Lock. The medical lock is mounted in the head end dome and is used to pass small items in and out of the stretcher. The medical lock has an inner and outer door and a pressure gauge on the outside to indicate if the medical lock is pressurized.

WARNING

When installing or removing the external door, do not use the pressure gauge or vent screw as a handle; use the appropriate knobs. Failure to do this may result in injury or death to personnel and damage to equipment.

1-4.4 Penetrator Plate. The penetrator plate incorporates all the quick disconnect fittings and connections that cross the stretcher pressure boundary. These connections and their descriptions are as follows:

a. Pressure Increase: Provides a connection for stretcher supply air.
b. BIBS Supply: Connection point for the BIBS mask.
c. Safety Valve Shut-Off (attached to the adjustable relief valve set to crack at 33 psi): Used if the relief valve does not reset or if it leaks.
d. BIBS Exhaust: Connection point for BIBS exhaust hose to vent exhausted oxygen outside the stretcher.
e. Emergency Vent: Used if relief valve does not lift.
f. Pneumo: Connection point for stretcher depth gauge.
g. Pressure Decrease: Connection location for stretcher pressure decrease hose.
h. Communications: Provides a connection point for communications with the patient inside the stretcher.

i. Blank Penetration: Provides a spare location for future use or for the use of medical monitoring devices.

1-4.4.1 Relief Valve. The tube is protected from over-pressurization with an adjustable safety relief valve (Figure 1-2). The stretcher will be shipped with the valve and it shall be set to a cracking pressure of 33 psi (74 fsw) when the unit is received by the fleet.

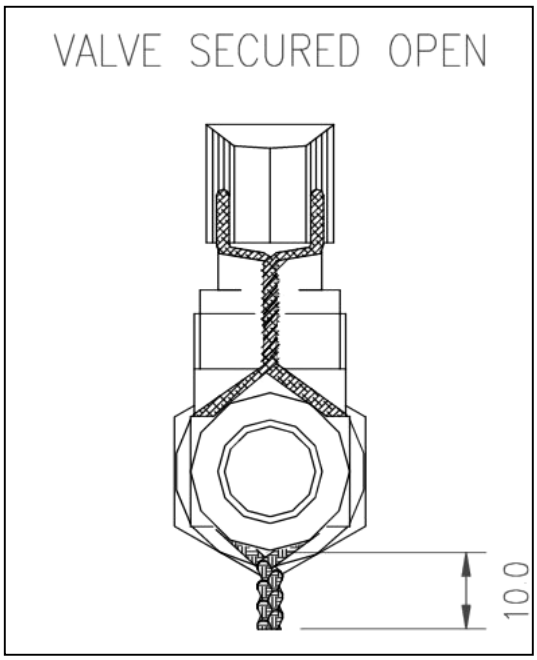

Figure 1-2. Safety Shut-Off Valve

1-4.5 Umbilical. The umbilical is a set of four hoses that transport air and oxygen between the control box quick disconnects. Neoprene covers are included to cover and protect the ends of the umbilical from damage.

1-4.6 Control Box. All of the standard operating controls and the primary depth gauge are contained in the control box, as shown in Figure 1-3. These controls and their functions are as follows:

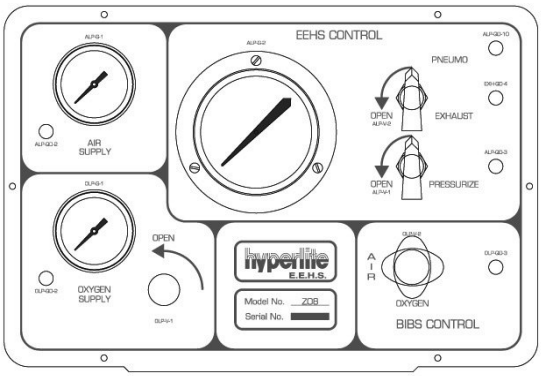

Figure 1-3. Control Box

a. Air Supply Pressure Valve: Increases stretcher pressure.
b. Stretcher Exhaust Valve: Decreases stretcher pressure.
c. Breathing Gas Supply Valve: A two-position valve that supplies either oxygen or air to the BIBS mask.
d. Depth Gauge: Indicates depth of the stretcher in feet of sea water above one atmosphere.
e. Inlet Attachments: Provided for both air and oxygen.
f. Oxygen Isolation Valve: Isolates the oxygen supply from the system.
g. Outlet Attachments for the umbilical connections to the penetrator plate.
h. Air and Oxygen Gauges: Indicate the reduced pressures supplied to the stretcher.

1-4.7 Oxygen Monitor. A battery-operated oxygen monitor (see Figure 1-4), the MiniOX 3000 Oxygen Monitor, measures oxygen concentrations in the chamber as a percentage. The monitor incorporates the following features:

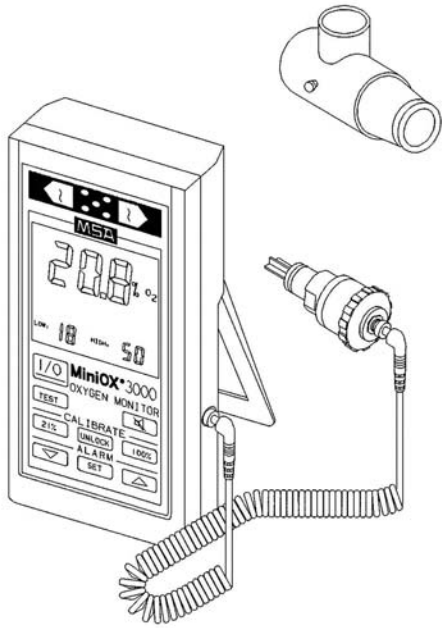

Figure 1-4. MiniOx 3000 Oxygen Monitor

a. Calibration function
b. High and low oxygen concentration alarms
c. Low and depleted battery alarms
d. Oxygen sensor indicator
e. Automatic error detection
f. Battery test
g. Oxygen alarm test

1-4.8 Communications. The headset-to-headset communication system enables dialogue between the patient in the hyperbaric stretcher and the operator controlling the procedure. The unit is operated through a master control box, which houses the electronic circuitry, an on/off switch, volume adjustment, and squelches. The communications box has ports for operator (pilot) and patient (copilot). The operator's system consists of an external headset with a boom microphone and a volume control

knob on the side of the headset. The patient's system is comprised of a headset with a connection to the throat microphone. There is a volume control knob on the side of the headset.

1-4.9 Adapter Fittings. The EEHS comes with the following different adaptors:

a. Control Box Bypass Adapter. Keeps BIBS mask operational when the control box has been removed from the system due to malfunction during stretcher use.

WARNING

The control box bypass adapter is provided solely to allow air to be supplied to the BIBS mask when the control box is being bypassed. Use for any other purpose is expressly forbidden and may result in injury or death to personnel.

b. Air Adapter: Permits the use of European air bottles with the air regulator.
c. Oxygen Adapter CG540-DIN: Permits use of European oxygen bottles with the oxygen regulator.
d. Oxygen Adapter CG870-CG540: Permits use of small emergency oxygen bottles with the oxygen regulator.

1-4.10 Regulators. Each stretcher is supplied with four regulators, two for air and two for oxygen. These regulators reduce the high-pressure gas contained in the cylinders to a pressure between 115 and 140 psig for oxygen and between 170 and 200 psig for air. The oxygen relief valve is set at 151 $\pm$5 psig and the air relief valve is set at 216 $\pm$5 psig.

CAUTION

In view of the block and bleed system incorporated in the control box, it is essential that the air supply pressure exceeds the oxygen supply pressure by at least 30 psig.

1-4.11 Oxygen/Air Supply. A majority of the EEHS systems have been delivered with two oxygen and two air cylinders. The supplied oxygen flasks are 2200-psi, 120-SCF aluminum cylinders. The supplied air flasks are 3000-psi, 100-SCF aluminum cylinders.

WARNING

Do not exceed the cylinder rated pressure when filling the air or oxygen bottles.

In some cases, an EEHS was not supplied with the gas cylinders. These systems may utilize standard navy 80-SCF SCUBA cylinders for air and K-Bottles for oxygen. Whichever gas supply is used, it shall be listed in the Pre-Survey Outline Booklet (PSOB) for the EEHS in addition to the gas usage and supply calculations. An Example of those calculations is provided in Appendix D.

Air is supplied to the stretcher by two standard 3000-psi 100-scf compressed gas bottles which are typically used for scuba operations. The air bottles are used one at a time, with one as primary and the other as secondary. The minimum volume of air that will be needed to transport a patient is 98 scf.

1-4.12 Oxygen/Air Bottle Racks. A rack is provided with the stretcher for use in transporting the oxygen and air bottles. This rack is required for use any time the stretcher is to be transported by aircraft. The rack is designed to carry either one each oxygen and air bottle or both oxygen or air bottles.

1-4.13 Internal Patient Pad. The internal patient pad is used to move the patient into and out of the stretcher, and provides a comfortable area for the patient during treatment. It is made of foam with a fire-resistant cover.

1.5 SPECIFICATIONS AND REFERENCE INFORMATION.

Tables 1-1 and 1-2 provide system specifications and applicable references for the EEHS.

Table 1-1. EEHS System Specifications

Design Code	ASME PVHO-1/Code Case 6
Working Pressure	26.7 psig (60 fsw)
Design Temperature	0°F – 100°F
Dimensions:	
Length	88.5"
Diameter	23.5"
Total Weight	210 lb.
Internal Volume	20.1 cu. ft.
End Domes	Acrylic, 0.9" thick
Medical Lock	Anodized aluminum, 4.8" diameter 4.9" depth
Materials:	
Stretcher Tube	Para-aramid/Silicone
End Domes	Acrylic/Nylon 6
O_2 / Air Racks	Aluminum
BIBS	1 Mask – Patient oxygen/ air supply with overboard exhaust
Gas Supply	174 scf of air/ 210 scf of oxygen
Communications	Modified Clarke Communications System
Furnishings	Internal Patient Pad

Table 1-2. Reference Publications

TITLE	NUMBER	STOCK NUMBER
Ships' Maintenance and Material Management (3M) Manual	OPNAVINST 4790.4	0579-LD-057-3100
NAVOSH Program Manual	OPNAVINST 5100.19 (for afloat)	
Vol. 1 NAVOSH and Major Hazard Specific Programs		0579-LD-057-1210
Vol. 2 Surface Ship Safety Standards	OPNAVINST 5100.23 (for shore)	0579-LD-057-1220
Vol. 3 Submarine Safety Standards		0579-LD-057-1230 0579-LD-057-3050
Naval Ships' Technical Manual, Chapter 262 (Lubricating Oils)	S9086-H7-STM-010	0901-LP-262-0000
Naval Ships' Technical Manual, Chapter 593 (Pollution Control)	S9086-T8-STM-000/CH593	0901-LP-593-0000
U.S. Navy Diving Manual	SS521-AG-PRO-010	0901-LP-708-8000
U.S Navy Diving and Hyperbaric Systems Safety Certification Manual	SS521-AA-MAN-010	0901-LP-312-4600
Users Guide for Scott Pressure Vak II - Oxygen Inhalator	N/A	N/A
MiniOX 3000 Oxygen Monitor	N/A	N/A

CHAPTER 2 – OPERATIONS

WARNING

Keep all sharp objects away from the stretcher. Sharp objects may puncture or otherwise damage the stretcher.

2-1 BASIC CHECKS.

When the EEHS is to be used, the component parts must first be removed from their storage boxes and inspected for any signs of external damage. The stretcher should not be used if such signs exist.

2-2 GAS SUPPLIES.

Under normal circumstances, air and oxygen will be used as supply gases for the EEHS. A minimum of 98 scf of air and 154 scf of oxygen is necessary prior to the start of any transport. This should be adequate for any foreseeable events during transport. Refer to Appendix D for gas requirement calculations and conversions.

WARNING

Obey all safety requirements involving the use of oxygen.

The correct regulator must be fitted to the gas supply cylinders for both the air and oxygen supplies. They are labeled and must not be interchanged. Use certified adapters as required if the two connections are not compatible.

2-3 HOSES BETWEEN SUPPLY CYLINDERS AND CONTROL BOX.

The two quick disconnects on the whips must be securely attached to the left side of the control box. Each connection is different to prevent the supply hoses from being improperly installed.

2-4 COMMUNICATIONS CONNECTIONS.

Connect the headset with the boom microphone to the communications box port marked “Pilot.” Then connect the communications umbilical to the communications box port marked “copilot.” The other end of the umbilical attaches to the communications connection on the penetrator end dome. Connect the headset with the throat microphone on the penetrator end dome inside the stretcher.

2-5 UMBILICAL BETWEEN CONTROL BOX AND STRETCHER.

The umbilical quick disconnects must be securely attached to the control box quick disconnects, followed by similar attachments at the penetrator plate. Detailed instructions for making the umbilical connections can be found in Operating Procedure OP-1 (Appendix A). Each connection is different to prevent the umbilical from being improperly installed.

2-6 STRETCHER INTERNAL CONNECTIONS.

One of the internal connections is for the remote air supply hose. This hose is used to better circulate the air in the stretcher when it is being pressurized or vented. Connect it to the end dome penetrator plate. The BIBS mask, another internal connection, is then connected to the end dome penetrator plate. The connectors are different and cannot be incorrectly connected. The last connection is for patient communications.

2-7 CHECKING THE SYSTEM.

Check that the stretcher pressure supply valve and the stretcher exhaust valves on the control box are both turned to the OFF positions and that the BIBS supply valve is turned to AIR. Open the air cylinder valve, check for pressure, and then open the oxygen cylinder valve. Check both supply pressure gauges to ensure that each cylinder is full. Check that the regulated supply pressures of both air and oxygen at the control box are correct. The reading should be in the following pressure ranges:

- Air: 170 – 200 psig
- Oxygen: 115 – 140 psig

With the BIBS supply valve turned to AIR, check that the air supply is reaching the mask by inhaling through it. Open the Oxygen isolation valve. Turn the BIBS supply valve to OXYGEN and check that the oxygen supply is functioning correctly. Leave the BIBS supply to OXYGEN. Note that the exhalation through the BIBS mask will not operate freely until the stretcher is pressurized. Connect both the operator's (pilot) headset and patient’s (copilot) to the communication box. Switch on the communication system to test, adjusting volume and squelch as needed.

2-8 MEDICAL LOCK.

Inspect the innermost medical lock door O-ring, which is used for sealing the door. The other O-ring is in three sections and is used exclusively to hold the door in place when there is no internal pressure. Close the vent and install the inner door into the medical lock. The outer door has only one O-ring that also requires inspection. Fully open the vent screw, as it is used as part of the locking mechanism. Close the door completely and, using the two knobs, rotate the door until it stops, then shut the vent screw.

2-9 MEDICAL CONSIDERATIONS FOR USE OF THE EEHS

While the EEHS system is a valuable tool, it has significant limitations and may pose serious hazards if used inappropriately.

WARNING

Before the patient is placed into the stretcher, make certain that the patient is conscious, has an unobstructed airway, is breathing, and has a pulse.

The most serious limitation of any monoplace hyperbaric system is the loss of "hands on" access to the patient. While this presents many challenges to physicians not accustomed to this situation, those

experienced in the use of monoplace chambers have learned that many of the problems can be overcome with careful preparation and vigilance.

The most important concern for use of the EEHS should be consideration of airway management. If the patient is not fully conscious and capable of maintaining his own airway, he shall not be placed in the EEHS unless personnel qualified in airway management are continuously managing the patient. The risk of airway obstruction in an unconscious patient is always present and the EEHS offers only very limited ability to observe respiration. Airway obstruction is worse than most cases of DCS or AGE, and the relative risks must be carefully weighed. The use of airway devices, such as oral or nasopharyngeal airways, endotracheal intubation, laryngeal mask airway, esophageal obturator airway, or other devices may be helpful, but should only be used by qualified personnel.

Acute head injury, by itself, is not necessarily a ruling out factor, but if the patient were unconscious, the above discussion would apply. Vigilance would be necessary to follow changes in level of consciousness. Trauma to the face, particularly involving the airway, would require careful consideration.

Chest trauma or the presence or pneumothorax or pneumomediastinum should be considered a relative consideration due to the possibility of development of tension pneumothorax. Unlike a multiplace hyperbaric chamber, a pneumothorax could not be vented at depth, and would thus be worsened on decompression with the possible development of tension pneumothorax. Immediate thoracostomy upon exit from the chamber could be performed, but this would be a very hazardous procedure. If the need for recompression was extreme and the EEHS was the only available asset, tube thoracostomy prior to recompression would be an option.

Significant multisystem trauma with shock would require careful consideration for use of the EEHS. Interventions necessary for support of shock, including large volumes of fluids, vasopressors, respiratory support, or CPR would be compromised by recompression in an EEHS.

Extremity trauma may present logistic difficulties due to positioning and the process of loading into the EEHS, and the management of the injury may be complicated, but this should not be a ruling out factor. In fact, as mentioned earlier, hyperbaric oxygen may be beneficial in many cases of extremity trauma.

2-10 CONFINED SPACE ANXIETY SYNDROME (CLAUSTROPHOBIA).

For individuals with Confined Space Anxiety Syndrome (claustrophobia), i.e., those unwilling to enter the EEHS tube head first, an alternate entry procedure must be employed. If the individual is unable to "work through it," back him out of the tube, allow him to look around for a second or two, have him take a couple of breaths, then re-enter. Do not intimidate or coerce the patient to crawl through the tube with the BIBS mask on. Instead, remove the BIBS mask and slide the connected mask through the stretcher to the head-end (medical lock) of the EEHS. Have the patient enter the tube feet-first and allow him to position himself comfortably in the tube, then have him don the mask and begin breathing through the BIBS. Offer encouraging and reassuring communication during the entry process and during the preparatory operations leading to pressurizing the system.

NOTE

If patient becomes unresponsive, he must be brought back to the surface.

2-11 ENTRY OF THE PATIENT INTO THE STRETCHER.

The following items are PROHIBITED in the stretcher:

- Matches, lighters, and tobacco
- Perfumes, after-shave, or any other volatile products
- Sprays
- Wool
- Any private electrical appliance
- Mercury thermometers
- Pocket warmers

Shoes should be removed, pockets emptied and the patient made comfortable and warm. Due to the material's low static electric properties, only 100% cotton garments may be worn in the EEHS. The only exception to this is that Diver swim trunks made of 35% cotton and 65% polyester may be worn. Ensure that no items that may cause a toxic or fire risk are taken into the stretcher, either loose or in the pockets of the patient's clothing. Place the head end of the internal patient pad at the foot end of the stretcher. Place the patient on the internal patient pad and attach the straps. Insert the pull straps through the stretcher. Place the BIBS mask and the headset on the patient. Ensure good oxygen flow and communications. Then place the remote air supply hose under the patient's arm. Next have one person at the head end of the stretcher pull on the pulling straps. One person should stabilize the patient and pad and one person should keep the hose from tangling. Pull the patient into the stretcher.

CAUTION

Care should be taken to ensure that the end domes do not fall in on the patient.

2-12 INSERTING THE END DOMES.

Ensure that the sealing faces of both the acrylic end domes and their mating faces on the flexible tube are clean and unobstructed. Apply a thin coat of talc on the end dome sealing surfaces to ease installation and removal of the end domes. Press down on the top of the flexible tube end seals to produce an elliptical end.

Insert the penetrator end at the patient's feet and the medical lock end at the patient's head, and insert each dome end in turn. Ensure that the medical lock of the head end dome and the emergency valves of the penetrator end dome are on the outside of the stretcher.

WARNING

Do not hold or push against the flexible tube while under pressure.

2-13 PRESSURIZING THE STRETCHER.

The patient will remain on the BIBS mask while the stretcher is pressurized. Implement the following procedure when pressurizing the stretcher:

- Verify that the Emergency Stretcher Exhaust Valve is closed.
- Verify that the BIBS Mask Exhaust is open.
- Verify that the Emergency Pressure Relief Valves are open.
- Check that the control box Exhaust Pressure Valve is closed.
- Open the stretcher Air Supply Pressure Valve.

Next, with one person at each end of the stretcher, pull the end domes outward. This will minimize air loss at the sealing faces and allow the end domes to seat firmly. Do not hold or push against the flexible tube. Commence pressurizing at 20 fpm in accordance with the *U.S. Navy Diving Manual*. The stretcher should begin to pressurize after a few seconds. If it does not, try to determine if and where a leak is present.

Check that there is nothing in between the sealing faces. Check that the emergency stretcher exhaust valve on the penetrator plate and the stretcher exhaust valves on the control box are both closed. Exert greater tension on the end dome handles and try again. Remember that pushing against the flexible tube in any way may stop the stretcher from sealing at all.

If any creasing is observed along the top of the stretcher, the stretcher will not seal. To rectify this, it may be necessary to redistribute the weight of the patient inside the stretcher to centralize it below the centerline of the stretcher. Once the stretcher has been sealed, it will become rigid even with minimal pressure.

After the stretcher has begun pressurizing, verify that the primary and secondary depth gauges are operating and that they indicate the pressure is increasing in the stretcher. Close the stretcher air supply pressure valve at the desired depth.

2-14 SETTING UP THE OXYGEN MONITOR.

NOTE

See Figure 2-1 for illustrations of referenced parts.

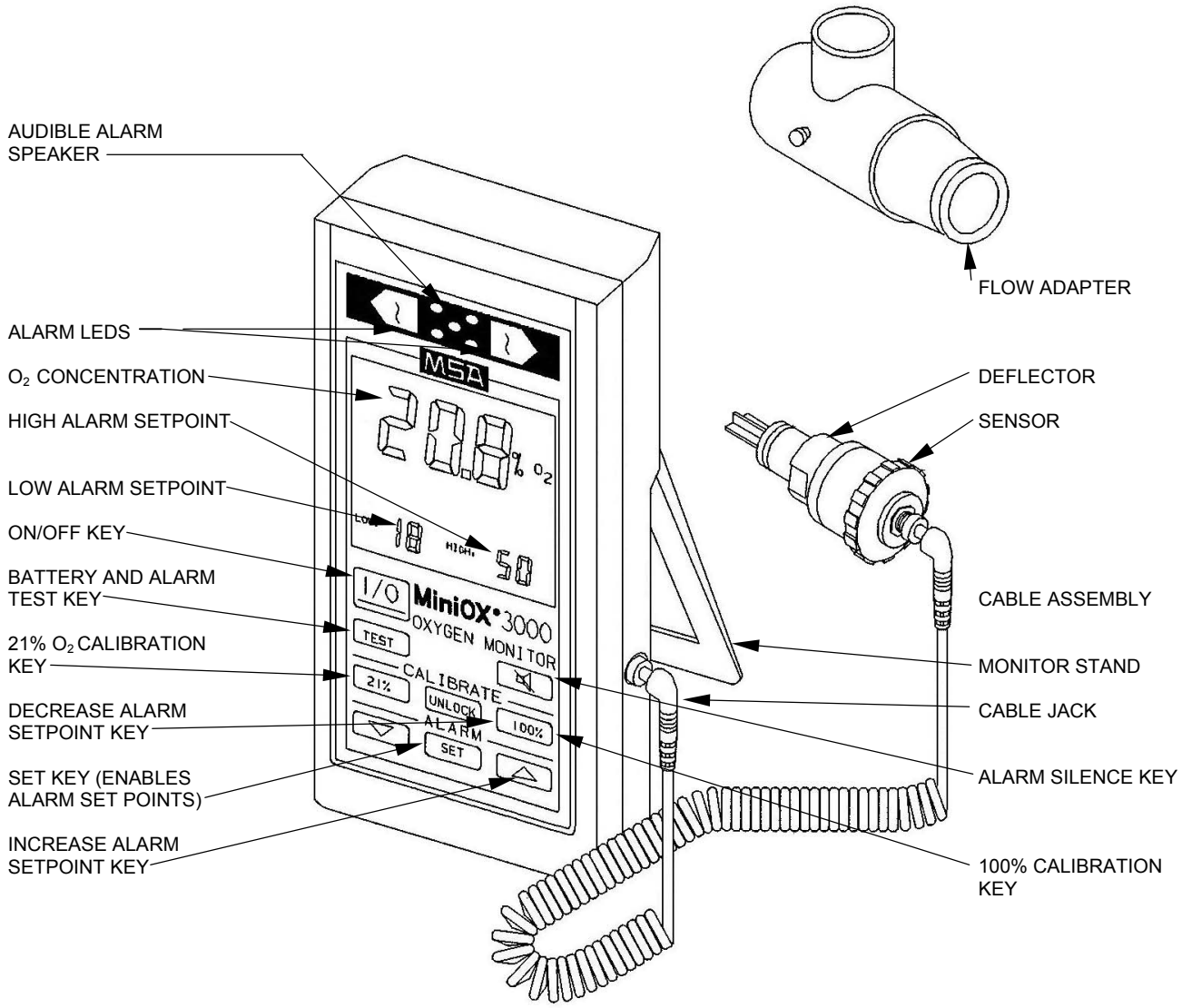

Figure 2-1. Oxygen Monitor

a. Remove the sensor from the package and attach it to the coiled cable.
b. Firmly press the connector until it snaps into place and then tighten the twist collar.
c. Insert the opposite end of the coiled cable into the jack on the side panel of the monitor, then tighten the twist collar.
d. Remove the deflector from the package. Insert the gasket into the open end of the deflector, ensuring that the gasket is properly seated within the deflector.
e. Gently screw the deflector into the sensor. Unscrew the two battery cover screws on the back of the monitor.
f. Remove the cover and install the battery.

The monitor is now ready to use.

2-15 OPERATING THE OXYGEN MONITOR.

The monitor will require calibration in the following situations:

- Daily, while in operation.
- When the operating environment changes.
- After the monitor is turned ON.
- If the sensor is disconnected and reconnected to the monitor.

The monitor can be calibrated either in room air or by using 100% oxygen. To calibrate in room air, first press “21%”, then press “UNLOCK.” After 20 seconds the calibration is complete. To calibrate with 100% oxygen, expose the sensor to 100% oxygen and allow the reading to stabilize prior to initiating the calibration. Then press “100%”, then “UNLOCK.” After 20 seconds the calibration is complete.

NOTE

The monitor cannot be set below 15% or above 99%.

2-15.1 Setting the Low Alarm. To set the low oxygen concentration alarm, proceed as follows:

a. Press “SET” once and the following will appear on the display:

- "AL"
- up / down arrows

b. Using the arrow keys, scroll up or down to the desired Low Alarm setpoint.

c. The monitor will "lock" this value. After five seconds the monitor will beep once, then automatically proceed to monitoring mode.

2-15.2 Setting the High Alarm. To set the high oxygen concentration alarm, proceed as follows:

a. Press “SET” twice. The following will appear on the display:

- "AL"
- up / down arrows

b. Using the arrow keys, scroll up or down to the desired High Alarm setpoint.

c. The monitor will "lock" this value. After five seconds the monitor will beep once then automatically proceed to monitoring mode.

2-16 CONNECTION OF HANDLE STRAPS.

Pass the ends of the handle straps through the loops provided on the protective fabric cover and check that the stabilizing wedges are evenly situated on either side of the bottom of the stretcher. If necessary,

adjust the length of the straps so that they are tight. This will ensure that the handles and D-rings are at the same level on either side of the stretcher.

2-17 TRANSPORTATION.

Transportation of a patient should only take place under the supervision of qualified personnel. The control box and the spares box may be positioned on the top of the stretcher and can be connected to the handle straps with the tie-down straps supplied. Use the brackets on the side of the boxes and the straps with a cleat to connect it to the D-rings. The air and oxygen supply cylinders may be placed in the rack to be moved along with the stretcher. Patient transport may be commenced once the stretcher is pressurized.

Note that when transporting a patient via aircraft, the main depth gauge will require corrections due to the change in atmospheric pressure at altitude. Table 2-1 provides corrections in FSW for the corresponding altitude of the aircraft. These values should be ***subtracted*** from the reading on the gauge to obtain the internal pressure of the stretcher.

Table 2-1. Depth Gauge Altitude Correction Table

Cabin Altitude in Feet Above Sea Level	Depth Gauge Correction in FSW
Sea level	0.0
1000	1.2
2000	2.3
3000	3.4
4000	4.5
5000	5.6
6000	6.6
7000	7.6
8000	8.5
9000	9.4
10,000	10.3
11,000	11.2
12,000	12.0
13,000	12.9
14,000	13.6
15,000	14.4
16,000	15.2
17,000	15.9
18,000	16.6
19,000	17.2
20,000	17.9
21,000	18.5
22,000	19.1
23,000	19.7
24,000	20.3
25,000	20.8

WARNING

When transporting the EEHS onboard an unpressurized aircraft, the operator runs the risk of lifting the stretcher relief valve. The relief valve will lift at approximately 9,250 ft altitude. If this occurs, the safety shut-off valve should be closed to prevent the stretcher from losing pressure.

2-18 MAINTENANCE OF STRETCHER SERVICES WHILE PRESSURIZED.

The essential services to the stretcher must be supplied continuously throughout each use. Under normal circumstances the stretcher will be pressurized with air and the patient will breathe oxygen or air. The pressures remaining in each tank must be monitored continuously. To change a cylinder, first make sure that the patient is not breathing from the cylinder that is going to be changed out. Then close the cylinder valve and purge the regulator by opening the regulator bleed screw (depending on the cylinder being changed) so as to dissipate the pressure in the regulator whip. Disconnect the regulator and transfer it to a full cylinder. Open the cylinder valve and re-check the regulated pressure.

WARNING

In the unlikely event of failure of one of the umbilical hoses, loss of pressure in the stretcher may be averted by removal of the corresponding quick connect coupling on the penetrator plate. Other pressure losses may be averted by closing the relevant valve on the control panel or supply cylinder.

While in use, the stretcher should always be shaded from direct sunlight to avoid overheating. In very hot climates, the stretcher may need to be physically cooled by covering the stretcher with sacking or matting and allowing cold water to run over the outside. The internal temperature should be kept at a suitable level below 84°F (29°C). Refer to paragraph 21-5.6.5 and Table 21-4 of the *U.S. Navy Diving Manual* for further guidance on maximum permissible exposure times at various temperatures.

The stretcher may be ventilated regularly, provided there is sufficient availability of air to complete the proposed transport. This procedure is carried out by partially opening the stretcher exhaust pressure valve and maintaining pressure in the stretcher by opening the stretcher air supply valve to compensate.

CAUTION

Care should be taken to ensure that the end domes do not fall in on the patient.

2-19 PATIENT TRANSFER AT THE SURFACE.

Transfer consists of quick decompression of the stretcher to atmospheric pressure, removal of the patient from the stretcher on the surface, and rapid recompression of the patient to treatment depth in the recompression chamber. The main consideration in the decision to transfer at the surface is the condition of the patient. Surface Transfer should only be used in those cases where the patient will

clearly benefit from transfer to the larger chamber. If the patient is doing well in the stretcher, do not use Surface Transfer. See Figure 2-3 for guidance.

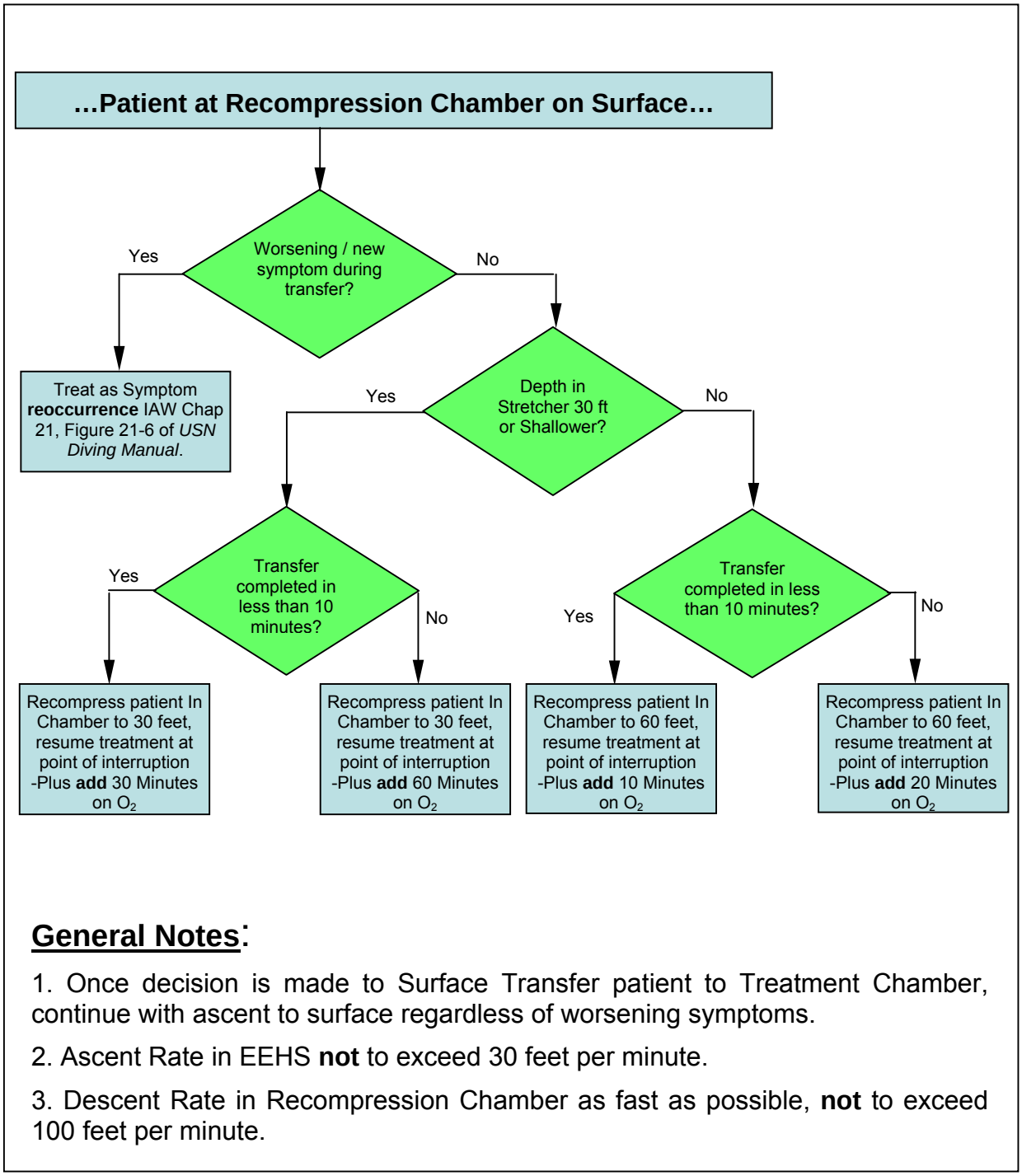

Figure 2-2. Surface Transfer Flow Chart

To initiate Surface Transfer, first ensure that the patient is breathing oxygen, then decompress the stretcher to the surface at a rate not to exceed 30 feet per minute. Quickly remove the patient from the stretcher and transfer him to the larger chamber. Recompress the patient and tender to treatment depth as quickly as possible, not to exceed 100 feet per minute. The time from leaving treatment depth in the stretcher to arrival at treatment depth in the larger chamber should not exceed 10 minutes.

If the patient deteriorates or develops new symptoms during the surface interval, recompress the patient to 60 feet and treat as a reoccurrence of symptoms in accordance with Figure 21-6 of the *U.S. Navy Diving Manual*. If the patient's condition remains unchanged during the surface interval, and if the stretcher depth was at 30 feet or less at the time of transfer, recompress to 30 feet; otherwise, recompress to 60 feet. Resume the treatment schedule at the point of interruption in the stretcher, ignoring any time spent breathing oxygen in the stretcher during decompression from 60 feet to 30 feet or from 30 feet to the surface.

When recompressing to 30 feet and if surface transfer was completed within 10 minutes, add 30 minutes to the oxygen breathing time at 30 feet; otherwise add 60 minutes. When recompressing to 60 feet, and if surface transfer was completed within 10 minutes, add 10 minutes to the oxygen breathing time at 60 feet; otherwise add 20 minutes. See Figure 2-4 for guidance.

2-20 COMPLETING TREATMENT IN STRETCHER.

If the patient's condition does not warrant immediate removal from the stretcher, continue treatment of the patient in the stretcher. When the patient has reached the conclusion of treatment as prescribed in accordance with Chapter 21 of the *U.S. Navy Diving Manual*, he should be removed from the stretcher by exhausting the internal pressure of the stretcher, in accordance with standard treatment table procedure. As soon as no differential pressure exists, the flexible tube will lose rigidity. Care should be taken to ensure that the end domes do not fall in on the patient. The end domes are removed in the reverse order from which they were inserted.

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CHAPTER 3 – SCHEDULED MAINTENANCE

3-1 INTRODUCTION.

3-1.1 Purpose. The purpose of this chapter is to provide guidance for the performance of planned maintenance of the EEHS.

3-1.2 Scope. This chapter provides general guidance on the performance of planned maintenance of the EEHS. OPNAVINST 4790.4 provides detailed guidance on managing PMS. Where a conflict may arise in management of PMS, OPNAVINST 4790.4 takes precedence over this manual.

WARNING

Repair or replace worn or damaged components immediately with authorized replacement components. Failure of equipment during operation may result in injury or death to personnel.

WARNING

Do not disassemble diving system components while a breathing gas circuit is pressurized. Failure to depressurize the system may result in injury or death to personnel and damage to equipment.

3-1.3 Arrangement. This chapter presents preventive maintenance information and requirements as follows:

a. Planned Maintenance System (PMS)
b. General Maintenance Instructions
c. Re-entry Control (REC) Procedures
d. Scheduled Maintenance Requirements
e. Overhaul Maintenance Concept

3-1.4 Maintenance Control. Organizational level maintenance is guided by PMS. Various planned and corrective maintenance actions require to be conducted under Re-entry Control (REC) procedures.

3-2 PLANNED MAINTENANCE SYSTEM.

The scheduled maintenance instructions in this manual are intended to complement the procedures furnished in the PMS documentation. In case of conflicts, the PMS documentation takes precedence. Such conflicts and maintenance procedure discrepancies in this manual should be reported immediately to NAVSEA 00C3 via Technical Manual Deficiency Evaluation Report (TMDER). PMS for the EEHS is covered by SYSCOM Maintenance Index Page (MIP), Control Number 5921-021. Discrepancies in PMS should be reported to Fleet Technical Support Center PACIFIC (FTSCPAC) via electronic Technical Feedback Report (TFBR).

3-3 SCHEDULED MAINTENANCE REQUIREMENTS.

To ensure reliable operation and continued certification of the EEHS, preventive maintenance and performance tests are to be carried out on a scheduled or situation-related basis. If scheduled maintenance requires component removal (e.g., gauge calibration), use of REC procedures and forms are mandatory.

Maintenance procedures not performed during startup or shutdown procedures are contained in the PMS and Maintenance Requirement Cards (MRCs). MRCs are furnished separately as part of the PMS package. The Maintenance Index Pages (MIPs) list the requirements specified by the MRCs for each item of equipment, including the periodicity code for the required maintenance.

3-3.1 Maintenance Index Page (MIP). An MIP is an index listing of a set of MRCs that apply to a major assembly of the EEHS. Each MIP includes:

a. Identification of the subcomponent
b. A title identifying the MRC set
c. Reference publications
d. Configuration data for the equipment
e. NAVSEA System Command (SYSCOM) maintenance requirement card control number and periodicity code
f. All maintenance requirements (task description) for a given system, subcomponent, or equipment
g. Which MRCs include one or more tests
h. Recommended rates (job codes), estimated man-hours, and a periodicity code for related maintenance

3-3.2 Maintenance Requirement Cards (MRCs). MRCs provide detailed procedures for performing required scheduled maintenance on the EEHS. MRCs include:

a. A brief description of the task
b. A periodicity code
c. Recommended rates (job codes), total man-hours, and elapsed time
d. Required safety precautions
e. REC procedure applicability
f. Required tools, parts, materials and test equipment
g. Detailed step-by-step procedures

3-3.3 Parts Availability. Prior to stowage, maintenance parts kept for the EEHS shall be inspected for shelf life criteria, inactive equipment maintenance, and usability. These objects will also be inspected on a quarterly basis.

3-3.3.1 Periodic Servicing. Every two years, the regulator will be inspected for damage and other visible defects and rebuilt in accordance with section 6-3.3.1 through section 6-3.3.4. Items in parentheses in Tables 7-15 and 7-16 need to be replaced. Replace the hose O-rings and carefully inspect the hose for signs of kinking, damage, cuts, or blisters. Pull back the protective sleeves, if fitted, and inspect carefully around the ferrules.

3-4 OVERHAUL/MAINTENANCE CONCEPT.

The maintenance plan for the EEHS provides the unit level commander maximum flexibility in the performance of maintenance actions required to keep the EEHS at the highest state of operational readiness.

The Planned Maintenance System (PMS) provides for planned maintenance actions to be conducted at pre-planned scheduled intervals.

Troubleshooting guidance and detailed corrective maintenance procedures are contained in Chapter 5. This guidance provides the unit commander and the chain of command with detailed procedures necessary to conduct corrective maintenance to the EEHS that is not covered under PMS.

Due to their direct impact on system safety, various planned and corrective maintenance actions are required to be conducted under REC procedures. Standardized Diver Re-entry Control Procedures can be found in the Diving Certification Publication section of NAVSEA 00C's website (www.supsalv.org). There is no requirement for conducting a full overhaul if the EEHS was provided with the planned and corrective maintenance procedures contained in the MIPs during its life cycle and herein are followed.

However, the following major planned maintenance actions should be factored into EEHS long range operational and maintenance schedules:

1) 60-month (5-year) requirement to hydrostatically test the HP oxygen and air flasks
2) 120-month (10-year) requirement to replace filament wound vessel
3) 240-month (20-year) requirement to replace stretcher end domes

3-5 GENERAL MAINTENANCE INSTRUCTIONS.

3-5.1 Re-entry Control. The repair work, testing, re-entry control procedures, and qualifications of personnel shall be as required by *U.S. Navy Diving and Manned Hyperbaric Systems Safety Certification Manual*, SS521-AA-MAN-010 and NAVSEA letter 3151 Ser 00C/4225 dated 23 Oct 96, *Standardized Diver Re-Entry Control (REC) Program*. Repairs and maintenance shall be:

a. Performed and inspected by qualified and responsible personnel
b. Recorded in a way which:
    1) Defines the boundaries of the work performed
    2) Specifies the nature of the work performed
    3) Defines the post-repair testing and cleaning performed (if pertinent)
    4) Records information attesting to the suitability of the materials used
    5) Records the signatures and printed name of those performing inspections, testing, and approving work. All signatures shall be dated at the time the individual performs the task.

Necessary test equipment, tools and consumable supplies are listed on the appropriate MRCs.

3-5.2 Disassembly and Replacement of Parts. Equipment should be disassembled only to the extent necessary for a scheduled maintenance action. Maintenance procedures authorized at the user-unit organizational level are specified in the MRCs. Use only authorized replacement parts.

WARNING

Cleanliness is imperative in maintaining and handling the EEHS. All tools and parts must be kept free of oil, grease, rust, or other contamination. Foreign substances within an assembly may result in equipment failure and possible injury or death to personnel.

3-5.3 Cleanliness. Cleaning of the breathing gas system shall be performed in accordance with MIL-STD-1330D.

3-5.4 Lubricants. Use only the lubricants authorized by the MRC. Apply lubricants sparingly.

CHAPTER 4 – STORAGE AND HANDLING

4-1 STORAGE CASE CONTENTS.

In its folded state, the EEHS and its supplementary equipment is stored in two lightweight, purpose-built cases. The total weight of the EEHS components is approximately 250 lb. (114 kg). Tables 4-1 and 4-2 list the contents of the EEHS shipping cases and provide the weights and dimensions for the EEHS cases. Table 4-3 provides weights and dimensions for the supplied bottle racks.

Table 4-1. Case I and II Components

CASE I	CASE II
Flexible Tube in a Protective Fabric Cover Repair Kit Three Handles Straps With D-Rings Horizontal Lifting Sling Control Box A sealed case containing the following: BIBS mask Communication System Digital Alarm Timer and Clock Control Box Retaining Strap Oxygen Monitor Thermometer Oxygen Monitor Adapter Two Oxygen Adapters	Penetrator End Dome Medical Lock End Dome Inner and Outer Medical Lock Doors Two Air Regulators Two Oxygen Regulators Umbilical Remote Air Inlet Hose Exhaust Hose

Table 4-2. Case I and II Weights and Dimensions

CASE I		CASE II	
Weight empty:	32 lb.	Weight empty:	25 lb.
Weight loaded:	132 lb.	Weight loaded:	110 lb.
Outside dimensions:	27.5 x 27 x 23 in.	Outside dimensions:	26 x 26 x 21 in.
Volume of Case:	10 cu. ft	Volume of Case:	8.2 cu. ft

Table 4-3. O_2/Air Rack Weights and Dimensions

O_2 RACK		AIR RACK	
Weight:	25 lb.	Weight:	25 lb.
Outside dimensions:	12 x 12 x 62 in.	Outside dimensions:	21 x 11 x 37.5 in.

4-2 FOLDING THE FLEXIBLE TUBE.

Returning the flexible tube to its storage case requires some skill, and the procedure for doing so requires training and practice. The storage case has dimensions such that the flattened tube fits snugly inside (i.e., the distance between the opposite corners of the case is one half of the circumference of the flexible tube). Note that this process requires two people to properly follow the recommended procedure.

Figure 4-1. Folding The Flexible Tube – Primary Fold

To return the flexible tube to storage, place one end into the case and hold the top of the tube to prevent it from falling over. Next, crease it by hand as close to the bottom of the storage case as possible, such that the two sides of the tube meet along the diagonal of the case (Figure 4-1).

The corners produced by the folding should then be compressed, where possible, to maximize the capacity of the case (Figure 4-2).

Figure 4-2. Folding The Flexible Tube – Second Fold

Make a second fold, using the same process as for the first, except that it should be made across the remaining two corners of the case. As before, the corners produced by the folding should then be compressed (Figure 4-2).

The third fold is made in the same manner and into the corners used by the first fold, while once again compressing the corners of the folded tube into the case (Figure 4-3).

Figure 4-3. Folding The Flexible Tube – Third Fold

The fourth and final fold will ensure that the lid of the box will close with ease (Figure 4-4).

Figure 4-4. Folding The Flexible Tube – Fourth Fold

4-3 STORAGE LOCATIONS.

CAUTION

The storage cases are heat sensitive above 140°F (60°C). Cover the cases to keep them out of direct sunlight; especially when stored in a non-ventilated enclosed area behind glass (e.g., in a car).

Store all packages containing the EEHS in a freestanding location. The cases should be readily accessible and not obstructed by other items. When choosing a storage location for the EEHS, bear in

mind that its use dictates that it should be available for rapid deployment. Also, be sure that the appropriate air and oxygen cylinders are available when using it.

WARNING

Keep all sharp objects away from the stretcher. Objects may puncture or otherwise damage the stretcher.

4-4 HANDLING.

The flexible tube in its protective fabric cover should be handled carefully at all times. Although it is extremely strong and abrasion resistant, it is vulnerable to sharp objects such as knives and pointed objects such as nails or needles. In the event of damage to the inside or outside silicone rubber coatings, this damage must be repaired prior to the re-use of the stretcher as per the instructions in Chapter 5.

In the event that any filament fibers have been cut, contact NAVSEA 00C3 for further inspection and possible repair. Ensure that the flexible tube is thoroughly cleaned before being packed away after each use and that there is no residual sand or other such material that may cause abrasion when not in use. The silicone rubbers used in the manufacture of the flexible filament wound tube are highly resistant to most corrosive substances spilled on it. NAVSEA 00C3 should be consulted in the event that spillage has taken place on the EEHS.

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CHAPTER 5 – TROUBLESHOOTING

5-1 INTRODUCTION.

5-1.1 Purpose. The purpose of this chapter is to provide guidance for troubleshooting the EEHS.

5-1.2 Scope. This chapter provides detailed guidance for troubleshooting the EEHS in conjunction with planned and corrective maintenance.

5-1.2 Safety During Troubleshooting. The troubleshooting procedures contained in this chapter do not relieve the individual from strictly adhering to all applicable safety precautions related to the EEHS.

5-2 TROUBLESHOOTING PROCEDURES.

Table 5-1, Equipment Troubleshooting Index, provides a list for quick reference to the applicable troubleshooting procedures. Tables 5-2 though 5-11 addresses a variety of symptoms and the corresponding procedures for identifying and correcting the potential problem (s). To troubleshoot a problem involving a particular piece of equipment, match the symptom(s) with those listed in the appropriate table. A symptom match will indicate a probable cause and the troubleshooting procedures to identify the problem. Once the problem is identified, refer to the corrective action to be taken.

NOTE

If troubleshooting requires disassembly of EEHS components, a Re-entry Control (REC) may be required prior to disassembly

.

Table 5-1. Equipment Troubleshooting Index

TABLE	EQUIPMENT TROUBLESHOOTING CHARTS	PAGE(S)
5-2	Air Supply	5-2 to 5-3
5-3	BIBS Mask	5-3 to 5-5
5-4	Divers Communications System	5-5 to 5-7
5-5	Exhaust System	5-7
5-6	Gauges	5-8
5-7	MiniOX 3000	5-8
5-8	Oxygen Supply	5-9 to 5-10
5-9	Valves, Piping and Pressure Vessel	5-10 to 5-11

Table 5-2. Troubleshooting Chart for Air Supply

SYMPTOM	PROBABLE CAUSE	TROUBLESHOOTING PROCEDURES	CORRECTIVE ACTION
WARNING **Do not tighten leaking connections while under pressure. A system that was previously gas tight and now leaks indicates a change in system hardware that over-tightening may aggravate and which could prove hazardous.**			
a. No air pressure.	1. Improper valve lineup.	1. Check piping system valves for correct lineup per approved operating procedure.	1. Check valve lineup and correct as necessary.
	2. Defective or empty air cylinder.	2. Check for leaks in the air supply valves, connections, cylinder and piping.	2. Check cylinder, connection, controls, and adjust or replace as necessary.
	3. Failure or malfunction of air regulator(s).	3. Check regulator for proper operation. Check inlet and outlet pressure gauges at regulator.	3. Repair or replace pressure regulator.
b. Low air pressure (less than 170 psig).	1. Supply valve(s) not fully open.	1. Check valves for proper lineup per approved operating procedure.	1. Check valve lineup and correct as necessary.
	2. Low air supply (cylinder).	2. Check for low cylinder pressure.	2. Switch to secondary source of air.
	3. Air pressure regulator not properly set.	3. Check outlet pressure of regulator at 170 – 200 psig.	3. Adjust regulator to 170 – 200 psig.
	4. Leakage from regulator inlet or outlet port due to faulty valve seat and/or O-ring.	4. Remove and inspect valve for defects. If pressure leaks to the outlet when the regulator is closed, it is an indication that the valve stem or the seat is damaged.	4. Repair or replace pressure regulator.
	5. Pressure gauge out of calibration.	5. Compare with indication of certified calibrated gauge	5. Remove and replace gauge with certified, calibrated gauge.
c. Air pressure high (greater than 200 psig)	1. Regulator is not set correctly.	1. None.	1. Adjust regulator setting. Place valve in proper set position (170-200 psig).

Table 5-2. Troubleshooting Chart for Air Supply (Continued)

SYMPTOM	PROBABLE CAUSE	TROUBLESHOOTING PROCEDURES	CORRECTIVE ACTION
c. Air pressure high (greater than 200 psig) (Continued).	2. Defective regulator caused by a ruptured diaphragm.	2. Back off handle of valve until all tension on valve diaphragm is removed.	2. Repair or replace pressure regulator.
	3. Pressure gauge out of calibration.	3. Compare with indication of certified calibrated gauge.	3. Remove and replace gauge with certified, calibrated gauge.

Table 5-3. Troubleshooting Chart for BIBS Mask

SYMPTOM	PROBABLE CAUSE	TROUBLESHOOTING PROCEDURES	CORRECTIVE ACTION
WARNING **Do not tighten leaking connections while under pressure. A system that was previously gas tight and now leaks indicates a change in system hardware that over-tightening could aggravate and prove hazardous.**			
a. Leakage at oxygen/air supply BIBS.	1. Loose connection at quick disconnect socket(s).	1. Check connection of supply and exhaust quick disconnect sockets at BIBS penetrator.	1. Tighten fitting(s).
	2. Cross-threading of quick disconnect socket(s).	2. Remove and inspect fittings.	2. Replace one or both fittings, as required.
	3. Defective fitting on quick disconnect.	3. Remove and inspect fitting.	3. Replace hose assembly.
b. Leakage at connections to one or both mask regulator assemblies.	1. Loose hose fitting at demand regulator.	1. Check fitting connection for tightness.	1. Tighten fitting.
	2. Defective gasket.	2. Inspect gasket for nicks, guts or gouges, and other signs of wear.	2. Replace gasket if damaged.
	3. Loose or damaged hose clamp at exhaust.	3. Check clamp for tightness and proper position.	3. Position and tighten clamp as required.
c. Leakage at mating of regulator assemblies, and mask assemblies	1. Loose regulator assembly (demand and/or exhaust).	1. Check exhaust to penetrator plate and mask to penetrator plate connections.	1. Tighten connection(s).

Table 5-3. Troubleshooting Chart for BIBS Mask (Continued)

SYMPTOM	PROBABLE CAUSE	TROUBLESHOOTING PROCEDURES	CORRECTIVE ACTION
c. Leakage at mating of regulator assemblies, and mask assemblies. (Continued)	2. Cross-threading of demand regulator or exhaust case threading connection.	2. Remove regulator assembly from penetrator plate and inspect threads for cross-threading and burrs.	2. Replace regulator assembly if cross-threading condition exists.
	3. Damaged O-ring(s).	3. Remove regulator assembly or disconnect penetrator plate from mask and inspect O-rings for damage, nicks, cuts or gouges.	3. If defective, replace O-rings.
	4. Stem not properly positioned in demand regulator diaphragm stem guide.	4. Remove regulator assembly from penetrator plate.	4. Correctly position stem guide and reinstall in regulator assembly.
d. Loss of oxygen/ air flow to mask assembly.	1. Oxygen/ air supply system failure or malfunction.	1. Perform emergency procedures EP-4, Loss of Oxygen, or EP-5, Loss of Air.	1. If improperly set up, correct valve lineup. Replace pressure regulator for air BIBS. See Table 5-8, Troubleshooting Chart for Oxygen Supply. Perform the corrective action as necessary, per Table 5-2 or Table 5-8.
	2. Open supply (demand) connection at oxygen/ air supply BIBS or demand regulator hose.	2. Check connections.	2. Reconnect fittings (BIBS quick disconnect socket, hose connection to regulator case, etc.).
	3. Foreign material in hose stem on regulator.	3. Remove hose from regulator stem; inspect stem.	3. Remove material.
	4. Damaged supply (demand) hose.	4. Remove supply hose and inspect.	4. Replace supply hose.
	5. Crimped supply (demand) hose.	5. Inspect supply hose for damage.	5. Eliminate crimp by removing hose and straightening. If crimp has resulted in damage to the hose, replace hose.

Table 5-3. Troubleshooting Chart for BIBS Mask (Continued)

SYMPTOM	PROBABLE CAUSE	TROUBLESHOOTING PROCEDURES	CORRECTIVE ACTION
e. High breathing resistance (inhalation).	1. Inlet pressure incorrect. 2. Defective or failed demand regulator/ regulator "Free Flow" control.	1. Check for loss of pressure (oxygen/ air supply). 2. None	1. Correct loss of oxygen/ air supply. 2. Replace demand regulator assembly.
f. High breathing resistance (exhalation).	1. Back pressure too high. 2. Exhalation valve sticking.	1. None 2. Don mask and exhale into mask. Resistance indicates valve is sticking.	1. Adjust BIBS back pressure regulator as necessary for comfortable breathing. 2. Replace exhaust flapper and seat assembly; replace exhaust regulator assembly.

Table 5-4. Troubleshooting Chart for Divers Communications System

SYMPTOM	PROBABLE CAUSE	TROUBLESHOOTING PROCEDURES	CORRECTIVE ACTION
a. Divers communications system not operational.	1. Power OFF/ ON not in ON position. 2. Faulty electrical wiring or connections. 3. Dirty or corroded batter terminals.	1. None. 2. Examine electrical wiring and connections. Use multi-meter to determine continuity. 3. Examine battery terminals for dirt and corrosion.	1. Place OFF/ ON switch in ON position. 2. Replace, clean, or tighten wiring and connections. 3. Clean battery terminals.
b. Low volume.	1. Low battery.	1. Check battery indicator light. Indicator light should be solid.	1. Switch to secondary battery. Replace batteries if indicator light is not solid, and check battery connection.

Table 5-4. Troubleshooting Chart for Divers Communications System (Continued)

SYMPTOM	PROBABLE CAUSE	TROUBLESHOOTING PROCEDURES	CORRECTIVE ACTION
c. Garbled voice to diver.	1. Tender volume to patient set too high.	1. Check tender volume setting.	1. Replace battery if indicator light is not solid, and check battery connection.
	2. Patient's earphones corroded or defective.	2. Examine patient's earphones for corrosion. Replace with earphone known to be good and check function. If the good earphone functions properly, patient's earphone in question is defective.	2. Replace patient's earphones.
	3. Tender's microphone corroded or defective.	3. Examine tender's microphone for corrosion. Replace with microphone known to be good and check function. If the good microphone functions properly, tender's microphone in question is defective.	3. Replace tender's microphone.
d. Garbled voice to tender.	1. Patient volume to tender set too high.	1. Check patient volume setting.	1. Turn down patient volume.
	2. Corroded or defective patient's microphone.	2. Examine patient's microphone for corrosion. Replace with microphone known to be good and check function. If the good microphone functions properly, patient's microphone in question is defective.	2. Replace patient's microphone.

Table 5-4. Troubleshooting Chart for Divers Communications System (Continued)

SYMPTOM	PROBABLE CAUSE	TROUBLESHOOTING PROCEDURES	CORRECTIVE ACTION
e. Communication cuts out.	1. Corroded or defective patient's microphone.	1. Examine patient's microphone for corrosion. Replace with microphone known to be good and check function. If the good microphone functions properly, patient's microphone in question is defective.	1. Replace patient's microphone
	2. Corroded or defective tender's headset.	2. Examine tender's headset for corrosion. Replace with microphone known to be good and check function. If the good microphone functions properly, tender's headset in question is defective.	2. Replace tender's headset.

Table 5-5. Troubleshooting Chart for Exhaust System

SYMPTOM	PROBABLE CAUSE	TROUBLESHOOTING PROCEDURES	CORRECTIVE ACTION
WARNING **Do not tighten leaking connections while under pressure. A system that was previously gas tight and now leaks indicates a change in system hardware that over-tightening could aggravate and prove hazardous.**			
a. Sound of gas leaking. Decrease in stretcher pressure.	1. Gas leaking.	1. Attempt to maintain depth by use of pressurizing control or execute EP-1 if directed by the dive supervisor.	1. Replace relief valve or exhaust valve.

Table 5-6. Troubleshooting Chart for Gauges

SYMPTOM	PROBABLE CAUSE	TROUBLESHOOTING PROCEDURES	CORRECTIVE ACTION
a. Needle does not return to zero.	1. Gauge partially pressurized. 2. Faulty gauge.	1. Verify gauge is not pressurized. 2. Compare with indication of certified calibrated gauge.	1. Depressurized gauge. 2. Remove and replace with certified calibrated gauge.
b. Faulty reading.	1. Gauge in need of recalibration.	1. Where possible, compare suspected gauge to a certified calibrated gauge.	1. Remove gauge for servicing and calibration at an approved facility. See Chapter 6.
c. Gauge does not indicate pressure or depth.	1. Air or oxygen valves improperly lined up. 2. Air or oxygen system malfunction.	1. Verify correct valve lineup per operating procedures. 2. Check stretcher air or oxygen supply/ exhaust system component.	1. Check valve lineup and correct as necessary. 2. Take corrective actions as necessary per Chapter 6.

Table 5-7. Troubleshooting Chart for MiniOX 3000

SYMPTOM	PROBABLE CAUSE	TROUBLESHOOTING PROCEDURES	CORRECTIVE ACTION
a. Gas analysis not operational.	1. Both ON/OFF switches not in ON position. 2. No electrical power. 3. Faulty electrical wiring or connections. 4. Worn out or defective oxygen sensor.	1. None. 2. None. 3. Examine electrical wiring and connections. Use multimeter to determine continuity. 4.None.	1. Place both selector switches in ON position. 2. Charge batteries. 3. Replace, clean or tighten wiring and connections. 4. Replace oxygen sensor.
b. Decline in Oxygen analyzer sensitivity.	1. O_2 analyzer requires calibration. 2. Worn out or defective oxygen sensor.	1. Check O_2 analyzer calibration. 2. None.	1. Recalibrate O_2 analyzer. See Chapter 2. 2. Replace oxygen sensor.

Table 5-8. Troubleshooting Chart for Oxygen Supply

SYMPTOM	PROBABLE CAUSE	TROUBLESHOOTING PROCEDURES	CORRECTIVE ACTION
WARNING **Do not tighten leaking connections while under pressure. A system that was previously gas tight and now leaks indicates a change in system hardware that over-tightening could aggravate and prove hazardous.**			
a. No oxygen pressure.	1. Improper valve lineup.	1. Check piping system valves for correct lineup per approved operating procedure.	1. Check valve lineup and correct as necessary.
	2. Defective or empty oxygen cylinder or leaking cylinder connections.	2. Check for system failures, malfunctions, leaks in the oxygen supply valves, connection, cylinder and piping; identify, isolate.	2. Check cylinder, connection, and controls and adjust or replace as necessary.
	3. Failure or malfunction or air regulator(s).	3. Check regulator for proper operation. Check inlet and outlet pressure gauges at regulator.	3. Repair or replace pressure regulator.
b. Low oxygen pressure (less than 115 psig).	1. Supply valve(s) not fully open.	1. Check valves for proper lineup per approved operating procedure.	1. Check valve lineup and correct as necessary.
	2. Low oxygen supply (cylinder).	2. Check for low cylinder pressure.	2. Switch to secondary source of oxygen.
	3. Oxygen pressure regulator not properly set.	3. Check outlet pressure of regulator at 115-140 psig.	3. Adjust regulator to 115-140 psig.
	4. Leakage from regulator inlet or outlet port due to faulty valve seat and/or O-ring.	4. Remove and inspect valve for defects. If pressure leaks to the outlet when the regulator is closed, it is an indication that the valve stem or the seat is damaged.	4. Repair or replace pressure regulator.
	5. Pressure gauge out of calibration.	5. Compare with indication of certified calibrated gauge.	5. Remove and replace gauge with certified, calibrated gauge.

Table 5-8. Troubleshooting Chart for Oxygen Supply (Continued)

SYMPTOM	PROBABLE CAUSE	TROUBLESHOOTING PROCEDURES	CORRECTIVE ACTION
c. Oxygen pressure high (greater than 140 psig).	1. Regulator is not set correctly.	1. None.	1. Adjust regulator setting. Place valve in proper set position (115-140 psig).
	2. Defective regulator caused by a ruptured diaphragm.	2. Back off handle of valve until all tension on valve diaphragm is removed.	2. Repair or replace pressure regulator.
	3. Pressure gauge out of calibration.	3. Compare with indication of certified calibrated gauge.	3. Remove and replace gauge with certified, calibrated gauge.

Table 5-9. Troubleshooting Chart for Valves, Piping, and Pressure Vessel

SYMPTOM	PROBABLE CAUSE	TROUBLESHOOTING PROCEDURES	CORRECTIVE ACTION
WARNING **Do not tighten leaking connections while under pressure. A system that was previously gas tight and now leaks indicates a change in system hardware that over-tightening could aggravate and prove hazardous.**			
a. Sound of gas leaking. Decrease in stretcher pressure.	1. Gas leaking.	1. Attempt to maintain depth by use of pressurization control or execute EP-1 if directed by the dive supervisor. If possible, isolate leak by shutting appropriate pressure vessel hull valve (e.g. relief valve isolation valve, depth gauge isolation valve, air supply bottle stop, etc.).	1. When operation can be secured, surface stretcher, then repair or replace component(s) as necessary. See Chapter 6.

Table 5-9. Troubleshooting Chart for Valves, Piping, and Pressure Vessel (Continued)

SYMPTOM	PROBABLE CAUSE	TROUBLESHOOTING PROCEDURES	CORRECTIVE ACTION
a. Sound of gas leaking. Decrease in stretcher pressure. (Continued)		Visually and audibly try to isolate the leak. The leak may be identified by coating the suspected leak areas with leak detection fluid or nonionic detergent/ water solution and watching for bubbles, indicating a leak location.	
b. No gas flow indication.	1. Improper valve lineup. 2. Faulty regulator. 3. Faulty pressure gauge.	1. Check valve lineup per approved operating procedures. 2. Check outlet pressure of regulator. 3. Check gauges per Troubleshooting Chart, Table 5-6.	1. Check valve lineup and correct as necessary. 2. Repair or replace pressure regulator. Repairs should only be performed by persons experienced in the operation and repair of pressure regulators. Refer to Chapter 6 for disassembly and reassembly procedures. 3. Remove and replace gauge with certified calibrated gauge

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CHAPTER 6 – CORRECTIVE MAINTENANCE

NOTE

All JIDs are shown at the end of this chapter in Figures 6-5 through 6-9.

6-1 INTRODUCTION.

6-1.1 Purpose. The purpose of this chapter is to provide guidance for the performance of periodic maintenance (repair) procedures for the EEHS.

6-1.2 Scope. This chapter provides detailed guidance on the conduct of periodic maintenance on the EEHS. Failure to comply with the procedures contained herein may result in an unsatisfactory repair and attendant potential for an unsafe condition to exist within the EEHS.

6-1.3 Re-entry Control Procedures (REC). Periodic maintenance actions that must be done under REC procedures are called out in this chapter. This is a minimum standard. Unit level commanders may elect to conduct additional types of periodic maintenance under REC procedures if they deem it appropriate.

6-1.4 Configuration Control and Certification. Failure to conduct periodic maintenance under REC procedures (where applicable) and in accordance with the procedures contained herein can result in the loss of configuration control and may lead to loss of system certification.

6-1.5 Periodic Maintenance Procedures. Periodic maintenance procedures may include one or a combination of all the following categories of maintenance actions:

a. Non-operator adjustments
b. Post-repair or replacement alignments
c. Removal, disassembly and inspection
d. Repair or replacement of a component
e. Cleaning, re-assembly, adjustment, installation, calibration, and checkout

Drawings such as exploded views, sectional views, cutaway views, piping diagrams, and functional block diagrams required to support these procedures are provided in this manual. It also may be necessary for the user to make reference to equipment technical manuals and manufacturers' operating and servicing manuals.

6-2 SAFETY PRECAUTIONS.

The following publications are in effect when accomplishing periodic maintenance on the EEHS:

a. *NAVOSH Program Manual OPNAVINST 5100.19 Series (for afloat); NAVOSH Program Manual, OPNAVINST 5100.23 Series (for shore)* or corresponding *U.S. Marine Corps or Army Directive(s).*
b. *U.S. Navy Diving Manual. NAVSEA SS521-AG-PRO-010*
c. Oxygen Analyzer Instruction and Service Manual.

6-3 REPAIR AND MAINTENANCE PROCEDURES.

Repair procedures primarily involve removal, repair, and/or replacement of components in the EEHS. Component replacement is a straightforward task requiring ordinary hand tools. All tools or test equipment required will be noted in the procedures where needed.

6-3.1 Flexible Tube. The flexible tube should be taken out of its storage container EVERY SIX MONTHS for a full visual inspection.

CAUTION

Do not remove the protective fabric cover unless there is suspected damage to the surface of the tube. Replacing the cover is quite difficult; therefore, it should only be removed when absolutely necessary.

Check the entire unit for superficial damage of the silicone rubber. In locations where the fibers are visible, check that there are no cuts in the windings. Provided that there are no cuts, the silicone rubber may be repaired if damaged.

If a circumferential tear is observed between the inner and outer skins on the ends of the tube, do not attempt a repair. Contact NAVSEA 00C3 for further instructions which will likely require shipping the damaged unit to ESSM for repairs by trained personnel. If damage is observed beyond minor surface nicks and cuts or end splitting, the tube shall be returned to the ESSM facility or a maintenance facility designated by NAVSEA 00C3. .

To repair damage to the silicone rubber, begin by rubbing the surface in the region of the damaged area with a fine emery paper to prepare the surface for the application of the new silicone rubber. Clean the surface thoroughly using a smooth cloth with an approved de-greaser compatible with the silicone rubber. Allow the unit to dry completely. A repair kit is available which contains an applicator designed for two-part mixes as well as a liquid elastomer sealant in a tube.

The following instructions should be followed carefully when performing a repair. Do not use other silicone rubbers, because they may not have the same adhesive properties to the silicone rubber used in the original manufacture of the flexible tube. If the protective fabric cover has been removed, prior to replacing it on the flexible tube, ensure that the tube is rotated at least 15 degrees from its original position relative to the cover. This will ensure more uniform wear over the life of the tube during use and when folding it away in its storage cases.

WARNING

Do not repair the stretcher if there is any damage to the fibers, as the integrity of the stretcher may have been impaired; contact NAVSEA 00C3 to determine the proper course of action.

Specific step-by-step instructions for repairing the surface of the flexible tube are contained in section 6-3.1.2 of this manual. In addition to these instructions, additional repair information can be found in the INSYS document “Repair Procedure for Hyperlite Hyperbaric Stretcher Bodies” (see Appendix C).

6-3.1.1 Silicone Rubber Repair Kit Contents.

- 150 ml 10:1 manual applicator, plunger and cover
- 2 G.E. RTV 664 silicone rubber 50ml 10:1 two-part cartridge
- 12 mixer nozzles
- 1 bottle SS 4155 silicone primer (potentially hazardous material)
- 1 tube of G.E. silicone RTV 108 adhesive sealant
- Scalpel (retractable)
- Roll temporary repair tape
- Instructions for use
- Also required are a thin release agent polyethylene sheet and some tissue to clean away excess material.

NOTE

Protective rubber gloves should be worn.

NOTE

All working surfaces and areas should be kept clean.

6-3.1.2 Silicone Rubber Repair Kit Instructions. Determine the nature of the damage to the silicone rubber and establish that there is no damage to the para-aramid fibers underneath. Damage to the para-aramid fibers must be inspected by NAVSEA 00C3 prior to repairs being performed.

Tears in the silicone rubber on the inside of the stretcher must be repaired to avoid leakage through the wall of the flexible cylindrical shell. Tears on the outside of the stretcher should not influence the pressure retaining properties of the flexible shell.

All repairs to inner surfaces will need to have a cover of the RTV 664 blue/gray silicone rubber to ensure a seal, as will areas on the end or outer surfaces where the RTV 664 blue/gray silicone rubber has been torn away.

To assemble and use the repair kit proceed as follows:

1. Silicone applicator components.

    a. Handle assembly with trigger, catch and cover

    b. Plunger

    c. Mixer nozzle

d. Cartridge with end cap containing silicone rubber

2. Repair kit use instructions.

a. With the cover closed, raise the catch and fully insert the plunger (ratio 10:1), with the part number upwards, into the handle assembly from the left.

b. Open the cover on the top of the handle assembly and insert the cartridge containing the two-part silicone rubber mix. Close the cover and check that the dispenser operates correctly.

c. Remove the end cap from the cartridge and insert the mixer nozzle. If necessary, cut back the nozzle end to increase the diameter of the nozzle end hole.

d. Carefully squeeze the trigger until the plunger makes contact with the inner piston on the cartridge, and continue carefully until the mixer nozzle is full and the two parts of the mixture have fully blended. It may be necessary to waste a small amount to ensure that full blending is taking place.

e. Apply the silicone carefully to the surface to be repaired.

f. When the repair is complete, discard the mixer nozzle.

g. Replace the end cap on the cartridge.

h. Disassemble the unit in the reverse order of assembly.

i. Clean all parts thoroughly.

NOTE

Special care must be taken when repairing the sealing areas of the stretcher to ensure that no lumps are left that may reduce the sealing ability of the tube. Use the end domes as molds but ensure that a release agent sheet of clear POLYETHYLENE is used so that the silicone rubber does not adhere to the end domes and tear on removal.

3. The following procedure should be followed when performing repairs to the surface of the silicone rubber.

a. Clean the surface using an approved de-greaser and a smooth dry cloth. Allow the tube to dry thoroughly.

b. Paint around the damage with Primer SS 4155 to improve adherence of the RTV 664. Leave to dry for one hour.

c. Rotate the tube so that the area to be repaired is at the bottom when repair is to be done on the inside, and repaired area is on top when repairing the outside. This will ensure that the new material will not flow out of the repaired area. Instructions for using the Repair Kit-Applicator Assembly are found in section 6-4.3.

d. Wait thirty minutes to allow any trapped bubbles to come to the surface, then cover the patch with a release agent sheet and, using your fingers, flatten down the area of the repair, leaving the release agent sheet in place until the repair has completely cured (24 hours). Use of a release agent sheet will allow you to continue with repairs to other parts of the stretcher.

e. Remove the release agent sheet carefully, ensuring that the repair patch does not tear away from the inner tube wall.

After initial curing has taken place, a hair dryer may be used to decrease the curing time; however, do not fold the tube for at least 24 hours. Small round patches of silicone rubber can easily be made up using a small watch glass as a gravity mold for the RTV 664. Remember that the material will spread after pouring. Allow curing before removal from the watch glass. Use the primer on both surfaces prior to bonding the patch to the flexible tube and use RTV 664 as the adhesive. The top flat surface should be the contact surface with the flexible tube, thus ensuring that there are not uneven edges. All parts of the manual applicator should be thoroughly cleaned after use. The nozzle is disposable and should be discarded.

NOTE

The same cartridge may be used subsequently, provided that the material (silicone rubber two-part mix) is within its shelf life.

6-3.2 Protective Fabric Cover. The following washing/cleaning instructions apply:

- Maximum water temperature for washing — 185°F (85°C).
- Do not boil or use soap-based products.
- Do not use chlorine-based bleach.
- Use warm iron only.
- Dry clean with perchlorethylene only.

6-3.3 The Air and Oxygen Regulators, Control Box, End Domes, and Umbilical. This equipment requires inspection for damage after each use. The stretcher should not be used until damaged items have been repaired or replaced as necessary. Provided that the equipment is stored in a dry cool place and kept in the sealed containers supplied when purchased, the equipment mentioned above should not need frequent servicing.

The main depth gauge on the control box has a needle with an adjustable setting. During shipping or transit, it is possible that the needle is out of calibration and does not indicate zero pressure when not in use. ***The gauge is not defective; it only requires minor adjustment.*** To adjust the needle, open the gauge, loosen the screw on the shaft, and adjust the needle as necessary to indicate a zero setting.

NOTE

All components must be certified clean in accordance with U.S. Navy Diving and Hyperbaric Systems Certifications Manual. Only qualified personnel are authorized to disassemble, repair, or clean oxygen system components.

It is recommended that the air and oxygen regulators be serviced prior to each NAVSEA re-certification. This can be done by dismantling the units, checking each item for wear or damage, repairing or replacing where necessary, cleaning thoroughly, and re-assembling. After necessary repairs have been performed, each system needs to be fully operationally tested prior to the System Certification Authority (SCA) certification.

WARNING

Each EEHS is supplied with four regulators; two for air and two for oxygen. They must not be interchanged because the oxygen regulators are supplied "Oxygen Clean." Failure to heed this warning may result in serious malfunction of the equipment or injury or death of personnel.

6-3.3.1 Regulators for Air and Oxygen.

a. Introduction:

This section is intended to assist authorized service personnel in diagnosing problems, making repairs and carrying out the periodic service required to maintain safe and reliable operation. Before carrying out any work on the regulator, the diagrams should be studied carefully, a suitable clean work area should be selected, and all the necessary tools and parts should be available.

b. Contents:

- Diagnosis and Identification of Regulator Problems
- Inspecting and Overhauling the Air Regulator
- Inspecting and Overhauling the Oxygen Regulator
- Control Panel Valves
- Penetrator Plate Valves
- Penetrator Plate Electrical Penetrations
- Umbilical

c. Tools:

Only a small range of tools and equipment are required to maintain the regulator. Use the special tools available to prevent damage to the equipment.

- Lubricant approved for use in oxygen clean systems
- 42mm Pin Spanner

- 3/4" Ring Spanner
- 5/8" Ring Spanner
- 5mm hex key wrench
- 6mm hex key wrench
- 6mm hex bit socket
- Torque wrench 0 – 80 ft-lb (0 – 8.5 Nm)
- Pressure gauge in range 0 – 300 psig (0 – 20 bar)
- HP Air and Oxygen Supply
- First stage work handle (Apeks PN AT48)

6-3.3.2 Diagnosis and Identification of Regulator Problems. Prior to disassembly, inspect the regulator assemblies to verify proper operation or to identify problem areas within the HP or LP section of each. Refer to Table 6-1.

Table 6-1. Regulator Diagnostic Chart

High Pressure Creep/High MP	1.` HP valve (16) is worn or damaged. 2. HP valve seat in regulator body (12) is worn or damaged. 3. High pressure balance plug (21) is damaged or worn. 4. O-ring at balance plug (20) is damaged or worn. 5. O-ring inside balance plug (19) is damaged or worn. 6. Spring adjuster (6) too far in.
External Air Leakage or Secondary Diaphragm Distended or Bursts.	1. Blanking plug O-rings (15) are worn or damaged. 2. Diaphragm (10) worn or damaged. 3. Diaphragm seating surface damaged. 4. Connector O-ring (18) worn or damaged. 5. Diaphragm clamp (7) loose. 6. O-ring on balance plug (21) worn or damaged.
Restricted Air Flow Or High Inhalation Resistance Through Entire System.	1. Cylinder valve not completely open. 2. Cylinder valve needs servicing. 3. Air regulator disc filter (33), or oxygen regulator conical filter (23) clogged.

6-3.3.3 Inspecting and Overhauling the Air Regulator.

NOTE

The parts callout numbers (in parentheses) for the regulator and relief valve in this section refer to the numbers found in the applicable figures and tables for the regulator or relief valve.

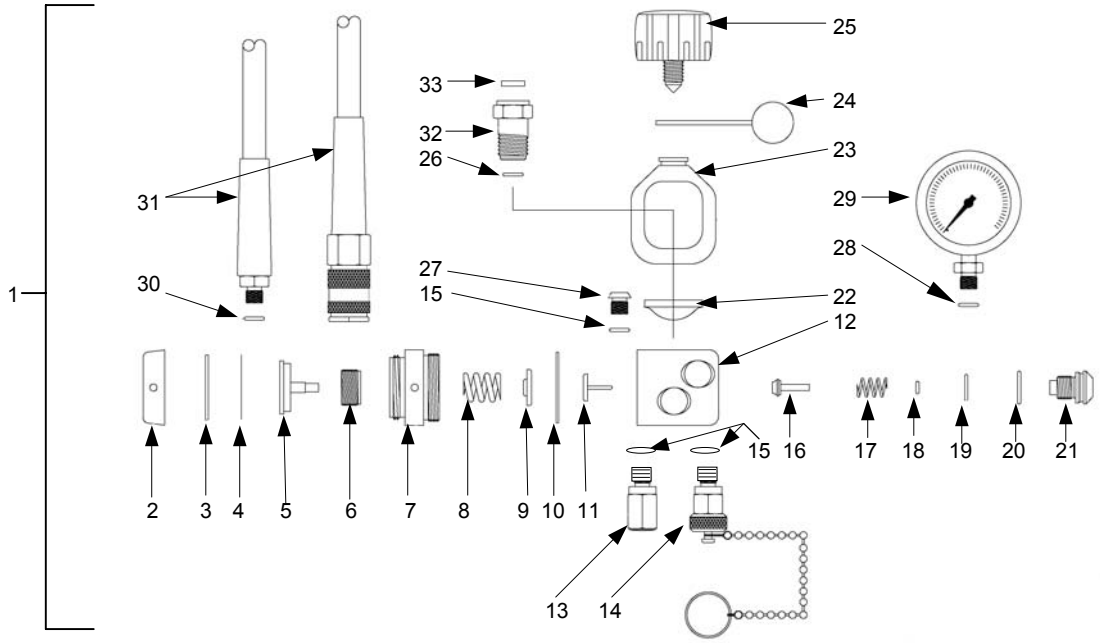

Figure 6-1. Exploded View of Air Regulator

Table 6-2. Parts Identification for Air Regulator

ITEM NO.	SOS PN	APEKS PN	DESCRIPTION	QTY.
6-1-1	Z10-01-02		Assembly, Air Regulator	1
-2	Z10-35-01-01	AP1484	Environmental End Cap	1
-3*	Z10-35-01-02	AP1482	Hydrostatic Diaphragm	1
-4	Z10-35-02-03	NA	AHP-R-1 Label	AR
-5	Z10-35-01-04	AP1483	Hydrostatic Transmitter	1
-6	Z10-35-01-05	AP1474	Spring Adjuster	1
-7	Z10-35-01-06	AP1473	Diaphragm Clamp	1
-8	Z10-35-02-07	AP6545	Spring	1
-9	Z10-35-01-08	AP1476	Spring Carrier	1
-10*	Z10-35-01-09	AP1478	Diaphragm	1
-11	Z10-35-01-10	AP1479	Valve. Lifter	1
-12	Z10-35-01-11	AP5201	Regulator Body	1
-13	Z10-01-03	NA	Relief Valve	1
-14	Z10-35-01-13	NA	Bleed Screw	1
-15	Z10-35-01-14	AP1445	O-Ring, Viton	3
-16*	Z10-35-01-15	AP1419	High Pressure Valve	1
-17	Z10-35-01-16	AP1415	Spring	1
-18*	Z10-35-01-17	AP1299	O-Ring, Viton	1
-19*	Z10-35-01-18	AP1410	O-Ring, Viton	1
-20*	Z10-35-01-19	AP1438	O-Ring, Viton	1
-21	Z10-35-01-20	AP5202	High Pressure Balance Plug	1
-22	Z10-35-02-21	AP1446	Distance Piece	1
-23	Z10-35-02-22	AP1403	Yoke Clamp	1

Table 6-2. Parts Identification for Air Regulator (Continued)

ITEM NO.	SOS PN	APEKS PN	DESCRIPTION	QTY.
-24	Z10-35-01-23	AP1404	Protective Ball	1
-25	Z10-35-02-24	AP1402	Yoke Screw	1
-26*	Z10-35-02-25	AP1409	O-Ring, Viton	1
-27	Z10-35-01-26	AP1487	Blanking Plug	1
-28*	Z10-35-01-27	AP1445	O-Ring, Viton	1
-29	Z10-35-02-28	130.15 (Air)	Gauge, Air Service	AR
-30*	Z10-35-01-29	AP1409	O-Ring, Viton	1
-31	Z10-35-01-30	NA	Whip Assembly	1
-32	Z10-35-02-31	AP1407	Yoke Clamp Connector	1
-33*	Z10-35-02-32	AP1406	Disc Filter	1
Note: Callout numbers with an asterisk (*) indicate parts that require replacement at each servicing. These parts are included in Apeks Regulator Service Kit, PN AP0241				

a. Disassemble the air regulator as follows:

CAUTION

When disassembling or reassembling regulator, only use plastic or brass O-ring picks to remove or install the O-rings. Every precaution shall be taken to prevent scratching the O-ring seating surface, as any damage to the sealing surface will result in leaks at the seal.

NOTE

It is recommended that each regulator be examined annually and serviced every two years.

1) If installed, remove the umbilical hose (31) from the regulator body (12). Remove the O-ring (30).

2) Remove the following from the regulator body (12):

   a) Relief valve (13) and O-ring (15). Set the relief valve aside until completion of step 11).

   b) Bleed screw (14) and O-ring (15).

   c) HP gauge (29) and O-ring (28).

3) Install the first stage work handle (PN AT48) and place the regulator into a vise, taking care not to damage the regulator body.

4) Using the 6mm hex key wrench, unscrew the HP balance plug (21) and remove the balance plug assembly.

5) Separate the balance plug assembly by pulling on each end to remove the HP valve (16) and HP valve spring (17). Using a brass or plastic O-ring pick, remove the O-rings (18, 19, and 20) from the HP balance plug (21).

6) Using a C-pin spanner wrench (PN AT30), remove the environmental end cap (2). Remove the hydrostatic transmitter (5) from inside the diaphragm clamp (7).

7) Using a C-pin spanner wrench (PN AT30), remove the diaphragm clamp (7). This will remove the spring adjuster (6). Carefully remove the hydrostatic diaphragm (3) from the environmental end cap (2).

8) Remove the spring (8) and spring carrier (9). Carefully remove the diaphragm (10) from the regulator body (12).

9) Remove the valve lifter (11) from the regulator body (12).

10) Remove the yoke connection by removing the yoke screw (25) and yoke protective ball (24) from the yoke clamp (23). Using a 3/4" wrench, remove the yoke clamp connector (32) from the regulator body (12). Remove the O-ring (26) from the yoke clamp connector.

11) Remove the disc filter (33) by inserting a dowel through the lower opening in the yoke clamp (23) and pushing the filter element out of the clamp.

b. Disassemble the regulator relief valve (13) as follows:

NOTE

Each relief valve will contain **either** item number 4 or item numbers 9 and 10.

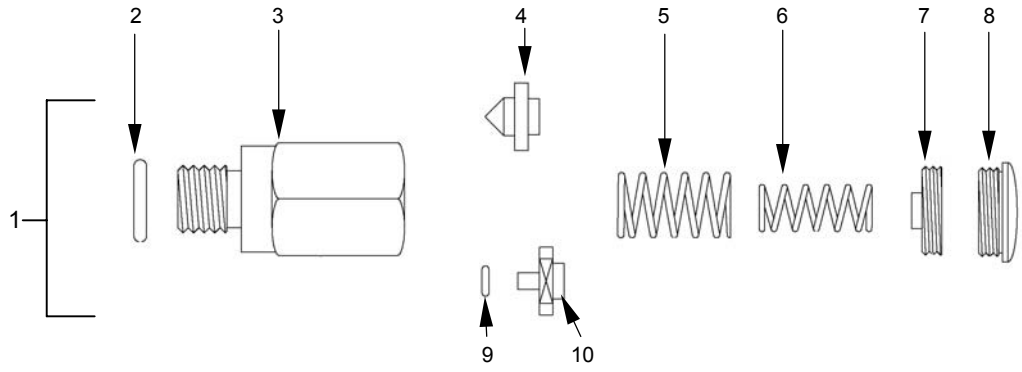

Figure 6-2. Exploded View of Air Regulator Relief Valve

Table 6-3. Parts Identification for Air Regulator Relief Valve

ITEM NO.	SOS PN	DESCRIPTION	QTY.
6-2-1	Z10-01-03	Relief Valve	1
-2	VR1049	O-ring	1
-3		Relief valve body	1
-4*		Nylon seal	1
-5		Large spring	1
-6		Small spring	1
-7		Spring Adjuster	1
-8		End Cap	1
-9*		O-ring	1
-10*		Carrier	1
*NOTE: Each valve will have either item number 4 or item numbers 9 and 10. If item 4 is installed, replace the relief valve.			

1) Remove the end cap (8).

2) Loosen and remove the spring adjuster (7). Remove and inspect the large and small springs (5 and 6) for dirt, corrosion, deposits, and serviceability.

NOTE

If the relief valve contains the nylon seal (4) replace the valve assembly with an updated valve containing the O-ring and carrier (9 and 10).

3) Remove the nylon seal (4) or O-ring and carrier (9 and 10), as appropriate.

4) Remove the O-ring (2) from the valve body.

c. Clean regulator and relief valve parts prior to reassembly as follows:

1) Place all parts in an ultrasonic cleaning bath containing the appropriate cleaning solution.

2) Minimum cleaning time is 6 minutes. Longer cleaning may be used, if necessary.

3) Rinse all components in warm fresh water to remove cleaning solution.

4) Dry parts by blowing them down or allowing them to air dry.

d. Reassemble the relief valve as follows:

NOTE

All O-rings should be lubricated with lubricant approved for use in oxygen clean systems, MIL-PRF-27617 Type III (Christo-Lube or equivalent), prior to reassembling the regulator. Dress the O-rings with a light film of lubricant and remove any excess by running the O-ring between the thumb and forefinger. Excessive grease, if left on an O-ring, will attract particulate matter which will damage the O-ring.

NOTE

If the nylon valve seal (4) is to be used, do not install the carrier (10) and O-ring (9) when assembling the relief valve.

1) Install the O-ring (9) onto the carrier (10), if used.

2) Place either the nylon seal (4) or the carrier (10) onto the large and small springs (5 and 6) and place the valve assembly into the valve body (3).

3) Thread the spring adjuster (7) into the valve body (3) until tension is felt, indicating that the adjuster has contacted the valve springs.

4) Install an O-ring (2) onto the valve body.

5) Using a suitable air source, set the relief valve to 216 $\pm$ 5 psig by adjusting the spring adjuster.

6) Install the end cap (8) onto the valve body.

7) Remove the relief valve from the test stand; remove the O-ring installed in step 4).

8) Set the relief valve aside for installation onto the regulator later in step e.10).

e. Reassemble the air regulator as follows:

1) Install a new disc filter (33) smooth side up into the yoke clamp connector (32). Install a new O-ring (26) onto the end of the yoke clamp connector.

2) Insert the yoke clamp connector (32) through the yoke clamp (23) and distance piece (22). Verify that the O-ring is in its proper location.

CAUTION

Verify that the regulator body is positioned such that the yoke is held vertically with the O-ring on top. Failure to position the yoke in this position may result in the O-ring not seating properly in the regulator.

3) Thread the yoke clamp connector (32) into the regulator body (12) until finger-tight and the distance piece (22) contacts the regulator body.

4) Install the first stage work handle (PN AT48) onto the regulator body. Place the work handle in a vise.

5) Using a 3/4" wrench, tighten the yoke clamp connector (32). Place the protective ball (24) onto the yoke clamp. Install the yoke clamp screw (25) into the yoke and tighten until the protective ball is retained in place.

6) Rotate the regulator in the vise as necessary to place the dry sealed chamber upwards.

7) Place the valve lifter (11) into the hole at the center of the regulator body (12). Carefully install a new diaphragm (10) into the regulator body. Run a finger around the edge of the diaphragm to verify that it is properly seated.

8) Place the spring carrier (9) onto the center of the diaphragm. Place the spring (8) onto the spring carrier. Thread the diaphragm clamp (7) onto the regulator body (12). Tighten the diaphragm clamp hand-tight. While tightening the diaphragm clamp, verify that the diaphragm, spring, and spring carrier remain centered in the regulator body cavity. Using a C-pin spanner wrench (PN AT30), tighten the diaphragm clamp until there is metal-to-metal contact between the diaphragm clamp and the regulator body.

9) Rotate the regulator in the vise to place the high pressure valve end upward.

NOTE

All O-rings should be lubricated with lubricant approved for use in oxygen clean systems, MIL-PRF-27617 Type III (Christo-Lube or equivalent), prior to reassembling the regulator. Dress the O-rings with a light film of lubricant and remove any excess by running the O-ring between the thumb and forefinger. Excessive grease, if left on an O-ring, will attract particulate matter which will damage the O-ring.

10) Install new O-rings (18, 19, and 20) onto the HP balance plug (21). Press the spring (17) onto the balance plug. Carefully insert a new HP valve (16) into the balance plug. Carefully insert the HP balance plug assembly into the regulator body and, using a 6mm hex key wrench, tighten the balance plug until it is hand-tight. Torque the balance plug to 8 Nm (5.9 ft-lb).

f. Adjust the air regulator.

1) Attach the regulator to a charged (3000 psig) scuba air source. Verify that the diaphragm clamp (7) is positioned to allow access for adjusting the regulator.

2) Slowly crack open the air supply valve and allow air to flow through the regulator to blow out any contaminants or particulate material in the regulator. Close the air supply valve.

NOTE

All O-rings should be lubricated with lubricant approved for use in oxygen clean systems, MIL-PRF-27617 Type III (Christo-Lube or equivalent), prior to reassembling the regulator. Dress the O-rings with a light film of lubricant and remove any excess by running the O-ring between the thumb and forefinger. Excessive grease, if left on an O-ring, will attract particulate matter which will damage the O-ring.

3) Using new O-rings (15 and 30, as necessary), install the regulator relief valve (13), bleed screw (14), and LP air hose (31). Using a new O-ring (28), install the HP gauge (29). Install a test gauge and O-ring at the remaining LP air port on the regulator body.

CAUTION

If at any time during testing the test pressure gauge exceeds 14 bar (206 psig), then there is a high pressure leak with the regulator. Close the air supply valve and investigate the cause of the internal leak.

4) If there are no leaks at the regulator, close the air supply valve and depressurize the regulator by opening the regulator bleed screw (14).

NOTE

Turning the spring adjuster clockwise (CW) increases pressure; counterclockwise (CCW) decreases pressure. Refer to Table 6-4 for setup specifications.

Table 6-4. Regulator Specifications

TYPE	DIAPHRAGM OPERATED BALANCE VALVE
Manufacturer	Apeks Marine Equipment Ltd.
Model	TX50, Dry Sealed Chamber
Max. working pressure - Yoke	3500 psi
Max. working pressure - DIN 477 type 50 screw connector	4500 psi
Relief valves	Air 216 $\pm$ 5 psig / Oxygen 151 $\pm$ 5 psig
Low pressure output	Air 170 – 200 psig / Oxygen 115 – 140 psig
Low pressure ports	3 x 3/8" UNF, 1 x 1/2" UNF
High pressure ports	1 x 7/16" UNF
Environmental protection	Dry sealed system
Body	Chromium plated brass
Springs	Stainless steel
O-rings	Viton
Diaphragm	Reinforced Neoprene

5) Adjust the regulator pressure by turning the spring adjuster (6) in 1/8-turn increments. After each adjustment open the air supply valve and monitor the pressure on the test gauge. Adjust the pressure to obtain between 9 and 10 bar (170 and 200 psig). Cycle the regulator by opening and closing the bleed screw (14) while observing pressure. After each cycling of the bleed screw, the test gauge pressure should return to the set pressure and stabilize. If the pressure creeps up, then an internal HP leak is indicated; refer to the troubleshooting chart (Table 6-1) and investigate possible causes.

6) Adjust the regulator until satisfactory pressure setting is achieved.

7) Close the air supply valve and bleed down the regulator pressure by cracking open the bleed screw. Close the bleed screw and reopen the air supply; verify that the regulator pressure has returned to the setpoint pressure. If air pressure check is satisfactory, proceed to step 10. If not satisfactory, refer to the troubleshooting chart and investigate.

8) While the regulator is pressurized, insert the load transmitter (5) into the environmental end cap (7). Press a new hydrostatic diaphragm (3) into the environmental end cap (2).

9) Thread the environmental end cap (2) onto the diaphragm clamp (7) and tighten hand-tight. Using the C-pin spanner wrench (PN AT30), tighten the environmental end cap until there is metal-to-metal contact.

10) After the end cap is installed, repeatedly crack open and shut the bleed screw to cycle the regulator. The regulator should return to the setpoint pressure after each cycle and then, when the bleed screw is finally shut return to setpoint pressure without "creep".

11) Shut the air supply valve. Remove the test gauge and, using a new O-ring (15) install the MP blanking plug (26).

12) Reopen the air supply valve and immerse the regulator assembly in fresh water. Inspect the regulator assembly for any indication of air leaks.

13) If all tests are satisfactory, shut the air supply valve, remove the regulator from the air supply bottle and install the protective clamp (23); tighten the yoke clamp screw (25).

6-3.3.4 Inspecting and Overhauling the Oxygen Regulator.

CAUTION

When disassembling or reassembling regulator, use only plastic or brass O-ring picks to remove or install the O-rings. Every precaution shall be taken to prevent scratching the O-ring seating surface as any damage to the sealing surface will result in leaks at the seal.

CAUTION

During removal, disassembly, repair, and replacement every precaution shall be taken to maintain oxygen component cleanliness as stated in MIL-STD-1330.

NOTE

It is recommended that each regulator be examined annually and serviced every two years.

NOTE

The parts callout numbers (in parentheses) for the regulator and relief valve in this section refer to the numbers found in the applicable figures and tables for the regulator or relief valve.

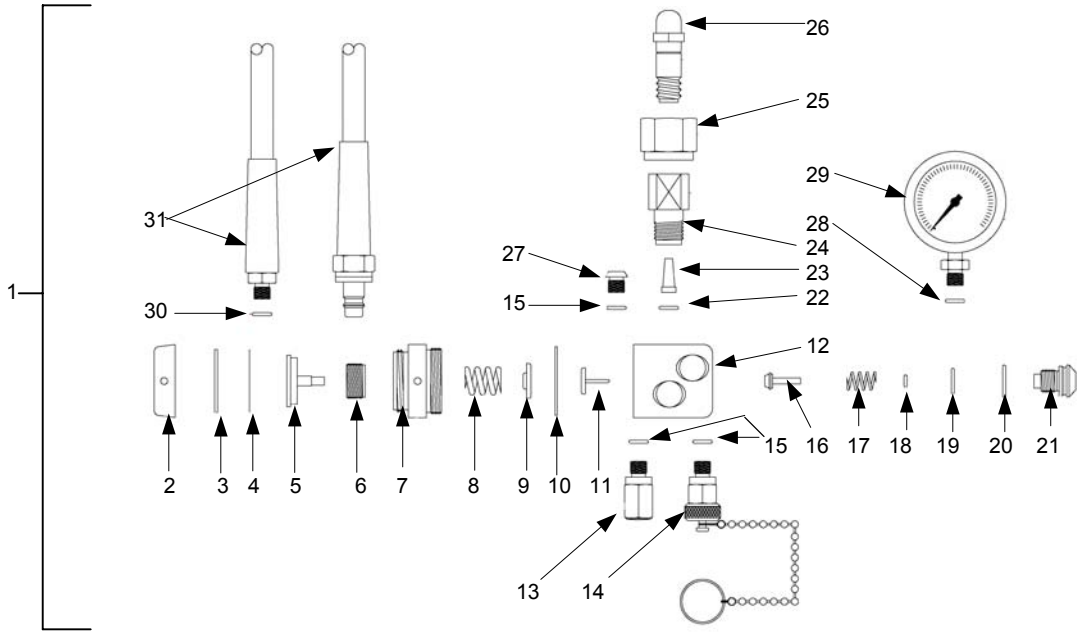

Figure 6-3. Exploded View of Oxygen Regulator

Table 6-5. Parts Identification List for Oxygen Regulator

ITEM NO.	SOS PN	APEKS PN	DESCRIPTION	QTY.
6-3-1	Z10-01-01		Assembly, Oxygen Regulator	1
-2	Z10-35-01-01	AP1484	Environmental end cap	1
-3*	Z10-35-01-02	AP1482	Hydrostatic diaphragm	1
-4	Z10-35-01-03	NA	AHP-R-1 Label	AR
-5	Z10-35-01-04	AP1483	Hydrostatic Transmitter	1
-6	Z10-35-01-05	AP1474	Spring Adjuster	1
-7	Z10-35-01-06	AP1473	Diaphragm Clamp	1
-8	Z10-35-01-07	AP1475	Spring	1
-9	Z10-35-01-08	AP1476	Spring Carrier	1
-10*	Z10-35-01-09	AP1478	Diaphragm	1
-11	Z10-35-01-10	AP1479	Valve Lifter	1
-12	Z10-35-01-11	AP5201	Regulator Body	1
-13	Z10-01-03	NA	Relief Valve	1
-14	Z10-35-01-13	NA	Bleed Screw	1
-15*	Z10-35-01-14	AP1409	O-Ring, Viton	3
-16*	Z10-35-01-15	AP1419	High Pressure Valve	1
-17	Z10-35-01-16	AP1415	Spring	1
-18*	Z10-35-01-17	AP1299	O-Ring, Viton	1
-19*	Z10-35-01-18	AP1410	O-Ring, Viton	1
-20*	Z10-35-01-19	VR1300	O-Ring, Viton	1
-21	Z10-35-01-20	AP5202	High Pressure Balance Plug	1
-22*	Z10-35-01-21	VR1409	O-Ring, Viton	1
-23*	Z10-35-01-22	AP1472	Conical Filter	1
-24	Z09-02-10	NA	Adapter	1
-25	Z10-35-01-24	PN62	CGA 540 Nut	1
-26	Z10-35-01-25	PN63	CGA 540 Nipple	1
-27	Z10-35-01-26	VR1408	Blanking Plug	1
-28*	Z10-35-01-27	VR1445	O-Ring, Viton	1
-29	Z10-35-01-28	130.15 (O_2)	Gauge, Oxygen Service	AR
-30*	Z10-35-01-29	AP1409	O-Ring, Viton	1
-31	Z10-02-01	NA	Whip Assembly	1
Note: Callout numbers with an asterisk (*) indicate parts that require replacement at each servicing. These parts are included in Apeks Regulator Service Kit, PN AP0241				

a. Disassemble the oxygen regulator as follows:

1) If installed, remove the umbilical hose (31) from the regulator body (12). Remove the O-ring (30).

2) Remove the following from the regulator body (12):
   a) Relief valve (13) and O-ring (15). Set the relief valve aside until ready to disassemble and inspect the valve internals.

   b) Bleed screw (14) and O-ring (15).

   c) HP gauge (29) and O-ring (28).

3) Install the first stage work handle (PN AT48) and place the regulator into a vise, taking care not to damage the regulator body.

4) Using the 6mm hex key wrench, remove the HP balance plug (21) and remove the balance plug assembly .

5) Separate the balance plug assembly by pulling on each end to remove the HP valve (16) and HP valve spring (17) from the balance plug bolt. Using a brass or plastic O-ring pick, remove the O-rings (18, 19, and 20) from the balance plug.

6) Using a C-pin spanner wrench (PN AT30) remove the environmental end cap (2). Remove the hydrostatic transmitter (5) from inside the diaphragm clamp (7).

7) Using a C-pin spanner wrench (PN AT30) remove the diaphragm clamp (7). This will remove the spring adjuster (6). Carefully remove the hydrostatic diaphragm (3) from the environmental end cap (2).

8) Remove the spring (8) and spring carrier (9). Carefully remove the diaphragm (10) from the regulator body (12).

9) Remove the valve lifter (11) from the regulator body (12).

10) Using the 6mm hex key wrench, remove the DIN connector and separate the connector into four pieces (24, 25, 26, and 27).

11) Remove the cone filter (23) and O-ring (22) from the face of the handwheel connector (24).

b. Disassemble the regulator relief valve (13) as follows:

NOTE

Each relief valve will contain **either** item 4 or item numbers 9 and 10.

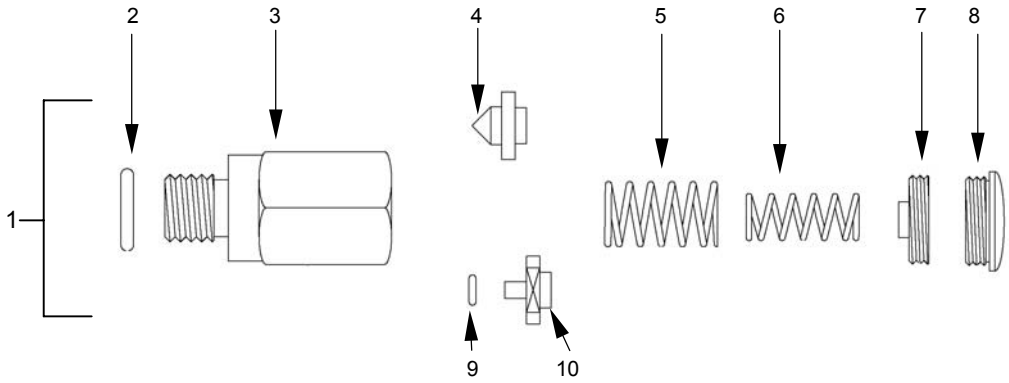

Figure 6-4. Exploded View of Oxygen Regulator Relief Valve

Table 6-6. Parts Identification for Oxygen Regulator Relief Valve

ITEM NO.	SOS PN	DESCRIPTION	QTY.
6-4-1	Z10-01-03	Relief Valve	1
-2	VR1049	O-ring	1
-3		Relief valve body	1
-4*		Nylon seal	1
-5		Large spring	1
-6		Small spring	1
-7		Spring Adjuster	1
-8		End Cap	1
-9*		O-ring	1
-10*		Carrier	1
NOTE: Each valve will have either item 4 or item numbers 9 and 10. If item 4 is installed, replace the relief valve assembly.			

1) Remove the end cap (8).

2) Loosen and remove the spring adjuster (7). Remove and inspect the large and small springs (5 and 6) for dirt, corrosion, deposits, and serviceability.

NOTE

If the relief valve contains the nylon seal (4), replace the valve assembly with an updated valve containing the O-ring and carrier (9 and 10).

3) Remove the nylon seal (4) or O-ring and carrier (9 and 10), as appropriate.

4) Remove the O-ring (2) from the valve body.

c. Clean regulator and relief valve parts prior to reassembly.

CAUTION

During removal, disassembly, repair, and replacement every precaution shall be taken to maintain oxygen component cleanliness as stated in MIL-STD-1330.

1) Clean all replacement parts for the regulator and relief valves prior to reassembly in accordance with MIL-STD-1330.

2) Maintain clean, any parts that are not replaced (i.e. regulator body, gauges) in accordance with MIL-STD-1330.

d. Reassemble the relief valve as follows:

NOTE

All O-rings should be lubricated with lubricant approved for use in oxygen clean systems, MIL-PRF-27617 Type III (Christo-Lube or equivalent), prior to reassembling the regulator. Dress the O-rings with a light film of lubricant and remove any excess by running the O-ring between the thumb and forefinger. Excessive grease, if left on an O-ring, will attract particulate matter which will damage the O-ring.

NOTE

If the nylon valve seal (4) is to be used, do not install the carrier (10) and O-ring (9) when assembling the relief valve.

1) Install the O-ring (9) onto the carrier (10), if used.

2) Place either the valve seal (4) or the carrier (10) onto the large and small springs (5 and 6) and place the valve assembly into the valve body (3).

3) Thread the spring adjuster (7) into the valve body (3) until tension is felt, indicating that the adjuster has contacted the valve springs.

4) Install an O-ring (2) onto the valve body.

5) Using a suitable pressure source, set the relief valve to 151 $\pm$ 5 psig by adjusting the spring adjuster.

6) Install the end cap (8) onto the valve body.

7) Remove the relief valve from the test stand; remove the O-ring installed in step 4).

8) Set the relief valve aside for installation onto the regulator in step f. 3) below.

e. Reassemble the oxygen regulator as follows:

NOTE

All O-rings should be lubricated with lubricant approved for use in oxygen clean systems, MIL-PRF-27617 Type III (Christo-Lube or equivalent), prior to reassembling the regulator. Dress the O-rings with a light film of lubricant and remove any excess by running the O-ring between the thumb and forefinger. Excessive grease, if left on an O-ring, will attract particulate matter which will damage the O-ring.

1) Install a new cone filter (23) into the handwheel connector (24). Install a new O-ring (22) onto the end of the handwheel connector.

2) Thread the handwheel connector (24) into the regulator body (12). Place the CGA 540 Nut (25) over the lower end of the CGA 540 nipple (26) and then thread the nipple into the handwheel connector. Tighten the handwheel connector and CGA 540 nipple.

3) Install the first stage work handle (PN AT48) onto the regulator body. Place the work handle in a vise.

4) Using a 3/4" wrench, tighten the handwheel connector (24). Install the CGA 540 nut (25) and CGA 540 nipple (26) on the handwheel connector and tighten.

5) Rotate the regulator in the vise as necessary to place the dry sealed chamber upwards.

6) Place the valve lifter (11) into the hole at the center of the valve body. Carefully install a new diaphragm (10) into the valve body. Run a finger around the diaphragm's edge to verify that it is properly seated.

7) Place the spring carrier (9) onto the center of the diaphragm. Place the spring (8) onto the spring carrier. Thread the diaphragm clamp (7) onto the regulator body. Tighten the diaphragm clamp hand-tight. While tightening the diaphragm clamp, verify that the diaphragm, spring, and spring carrier remain centered in the regulator body cavity. Using a C-pin spanner wrench (PN AT30), tighten the diaphragm clamp until there is metal-to-metal contact between the diaphragm clamp and the regulator body.

8) Rotate the regulator in the vise to place the high pressure valve end upward.

9) Install new O-rings (18, 19, and 20) onto the HP balance plug (21). Press the spring (17) onto the balance plug. Carefully insert a new HP valve (16) into the balance plug. Carefully insert the HP balance plug assembly into the regulator body and, using a 6mm hex key wrench, tighten the balance plug until it is hand-tight. Torque the balance plug to 8 Nm (5.9 ft-lb).

f. Adjust the oxygen regulator.

1) Attach the regulator to a charged (2200 psig) oxygen source. Verify that the diaphragm clamp (7) is positioned to allow access for adjusting the regulator.

2) Crack open the oxygen supply valve and allow oxygen to flow through the regulator to blow out any contaminants or particulate material in the regulator. Close the oxygen supply valve.

NOTE

All O-rings should be lubricated with lubricant approved for use in oxygen clean systems, MIL-PRF-27617 Type III (Christo-Lube or equivalent), prior to reassembling the regulator. Dress the O-rings with a light film of lubricant and remove any excess by running the O-ring between the thumb and forefinger. Excessive grease, if left on an O-ring, will attract particulate matter which will damage the O-ring

3) Using new O-rings (15) install the regulator relief valve assembly(13), bleed screw (14), and LP oxygen hose (31). Using a new O-ring (28), install the HP gauge (29). Install a test gauge and O-ring at the remaining LP oxygen port on the regulator body.

CAUTION

If at any time during testing the test pressure gauge exceeds 11 bar (162 psig), then there is a high pressure leak with the regulator. Shut the oxygen supply valve and investigate the cause of the internal leak.

4) If there are no leaks at the regulator, shut the oxygen supply valve and depressurize the regulator by opening the regulator vent valve (14).

NOTE

Turning the spring adjuster clockwise (CW) increases pressure; counterclockwise (CCW) decreases pressure. Refer to Table 6-2 for setup specifications.

5) Adjust the regulator pressure by turning the spring adjuster (6) in 1/8-turn increments. After each adjustment, open the oxygen supply valve and monitor the pressure on the MP test gauge. Pressure is adjusted to obtain between 8 and 9.5 bar (115 and 140 psig). Cycle the regulator by opening and closing the bleed screw (14) while observing pressure. After each cycling of the bleed screw, the regulator should return to the set pressure and stabilize. If the pressure creeps up then an internal HP leak is indicated; refer to the troubleshooting chart (Table 6-1) and investigate possible causes.

6) Adjust the regulator until satisfactory pressure setting is achieved.

7) Close the oxygen supply valve and bleed down the regulator pressure by cracking open the bleed screw. Shut the bleed screw and reopen the oxygen supply; verify that the regulator pressure has returned to the setpoint pressure. If oxygen pressure check is satisfactory, proceed to step 8). If not satisfactory, refer to the troubleshooting chart and investigate.

8) While the regulator is pressurized, insert the load transmitter (5) into the Environmental end cap (7). Press a new hydrostatic diaphragm (3) into the environmental end cap (2).

9) Thread the environmental end cap (2) onto the diaphragm clamp (7) and tighten hand-tight. Using the C-pin spanner wrench (PN AT30), tighten the environmental end cap until there is metal-to-metal contact.

10) After the end cap is installed, repeatedly crack open and close the bleed screw to cycle the regulator. The regulator should return to the setpoint pressure after each cycle and then, when the bleed screw is finally closed, return to setpoint pressure without creep.

11) Close the oxygen supply valve. Remove the test gauge and, using a new O-ring (15), install the MP blanking plug (26).

12) Reopen the oxygen supply valve and immerse the regulator assembly in fresh water. Inspect the regulator assembly for any indication of air leaks.

13) If all tests are satisfactory, close the oxygen supply valve and remove the regulator from the oxygen supply bottle.

6-3.3.5 Control Panel Valves. Operator maintenance of the control panel valves consists of external cleaning of the valve and attached hardware, and inspection and replacement of damaged or worn components.

a. Removal:

1) Perform tag-out.
2) Begin REC procedures.
3) Remove the six screws holding the control panel in place.
4) Clean exterior of valve and associated piping to prevent contamination when valves are removed from the piping system.
5) If a valve is to be removed for repair or replacement, remove the valve handle.
6) Remove retaining nut.
7) Unscrew and slide valve union nut(s) away from valve.
8) Remove valve assembly from system.

b. Installation:

WARNING

Only oxygen-approved (MIL-T-27730) PTFE antiseizing tape may be used on oxygen system threaded connections.

1) For fittings with pipe threads, apply 2 to 3 turns of PTFE Teflon tape to male threads.
2) Refer to Figure 6-6 and Figure 6-7 for torque values of union nut(s).
3) Install retaining nuts.
4) Install valve handles that were removed in step 3) above.
5) Clear red tag.
6) Pressurize system to maximum operating pressure; check for and correct any leaks.
7) Replace control panel and six retaining screws.
8) Complete REC forms.

6-3.3.6 Penetrator Plate Valves. Operator maintenance of the Penetrator Plate valves consists of external cleaning, inspection, and replacement of damaged or worn components.

a. Removal:

1) Perform tag-out.
2) Begin REC procedures.
3) Clean exterior of valve and associated hardware.
4) Removal of some valves requires the removal of adjacent valves first.
5) Remove retaining nut(s).
6) Remove valve assembly from system.

b. Installation:

1) For fittings with pipe threads, apply 2 to 3 turns of Teflon tape to male threads.
2) When replacing valves that go through the penetrator plate replace O-rings part number Z07-35-02/03 and Z07-35-02/23.
3) Refer to Figure 6-6 and Figure 6-7 for torque values of retaining nut(s).
4) Clear Red tag.
5) Pressurize system to maximum operating pressure; check for and correct any leaks.
6) Complete REC forms.

6-3.3.7 Penetrator Plate Electrical Penetrations. Operator maintenance of the penetrator plate electrical penetrations consists of external cleaning of the connectors and associated hardware and inspection and replacement of damaged or worn components.

a. Removal:

1) Perform tag-out.
2) Begin REC procedures.
3) Clean exterior of electrical penetration.
4) Remove retaining nut.
5) Remove complete electrical penetration from system.

b. Installation:

1) When replacing electrical penetration Z07-35-02/21 or Z07-35-02/24 they will come with new O-ring Z07-35-02/21a and retaining nut Z07-35-02/21b.
2) Tighten retaining nut(s) until no leakage is observed.
3) Clear red tag
4) Pressurize system to maximum operating pressure; check for and correct any leaks.
5) Complete REC forms.

6-3.3.8 Umbilical. Operator maintenance of the umbilical consists of external cleaning of the valve and attaching hardware, inspection, and replacement of damaged or worn components.

a. Removal:

1) Perform tag-out.
2) Begin REC procedures.
3) Remove existing heat shrink.
4) Remove damaged hose(s) from neoprene covers.

b. Installation:

1) Install neoprene covers on new hose(s).
2) Install plastic retaining straps with 2” diameter heat shrink.
3) Clear red tag.
4) Pressurize system to maximum operating pressure; check for and correct any leaks.
5) Complete REC forms.

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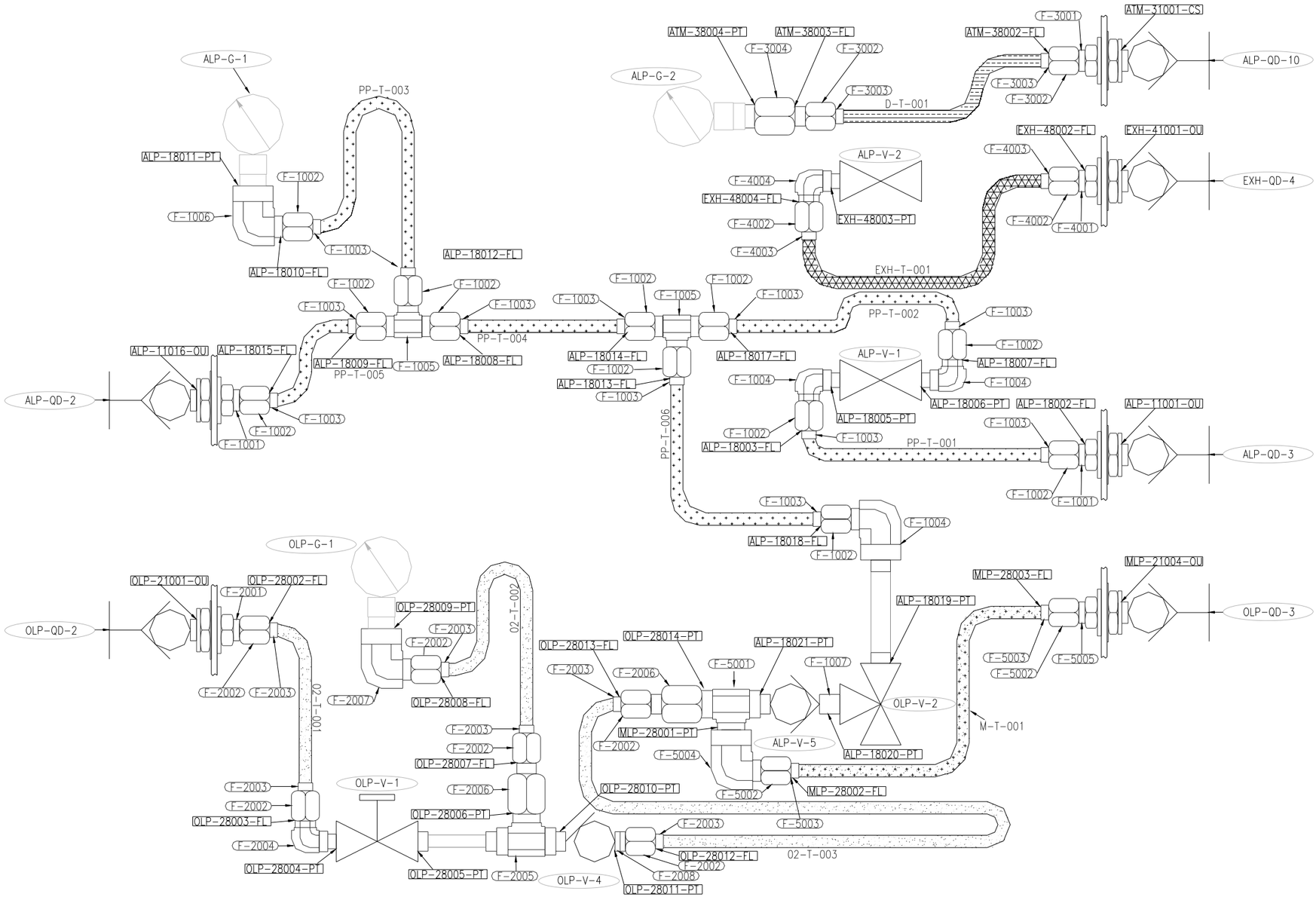

Figure 6-5. Control Box JID

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REGULATOR AND GAUGE LIST							ASSEMBLY REFERENCE
GAUGE No.	DESCRIPTION	DIAL Ø	PRESSURE RANGE	CONNECTION	PART No.	REMARKS	FIGURE No.
AHP-G-1	PRIMARY H/P AIR SUPPLY GAUGE	Ø63mm	0 - 5000 PSIG	1/4" NPT		OIL FREE	6-6
AHP-G-2	SECONDARY H/P AIR SUPPLY GAUGE	Ø63mm	0 - 5000 PSIG	1/4" NPT		OIL FREE	6-7
ALP-G-1	AIR SUPPLY PRESSURE GAUGE	Ø63mm	0 - 230 PSIG	1/8" NPT	Z08-35-02-02	OIL FREE	6-3
ALP-G-2	MAIN DEPTH GAUGE	Ø100mm	-15 - +80 FSW	1/4" NPT	Z08-35-02-01	OIL FREE	6-3
ALP-G-3	INTERNAL DEPTH GAUGE		-15 - +80 FSW		Z08-30-04	OIL FREE	6-3
OHP-G-1	PRIMARY H/P OXYGEN SUPPLY GAUGE	Ø63mm	0 - 5000 PSIG	1/4" NPT		OIL FREE	6-6
OHP-G-2	SECONDARY H/P OXYGEN SUPPLY GAUGE	Ø63mm	0 - 5000 PSIG	1/4" NPT		OIL FREE	6-7
OLP-G-1	OXYGEN SUPPLY PRESSURE GAUGE	Ø63mm	0 - 230 PSIG	1/4" NPT	Z08-35-02-10	OIL FREE	6-3
AHP-R-1	PRIMARY AIR REGULATOR			1/4" NPT			6-6
AHP-R-2	SECONDARY AIR REGULATOR			1/4" NPT			6-7
OHP-R-1	PRIMARY OXYGEN REGULATOR			1/4" NPT			6-6
OHP-R-2	SECONDARY OXYGEN REGULATOR			1/4" NPT			6-7

FITTING LIST						ASSEMBLY REFERENCE
FITTING No.	NOMINAL SIZE	TYPE	MATERIAL	SERVICE	PART No.	FIGURE No.
F-1001	4 - JIC	COUPLING	STAINLESS STEEL 316	PP-T-001 -005	Z08-02-04	6-3
F-1002	Ø 1/4" TUBE	NUT	BRASS	PP-T-001 -002 -003 -004 -005 -006	Z08-35-03-02	6-3
F-1003	Ø 1/4" TUBE	GLAND	BRASS	PP-T-001 -002 -003 -004 -005 -006	Z08-35-03-03	6-3
F-1004	4 - JIC	ELBOW	BRASS	PP-T-001 -002 -006	Z08-35-02-18	6-3
F-1005	4 - JIC	TEE	BRASS	PP-T-002 -003 -004 -005 -006	Z08-35-02-20	6-3
F-1006	4 - JIC	ELBOW	BRASS	PP-T-003	Z08-35-02-22	6-3
F-1007	Ø 1/4" NPT	COUPLING	BRASS	OLP-V-2	Z08-35-02-36	6-3
F-1008	Ø 1/4" NPT	COUPLING	STAINLESS STEEL 316	ALP-QD-5 - ALP-QD-6	Z07-02-06	6-6
F-2001	4 - JIC	COUPLING	STAINLESS STEEL 316	02-T-001	Z08-02-04	6-3
F-2002	Ø 1/4" TUBE	NUT	BRASS	02-T-001 -002 -003	Z08-35-03-02	6-3
F-2003	Ø 1/4" TUBE	GLAND	BRASS	02-T-001 -002 -003	Z08-35-03-03	6-3
F-2004	4 - JIC	ELBOW	BRASS	02-T-001	Z08-35-02-18	6-3
F-2005	Ø 1/4" NPT	TEE	BRASS	02-T-003	Z08-35-02-21	6-3
F-2006	4 - JIC	ADAPTOR	BRASS	02-T-002 -003	Z08-35-02-17	6-3
F-2007	Ø1/4" NPT	ELBOW	BRASS	02-T-002	Z08-35-02-37	6-3
F-2008	4 - JIC	ADAPTOR	BRASS	02-T-003	Z08-35-02-36	6-3
F-3001	4 - JIC	COUPLING	STAINLESS STEEL 316	D-T-001	Z08-02-04	6-3
F-3002	Ø 1/4" TUBE	NUT	BRASS	D-T-001	Z08-35-03-02	6-3
F-3003	Ø 1/4" TUBE	GLAND	BRASS	D-T-001	Z08-35-03-03	6-3
F-3004	Ø 1/4" NPT	ADAPTOR	BRASS	D-T-001	Z08-35-02-17	6-3
F-3005	Ø 1/4" NPT	COUPLING	STAINLESS STEEL 316	ALP-QD-8	Z07-02-07	6-6
F-4001	4 - JIC	COUPLING	STAINLESS STEEL 316	EXH-T-001	Z08-02-04	6-3
F-4002	Ø 1/4" TUBE	NUT	BRASS	EXH-T-001	Z08-35-03-02	6-3
F-4003	Ø 1/4" TUBE	GLAND	BRASS	EXH-T-001	Z08-35-03-03	6-3
F-4004	Ø 1/4" NPT	ELBOW	BRASS	EXH-T-001	Z08-35-02-18	6-3
F-4005	Ø 1/4" NPT	COUPLING	STAINLESS STEEL 316	EXH-QD-2	Z07-02-05	6-6
F-4006	Ø 1/4" NPT	COUPLING	STAINLESS STEEL 316	OLP-V-3	Z07-02-11	6-6
F-4007	Ø 1/4" NPT	COUPLING	BRASS	EXH-QD-1	Z07-35-05-04	6-6
F-4008	Ø 1/4" NPT	COUPLING	STAINLESS STEEL 316	ALP-V-4	Z07-02-04	6-6
F-4009	Ø 1/4" NPT	COUPLING	STAINLESS STEEL 316	ALP-V-3	Z07-02-04	6-6
F-5001	Ø 1/4" NPT	TEE	BRASS	02-T-003 M-T-001	Z08-35-02-21	6-3
F-5002	Ø 1/4" TUBE	NUT	BRASS	M-T-001	Z08-35-03-02	6-3
F-5003	Ø 1/4" TUBE	GLAND	BRASS	M-T-001	Z08-35-03-03	6-3
F-5004	Ø 1/4" NPT	ELBOW	BRASS	M-T-001	Z08-35-02-22	6-3
F-5005	4 - JIC	COUPLING	STAINLESS STEEL 316	M-T-001	Z08-02-04	6-3
F-5006	Ø 1/4" NPT	COUPLING	STAINLESS STEEL 316	OLP-QD-5 - OLP-QD-6	Z07-02-10	6-6

TUBE / FLEX LIST							ASSEMBLY REFERENCE
PIPE/TUBE No.	TUBE Ø	SECTION	MATERIAL	SPECIFICATION	SERVICE	DRAWING No.	FIGURE No.
D-T-001	Ø1/4"O/D	22 SWG	CUPRONICKEL	90/10	ALP-QD-4 TO PNEUMO-1	Z08-33-24	6-3
EXH-T-001	Ø1/4"O/D	22 SWG	CUPRONICKEL	90/10	ALP-QD-3 TO ALP-V-2	Z08-33-25	6-3
PP-T-001	Ø1/4"O/D	22 SWG	CUPRONICKEL	90/10	ALP-QD-2 TO ALP-V-1	Z08-33-26	6-3
PP-T-002	Ø1/4"O/D	22 SWG	CUPRONICKEL	90/10	ALP-V-1 TO F-1005	Z08-33-27	6-3
PP-T-003	Ø1/4"O/D	22 SWG	CUPRONICKEL	90/10	F-1005 TO ALP-G-1	Z08-33-28	6-3
PP-T-004	Ø1/4"O/D	22 SWG	CUPRONICKEL	90/10	F-1005 TO F1005	Z08-33-29	6-3
PP-T-005	Ø1/4"O/D	22 SWG	CUPRONICKEL	90/10	ALP-QD-2 TO F1005	Z08-33-30	6-3
PP-T-006	Ø1/4"O/D	22 SWG	CUPRONICKEL	90/10	F-1005 TO OLP-V-2	Z08-33-31	6-3
02-T-001	Ø1/4"O/D	22 SWG	CUPRONICKEL	90/10	OLP-QD-2 TO OLP-V-1	Z08-33-33	6-3
02-T-002	Ø1/4"O/D	22 SWG	CUPRONICKEL	90/10	F2005 TO OLP-G-1	Z08-33-34	6-3
02-T-003	Ø1/4"O/D	22 SWG	CUPRONICKEL	90/10	OLP-V-4 TO F-5001	Z08-33-35	6-3
M-T-001	Ø1/4"O/D	22 SWG	CUPRONICKEL	90/10	F-5001 TO OLP-QD-3	Z08-33-32	6-3
ALP-H-1	Ø1/4"I/D	12 SWG	TEFLON LINED	SYNFLEX 3130-04	AHP-R-1 - ALP-QD-1		6-6
ALP-H-2	Ø1/4"I/D	12 SWG	TEFLON LINED	SYNFLEX 3130-04	AHP-R-2 - ALP-QD-11		6-7
ALP-H-3	Ø1/4"I/D	12 SWG	TEFLON LINED	SYNFLEX 3130-04	AIR UMBILICAL		6-6
ALP-H-4	Ø1/4"I/D	12 SWG	RPVC	RPVC	PNEUMO UMBILICAL		6-6
OLP-H-1	Ø1/4"I/D	12 SWG	TEFLON LINED	SYNFLEX 3130-04	OHP-R-1 - OLP-QD-1		6-6
OLP-H-2	Ø1/4"I/D	12 SWG	TEFLON LINED	SYNFLEX 3130-04	OHP-R-2 - OLP-QD-8		6-7
OLP-H-3	Ø1/4"I/D	12 SWG	TEFLON LINED	SYNFLEX 3130-04	BIBS UMBILICAL		6-6
EXH-H-1	Ø3/8"I/D	12 SWG	RPVC	RPVC	EXHAUST UMBILICAL		6-6

VALVE LIST						ASSEMBLY REFERENCE
VALVE No.	NOMINAL Ø	MATERIAL	TYPE	SERVICE	PART No.	FIGURE No.
ALP-QD-1	Ø1/4"	BRASS	QUICK DISCONNECT	AIR SUPPLY	Z10-35-05-2	6-6
ALP-QD-2	Ø1/4"	BRASS	QUICK DISCONNECT	AIR SUPPLY	Z08-35-02-08	6-3
ALP-QD-3	Ø1/4"	BRASS	QUICK DISCONNECT	AIR SUPPLY	Z08-35-02-08	6-3
ALP-QD-4	Ø1/4"	BRASS	QUICK DISCONNECT	AIR SUPPLY	Z09-35-04-2	6-6
ALP-QD-5	Ø1/4"	BRASS	QUICK DISCONNECT	AIR SUPPLY	Z07-35-05-13	6-6
ALP-QD-6	Ø1/4"	BRASS	QUICK DISCONNECT	AIR SUPPLY	Z07-35-05-17	6-6
ALP-QD-7	Ø1/4"	BRASS	QUICK DISCONNECT	AIR SUPPLY	Z09-35-02-01	6-6
ALP-QD-8	Ø1/4"	BRASS	QUICK DISCONNECT	PNEUMO	Z08-35-02-06	6-6
ALP-QD-9	Ø1/4"	BRASS	QUICK DISCONNECT	PNEUMO	Z09-02-03	6-6
ALP-QD-10	Ø1/4"	BRASS	QUICK DISCONNECT	PNEUMO	Z08-35-02-06	6-6
ALP-QD-11	Ø1/4"	BRASS	QUICK DISCONNECT	AIR SUPPLY	Z10-35-05-2	6-7
EXH-QD-1	Ø1/4"	BRASS	QUICK DISCONNECT	BIBS EXHAUST	Z07-35-05-05	6-6
EXH-QD-2	Ø1/4"	BRASS	QUICK DISCONNECT	EXHAUST	Z07-35-05-18	6-6
EXH-QD-3	Ø1/4"	BRASS	QUICK DISCONNECT	EXHAUST	Z09-02-04	6-6
EXH-QD-4	Ø1/4"	BRASS	QUICK DISCONNECT	EXHAUST	Z08-35-02-09	6-3
EXH-QD-5	Ø1/4"	BRASS	QUICK DISCONNECT	EXHAUST	SCOTT	6-6
OLP-QD-1	Ø1/4"	BRASS	QUICK DISCONNECT	OXYGEN SUPPLY	Z10-35-04-2	6-6
OLP-QD-2	Ø1/4"	BRASS	QUICK DISCONNECT	OXYGEN SUPPLY	Z08-35-02-07	6-3
OLP-QD-3	Ø1/4"	BRASS	QUICK DISCONNECT	BIBS SUPPLY	Z08-35-02-07	6-3
OLP-QD-4	Ø1/4"	BRASS	QUICK DISCONNECT	BIBS SUPPLY	Z09-35-03-2	6-6
OLP-QD-5	Ø1/4"	BRASS	QUICK DISCONNECT	BIBS SUPPLY	Z07-35-05-08	6-6
OLP-QD-6	Ø1/4"	BRASS	QUICK DISCONNECT	BIBS SUPPLY	Z07-35-05-17	6-6
OLP-QD-7	Ø1/4"	BRASS	QUICK DISCONNECT	BIBS SUPPLY	SCOTT	6-6
OLP-QD-8	Ø1/4"	BRASS	QUICK DISCONNECT	OXYGEN SUPPLY	Z10-35-04-2	6-6
ALP-V-1	Ø1/4"	BRASS	BALL VALVE	PRESSURE INCREASE	Z08-35-02-05	6-3
ALP-V-2	Ø1/4"	BRASS	BALL VALVE	EXHAUST	Z08-35-02-05	6-3
ALP-V-3	Ø1/4"	BRASS	BALL VALVE	SAFETY VALVE SHUTOFF	Z07-35-05-01	6-6
ALP-V-4	Ø1/4"	BRASS	BALL VALVE	EMERGENCY VENT	Z07-35-05-01	6-6
ALP-V-5	Ø1/4"	BRASS	CHECK VALVE	AIR SUPPLY	Z08-35-02-03	6-3
OLP-V-1	Ø1/4"	BRASS	NEEDLE VALVE	OXYGEN SHUT OFF	Z08-35-02-35	6-3
OLP-V-2	Ø1/4"	BRASS	BALL VALVE	BIBS CONTROL	Z08-35-02-04	6-3
OLP-V-3	Ø1/4"	BRASS	BALL VALVE	BIBS EXHAUST	Z07-35-05-01	6-6
OLP-V-4	Ø1/4"	BRASS	CHECK VALVE	BIBS OXYGEN SUPPLY	Z08-35-02-03	6-3
ALP-RV-1	Ø1/4"	316	RELIEF VALVE	EXHAUST	Z07-35-05-06	6-6

Figure 6-6. Control Box Parts List

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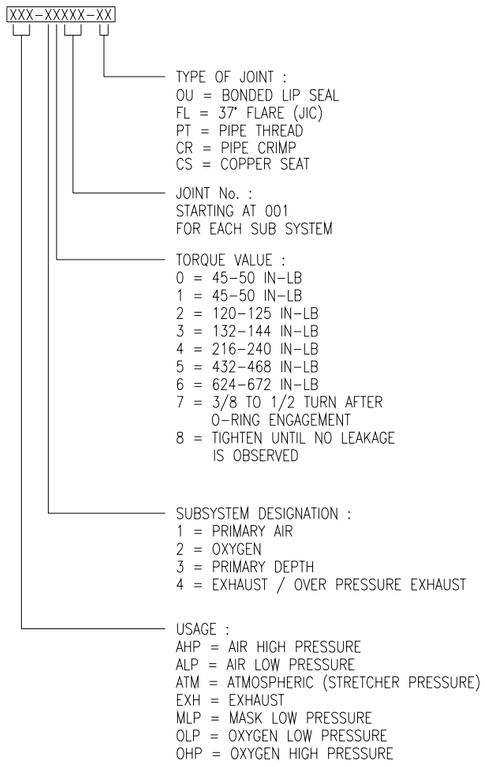
JOINT IDENTIFICATION LEGEND :



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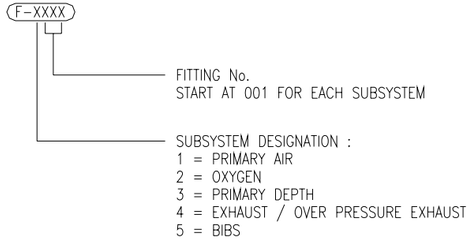
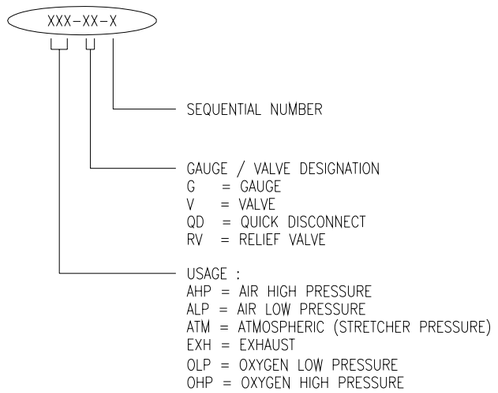
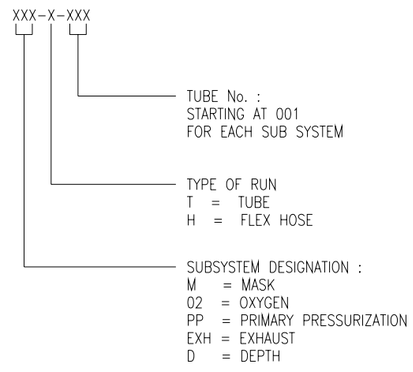


VALVES AND GAUGES ARE IDENTIFIED BY :



TUBES AND HOSES ARE IDENTIFIED BY :



COMPONENT LEGEND

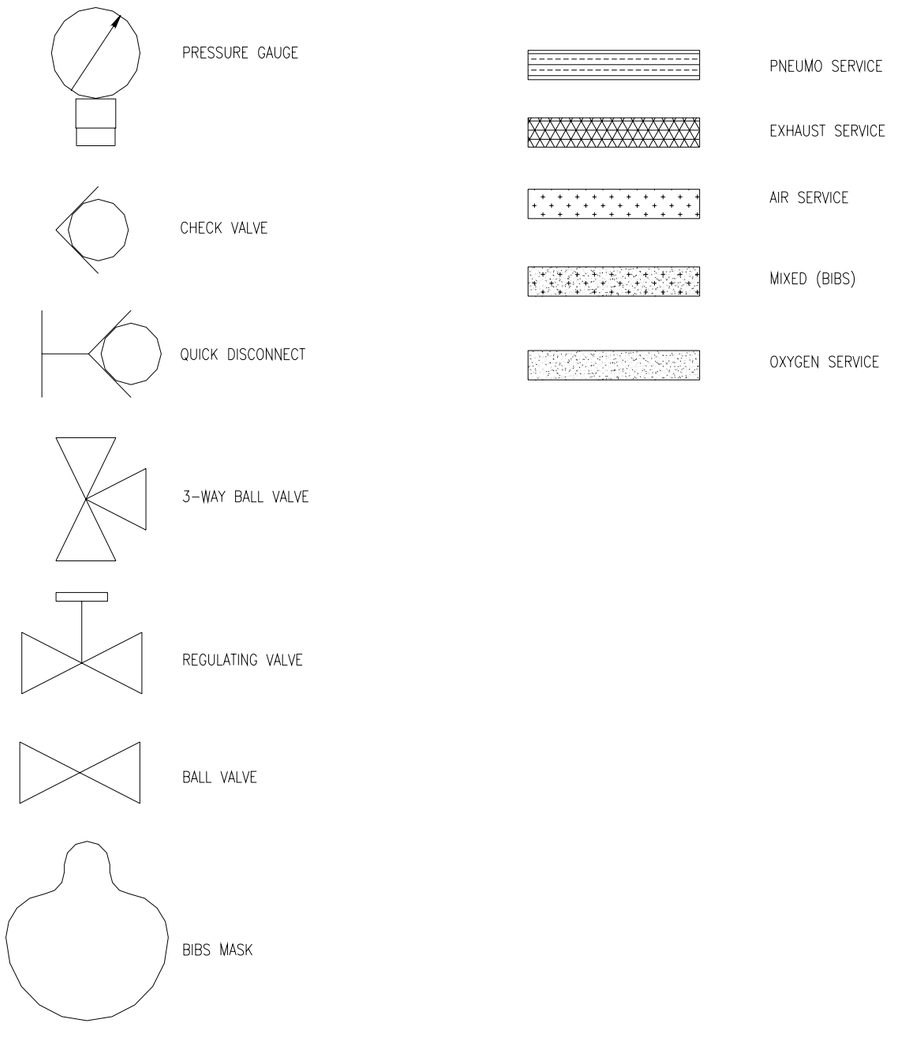


Figure 6-7. Identification Legend

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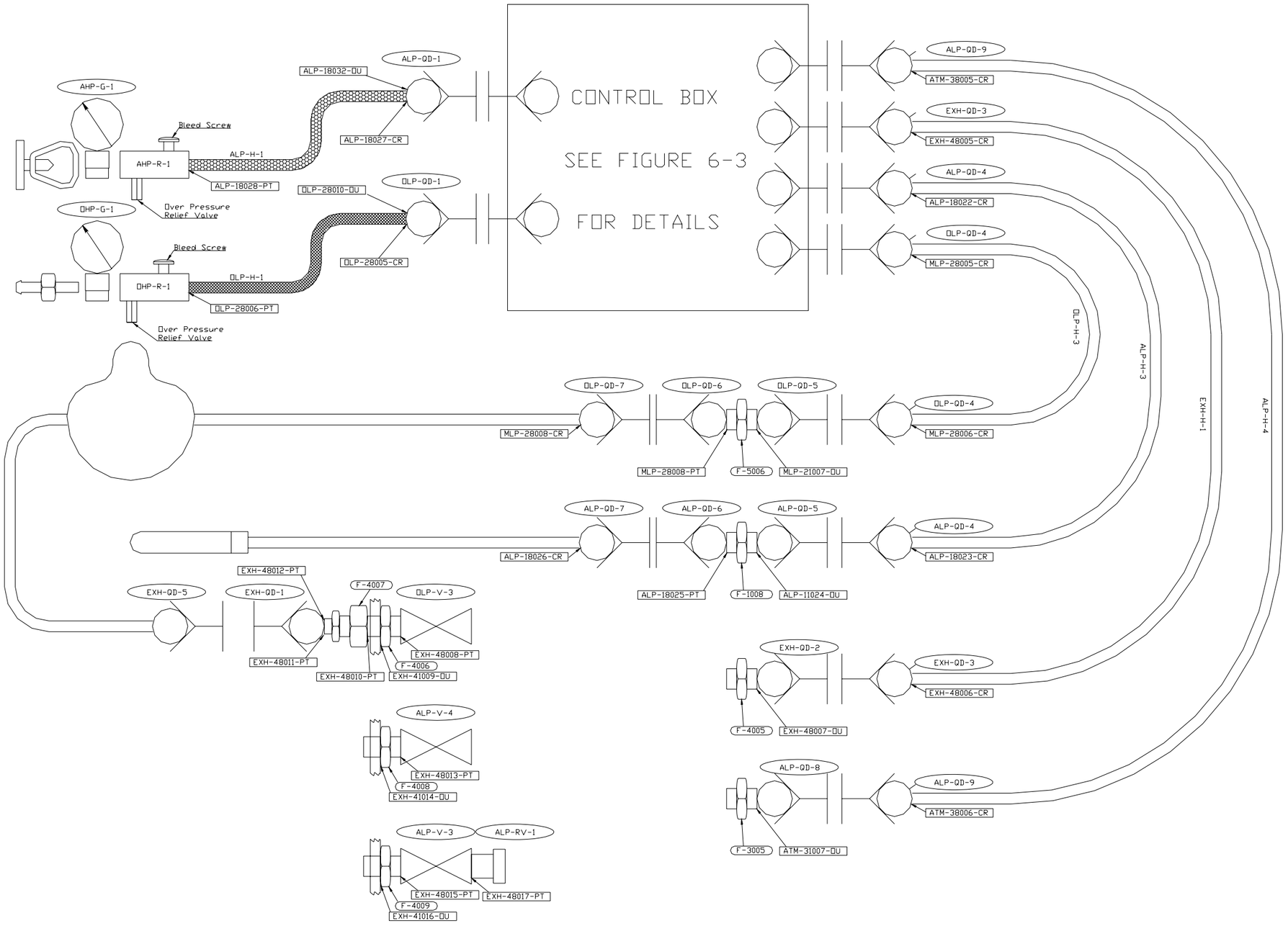

Figure 6-8. System JID

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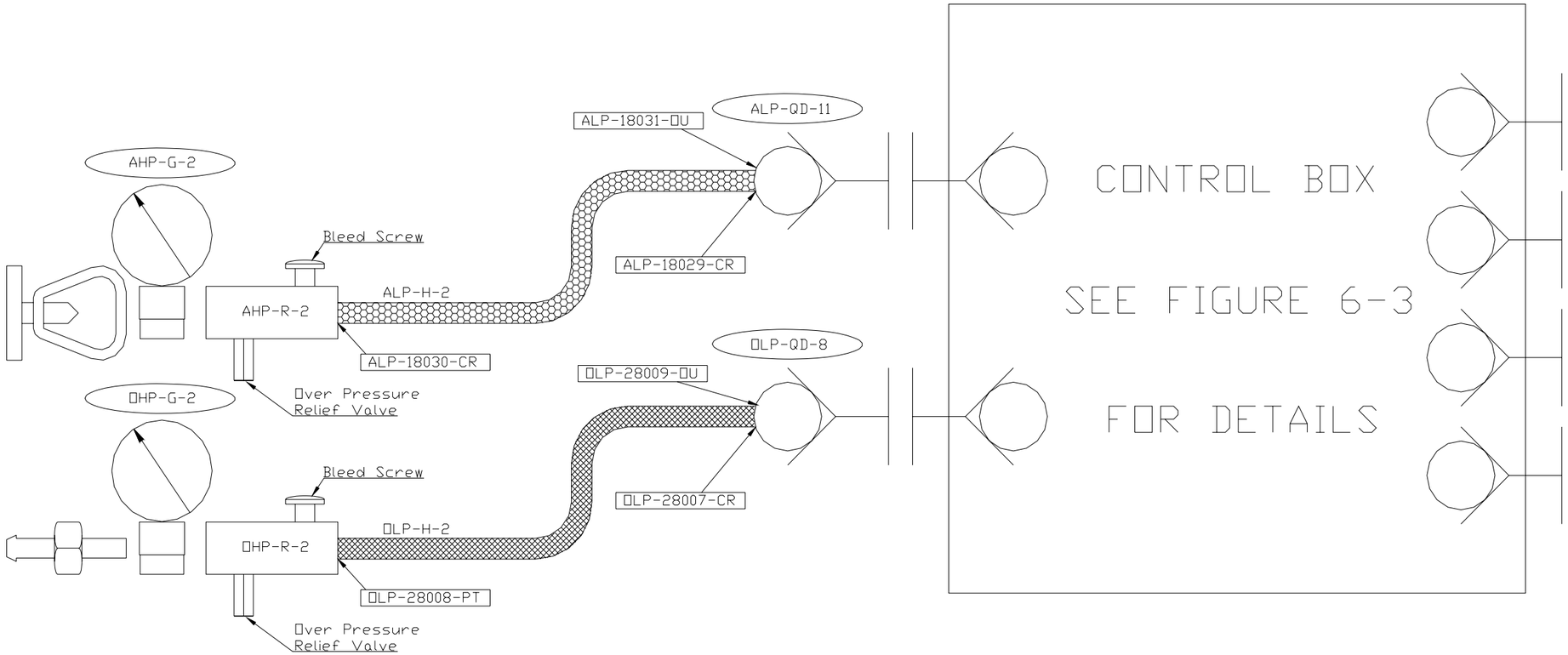

Figure 6-9. Secondary Oxygen and Air Regulator JID

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CHAPTER 7 – PARTS LIST

7-1 INTRODUCTION.

7-1.1 Purpose. The purpose of this chapter is to provide a listing of removable/ repairable parts and assemblies for the EEHS and a list of CAGE codes.

7-1.2 Scope. This chapter provides a detailed parts listing for the EEHS.

NOTE

Some parts used on the EEHS are replaced at the assembly level and thus are listed by applicable assembly part number and are not broken down further by individual part numbers.

7-1.3 How to Use the Parts List. The parts list is divided into the following seven columns:

1. FIGURE NUMBER – Provides the figure number corresponding to the specific part.
2. ITEM NUMBER – Lists the callout or index number of each specific part as it appears on the figure.
3. DESCRIPTION – Lists the part by name, with identifying description, if applicable.
4. CAGE – Lists the Commercial and Government Entity (CAGE) code which enables the user to identify the original manufacturer of each specific part. This information can be used in conjunction with Table 7-1 to locate an individual manufacturer.
5. PART NUMBER – Lists the original manufacturer's part number.
6. NSN – Lists the Navy Stock Number (NSN) of those parts for which one has been assigned.
7. QTY – Identifies the quantity of each component in the EEHS.

Table 7-1. List of Commercial and Government Entity (CAGE) Codes

CAGE	MANUFACTURER'S NAME AND ADDRESS
KB592	SOS LTD 612 WATFORD WAY LONDON NW7 3JH ENGLAND, UK
6S753	AMRON INTERNATIONAL DIVING SUPPLY, INC. 759 WEST FOURTH AVENUE ESCONDIDO, CA 92025-4089
U5360	APEKS MARINE EQUIPMENT LTD ROMAN ROAD INDUSTRIAL ESTATE NEPTUNE WAY BLACKBURN, UNITED KINGDOM BB12BT

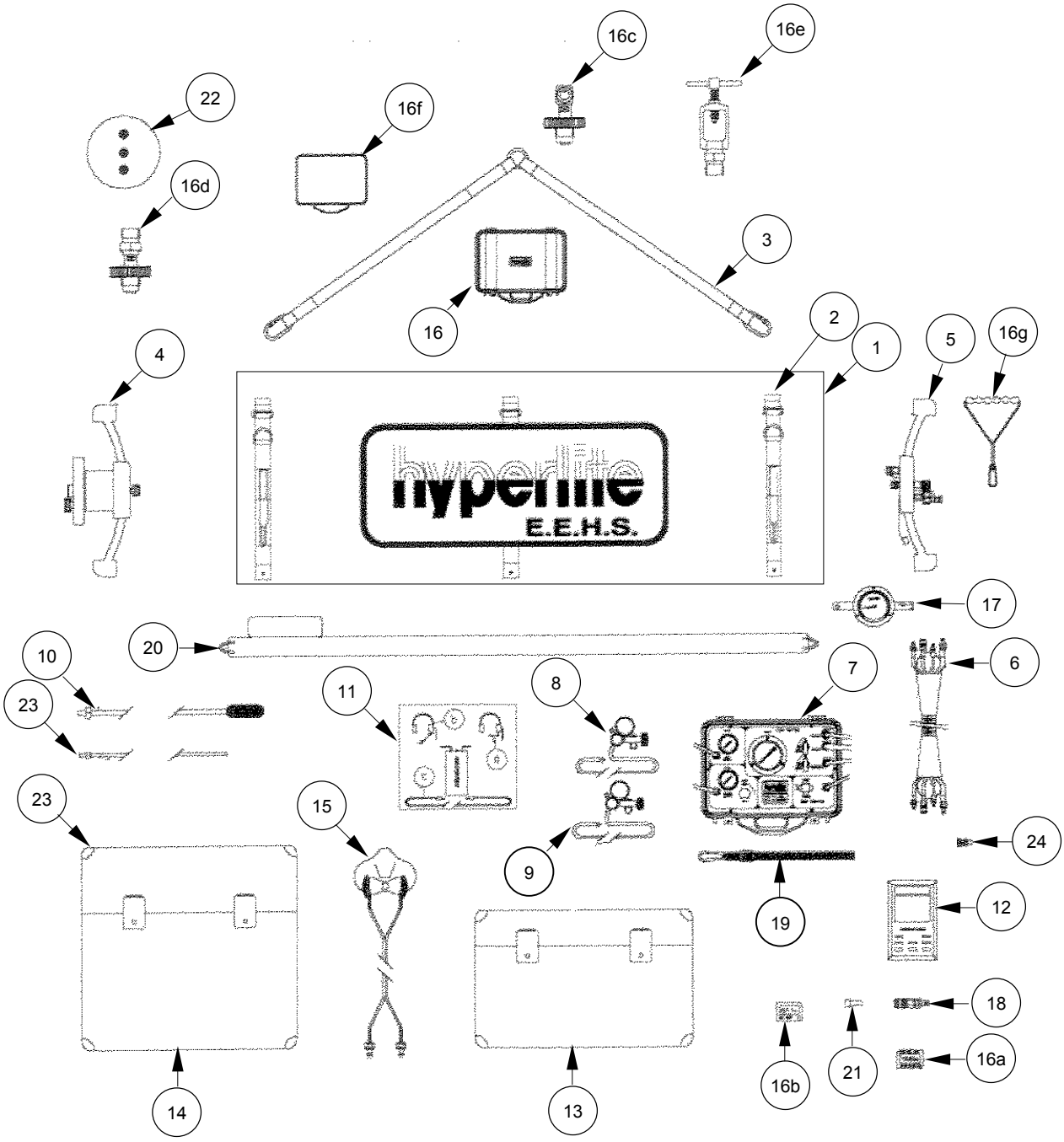

Figure 7-1. EEHS System Overview

Table 7-2. Components List

FIG.NO.	ITEM NO.	DESCRIPTION	CAGE	PART NUMBER	NSN	QTY
7-1	-1	Pressure Tube	KB592	Z05-02-01		1
	-1a	Protective Cover	KB592	Z05-02-05		1
	-2	Handle Strap	KB592	Z13-01-01		3
	-3	Horizontal Lift Sling	KB592	Z13-02-01		1
	-4	End Dome, Medical Lock	KB592	Z12-01-01		1
	-5	End Dome, Pen Plate	KB592	Z07-01-03		1
	-6	Umbilical	KB592	Z09-01-01		1
	-7	Control Box	KB592	Z08-01-01		1
	-8	Air Regulator	KB592	Z10-01-02		2
	-9	Oxygen Regulator	KB592	Z10-01-01		2
	-10	Remote Air Supply Hose	KB592	Z09-01-02		1
	-11	Communications Box	KB592	Z14-37-24		1
	-11a	External Headset/Boom mike.	KB592	Z14-37-25		1
	-11b	Internal Headset/Throat mike	KB592	Z14-37-26		1
	-11c	Extension Lead	KB592	Z14-37-35		1
	-12	Oxygen Monitor	6S753	MINIOX3000		1
	-13	End Dome Transport Case	KB592	Z14-37-11		1
	-14	Tube Transport Case	KB592	Z14-37-12		1
	-15	BIBS Mask	6S753	803139-00-02	4220-01-173-5384	1
	-16	Spares Box	KB592	Z14-37-14		1
	-16a	Timer	6S753	Z14-37-18		1
	-16b	Thermometer	6S753	Z14-37-34		1
	-16c	Air Adapter	6S753	Z14-37-20		1
	-16d	Oxygen Adapter- CGA 540	6S753	Z14-37-21		1
	-16e	Oxygen Adapter- CGA 870	6S753	Z14-37-23		1
	-16f	Rubber Repair Kit	KB592	Z14-37-22		1
	-16g	End Dome Pull Handle	KB592	Z13-01-02		2
	-17	Internal Depth Gage	KB592	Z07-37-41		1
	-18	Control Box Bypass	KB592	Z10-01-04		1
	-19	Control Box Tie-Down	KB592	Z13-01-03		4
	-20	Internal Patient Pad	KB592	Z14-37-31		1
	-21	38-psi Relief Valve	6S753	D532T1-N-2M-38-ASME		1
	-22	Rubber Protector INT Gauge	KB592	Z14-37-37		1
	-23	Overboard Dump Hose	KB592	Z14-37-38		1
	-24	Oxygen Monitor Adapter	KB592	Z14-37-36		1

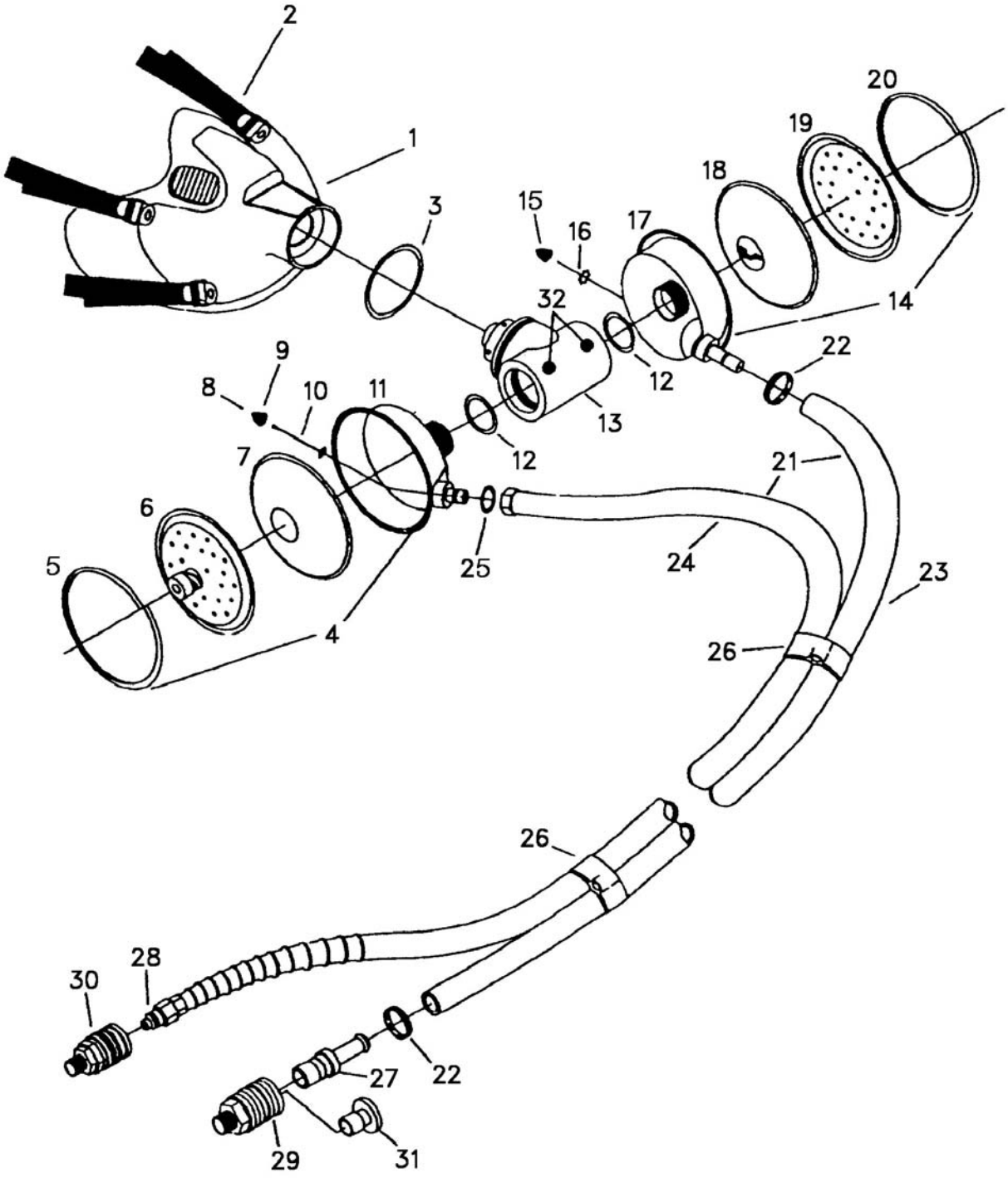

Figure 7-2. Built-In Breathing System (BIBS) Mask Assembly

Table 7-3. Built-In Breathing System (BIBS) Mask Assembly

FIG. NO.	ITEM NO.	DESCRIPTION	CAGE	PART NUMBER	NSN	QTY
7-2	-	BIBS Mask Assembly	6S753	803139-01-02	4220-01-173-5484	1
	-1	Face Seal Assembly - Medium	6S753	803152-02	4220-01-431-9441	1
	-2	Harness Assembly: Straps Only	6S753	803115-01	4220-01-284-4328	1
	-3	O-ring Manifold To Face Seal	6S753			1
	-4	Demand Regulator Assembly: To be replaced as a complete unit; includes items 5–11	6S753	800954-01	4330-01-431-9103	1
	-5	Clamp, Regulator Cover	6S753			1
	-6	Cover, Demand Regulator	6S753			1
	-7	Diaphragm, Demand Regulator	6S753			1
	-8	Valve Clamp	6S753			1
	-9	Valve Spring	6S753			1
	-10	Valve Stem Case Assembly	6S753			1
	-11	Case Assembly; Includes items 8–10	6S753			1
	-12	O-ring Manifold To Regulators	6S753	18062-00		1
	-13	Manifold	6S753	803100-01	4930-01-286-5071	1
	-14	Exhaust Regulator Assembly: To be replaced as a complete unit; includes items 15–20	6S753	801274-00	4220-01-431-9437	1
	-15	Spring Valve	6S753			1
	-16	Valve, Exhalation	6S753			1
	-17	Case, Regulator, Exhaust	6S753			1
	-18	Clamp, Cover, Regulator	6S753			1
	-19	Cover, Regulator, Exhaust	6S753			1
	-20	Clamp, Cover, Regulator	6S753			1
	-21	Dual Hose Assembly, Complete	6S753	803166-10	4220-01-431-9431	1
	-22	Clamp, Hose	6S753	20433-00	4240-01-172-3916	1
	-23	Hose, Exhaust 10 ft	6S753	59719-10		1
	-24	Hose Assembly, Demand, 10 ft	6S753	26037-10		1
	-25	Gasket, Hose, Demand	6S753	2827-49	5325-01-284-4219	1
	-26	Grommet, Hose	6S753	10002573	5325-01-284-4337	1
	-27	Plug, Nose, Exhaust	6S753	59852-00		1
	-28	Plug, Nose, Demand	6S753	18970-00		1

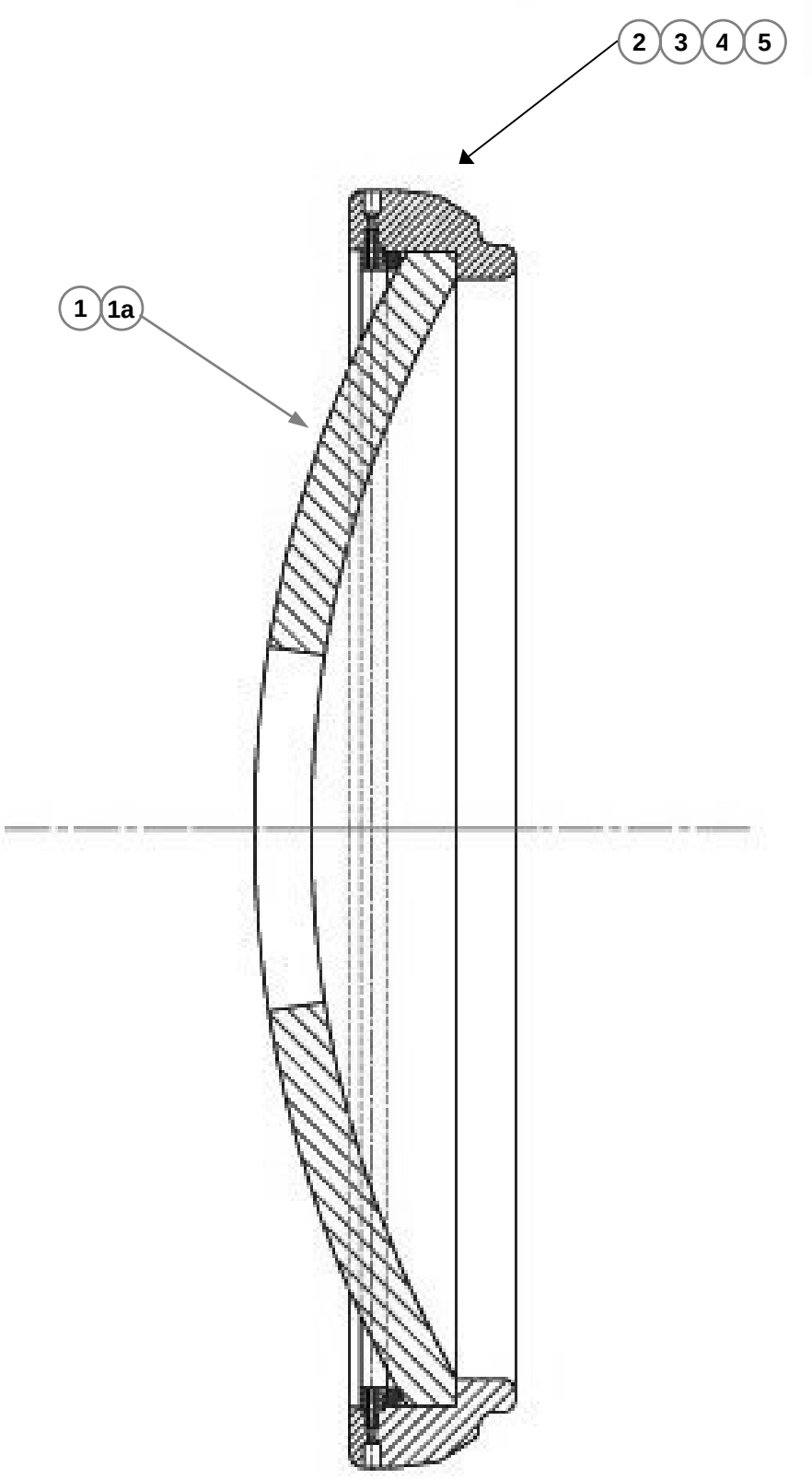

Figure 7-3. Dome End Ring Assembly

Table 7-4. Dome End Ring Assembly

FIG.NO.	ITEM NO.	DESCRIPTION	CAGE	PART NUMBER	NSN	QTY
7-3	-1	Dome End Window	KB592	Z06-02-01		2
	-2	Dome Edge Ring	KB592	Z06-02-03		2
	-3	Backup Ring	KB592	Z06-02-08		2
	-4	O-ring, 8.00 mm	KB592	Z06-35-01-4		2
	-5	25mm SS Self-Cutting Screws	KB592	Z06-35-01-5		24

Table 7-5. Penetration Plate Assemblies

FIG NO.	ITEM NO.	DESCRIPTION	CAGE	PART NUMBER	NSN	QTY
7-4	-1	Shutoff Valve	KB592	Z07-02-08		3
	-2	Penetration	KB592	Z07-02-04		2
	-3	17 x 2.5 Viton O-ring	6S753	10024321		8
	-4	Reducing Nipple	6S753	B-6-RB-4	4730-01-085-2745	1
	-5	Quick Connect (Open)	KB592	Z07-35-02/05		1
	-6	Relief Valve	6S753	D532T1-2M-38 ASME		1
	-7	Vent Protector	6S753	1/8/30		3
	-8	Quick Connect (S/O)	KB592	Z07-35-02/08		1
	-9	$^1/_4$ BSP Bonded Seal	KB592	Z07-35-02/09		5
	-10	Penetration	KB592	Z07-02-05		1
	-11	Penetration	KB592	Z07-02-10		1
	-12	Quick Connect (S/O)	KB592	Z07-35-02/12		1
	-13	Quick Connect (S/O)	KB592	Z07-35-02/13		1
	-14	Penetration	KB592	Z07-02-06		1
	-15	$^1/_8$ BSP Seal	KB592	Z07-35-02/15		3
	-16	Penetration	KB592	Z07-02-11		1
	-17	Quick Connect (Open)	KB592	Z07-35-02/17		1
	-18	Quick Connect (S/O)	KB592	Z07-35-02/18		1
	-19	Quick Connect (S/O)	KB592	Z07-35-02/19		1
	-20	Penetration	KB592	Z07-02-07		1
	-21	Electrical Penetration	STET	SGJ1B306 CLLPV or CNLPV		1
	-21a	O-ring Supplied with 21				1
	-21b	Lock Nut Supplied With 21				1
	-22	Gauge Assembly	KB592	Z07-30-04		1
	-23	17 x 2.5 Viton O-ring	6S753	10024310		8
	-24	Electrical Penetration	6S753	SJG1B306 CNLPV		1
	-25	Blanking Plug	KB592	Z07-02-23		1
		Penetration Plate	KB592	Z07-02-19		1
		Keep Plate	KB592	Z07-04-02		1
		O-ring	6S753	149748		1
		Neoprene Ring	KB592	Z12-02-16		1
		Penetrator Bolt	KB592	Z07-02-12		2

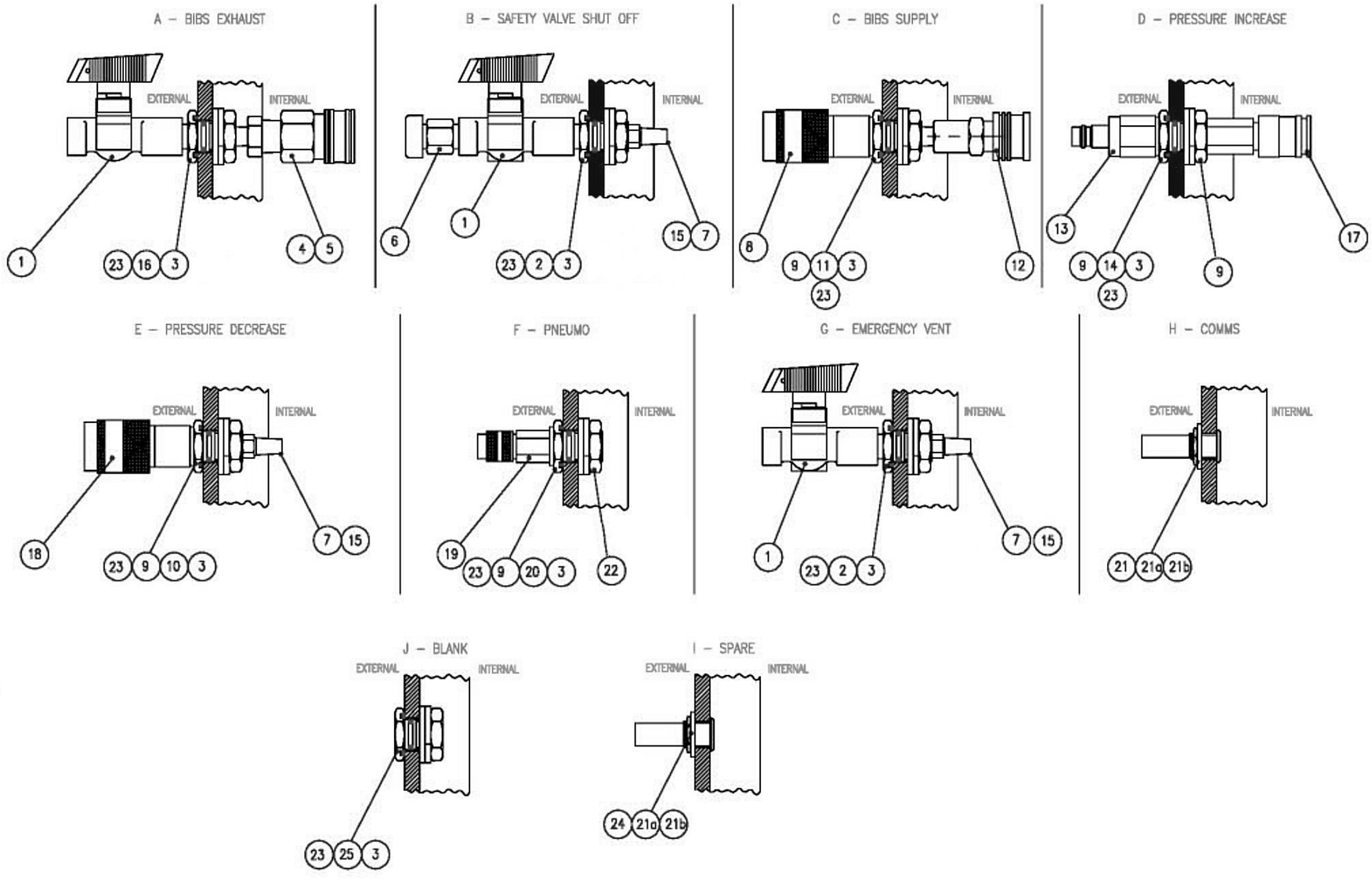

Figure 7-4. Penetrator Plate Assemblies

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Table 7-6. Valve List

FIG NO.	ITEM NO.	DESCRIPTION	CAGE	PART NUMBER	NSN	QTY
----	ALP-QD-1	Air Supply Quick Disconnect	KB592	Z10-35-05/02		1
	ALP-QD-2	Air Supply Quick Discon	KB592	Z08-35-02/08		1
	ALP-QD-3	Air Supply Quick Discon	KB592	Z08-35-02/08		1
	ALP-QD-4	Air Supply Quick Discon	KB592	Z09-35-04/02		1
	ALP-QD-5	Air Supply Quick Discon	KB592	Z07-35-05/13		1
	ALP-QD-6	Air Supply Quick Discon	KB592	Z07-35-05/17		1
	ALP-QD-7	Air Supply Quick Discon	KB592	Z09-35-02/01		1
	ALP-QD-8	Pneumo Quick Discon	KB592	08-35-02/06		1
	ALP-QD-9	Pneumo Quick Discon	KB592	Z09-02/03		1
	ALP-QD-10	Pneumo Quick Discon	KB592	Z08-35-02/06		1
	ALP-QD-11	Air Supply Quick Discon	KB592	Z10-35-05/02		1
	EXH-QD-1	BIBS EXH Quick Discon	KB592	Z07-35-05/05		1
	EXH-QD-2	EXH Quick Discon	KB592	Z07-35-05/18		1
	EXH-QD-3	EXH Quick Discon	KB592	Z09-02-04		1
	EXH-QD-4	EXH Quick Discon	KB592	Z09-35-03/02		1
	EXH-QD-5	EXH Quick Discon	KB592	Z07-35-02/05		1
	OLP-QD-1	O_2 Supply Quick Discon	KB592	Z10-35-04/02		1
	OLP-QD-2	O_2 Supply Quick Discon	KB592	Z08-35-02/07		1
	OLP-QD-3	BIBS Supply Quick Discon	KB592	Z08-35-02/07		1
	OLP-QD-4	BIBS Supply Quick Discon	KB592	Z09-35-03/02		1
	OLP-QD-5	BIBS Supply Quick Discon	KB592	Z08-35-05/08		1
	OLP-QD-6	BIBS Supply Quick Discon	KB592	Z07-35-05/17		1
	OLP-QD-7	BIBS Supply Quick Discon	KB592	Z07-35-02/12		1
	OLP-QD-8	O_2 Supply Quick Discon	KB592	Z10-35-04/02		1
	ALP-V-1	Increase Ball Valve	KB592	Z08-35-02/05		1
	ALP-V-2	EXH Ball Valve	KB592	Z08-35-02/05		1
	ALP-V-3	Safety Shutoff Valve	KB592	Z07-35-05/01		1
	ALP-V-4	Emergency Vent Valve	KB592	Z07-35-05/01		1
	ALP-V-5	Air Supply Check Valve	6S753	4F-C4L-1-B	4820-01-478-2428	1
	OLP-V-1	O_2 Shutoff Needle Valve	6S753	B-1RF4	4820-00-111-6513	1
	OLP-V-2	BIBS Control Ball Valve	6S753	Z08-35-02/04		1
	OLP-V-3	BIBS EXH Ball Valve	6S753	Z07-35-05/01		1
	OLP-V-4	BIBS Supply Check Valve	6S753	4F-C4L-1-B	4820-01-478-2428	1
	ALP-V-1	EXH Relief Valve	6S753	Z07-35-05/06 ASME		1

Table 7-7. Control Box Modification

FIG NO.	ITEM NO.	DESCRIPTION	CAGE	PART NUMBER	NSN	QTY
----	1	SS Tie Down Bracket	KB592	Z08-35-04/1		2
	2	Peli Protector 1500 Case	KB592	Z08-35-04/2		1
	3	Fascia Support Bracket	KB592	Z08-35-04/3	4820-01-478-2428	6
	4	Flow Diagram	KB592	Z08-06-02		1
	5	Hyperlite Label	KB592	Z08-35-04/5		1
	6	Serial No. Label	KB592	Z08-35-04/6		1

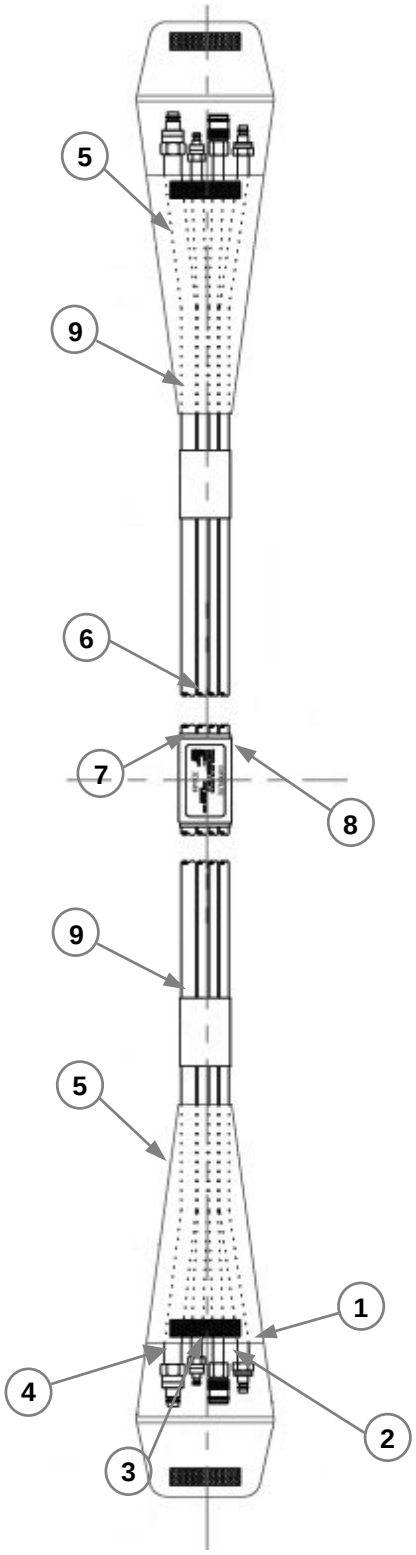

Figure 7-5. Main Umbilical

Table 7-8. Main Umbilical Assembly

FIG.NO.	ITEM NO.	DESCRIPTION	CAGE	PART NUMBER	NSN	QTY
7-5	-1	BIBS Supply Hose	KB592	Z09-02-01		1
	-2	Air Supply Hose	KB592	Z09-02-02		1
	-3	Pneumo Hose	KB592	Z09-02-03		1
	-4	Exhaust Hose	KB592	Z09-02-04		1
	-5	Protective Cover	KB592	Z09-35-01/05		2
	-6	Ident. Label	KB592	Z09-06-01		1
	-7	Heat Shrink	KB592	Z09-35-01-07		1
	-8	Heat Shrink	KB592	Z09-35-01-08		1
	-9	Heat Shrink	KB592	Z09-35-01-09		2

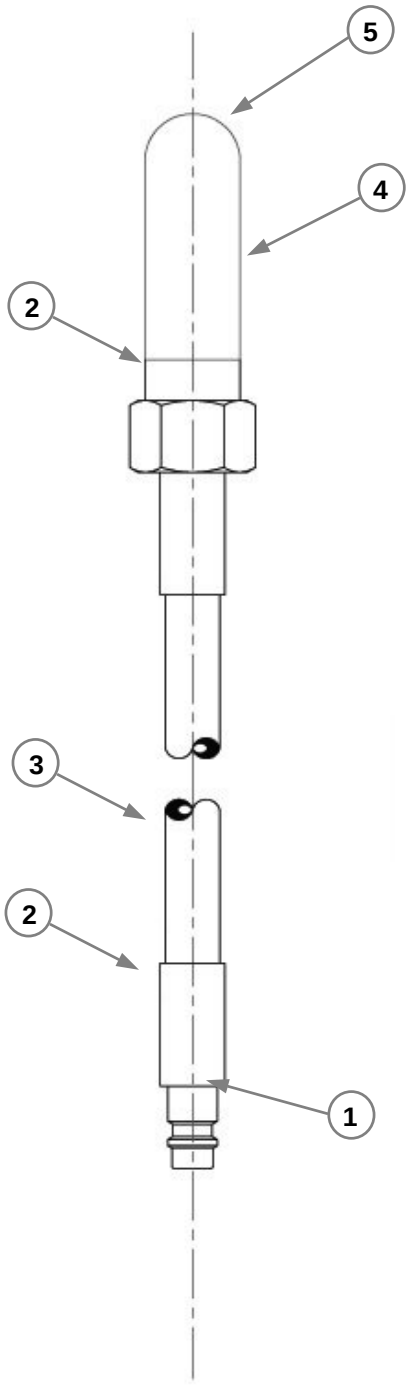

Figure 7-6. Remote Air Hose Assembly

Table 7-9. Remote Air Hose Assembly

FIG.NO.	ITEM NO.	DESCRIPTION	CAGE	PART NUMBER	NSN	QTY
7-6	-1	Quick Connect Plug	KB592	Z09-35-02/01		1
	-2	Brass Hose Ferrule	KB592	Z09-35-02/02		2
	-3	Rubber Hose	KB592	Z09-35-02/03		2 MTR
	-4	Hose Tail	KB592	Z09-35-/04		1
	-5	Filter	6S753	PS-38		1

Table 7-10. Tube/Flex List

FIG.NO.	ITEM NO.	DESCRIPTION	CAGE	SERVICE	NSN	QTY
----	ALP-H-1	Air Regulator Whip	KB592	AHP-R-1 To ALP-QD-1		1
	ALP-H-2	Air Regulator Whip	KB592	AHP-R-2 To ALP-QD-11		1
	ALP-H-3	Air Umbilical	KB592	Air Umbilical		1
	ALP-H-4	Pneumo Umbilical	KB592	Pneumo Umbilical		1
	OLP-H-1	Oxygen Regulator Whip	KB592	ALP-QD-4 To Pneumo-1		1
	OLP-H-2	Oxygen Regulator Whip	KB592	ALP-QD-4 To Pneumo-1		1
	OLP-H-3	BIBS Umbilical	KB592	BIBS Umbilical		1
	EXH-H-1	Exhaust Umbilical	KB592	Exhaust Umbilical		1

Table 7-11. Regulator and Gauge List

FIG.NO.	ITEM NO.	DESCRIPTION	CAGE	PART NUMBER	NSN	QTY
----	AHP-G-1	PRI H/P Air Supply Gauge	KB592	0-5000 psig		1
	AHP-G-2	SEC H/P Air Supply Gauge	KB592	0-5000 psig		1
	ALP-G-1	L/P Air Pressure Gauge	KB592	0-230 psig		1
	ALP-G-2	PRI Depth Gauge	KB592	-15 to + 80 FSW		1
	ALP-G-3	Internal Depth Gauge	KB592	0 – 80 FSW		1
	OHP-G-1	PRI H/P O_2 Supply Gauge	KB592	0 –5000 psig		1
	OHP-G-2	SEC H/P O_2 Supply Gauge	KB592	0 – 5000 psig		1
	OLP-G-3	L/P O_2 Pressure Gauge	KB592	0 – 230 psig		1
	AHP-R-1	PRI Air Regulator	KB592	Model Apeks TX50 (modified)		1
	AHP-R-2	SEC Air Regulator	KB592	Model Apeks TX50 (modified)		1
	OHP-R-1	PRI O_2 Regulator	KB592	Model Apeks TX50 (modified)		1
	OHP-R-2	SEC O_2 Regulator	KB592	Model Apeks TX50 (modified)		1

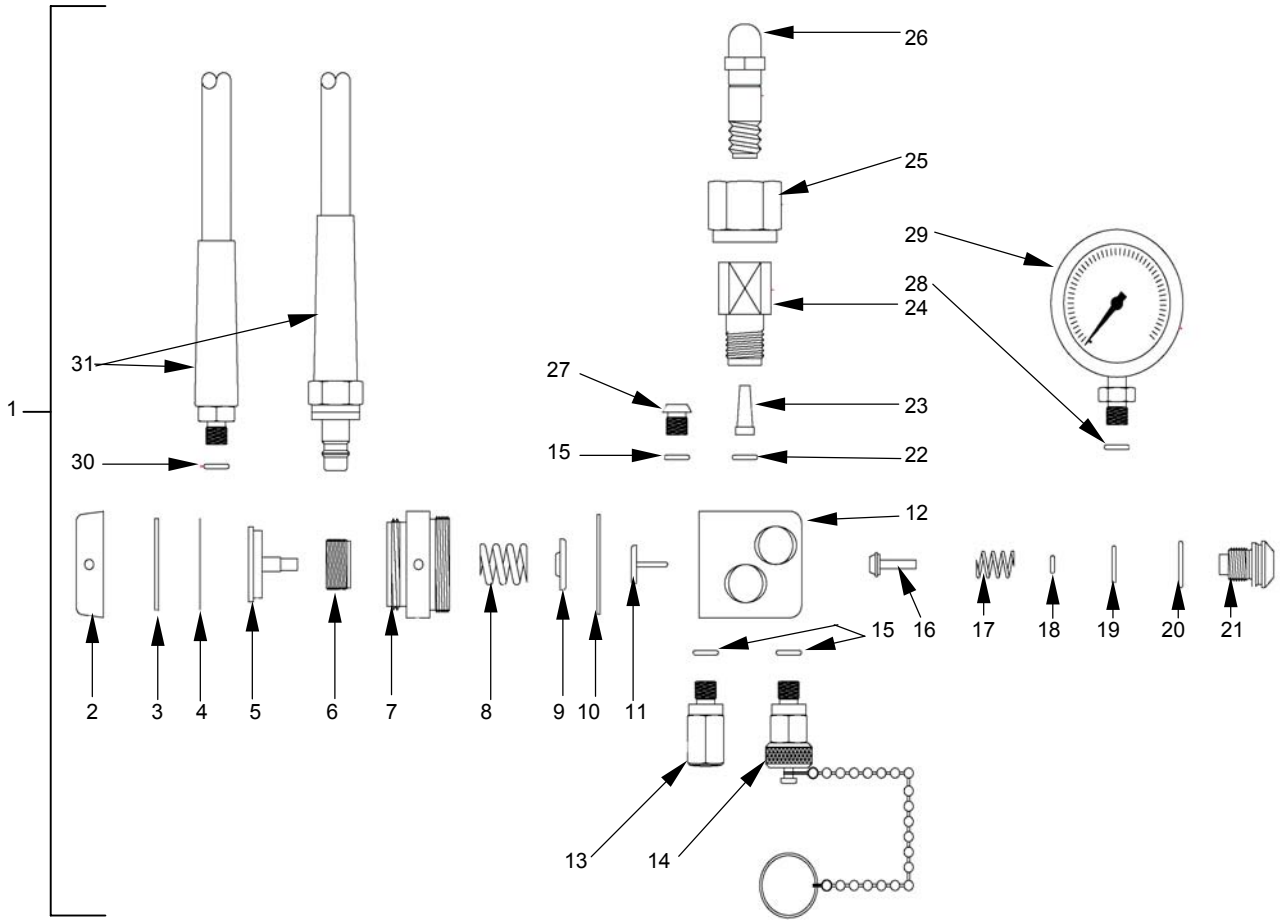

Figure 7-7. Oxygen Regulator Assembly

Table 7-12. Oxygen Regulator Assembly

FIG.NO.	ITEM NO.	DESCRIPTION	CAGE	PART NUMBER	NSN	QTY
7-7	-1	Assembly, Oxygen Regulator	KB592	Z10-01-01		1
	-2	Environmental end cap	KB592	Z10-35-01-01		1
	-3*	Hydrostatic Diaphragm	KB592	Z10-35-01-02		1
	-4	OHP-R-1 Label	KB592	Z10-35-01-03		AR
	-4a	OHP-R-2 Label	KB592	Z10-35-01-03a		AR
	-5	Hydrostatic Transmitter	KB592	Z10-35-01-04		1
	-6	Spring Adjuster	KB592	Z10-35-01-05		1
	-7	Diaphragm Clamp	KB592	Z10-35-01-06		1
	-8	Spring	KB592	Z10-35-01-07		1
	-9	Spring Carrier	KB592	Z10-35-01-08		1
	10*	Diaphragm	KB592	Z10-35-01-09		1
	-11	Valve Lifter	KB592	Z10-35-01-10		1
	-12	Regulator Body	KB592	Z10-35-01-11		1
	-13	Relief Valve	KB592	Z10-01-03		1
	-14	Bleed Screw	KB592	Z10-35-01-13		1
	-15*	O-Ring	KB592	Z10-35-01-14		2
	-16*	H.P. Valve	KB592	Z10-35-01-15		1
	-17	Spring	KB592	Z10-35-01-16		1
	-18*	O-Ring	KB592	Z10-35-01-17		1
	-19*	O-Ring	KB592	Z10-35-01-18		1
	-20*	O-Ring	KB592	Z10-35-01-19		1
	-21	H.P. Balance Plug	KB592	Z10-35-01-20		1
	-22*	O-ring	KB592	Z10-35-01-21		1
	-23*	Conical Filter	KB592	Z10-35-01-22		1
	-24	Adapter	KB592	Z-09-02-10		1
	-25	CGA 540 Nut	KB592	Z10-35-01-24		1
	-26	CGA 540 Nipple	KB592	Z10-35-01-25		1
	-27	Blanking Plug	KB592	Z10-35-01-26		1
	-28*	O-Ring	KB592	Z10-35-01-27		1
	-29	Oxygen Gauge (OHP-G-1)	KB592	Z10-35-01-28		1
	-29a	Oxygen Gauge (OHP -G-2)	KB592	Z10-35-01-28a		1
	-29*	O-Ring	KB592	Z10-35-01-29		1
	-31	Whip Assembly	KB592	Z10-02-01		1

*NOTE: These items are to be replaced when servicing. These items are included in the Apeks Regulator Service Kit, PN AP0241.

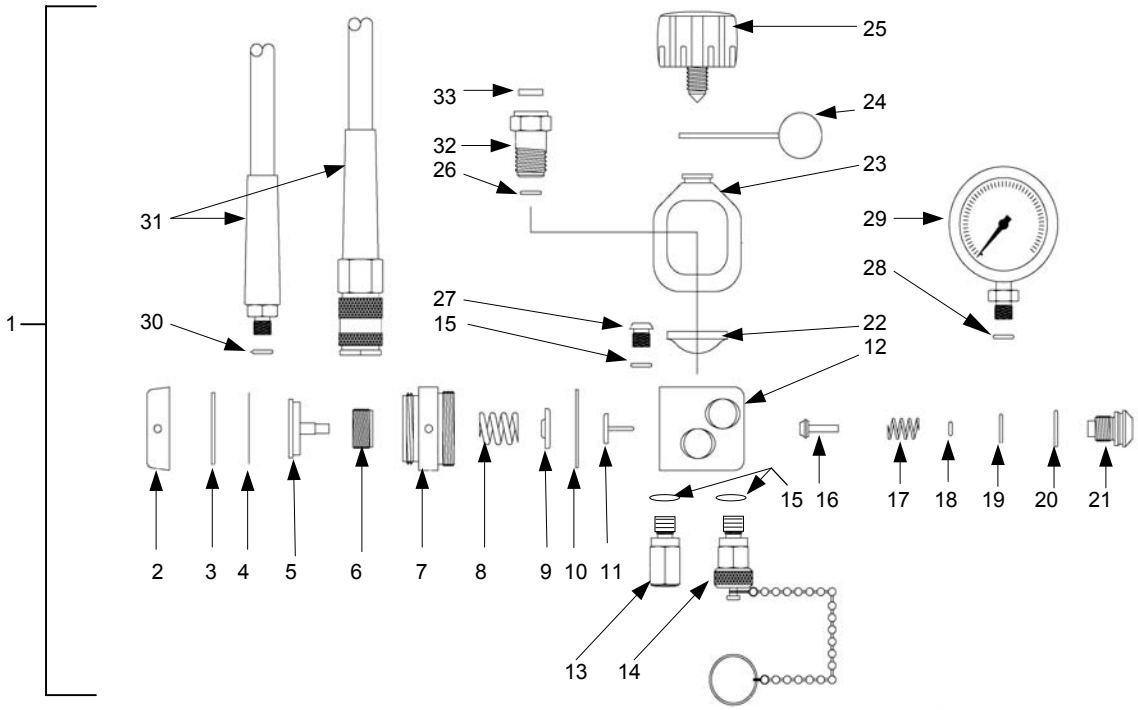

Figure 7-8. Air Regulator Assembly

Table 7-13. Air Regulator Assembly

FIG.NO.	ITEM NO.	DESCRIPTION	CAGE	PART NUMBER	NSN	QTY
7-7	-1	Assembly, Air Regulator	KB592	Z10-01-02		1
	-2	Environmental end cap	KB592	Z10-35-01-01		1
	-3*	Hydrostatic Diaphragm	KB592	Z10-35-01-02		1
	-4	AHP-R-1 Label	KB592	Z10-35-01-03		AR
	-4a	AHP-R-2 Label	KB592	Z10-35-01-03a		AR
	-5	Hydrostatic Transmitter	KB592	Z10-35-01-04		1
	-6	Spring Adjuster	KB592	Z10-35-01-05		1
	-7	Diaphragm Clamp	KB592	Z10-35-01-06		1
	-8	Spring	KB592	Z10-35-01-07		1
	-9	Spring Carrier	KB592	Z10-35-01-08		1
	-10*	Diaphragm	KB592	Z10-35-01-09		1
	-11	Valve Lifter	KB592	Z10-35-01-10		1
	-12	Regulator Body	KB592	Z10-35-01-11		1
	-13	Relief Valve	KB592	Z10-01-03		1
	-14	Bleed Screw	KB592	Z10-35-01-13		1
	-15*	O-ring	KB592	Z10-35-01-14		3
	-16*	H.P. Valve	KB592	Z10-35-01-15		1
	-17	Spring	KB592	Z10-35-01-16		1
	-18*	O-Ring	KB592	Z10-35-01-17		1
	-19*	O-Ring	KB592	Z10-35-01-18		1
	-20*	O-Ring	KB592	Z10-35-01-19		1
	-21	H.P. Balance Plug	KB592	Z10-35-01-20		1
	-22	Distance Piece	KB592	Z10-35-02-21		1
	-23	Yoke Clamp	KB592	Z10-35-02-22		1
	-24	Protective Ball	KB592	Z10-35-02-23		1
	-25	Yoke Clamp Screw	KB592	AZ10-35-02-24		1
	-26*	O-Ring	KB592	Z10-35-02-25		1
	-27	Blanking Plug	KB592	Z10-35-01-26		1
	-28*	O-Ring	KB592	Z10-35-01-27		1
	-29	Air Gauge (AHP-G-1)	KB592	Z10-35-02-28		AR
	-29a	Air Gauge (AHP -G-2)	KB592	Z10-35-02-28a		AR
	-30*	O-ring	KB592	Z10-35-01-29		1
	-31	Whip Assembly	KB592	Z10-35-01-30		1
	32	Yoke Clamp Connector	KB592	Z10-35-02-31		1
	-33*	Disc Filter	KB592	Z10-35-02-32		1

*NOTE: These items are to be replaced when servicing. These items are included in the Apeks Regulator Service Kit, PN AP0241.

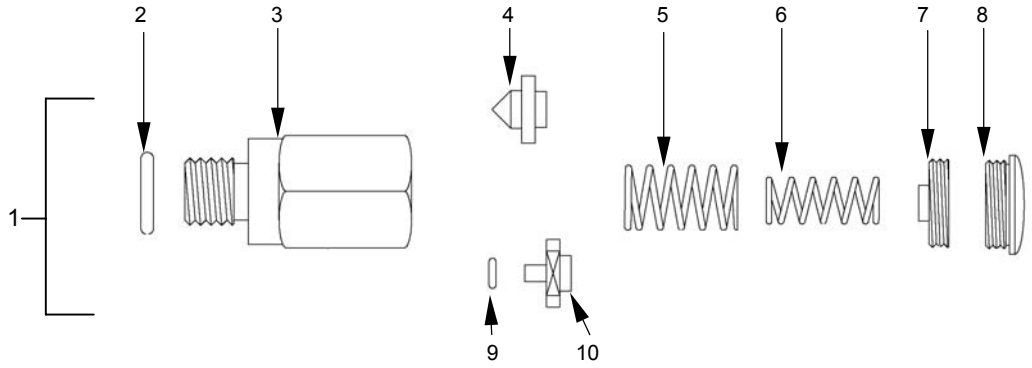

Figure 7-9. Regulator Relief Valve

Table 7-14. Regulator Relief Valve

FIG.NO.	ITEM NO.	DESCRIPTION	CAGE	PART NUMBER	NSN	QTY
7-9	-1	Regulator Relief Valve	KB592	Z-10-01-03		1
	-2	O-ring	6S753	VR1409		1
	-3	Relief Valve Body	KB592			1
	-4	Large Spring	KB592			1
	-5	Small Spring	KB592			1
	-6	Spring Adjuster	KB592			1
	-7	End Cap	KB592			1
	-8	Nylon Seal	KB592			1
	-9	O-ring	KB592			1
	-10	Carrier	KB592			1

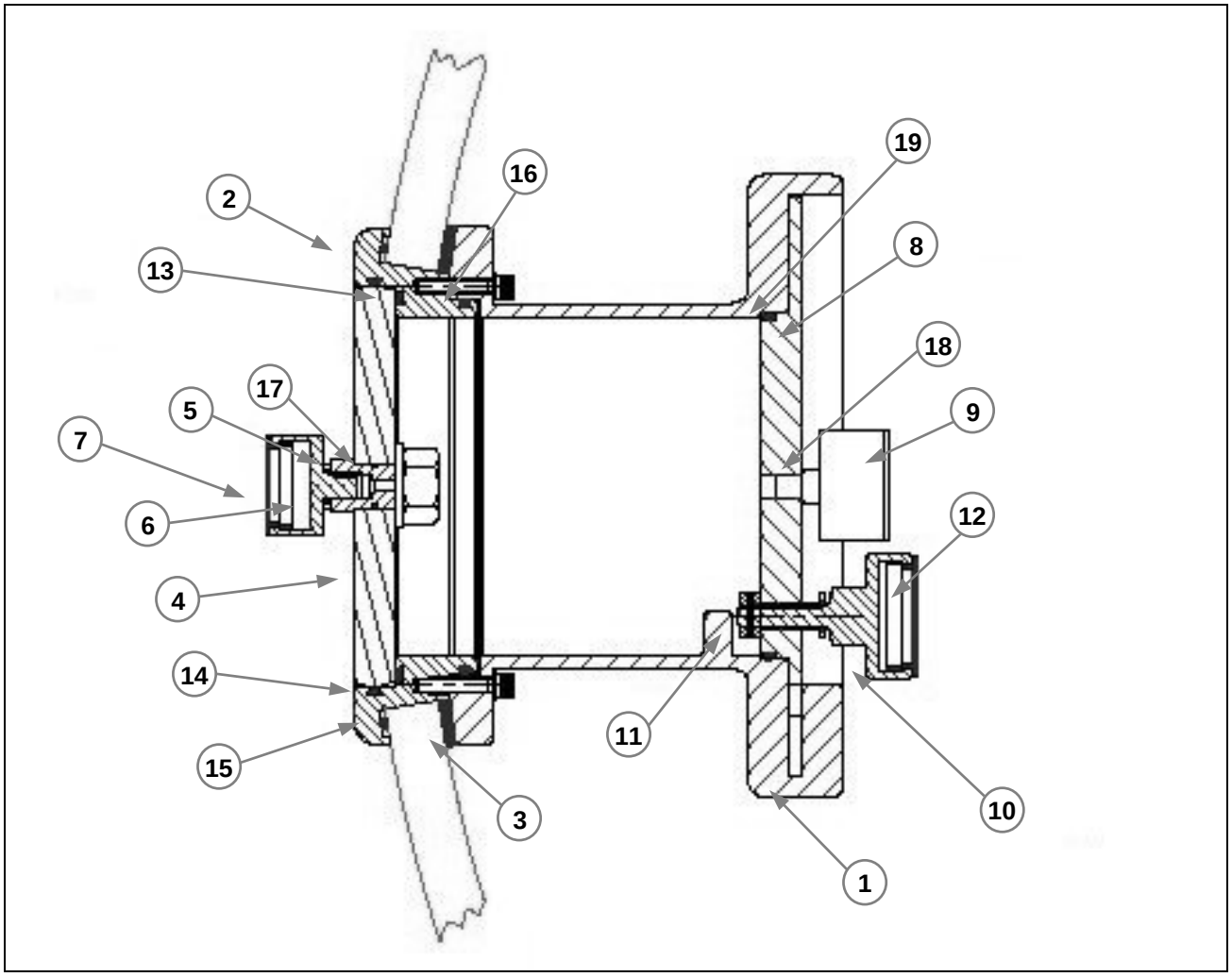

Figure 7-10. Medical Lock Assembly

Table 7-15. Medical Lock Assembly

FIG.NO.	ITEM NO.	DESCRIPTION	CAGE	PART NUMBER	NSN	QTY
7-10	-1	Medical Lock Body	KB592	Z12-02-10		1
	-2	Medical Lock Retaining Plate	KB592	Z12-02-12		1
	-3	Outer Seal	KB592	Z12-02-16		1
	-4	Internal Door	KB592	Z12-02-01		1
	-5	Internal Door Lock	KB592	Z12-02-02		1
	-6	Pressure Relief Knob	KB592	Z12-02-03		1
	-7	Pry-Out Plug 1187	KB592	Z12-35-02/04		1
	-8	External Medical Lock Door	KB592	Z12-02-05		1
	-9	Knob	KB592	Z12-02-06		2
	-10	Door Screw	KB592	Z12-02-07		1
	-11	Stop	KB592	Z12-02-08		1
	-12	Pry-Out Plug	KB592	Z12-35-03/12		1
	-13	O-ring 133 x 3.00	6S753	1333V		1
	-14	3.50 O-ring Chord x 50mm	6S753	10000465		3
	-15	O-ring 158.12 x 7.00	6S753	149748		1
	-16	O-ring 130 x 3.00	6S753	098558		1
	-17	13.1 x 1.6 O-ring	6S753	375195		1
	-18	16.3 x 2.4 O-ring	6S753	093335		2
	-19	119.5 x 3.0 O-ring	6S753	095788		1
		Location Spigot	KB592	Z12-02-13		1
		Pressure Gauge EDO $^1/_8$ “	6S753	Z12-35-03/13		1
		$^1/_4$ “ NPT Blanking Plug	6S753	B-4-HP		1

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APPENDIX A

EMERGENCY EVACUATION HYPERBARIC STRETCHER (EEHS) OPERATING PROCEDURES

OPERATING PROCEDURES INDEX

EMERGENCY EVACUATION HYPERBARIC STRETCHER (EEHS) OPERATING PROCEDURES

EEHS OP-1
EEHS PRE-MISSION

Date: 15 September 2007

OP ASSIGNED TO: _____ DATE: _____

SPECIAL INSTRUCTIONS

1. ENSURE THIS OP IS VALID BY COMPARING THE REVISION DATE ABOVE TO THE CURRENT EEHS O&M MANUAL.
2. EACH STEP SHOULD BE CHECKED INDIVIDUALLY.
3. REPORT ANY DISCREPANCIES TO THE DIVING SUPERVISOR.

EEHS OPERATOR: _____

DIVING SUPERVISOR: _____

EEHS OP-1 – PRE-MISSION

ITEM	DESCRIPTION	COMPONENT	PROCEDURE	LOCATION	CHECK	NOTE
1	Remove and Unfold Tube					
2	Conduct Visual Inspection Of Stretcher tube, End Domes, Medical Lock O-rings, Control Box, Umbilical, Regulators, Hoses, Internal Patient Pad, and Gas Bottles					
3	System Certified and Applicable PMS Completed					
4	Check That the Pressure Gauges Have Been Calibrated					
5	Outside Chamber: - Stopwatches - *U.S. Navy Dive Manual* - Stretcher Log					
6	Ensure All Valves Are Shut					
7	Air Regulator	AHP-R-1	Connect	Air Supply Bottle		
8	Air Hose	ALP-QD-1 TO ALP-QD-2	Connect	Control Box		
9	O_2 Regulator	OHP-R-1	Connect	O_2 Supply Bottle		
10	O_2 Hose	OLP-QD-1 TO OLP-QD-2	Connect	Control Box		
11	Umbilical/ Air Black Hose	ALP-QD-4 TO ALP-QD-3	Connect	Control Box		
12	Umbilical/ BIBS Green Hose	OLP-QD-4 TO OLP-QD-3	Connect	Control Box		
13	Umbilical/ Exhaust Yellow Hose	EXH-QD-3 TO EXH-QD-4	Connect	Control Box		
14	Umbilical /Pneumo Blue Hose	ALP-QD-9 TO ALP-QD-10	Connect	Control Box		
15	Umbilical/ Comms and Strain Relief		Connect	Penetrator End Dome (Outside)		
16	Umbilical/ Comms		Connect	Comms Box Copilot		
17	Headset		Connect	Comms Box Pilot		
18	BIBS Mask		Connect	Penetrator End Dome (Inside)		
19	Put Rubber Protector on Internal Depth Gauge					
20	Remote Air Supply Hose	ALP-QD-7	Connect	Penetrator End Dome (Inside)		
21	Internal Headset and Strain Relief		Connect	Penetrator End Dome (Inside)		

EEHS OP-1 – PRE-MISSION

ITEM	DESCRIPTION	COMPONENT	PROCEDURE	LOCATION	CHECK	NOTE
22	Umbilical/ Air Black Hose	ALP-QD-4 TO PRESSURE INCREASE	Connect	Penetrator End Dome		
23	Umbilical/ BIBS Green Hose	OLP-QD-4 TO BIBS SUPPLY	Connect	Penetrator End Dome		
24	Umbilical/ Exhaust Yellow Hose	EXH-QD-3 TO PRESSURE DECREASE	Connect	Penetrator End Dome		
25	Umbilical/Pneumo Blue Hose	ALP-QD-9 TO PNEUMO	Connect	Penetrator End Dome		
26	Umbilical/ Comms		Connect	Penetrator End Dome		
27	Emergency Vent		Shut	Penetrator End Dome		
28	Safety Valve Shutoff		Wired/Open	Penetrator End Dome		
29	BIBS Exhaust		Open	Penetrator End Dome		
30	BIBS Control Valve	OLP-V-2	Turn to air	Control Box		
31	Pressurize Valve	ALP-V-1	Shut	Control Box		
32	Exhaust Valve	ALP-V-2	Shut	Control Box		
33	Air Cylinder Valve		Open	Air Bottle		
34	Air Supply HP Gauge	AHP-G-1	Check and Record Pressure _____ PSIG	Air Regulator		
NOTE Supervisor Verify That There is Sufficient Air to Complete Mission						
35	Oxygen Supply Valve		Open	Oxygen Bottle		
36	Oxygen Supply HP Gauge	OHP-G-1	Check and Record Pressure _____ PSIG	Oxygen Bottle		
NOTE Supervisor Verify That There is Sufficient Oxygen to Complete Mission						
37	Air Supply LP Gauge	ALP-G-1	Check 170 - 200 PSIG	Control Box		
38	Oxygen Isolation Valve	OPL-V-1	Open	Control Box		
39	Oxygen Supply LP Gauge	OLP-G-1	Check 115 - 140 PSIG	Control Box		
40	BIBS		Breathe BIBS Mask to Ensure Air Flow	BIBS Mask		

EEHS OP-1 – PRE-MISSION

ITEM	DESCRIPTION	COMPONENT	PROCEDURE	LOCATION	CHECK	NOTE
			NOTE Ensure That (OLP-V-2) Fully Turned to “Air” or to” Oxygen”			
41	BIBS Supply Valve	OLP-V-2	Turn To Oxygen	Control Box		
42	BIBS		Breathe BIBS Mask to Ensure Oxygen Flow	BIBS Mask		
43	Comm Switch		Turn On	Comm Box		
44	Comm System		Test	Comm System		
45	Oxygen Bottle Valve		Shut	Oxygen Bottle		
46	BIBS		Breathe Down	BIBS Mask		
47	Medical Lock/ Inner Door		Install	Medical Lock		
48	Medical Lock End Dome		Install	Tube/ Head End		
49	Penetrator End Dome		Install	Tube/ Foot End		
50	End Dome Handles		Pull to Seal Tube	End Domes		
51	Pressure Increase Valve	ALP-V-1	Open	Control Box		
52	Pressure Increase Valve	ALP-V-1	Shut at 10 Feet	Control Box		
53	Check Stretcher for Leaks, and Proper Operation of Oxygen Analyzer in Accordance with Sections 2-14 And 2-15.					
54	Medical Lock/ Outer Door		Install	Medical Lock		
55	Exhaust Valve	ALP-V-2	Open	Control Box		
56	Exhaust Valve	ALP-V-2	Shut At Surface	Control Box		
57	Air Bottle Valve		Shut	Air Bottle		
58	Vent Screw		Open Slowly	Air Regulator		
59	Vent Screw		Shut	Air Regulator		
60	Air Supply Hose	ALP-QD-1	Disconnect	Control Box		
61	Oxygen Supply Hose	OLP-QD-1	Disconnect	Control Box		
62	Air Regulator	AHP-R-1	Disconnect	Air Bottle		
63	Oxygen Regulator	OHP-R-1	Disconnect	Oxygen Bottle		
64	End Domes		Remove	Tube		
65	Umbilical/ Comms		Disconnect	Comms Box Pilot and Copilot		
66	Umbilical/ Comms and Strain Relief		Disconnect	Penetrator End Dome (Outside)		

EEHS OP-1 – PRE-MISSION

ITEM	DESCRIPTION	COMPONENT	PROCEDURE	LOCATION	CHECK	NOTE
67	Umbilical/ AIR, BIBS, EXH, PNEUMO	ALP-QD-4, OLP-QD-4, EXH-QD-3, ALP-QD-9	Disconnect	Penetrator End Dome		
68	Umbilical/ Comms and Strain Relief		Disconnect	Penetrator End Dome (Inside)		
69	BIBS Mask		Disconnect	Penetrator End Dome (Inside)		
70	Remote Air Supply Hose	ALP-QD-7	Disconnect	Penetrator End Dome (Inside)		
71	Umbilical/ AIR,BIBS,EXH,PNEUMO	ALP-QD-4, OLP-QD-4, EXH-QD-3, ALP-QD-9	Disconnect	Control Box		
72	Medical Lock Doors		Remove	Medical Lock		
73	Pack Loose Items in Spares Case					
74	Insert and Fold Flexible Tube Into Large Storage Case					
75	Shut Large Storage Case					
76	Place Penetrator End Dome on Foam Ring					
77	Place Large Foam Ring Around Valves					
78	Store Medical Lock End Dome on Foam Ring on Top of Penetrator End Dome					
79	Store Umbilical, Remote Air Supply Hose, and Aircraft Overboard Dump Hose on Top of Medical Lock End Dome					
80	Place Medical Lock Doors and Regulators in Protective Pouches Around End Domes					
81	Shut Storage Case					

– END OF PROCEDURE –

Comments

EMERGENCY EVACUATION HYPERBARIC STRETCHER (EEHS) OPERATING PROCEDURE

EEHS OP-2

EEHS OPERATION

Date: 15 September 2007

OP ASSIGNED TO: _____ DATE: _____

SPECIAL INSTRUCTIONS

1. ENSURE THIS OP IS VALID BY COMPARING THE REVISION DATE ABOVE TO THE CURRENT EEHS O&M MANUAL.
2. EACH STEP SHOULD BE CHECKED INDIVIDUALLY.
3. REPORT ANY DISCREPANCIES TO THE DIVING SUPERVISOR.

EEHS OPERATOR: _____

DIVING SUPERVISOR: _____

OP-2 – OPERATION

ITEM	COMPONENT	DESCRIPTION	PROCEDURE	LOCATION	CHECK	NOTE
1	Ensure OP-1 Has Been Competed Within the Last 30 Days					
2	Remove and Unfold Tube					
3	Clear of All Extraneous Equipment					
4	Outside Chamber: - Stopwatches - *U.S. Navy Dive Manual* - Stretcher Log					
5	Ensure All Valves Are Shut					
6	Air Regulator	AHP-R-1	Connect	Air Supply Bottle		
7	Air Hose	ALP-QD-1 TO ALP-QD-2	Connect	Control Box		
8	O_2 Regulator	OHP-R-1	Connect	O_2 Supply Bottle		
9	O_2 Hose	OLP-QD-1 TO OLP-QD-2	Connect	Control Box		
10	Umbilical/ Air Black Hose	ALP-QD-4 TO ALP-QD-3	Connect	Control Box		
11	Umbilical/ BIBS Green Hose	OLP-QD-4 TO OLP-QD-3	Connect	Control Box		
12	Umbilical/ Exhaust Yellow Hose	EXH-QD-3 TO EXH-QD-4	Connect	Control Box		
13	Umbilical/ Pneumo Blue Hose	ALP-QD-9 TO ALP-QD-10	Connect	Control Box		
14	Umbilical/ Comms		Connect	Comms Box Copilot		
15	Headset		Connect	Comms Box Pilot		
16	BIBS Mask		Connect	Penetrator End Dome (Inside)		
17	Remote Air Supply Hose	ALP-QD-7	Connect	Penetrator End Dome (Inside)		
18	Internal Headset and Strain Relief		Connect	Penetrator End Dome (Inside)		
19	Put Rubber Protector On Internal Depth Gauge					
20	Umbilical/ Air Black Hose	ALP-QD-4 TO PRESSURE INCREASE	Connect	Penetrator End Dome		
21	Umbilical/ BIBS Green Hose	OLP-QD-4 TO BIBS SUPPLY	Connect	Penetrator End Dome		
22	Umbilical/ Exhaust Yellow Hose	EXH-QD-3 TO PRESSURE DECREASE	Connect	Penetrator End Dome		
23	Umbilical/ Pneumo Blue Hose	ALP-QD-9 TO PNEUMO	Connect	Penetrator End Dome		
24	Umbilical/ Comms and Strain Relief		Connect	Penetrator End Dome (Outside)		
25	Emergency Vent		Shut	Penetrator End Dome (Outside)		

OP-2 – OPERATION

ITEM	COMPONENT	DESCRIPTION	PROCEDURE	LOCATION	CHECK	NOTE
26	Safety Valve Shutoff		Wired/Open	Penetrator End Dome (Outside)		
27	BIBS Exhaust		Open	Penetrator End Dome (Outside)		
28	BIBS Control Valve	OLP-V-2	Turn To Air	Control Box		
29	Air Cylinder Valve		Open	Air Bottle		
30	Air Supply HP Gauge	AHP-G-1	Check and Record Pressure _____ PSIG	Air Regulator		
NOTE Supervisor Verify That There Is Sufficient Air to Complete Mission						
31	Oxygen Supply Valve		Open	Oxygen Bottle		
32	Oxygen Supply HP Gauge	OHP-G-1	Check and Record Pressure _____ PSIG	Oxygen Bottle		
33	Oxygen Isolation Valve	OLP-V-1	Open			
NOTE Supervisor Verify That There Is Sufficient Oxygen to Complete Mission						
34	Air Supply LP Gauge	ALP-G-1	Check 170 - 200 PSIG	Control Box		
35	Oxygen Supply LP Gauge	OLP-G-1	Check 115 - 140 PSIG	Control Box		
36	BIBS		Breathe BIBS Mask to Ensure Air Flow	BIBS Mask		
37	BIBS Supply Valve	OLP-V-2	Turn to Oxygen	Control Box		
38	BIBS		Breathe BIBS Mask to Ensure Oxygen Flow	BIBS Mask		
39	Medical Lock Doors (Inner & Outer)		Install	Medical Lock		
40	Medical Lock Vents		Insure Shut	Medical Lock Doors		
41	Connect Straps to Paitent Pad for Pulling Patient Through Stretcher					
42	Place Patient on Internal Patient Pad					
43	Place BIBS Mask on Patient and Adjust Straps to Ensure Comfortable Fit W/O Leakage					
44	Place Headset on Patient					
45	Ensure Oxygen Flow, and Comm Check					
46	Place Remote Air Supply Hose Under Patients Arm					
47	Pull Patient Head First Until Feet Are Well Within Stretcher					
48	Penetrator End Dome		Insert at Foot End	Tube		
49	End Dome (Medical Lock)		Insert at Head End	Tube		
50	Exhaust Valve	ALP-V-2	Check Shut	Control Box		
51	Check Oxygen Analyzer for Proper Operation IAW Sections 2-14 and 2-15					

OP-2 – OPERATION

ITEM	COMPONENT	DESCRIPTION	PROCEDURE	LOCATION	CHECK	NOTE
Pressurize Stretcher						
52	Pressure Increase Valve	ALP-V-1	Pressurize to 60 FSW IAW U.S. Diving Manual	Control Box		
To Transfer Item From Outside Stretcher to Inside Stretcher: Conduct Steps 53 to 61						
53	Patient Shut Medical Lock Equalization Bleed Screw					
54	Outside Tender Slowly Open Medical Lock Vent Screw Completely					
55	Outside Tender Remove Medical Lock Door/ Place Item Inside					
56	Outside Tender Replace Medical Lock Door					
57	Outside Tender Shut Medical Lock Vent Screw					
58	Patient Open Medical Lock Equalization Screw Slowly					
59	Patient Remove Medical Lock Door					
60	Patient Remove Item and Shut Medical Lock Door					
61	Patient Shut Medical Lock Equalization Screw					
To Transfer Item From Inside Stretcher to Outside: Conduct Steps 62 To 70						
62	Outside Tender Open Medical Lock Vent Screw and Bleed to 0 PSIG. Outside Tender Shut Medical Lock Vent Screw.					
63	Outside Tender Shut Medical Lock Vent Screw Completely					
64	Patient Open Medical Lock Equalization Screw Slowly					
65	Patient Remove Medical Lock Door and Place Items Inside					
66	Patient Replace Medical Lock Door					
67	Patient Shut Medical Lock Equalization Screw					
68	Outside Tender Slowly Open Medical Lock Vent Screw Completely					
69	Outside Tender Remove Medical Lock Door					
70	Outside Tender Remove Items and Then Replace Medical Lock Door					
71	Outside Tender Shut Medical Lock Vent Screw Completely					
To Change Air Supply Cylinder: Conduct Steps 71 to 79						
72	Pressure Increase Valve	ALP-V-1	Shut	Control Box		
73	Shut Air Supply Cylinder Valve					
74	Slowly Open Purge Screw on Regulator and Bleed Down					
75	Shut Purge Screw on Regulator					
76	Remove Regulator From Air Cylinder (or use spare regulator and attach QD)					
77	Connect Regulator to Replacement Cylinder					
78	Open Air Supply Cylinder Valve					

OP-2 – OPERATION

ITEM	COMPONENT	DESCRIPTION	PROCEDURE	LOCATION	CHECK	NOTE
79	Air Supply HP Gauge	AHP-G-1	Check and record pressure _____ PSIG	Air Regulator		
80	Air Supply LP Gauge	ALP-G-1	Check 170 - 200 PSIG	Control Box		
To Change Oxygen Supply Cylinder: Conduct Steps 80 to 89						
81	BIBS Supply Valve	OLP-V-2	Turn to Air	Control Box		
82	Shut Empty Oxygen Supply Cylinder Valve					
83	Slowly Open Purge Screw on Regulator and Bleed Down					
84	Shut Purge Screw on Regulator					
85	Remove Regulator from Oxygen Bottle (or use spare regulator and attach QD)					
86	Connect Regulator to Replacement Oxygen Cylinder					
87	Open Oxygen Supply Cylinder Valve					
88	Oxygen Supply LP Gauge	OLP-G-1	Check 115 - 140 PSIG	Control Box		
89	Oxygen Supply HP Gauge	OHP-G-1	Check and record pressure _____ PSIG	Oxygen Regulator		
90	BIBS Supply Valve	OLP-V-2	Turn to Oxygen	Control Box		
To Prepare for Transportation: Conduct Steps 90 to 95						
91	Pass Handle Strap Ends Through Loops on Fabric Cover					
92	Ensure Stabilizing Wedges Are Evenly Situated on Either Side of the Bottom of the Stretcher					
93	Adjust Straps So They Are Tight					
94	Position Control Box on Top of Stretcher and Connect to Straps					
95	Position Spares Box on Top of Stretcher and Connect to straps					
96	The Stretcher Can Now Be Transported To Therapeutic Chamber					
97	Exhaust Valve	ALP-V-2	Travel patient to surface at 30 fpm	Control Box		
98	Remove End Domes And BIBS Mask/Headset					
99	Remove Foot End Dome					
100	Remove Head Dome					
101	Patient Remove Head First					
-END OF PROCEDURE-						

EMERGENCY EVACUATION HYPERBARIC STRETCHER (EEHS) OPERATING PROCEDURE

EEHS OP-3
EEHS SHUT-DOWN

Date: 15 September 2007

OP ASSIGNED TO: _____ DATE: _____

SPECIAL INSTRUCTIONS

1. ENSURE THIS OP IS VALID BY COMPARING THE REVISION DATE ABOVE TO THE CURRENT EEHS O&M MANUAL.
2. EACH STEP SHOULD BE CHECKED INDIVIDUALLY.
3. REPORT ANY DISCREPANCIES TO THE DIVING SUPERVISOR.

EEHS OPERATOR: _____

DIVING SUPERVISOR: _____

SH700-A2-MMC-010

EEHS OP-3 – SHUT-DOWN

ITEM	COMPONENT	DESCRIPTION	PROCEDURE	LOCATION	CHECK	NOTE
1	Oxygen Bottle Valve		Shut	Oxygen Bottle		
2	Air Bottle Valve		Shut	Air Bottle		
3	Vent Screw		Open Slowly	Oxygen Regulator		
4	Vent Screw		Open Slowly	Air Regulator		
5	Vent Screw		Shut	Oxygen Regulator		
6	Vent Screw		Shut	Air Regulator		
7	BIBS		Breathe down	BIBS Mask		
8	Air Supply Hose	ALP-QD-1	Disconnect	Control Box		
9	Oxygen Supply Hose	OLP-QD-1	Disconnect	Control Box		
10	Air Regulator	AHP-R-1	Disconnect	Air Bottle		
11	Oxygen Regulator	OHP-R-1	Disconnect	Oxygen Bottle		
12	Umbilical/ Comms		Disconnect	Comms Box		
13	Umbilical/ AIR, BIBS, EXH, PNEUMO	ALP-QD-4,OLP-QD-4,EXH-QD-3,ALP-QD-9	Disconnect	Control Box		
14	Umbilical/ AIR, BIBS, EXH, PNEUMO	ALP-QD-4,OLP-QD-4,EXH-QD-3,ALP-QD-9	Disconnect	Penetrator End Dome		
15	BIBS Mask		Disconnect	Penetrator End Dome (Inside)		
16	Remote Air Supply Hose	ALP-QD-7	Disconnect	Penetrator End Dome (Inside)		
17	Comms System		Disconnect	Penetrator End Dome (Inside AND Outside)		
18	Medical Lock Doors		Remove	Medical Lock		
19	Clean All System Components					
20	Visually Inspect All Components of System for Damage					
21	Pack Loose Items in Spares Case					
22	Insert and Fold Flexible Tube Into Large Storage Case					
23	Shut Large Storage Case					
24	Place Penetrator End Dome on Foam Ring					
25	Place Large Foam Ring Around Valves					
26	Store Medical Lock End Dome on Foam Ring on Top of Penetrator End Dome					
27	Store Umbilical, Remote Air Supply Hose, and Aircraft Overboard Dump Hose on Top of Medical Lock End Dome					
28	Place Medical Lock Doors and Regulators in Protective Pouches Around End Domes					
29	Shut Storage Case					
30	Refill All Air and Oxygen Supply Cylinders for Next Use					
-END OF PROCEDURE-						

APPENDIX B

EMERGENCY EVACUATION HYPERBARIC STRETCHER (EEHS) EMERGENCY PROCEDURES

EMERGENCY PROCEDURES INDEX

EMERGENCY EVACUATION HYPERBARIC STRETCHER (EEHS) EMERGENCY PROCEDURE

EEHS EP-1
EEHS RAPID LOSS OF PRESSURE

Date: 15 September 2007

OP ASSIGNED TO: _____ DATE: _____

SPECIAL INSTRUCTIONS

1. ENSURE THIS OP IS VALID BY COMPARING THE REVISION DATE ABOVE TO THE CURRENT EEHS O&M MANUAL.
2. EACH STEP SHOULD BE CHECKED INDIVIDUALLY.
3. REPORT ANY DISCREPANCIES TO THE DIVING SUPERVISOR.

EEHS OPERATOR: _____

DIVING SUPERVISOR: _____

EEHS EP-1

EEHS RAPID LOSS OF PRESSURE

DATE:

NOTE:

ITEM	COMPONENT	DESCRIPTION	PROCEDURE	LOCATION	CHECK	NOTE
1	Pressure Increase Valve	ALP-V-1	Chamber Operator add to Maintain Depth	Control Box		
2	Exhaust Valve	ALP-V-2	Shut	Control Box		
3	Emergency Vent Relief		Shut	Penetrator End Dome (Outside)		
4	Safety Valve Shut-Off		Shut	Penetrator End Dome (Outside)		
5	Medical Lock Equalization Screw		Shut	Medical Lock		

NOTE 1
Outside Personnel: Check All Fittings, Piping and End Domes for Leaks. Isolate and Repair as Required

-END OF PROCEDURE-

EMERGENCY EVACUATION HYPERBARIC STRETCHER (EEHS) EMERGENCY PROCEDURE

EEHS EP-2
EEHS INCREASE IN PRESSURE

Date: 15 September 2007

OP ASSIGNED TO: _____ DATE: _____

SPECIAL INSTRUCTIONS

1. ENSURE THIS OP IS VALID BY COMPARING THE REVISION DATE ABOVE TO THE CURRENT EEHS O&M MANUAL.
2. EACH STEP SHOULD BE CHECKED INDIVIDUALLY.
3. REPORT ANY DISCREPANCIES TO THE DIVING SUPERVISOR.

EEHS OPERATOR: _____

DIVING SUPERVISOR: _____

EEHS EP-2

EEHS INCREASE IN PRESSURE

DATE:

NOTE:

ITEM	COMPONENT	DESCRIPTION	PROCEDURE	LOCATION	CHECK	NOTE
1	BIBS Control	OLP-V-2	Shift to Air	Control Box		
2	Exhaust Valve	ALP-V-2	Open as Necessary to Maintain Depth	Control Box		
3	Pressure Increase Valve	ALP-V-1	Shut	Control Box		
4	BIBS Exhaust Valve	OLP-V-3	Check Open	Penetrator End Dome (outside)		

NOTE 1
Outside Personnel: Investigate Source of Pressure. Isolate and Repair

-END OF PROCEDURE-

EMERGENCY EVACUATION HYPERBARIC STRETCHER (EEHS) EMERGENCY PROCEDURE

EEHS EP-3
EEHS CONTAMINATED GAS SUPPLY

Date: 15 September 2007

OP ASSIGNED TO: _____ DATE: _____

SPECIAL INSTRUCTIONS

1. ENSURE THIS OP IS VALID BY COMPARING THE REVISION DATE ABOVE TO THE CURRENT EEHS O&M MANUAL.
2. EACH STEP SHOULD BE CHECKED INDIVIDUALLY.
3. REPORT ANY DISCREPANCIES TO THE DIVING SUPERVISOR.

EEHS OPERATOR: _____

DIVING SUPERVISOR: _____

EEHS EP-3

EEHS CONTAMINATED GAS SUPPLY

DATE:						
NOTE:						
ITEM	COMPONENT	DESCRIPTION	PROCEDURE	LOCATION	CHECK	NOTE
1	BIBS Control Valve	OLP-V-2	If Patient is on Oxygen, Switch to Air. if Patient Is on Air, Switch to Oxygen.	Control Box		
2	Gas Supply		Switch to Secondary Air Bottle Use OP-2 Item 69 – 76 or Oxygen Bottles. Use OP-2 Item 77 – 85	Gas Supply		
3	Pressure Increase And Decrease Valves		Ventilate Stretcher as Directed by Diving Supervisor	Control Box		
-END OF PROCEDURE-						

EMERGENCY EVACUATION HYPERBARIC STRETCHER (EEHS) EMERGENCY PROCEDURE

EEHS EP-4
EEHS LOSS OF OXYGEN

Date: 15 September 2007

OP ASSIGNED TO: _____ DATE: _____

SPECIAL INSTRUCTIONS

1. ENSURE THIS OP IS VALID BY COMPARING THE REVISION DATE ABOVE TO THE CURRENT EEHS O&M MANUAL.
2. EACH STEP SHOULD BE CHECKED INDIVIDUALLY.
3. REPORT ANY DISCREPANCIES TO THE DIVING SUPERVISOR.

EEHS OPERATOR: _____

DIVING SUPERVISOR: _____

EEHS EP-4

EEHS LOSS OF OXYGEN

DATE:

NOTE:

ITEM	COMPONENT	DESCRIPTION	PROCEDURE	LOCATION	CHECK	NOTE
1	BIBS Control Valve	OPL-V-2	Turn to Air	Control Box		
2	BIBS Quick-Disconnect		Patient Check for Proper Connection	Penetrator End Dome (Inside)		
3	BIBS Quick-Disconnect		Check for Proper Connection	Penetrator End Dome		
4	Oxygen Supply LP Gauge	OLP-G-1	Check for 115 – 140 PSIG	Control Box		
5	Oxygen Supply HP Gauge	OHP-G-1	Check Bottle Pressure	Oxygen Regulator		
6	Oxygen Bottle		Switch to Secondary Oxygen Bottle. See OP-2 Items 80 – 89	Oxygen Bottle		

NOTE 1

Outside Personnel: Determine Cause of Failure

-END OF PROCEDURE-

EMERGENCY EVACUATION HYPERBARIC STRETCHER (EEHS) EMERGENCY PROCEDURE

EEHS EP-5
EEHS LOSS OF PRIMARY AIR SUPPLY

Date: 15 September 2007

OP ASSIGNED TO: _____ DATE: _____

SPECIAL INSTRUCTIONS

1. ENSURE THIS OP IS VALID BY COMPARING THE REVISION DATE ABOVE TO THE CURRENT EEHS O&M MANUAL.
2. EACH STEP SHOULD BE CHECKED INDIVIDUALLY.
3. REPORT ANY DISCREPANCIES TO THE DIVING SUPERVISOR.

EEHS OPERATOR: _____

DIVING SUPERVISOR: _____

EEHS EP-5

EEHS LOSS OF PRIMARY AIR SUPPLY

DATE:

NOTE:

ITEM	COMPONENT	DESCRIPTION	PROCEDURE	LOCATION	CHECK	NOTE
1	BIBS Control Valve	OLP-V-2	Turn to Oxygen	Control Box		
2	Quick-Disconnect (Air Supply Hose)		Check for Proper Connection	Control Box		
3	Quick-Disconnect (Air Supply Umbilical)		Check for Proper Connection	Control Box		
4	Quick-Disconnect (Air Supply Umbilical)		Check for Proper Connection	Penetrator End Dome		
5	Air Supply LP Gauge		Check for 170 - 200 PSIG	Control Box		
6	Air Supply HP Gauge		Check Bottle Pressure	Air Regulator		
7	Air Bottle		Switch to Secondary Air Bottle. See OP-2 Item 71 – 79	Air Bottle		

-END OF PROCEDURE-

APPENDIX C

INSYS “REPAIR PROCEDURE FOR HYPERLITE HYPERBARIC STRETCHER BODIES”

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Composites Business Area
Reddings Wood, Ampthill, BEDFORD
MK45 2HD

Amendment Record

Amendment List			Incorporated by	
No.	Reason for Change	Pages Affected	Signature	Date
1				
2				
3				
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Index

1.0 Scope

1.1 The purpose of this procedure is to establish a process to enable repairs to be completed on a Hyperlite Hyperbaric Stretcher body (S.A.T drawings Z05-02-01 revision 6 and Z05-03-01 revision 6 and INSYS Ltd part number CBA-001018 issue 3) at a designated repair facility. There are essentially two different kinds of repairs that can be performed. These are a cosmetic repair, typically in the outer surface and a pressure lose repair, most likely on the inner surface. It is important to note that repairs for pressure loses are not always successful and final pressure testing is the only recommended measure of success.
The process for both repairs is identical and is detailed in this procedure.

2.0 Related Documents

2.1 S.A.T drawings Z05-02-01 revision 6 and Z05-03-01 revision 6.

2.2 INSYS Ltd part number CBA-001018 issue 3

3.0 Raw Materials

3.1	Silicone rubber	RTV664 part A and B. (GE Silicones)
3.2	Priming Agent	SS4155. (GE Silicones)
3.3	Acetone	

4.0 Background

4.1 The Hyperlite tube is manufactured from silicone and aramid fibre (Twaron). Its construction is basically in three stages each with a specific purpose. These are as follows:

- Tube inner surface – the primary purpose of the inner surface is to act as an airtight seal, preventing any pressure lose, this includes both window sealing areas.
- Aramid (Twaron) winding – the purpose of the winding is to withstand the operating pressures, preventing the inner surface from expanding, deforming and bursting.
- Tube outer surface – this is to present a finished surface, preventing damage to the winding. It is perforated during manufacture and is not an airtight surface.

4.2 Because of the necessary flexible qualities of the tube and the repeated manhandling, inflation and deflation, the tube is very subseptible to damage if not handled with care. The purpose of this procedure is to lay down a standard process to complete repairs.

5.0 Repair Process

5.1 It is most important that any damage to the tube is repaired as soon as possible. Any contamination of water, grease etc. into the winding could potentially prevent a repair from adhering successfully.

5.2 Always follow the material manufacturers health and safety information on all materials used in any repairs.

5.3 Before any repair is undertaken it is recommended that the whole tube be cleaned with warm soapy water and a soft cloth, do not allow any water to enter any damage. When carrying out any operation it is advisable to lay polythene or a similar material on the floor or work surface to protect the tube as much as possible.

5.4 Clean the area to be repaired using Acetone or M.E.K. this is vital to the success of the repair as it removes any residual release agents from the surface. Thoroughly clean inside and out, the damaged area. Allow to dry.

5.5 If the damaged to be repaired exposes the aramid fibre it is necessary to prime this material. This is to be done after cleaning the area. Open up the area of damage and using a small pencil brush paint the fibers using priming agent SS4155. This must be left for at least an hour to dry before commencing any repair.

5.6 When all the areas to be repaired have been cleaned and where necessary primed, the tube is ready for the compound to be mixed. Should this not take place within 24 hours of the areas being cleaned and primed, it will be necessary to repeat this process again.

5.7 The compound is mixed as follows:
Weigh out silicone rubber compound RTV664 in the ratio of ten parts of A to one part B. Mix thoroughly before placing in a vacuum chamber and degassing for a minimum of ten minutes.

5.8 The compound should be applied to the repair using a small spatula. When applying the compound it is important that the tear or repair is filled with the mixed compound. This must then be closed and any excess removed. Due to difficulty in effecting a good repair, because of silicone's aversion to tape etc. it is recommended that repairs are done in small numbers or individually, this enables the tube to be rotated to position the repair as low as possible to prevent the silicone compound from draining away before it can cure. Each repair will require its own individual process method. Below are some common examples of the types of damaged and recommended repairs schemes:

- Inner skin tears – prepare and fill tear as previously described. Close the tear, removing excess compound as it closes. When closed, consolidate by rolling a cylindrical shaped object over the area, again wipe away excess compound. Cover the area with a release film (a P.T.F.E or polythene film is ideal) before applying a weight (a small sand bag is ideal) that is left throughout the cure (twenty-four hours). When cured remove the weight and release film.

- Outer skin tears – prepare and fill tear as previously described. Close the tear removing excess compound as it closes. When closed, gently smooth over the area and apply a release film. Apply masking tape to the release film to consolidate and hold the repair shut during curing (twenty-four hours). When cured remove the tape and release film.
- Window sealing area tear – potentially the most difficult area to repair and the area of most activity in service. The most common damage is the join of the inner and outer skins splitting. This is repaired by preparing and filling the damage as described. It is then necessary to clean away any excessive compound. To consolidate and keep the repair to the correct form during curing it is recommended to use plasticine or a similar material that can be moulded to the profile of the flange being repaired. This is then taped in position for the duration of the cure (twenty-four hours).

- Note – it is often necessary to return to the repair during the curing process. Particularly on a large repair, to wipe away any excessive bleed out of the silicone compound. When cured, a repair will often need to be refilled slightly due to shrinkage of the silicone. This is done by cleaning the area as described in 5.4 before applying an additional silicone compound mix until the area is satisfactorily covered. Allow to cure for twenty-four hours.

  When completed the tube must be pressure tested to validate the repair.

6.0 Testing.

6.1 Place the tube on a level surface. Wipe inside the window sealing areas with a soft cloth to remove any dirt or grit etc. Before fitting the windows, place a thermometer inside the tube that can be read during the test. Gently fit the windows. Ensure all the venting ports are shut and the pressure gauge fitted. Attach the air supply and begin to inflate the tube. Shut off the air supply when the pressure gauge is reading 3.15 bar. Allow to settle for half an hour before commencing the test.

6.2 Top up the air supply to 3.15 bar. Record the temperature inside the tube and leave for one hour.

6.3 After the hour has passed, record the pressure reading and temperature inside the tube. These readings must be factored to determine if the pressure has dropped more than the 1% allowed for a successful test.

APPENDIX D

EEHS GAS REQUIREMENTS
(SUPPORTING DATA AND CALCULATIONS)

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EEHS GAS REQUIREMENTS

(SUPPORTING DATA AND CALCULATIONS)

D-1 INTRODUCTION

These calculations have been included to show the gas requirements for conducting the most demanding chamber operation contemplated from the *US Navy Diving Manual,* which is a Treatment Table 6.

D-1.1 Assumptions

a. Chamber will contain one patient and no tender for all operations.
b. BIBS include an overboard dump
c. Breathing rate is 0.3 Actual Cubic Feet per Minute (ACFM) for the patient while on BIBS
d. Leak Rate = 10 FSW/ hr (maximum allowed)
e. Stretcher volume = 20.1 CF
f. Medical lock volume = 0.23 CF

D-1.2 Gas Requirements for Emergency Evacuation Hyperbaric Stretcher USN TT6 with NO Extensions

DEPTH (FSW)	TIME (MIN)	BIBS OXYGEM USE (SCF)	BIBS AIR USE (SCF)
0-60	3		1.71
60	20	16.92	
60	5		4.23
60	20	16.92	
60	5		4.23
60	20	16.92	
60	5		4.23
60-30	30	21.24	
30	15		8.59
30	60	34.38	
30	15		8.59
30	60	34.38	
30-0	30	13.05	
Totals	**288**	**153.81**	**31.58**

a. Determine SCF lost due to leakage based on the assumption of 10 FSW/ hr at 30 FSW.

At 33 FSW, pressure is 1 atm or 14.7 psi

→ 1 FSW = 0.0303 atm

Air Leaked = $(P_i - P_f)(V)$

= (0.0303)(20.1)

= 0.609 SCF/ FSW lost

For the maximum allowable leak rate of 10 FSW/ hr, a total of 6.1 SCF/ hr are lost.

From the gas requirements table (above), the maximum treatment time is 288 minutes or 4.8 hours.

→ The total amount of air lost is (4.8)(6.1) = 29.28 SCF

Pressurization Requirements	SCF
Air to pressurize EEHS to 60 FSW	35.60
Pressurize medical lock to 60 FSW 2 times	0.84
Pressurize medical lock to 30 FSW 2 times	0.42
Air lost due to leakage during USN TT6	29.28
TOTAL	**97.72**

TOTAL GAS USED	
AIR	66.14 + 31.58 = **97.72 scf**
OXYGEN	**153.81 scf**

D-1.3 Stretcher Gas Supply

a. Air

Primary air supply = 1 flask rack with two 3000 psi cylinders with 0.465 CF. floodable volume per flask

Minimum initial air pressure in flasks = 3000 psig

Minimum useable air pressure = 250 psig based on 200 psig maximum setting for air regulators rounded up to nearest 50 psig

Available Primary Air = (number of flasks) x (minimum initial air pressure – minimum useable air pressure) x (flask volume)

Available Primary Air = [(2) (3000 – 250)/ 14.7 psi/ atm] x [0.465 CF/ atm]

= 174.0 scf

Available Secondary Air = N/A

b. Oxygen

Primary O_2 supply = Two 2200 psi flasks with 0.753 CF floodable volume
Minimum initial O_2 pressure in flasks = 2200 psig
Minimum useable O_2 pressure = 150 psig based on 140 psig maximum setting for air regulators rounded up to nearest 50 psig

Available Primary O_2 = (number of flasks) x (minimum initial O_2 pressure – minimum useable O_2 pressure) x (flask volume)

Available Primary O_2 = [(2) (2200 – 150)/ 14.7 psi/ atm] x [0.753 CF/ atm]

= 210.0 scf

Available Secondary O_2 = N/A

D-1.4 Conclusions and Recommendations

The oxygen and air available from the two bottles of each gas supplied with the EEHS provide adequate quantities to meet the performance requirements of the system. If the supplied bottles are not available, SCUBA cylinders that are approved for U.S. Navy diving may be used to supply air to the EEHS. K-Bottles that are approved for use on other Diving and Life Support Systems may be used to supply oxygen to the EEHS. If these other gas supply configurations are to be used with the EEHS they must be listed in the systems Pre-Survey Outline Booklet and the appropriate calculations for those supplies must also be included.

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Ref: NAVSEAINST 4160.3A NAVSEA S0005-AA-GYD-030/TMMP

SAFETY SUMMARY NAVSEA/SPAWAR TECHNICAL MANUAL DEFICIENCY/EVALUATION REPORT (TMDER)

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TECHNICAL MANUAL

OPERATION AND MAINTENANCE MANUAL FOR THE EMERGENCY EVACUATION HYPERBARIC STRETCHER (EEHS)

OPERATION, MAINTENANCE, AND ILLUSTRATED PARTS BREAKDOWN