Hollis®

# PRISM™ 2

# USER SERVICE GUIDE


**This PRISM 2 Service Procedure conveys a list of components and service procedures that reflect the PRISM 2 as it was configured at the time of this writing (9/12/12).**

Doc. 12-4091 - r01 (9/12/12)

SUPPORT: TOLL-FREE 888-383-DIVE | FAX 510-729-5115 | E-MAIL info@hollisgear.com

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## INTRODUCTION

This guide provides procedures for proper "User Level Repairs" of the Hollis PRISM 2 Rebreather at the time of this writing. "User Level Repairs" are repairs that Hollis has deemed suitable for end users to perform themselves as needed. These guides do not cover all systems that require maintenance.

**It is still necessary to have a Hollis PRISM 2 Service Facility complete a "Full Service" annually to maintain safe operation of the unit.**

This guide does not replace proper instruction from a PRISM 2 Instructor. Instructions contained within this guide are only to be performed by persons trained to dive and assemble the PRISM 2. Before service, ensure with Hollis that this is the most current revision of this guide. If you do not completely understand the instructions given in this manual, lack the correct tools, or lack the appropriate level of mechanical knowledge - have an authorized Hollis PRISM 2 Service Facility or Hollis Customer Service complete repairs. Your Hollis PRISM 2 Dealer or PRISM 2 Instructor can personally advise you on this matter. You may prefer to have your local PRISM 2 Service Center perform all repairs. Hollis has provided these guides simply as a convenience for those individuals with the desire and aptitude to complete basic repairs themselves.

## WARNINGS, CAUTIONS, AND NOTES

Pay attention to the following symbols when they appear throughout this document. They denote important information and tips.

**WARNINGS:** are indicators of important information that if ignored may lead to injury or death.

**CAUTIONS:** indicate information that will help you avoid product damage, faulty assembly, or unsafe conditions.

**NOTES:** indicate tips and advice.

# DEFINITIONS

**Absorbent:** chemical media used to remove $CO_2$ from exhaled gas

**ADV:** automatic diluent valve

**Bailout:** redundant gas supply system

**BOV:** bail out valve

**Breakthrough:** where absorbent scrubber fails, no longer removing $CO_2$ at an adequate rate

**Breathing Loop:** parts of the rebreather that breathing gas circulates within

**Diluent:** a gas used for breathing volume and to reduce the fraction of oxygen in the Breathing Loop

**DSV:** dive surface valve

**$FO_2$:** fraction of oxygen

**HP:** high pressure

**IP:** intermediate pressure

**LP:** low pressure

**Negative Pressure Check:** a test placing the Breathing Loop under a vacuum condition to check for leaks

**OC:** open circuit

**OPV:** over-pressure valve

**$PO_2$:** partial pressure of oxygen

**Positive Pressure Check:** a test that looks for leaks in the Breathing Loop when pressurized

**QD:** quick disconnect

**WOB:** work of breathing

# PRISM 2 MODIFICATION WARNING

- This Service Guide is not an instructional manual for operation of the PRISM 2. This guide only provides instructions on repairing the unit. No person should breathe from, or attempt to use in any way, a Hollis Prism 2 rebreather, or any component part thereof, without first completing an appropriate Hollis Certified user-training course.

- DO NOT modify or change the Breathing Loop components with any after-market parts. Doing so could dangerously effect the breathing dynamics of the system and lead to serious injury or death.

- ONLY USE Hollis brand Oxygen Sensors.

- Ensure any BCD used with the unit provides adequate lift capacity

- If a Hollis alternate inflator regulator is removed or not installed, an adequate Bailout Gas Supply System must be used.

- DO NOT replace the first stage regulators with anything other than Hollis PRISM Regulators. Doing so could impair the function of the Oxygen Solenoid.

- Modifications could void the warranty. See www.HollisGear.com for exclusions.

# PRISM 2 GENERAL PROCEDURES (USER LEVEL)

## RECOMMENDED CHEMICALS & LUBRICANTS

**Lubrication:** Tribolube 71® or CHRISTO-LUBE® MCG 111

**CAUTION: Although equivalent Halocarbon Based Lubricants could be used, they may not provide the same level of Operational Performance.**

**NOTE: DOW CORNING® 7 silicone may be substituted for all parts EXCEPT those used on Oxygen Valves, Regulators, and Oxygen Solenoid Assembly Components.**

**Sanitizing (internal Breathing Loop parts):** Steramine™ solution

**Cleaning (Internal plastic parts):** Crystal Simple Green® solution or mild dish washing liquid

**Cleaning (external plastic parts):** Crystal Simple Green® solution or mild dish washing liquid

**Cleaning (external metal parts):** White Vinegar

**Cleaning (electrical contacts):** DeoxIT® Gold GN5

**CAUTION: The electrical connectors have thin precious metal plating. DO NOT scrape corrosion from contacts with a hard sharp object. DO NOT use abrasives, petroleum distillates, silicone based cleaners, erasers, combust able chemicals, or any other harsh cleaners. Hollis recommends the use of DeoxIT Gold® GN5 for cleaning the electrical contacts.**

## OXYGEN USE

**WARNING:**

**The Hollis PRISM 2 oxygen critical components are prepared for Oxygen Service when shipped from the factory. If Hollis PRISM OXYGEN Regulators, Oxygen Valves, or the Solenoid are subsequently used with equipment, or connected to an Air supply system, that is not rated for Oxygen Service, it cannot subsequently be used with Nitrox breathing gases containing more than 40% oxygen by volume unless it is again prepared for Oxygen Service by a Qualified Hollis Dealer Facility who is certified in and follows Oxygen Service Procedures.**

**This text ONLY covers disassembly, reassembly, and tuning procedures. Oxygen Service Procedures are beyond the scope of this guide and are not covered within this text. DO NOT attempt to service any Regulator, Valve, or Solenoid.**

# SAFETY

## ⚠ WARNING: ⚠

**The $CO_2$ absorbent material used in the Scrubber is caustic alkaline material. Take steps to protect yourself and your working environment from the effects of airborne dusting of absorbent, eye, and skin contact. Good protection would include gloves, eye protection, and a dust mask. See Material Safety Data Sheets for the absorbent material for further safety recommendations before working with the Scrubber Bucket Assembly.**

## PRIOR TO PERFORMING SERVICE:

### EXTERNAL INSPECTION

• Visually inspect the Regulator First Stage Cone Filters for any visible residue present.

• Closely examine all metal parts for any signs of external corrosion.

• If the metal parts have a chrome finish, check closely for any flaking or chipping. DO NOT clean any Parts found to be flaking or chipping chrome in an ultrasonic cleaner.

### PRIOR TO DISASSEMBLY

• Ensure that you have the latest revision of this Service Guide and all Hollis Service Updates. Contact Hollis Customer Service to confirm.

• Be certain to perform the Initial Inspection and Troubleshooting Procedures of each section of this Service Procedure Guide prior to beginning any Section's Disassembly. Doing so will provide clues as to which Internal Parts may be worn.

• Review the complete Disassembly and Reassembly sections provided in this Service Procedure Guide for the specific Assemblies being serviced.

• Ensure that you are equipped with all of the Tools and Parts needed. **DO NOT** attempt to perform the Service if not equipped with the proper Tools and Parts.

• Perform the outlined steps in the order given, without exception. The Reassembly Procedures have been outlined with the assumption that you first followed the Disassembly Procedures as outlined.

• Before reusing or scrapping any parts during service, refer to the Parts Replacement Schedule and Letter Codes (a, b, c) that follow the Exploded View Diagram Numbers. **DO NOT** allow old parts to be reused.

• O-rings are classified as being either dynamic or static. Dynamic O-rings are mounted directly on a moving Part, or they create a Seal against a moving Part. Static O-rings create a Seal between two non-moving Parts. Since Dynamic O-rings sustain friction and movement, they are to be discarded and replaced during every Service, regardless of age or appearance. Static O-rings are less subject to wear and after passing close Inspection may sometimes be reused, although this is not necessarily recommended. Always follow the Service & Parts Replacement Schedule Outlined in the following section.

• To help avoid any confusion during Disassembly, those parts that are not to be replaced automatically should be Inspected after Disassembly is completed. They should be laid out in the order they are removed, and compared with identical new parts to better discern their condition before Reassembly is performed.

• O-rings should be Inspected using a magnifier to ensure they are supple, well rounded, and completely free of any scoring or corrosion that would impair proper sealing. Replace any O-rings in questionable condition.

## CLEANING AND LUBRICATION:

### TOOLS AND CLEANING SUPPLIES

• Tools to be used must be clean and free of contaminates such as dirt, dust, silicone grease, and oil.

• A supply of warm to hot clean fresh water will be needed for rinsing.

• For blow drying parts and components, a clean (oil free) low pressure air supply is to be used.

### DISASSEMBLY

• Again, prior to beginning Disassembly perform the Inspection and Troubleshooting Procedures at the beginning of each of this Guide's sections.

• Disassemble the different PRISM 2 components in accordance with the disassembly section provided in this Service Procedure Guide.

### CLEANING TIPS

**CAUTION: DO NOT use a metal wire brush.**

**WARNING: If salt or grit is found on any O-rings, discard them and replace with new ones. DO NOT attempt to reuse them.**

• Prior to Cleaning, carefully remove any existing thread locking residue from the Threads using a brass or plastic dental instrument.

• During Cleaning, use special care not to damage Components such as those with delicate Seating Surfaces.

### CLEANING - GENERAL

Plastic or Rubber Parts

• Reusable soft and hard Parts, such as regulator Spacers and Protector Caps may be soaked and cleaned in a solution of warm water mixed with mild dish soap.

• To scrub away deposits, use only a soft nylon toothbrush.

Metal Parts, General

• General Metal parts may be soaked and cleaned in a solution of Crystal Simple Green®, mild dish washing liquid, or white vinegar (for corrosion).

• To scrub away deposits, use only a soft nylon toothbrush.

**WARNING: DO NOT introduce any cleaning agents into the Breathing Loop that may off gas or be unhealthy to breathe. Please see all Safety Data for any cleaning agent, and take all precautions to thoroughly rinse any cleaner residues away.**

## FINAL INSPECTION

• Examine all O-ring sealing surfaces for scratches, burs, gouges, and deformation. Repair as needed.

Sealing Surface Inspection Tips

• Use a bright inspection light and magnifying glass to aid seeing damage and defects in the dark colored plastic **(Fig. 1)**.


Fig. 1

• Follow the O-ring grooves with a toothpick, end of a paintbrush handle, or other such device that can not scratch the plastic. This will help you to identify defects you can not see.

## PRE-ASSEMBLY

• To ensure that the Parts do not become contaminated, assemble the components immediately after completion of Cleaning and Final Inspection.

• Ensure that all Replacement Parts used are those specified in the Service Procedure(s) for use with the PRISM 2.

Lubrication

• Lubricate O-rings and other components as described in the Reassembly Procedure sections of this Service Guide.

• Dress the O-rings with a very light film of Lubricant.

• Avoid applying excessive amounts of Lubricant, as this will collect contaminants such as sand.

• Use only Hollis approved lubricants. They are listed at the beginning of this section.

**ASSEMBLY**

• Assemble the PRISM 2 Components according to the Reassembly Procedures described in each section of this Service Procedure Guide. Refer to the PRISM 2 User Manual for instructions on how to assemble all Components together into a complete and working PRISM 2 unit.

• Perform any and all Testing as described in each section of this Service Guide.

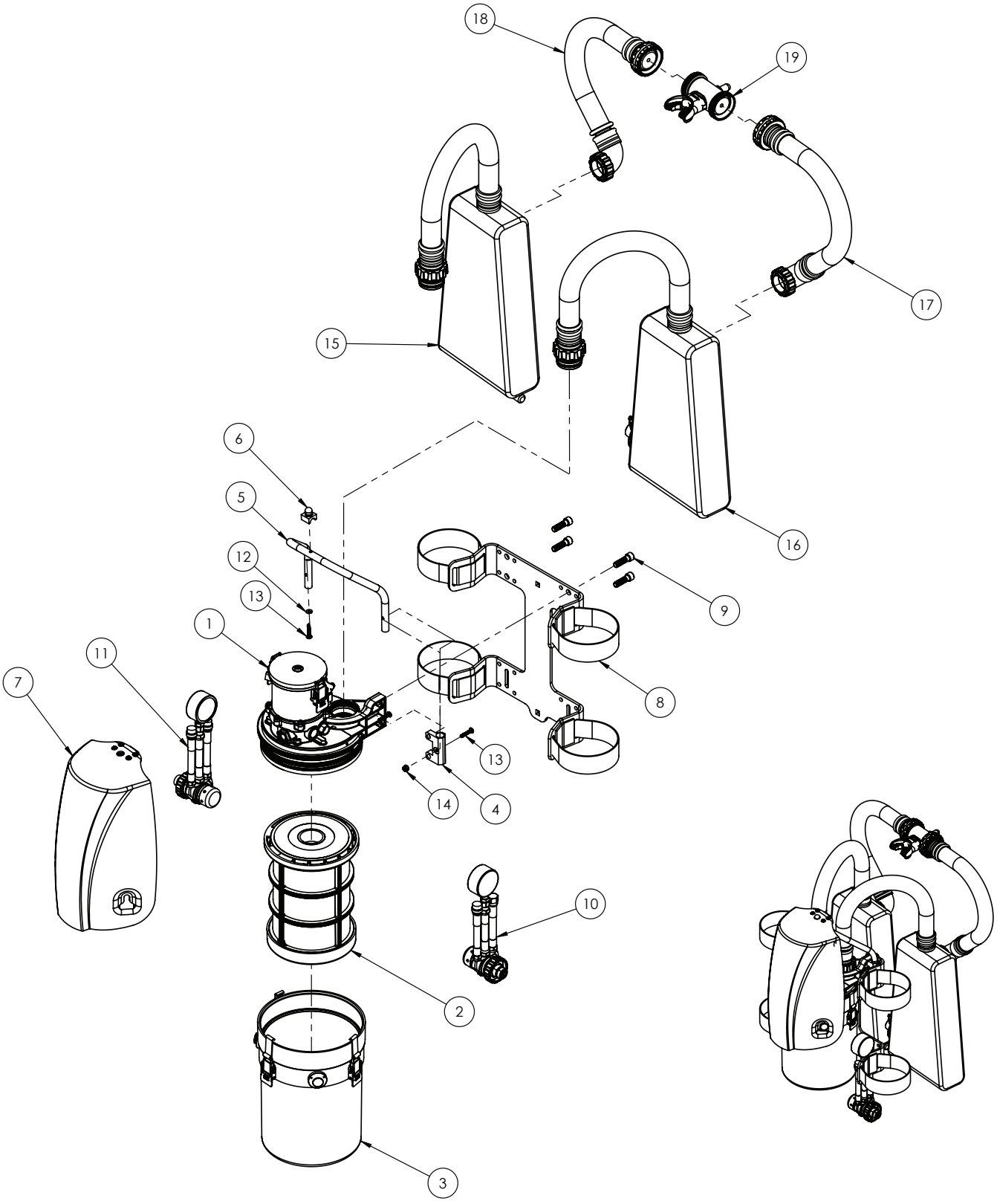
# 1. PRISM 2 SERVICE & PARTS REPLACEMENT SCHEDULE

**S = SERVICE, R = REPLACE**

| PART | AS NEEDED | 12 MONTHS | 36 MONTHS | 5 YEARS |
|---|---|---|---|---|
| Head to Inhalation Counterlung hose | S/R | | R | |
| Head to counterlung hose connector O-rings | S/R | R | | |
| Inhalation Counterlung | S/R | | | |
| ADV | S/R | R | | |
| Inhalation mushroom valve | S/R | R | | |
| Inhalation mushroom valve seat | S/R | | | R |
| Inhalation Hose | S/R | | R | |
| DSV O-rings (3) | S/R | R | | |
| Exhalation mushroom valve | S/R | R | | |
| Exhalation mushroom valve seat | S/R | | | R |
| Exhalation hose | S/R | | R | |
| Exhalation counterlung | S/R | | | |
| Manual O2 Addition Valve | S/R | R | | |
| OPV | R | | | R |
| Head to Enhalation Counterlung hose | S/R | | R | |
| Exhaust Plenum O-Ring (Not Gasket) | S/R | | | R |
| Red $CO_2$ Seal | S/R | R | | |
| Scrubber basket | S/R | | | |
| Basket Spring | S/R | | | |
| O2 cell holders | S/R | | | R |
| O2 cell wiring harness | S/R | | R | |
| Battery Cap sealing O-rings (2) | S/R | R | | |
| Battery Cap Latches | R | | | |
| Battery Cap Pressure Relief Valve | R | R | | |
| Bucket sealing O-Rings | S/R | R | | |
| Oeteker Clamps | R | | R | |
| Bucket Latches | R | | | |
| Oxygen First Stage | S | S | | |
| Diluent First Stage | S | S | | |
| O2 LP Hoses & QD | S/R | S | | R |
| O2 HP Hose & QD | S/R | S | | R |
| O2 Gas restrictors | S/R | S | | |

| PART | AS NEEDED | 12 MONTHS | 36 MONTHS | 5 YEARS |
|---|---|---|---|---|
| Diluent LP Hoses & QD | S/R | S | | R |
| Diluent HP Hose | S/R | | | R |
| O2 Pressure gauge | S/R | S | | |
| Diluent Pressure gauge | S/R | S | | |
| Oxygen Solenoid | S/R | S | | R |

# 2. PRISM 2 ASSEMBLIES DIAGRAM



# PRISM 2 ASSEMBLIES
# DIAGRAM PARTS LIST

| DIA. | P/N | DESCRIPTION | NOTES |
|---|---|---|---|
| 1 | 28674 | HEAD ASSEMBLY | Doc. 12-4093, Technician only |
| 2 | 27755 | SCRUBBER BASKET & CAP | Doc. 12-4094 |
| 3 | 27985 | BUCKET ASSEMBLY | Doc. 12-4094 |
| 4 | 28224 | NUT BAR | |
| 5 | 28680 | MOUNTING TUBE | |
| 6 | 28217 | MOUNTING POST | |
| 7 | 28681 | COVER ASSY. | |
| 8 | 29229 | H FRAME ASSY. | |
| 9 | 29228 | SCREW, NYLON | |
| 10 | 27270 | REG. ASSY. OXYGEN | Doc. 12-4096, Technician only |
| 11 | 27271 | REG. ASSY., DILUENT | Doc. 12-4096, Technician only |
| 12 | 28834 | WASHER | |
| 13 | 28832 | SCREW | |
| 14 | 24819 | LOCK NUT | |
| 15 | 28764 | COUNTERLUNG, INHALATION | Doc. 12-4094 |
| 16 | 28729 | COUNTERLUNG, EXHALATION | Doc. 12-4094 |
| 17 | 29225 | HOSE ASSY. EXHALE | Doc. 12-4094 |
| 18 | 29226 | HOSE ASSY. INHALE | Doc. 12-4094 |
| 19 | 27759 | DIVE SURFACE VALVE ASSY. | Doc. 12-4094 |

# 1. BREATHING LOOP

## Tools Required

### Standard Tools

magnifying lens
inspection light
pure breathing gas supply

### Specialty Tools

| | |
|---|---|
| P/N 220.9102 | Tribolube 71 |
| P/N 220.9101 | Christo-Lube MCG 111 |
| P/N TBD | Oetiker clamp pliers |
| P/N TBD | STERAMINE™ sanitizer |
| P/N TBD | Thin Nut Wrench |
| P/N TBD | SI-TECH® attachment tool |
| P/N TBD | O-ring removal tool (plastic) |

## TROUBLESHOOTING

The Breathing Loop (DSV/BOV, Breathing Hoses, Counter Lungs; Scrubber Assembly) of the PRISM 2 is sensitive to wear and tear **(Fig. 1)**. It should be thoroughly inspected during any service. The key failure to be looking for is a leak or a worn component that is about to fail. The Breathing Loop must be able to maintain a positive and a negative pressure. Throughout inspection be vigilant to identify bad O-rings, damaged mating surfaces, holes, sticking valves, damaged hoses, and damaged hose clamps.

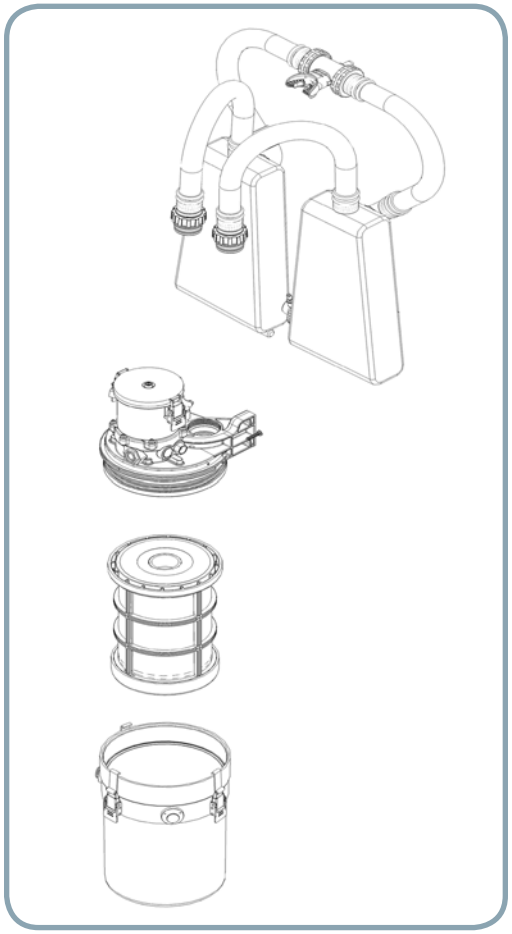


Fig. 1

Be on the lookout for modifications to the Breathing Loop that are not factory approved. These may include any number of things. For example a diver may have changed the Breathing Hoses to a longer hose for comfort reasons. This may seem benign but modifications that have not been tested and approved may increase Work Of Breathing (WOB) to an unsafe level or cause other safety risks. The Breathing Loop has been heavily tested by Hollis for many conditions of use. Technicians are not equipped nor authorized to perform the proper testing to evaluate the suitability of after market or modification parts. The technician **MUST** assemble the PRISM 2 to current factory standards and configuration. If there is any question as to the authenticity/approved nature of a component, contact Hollis Customer Service for further advice.

## INITIAL INSPECTION

1. Inspect the **BREATHING HOSES (13, 21, 31, 45)** for any holes, wear, age, or cracking. Discard if found. Stretch the hose slightly and inspect the rubber material. If you can see separation or light cracking in the rubber, discard **DO NOT** attempt to reuse.

2. Inspect all fittings for integrity. Discard if cracked or damaged. Ensure all fittings are secure.

**NOTE: All Breathing Loop Fittings tighten clockwise.**

3. Inspect the **COUNTERLUNGS (30, 44)** for tears or abnormal wear. Shake the **COUNTERLUNGS (30, 44)** to ensure no foreign objects have entered the **COUNTERLUNGS (30, 44)** during storage or transport. Clean or replace **COUNTERLUNGS (30, 44)** as necessary.

4. Inspect the **DRAIN VALVES (43, 54)** at the bottom of each **COUNTERLUNG (30, 44)** for proper operation. Loosen the locking collar clockwise, and actuate the **DRAIN VALVES (43, 54)** by depressing the nipple inward toward the body of the valve **(Fig. 2)**. It should pop back out when you let go of the valve. If it does not, it must be replaced. If in good condition, re-tighten the locking collar counterclockwise.

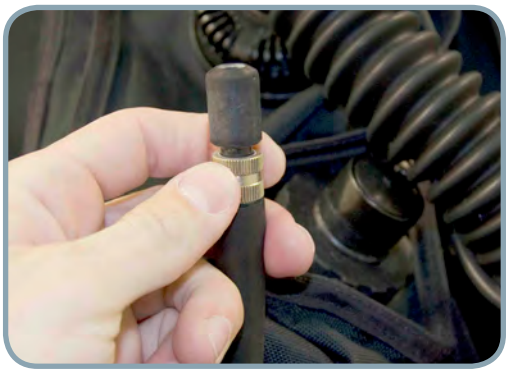


Fig. 2

5. Check the **ADV/MANUAL DILUENT ADDITION VALVE (52)** for tightness by gripping the **COUNTERLUNG (44)** Flange with one hand and turning the **ADV (52)** Fitting Nut clockwise until snug, **DO NOT** overtighten **(Fig. 3)**. Visually inspect the **ADV (52)** for cracks or breakage, anything that may cause a leak. See ADV/Manual Diluent Addition Valve section for further service procedures for this item.

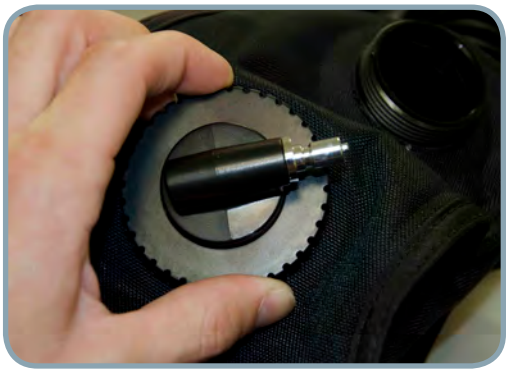


Fig. 3

6. Check the **MANUAL OXYGEN ADDITION VALVE (38)** for tightness by gripping the **COUNTERLUNG (30)** Flange with one hand and turning the **OXYGEN ADDITION VALVE (38)** Fitting Nut clockwise until snug, **DO NOT** overtighten **(Fig. 4)**. Visually inspect the valve for cracks or breakage, anything that may cause a leak. See Manual Oxygen Addition Valve section for further service procedures for this item.

7. Rotate the **OVER-PRESSURE VALVE (OPV) (40)** open and closed. You should feel a slight ratcheting as you twist. If the motion is not smooth The valve will need to be replaced. For now rotate the **OPV (40)** body clockwise until it is fully closed in preparation for a Positive Pressure Test **(Fig. 5)**.

Fig. 4

8. Inspect the **DSV/BOV (1)**. Open and close the valve to ensure smooth operation. Any scraping sounds or stiffness during barrel movement means the Valve requires service. See the DSV and BOV sections for further component service instructions.

9. Close **DSV/BOV (1)** for Positive Pressure Test.

**POSITIVE PRESSURE TEST**

1. Ensure all Breathing Loop components are connected and properly tightened as described above.

2. Rotate the **OVER-PRESSURE VALVE (OPV) (40)** body clockwise until it is fully closed.

3. Ensure the **DSV/BOV (1)** is closed.

Fig. 5

4. Using a regulator first stage and LP QD hose attached to the **ADV/MANUAL DILUENT VALVE (52)**, fill the **COUNTERLUNGS (30, 44)** with pure breathing gas, until gas vents from the **OVER-PRESSURE VALVE (OPV) (40)**. The **COUNTERLUNGS (30, 44)** should be full and firm to the touch.

5. Listen for any air escaping. Also look for any deflation of the **COUNTERLUNGS (30, 44)**.

6. Let the unit stand for 5 minutes inflated. Look again for any deflation or loss of **COUNTERLUNG (30, 44)** fullness.

7. Any escaping air or deflation means the breathing loop has failed The Positive Pressure Test.

8. If the unit passes step 7, open the **DSV/BOV (1)**. There should be a rush of air released. If that is not the case, the Breathing Loop has lost gas and failed the test.

**NOTE: Be aware that if the ambient temperature and introduced gas temperature are not matched the unit may falsely fail the Positive Pressure Test. Avoid this by allowing the unit and breathing gas supply tanks to reach room temperature before performing the test.**

9. If the Breathing Loop has failed this test, repair/replace any leaking component found during this test. Repeat the test as necessary to find the source of failure.

**NOTE: If the Breathing Loop has failed the Positive Pressure Test and the source of failure is known, continue the service with disassembly. Include the needed repair/service before reassembly. The unit will need to be Positive Pressure tested again and pass before being returned to the customer. This is to ensure repairs have fixed the issue and no other leaks were hidden by the initial leak.**

**DISASSEMBLY**

1. If not already done, disconnect LP QD Hoses from **MANUAL ADDITION VALVES (38, 52)**.

2. Pull the Primary HUD Display off of the **DSV/BOV (1)** **(Fig. 6)**. Set it aside carefully. Keep it out of the way so it is not damaged.

Fig. 6

3. Disconnect the **BREATHING HOSES (13, 21)** at the front of each **COUNTERLUNG (30, 44)** by turning the **PLASTIC FITTING NUT (19, 28)** counterclockwise **(Fig. 7)**. Then pull the **PLASTIC ELBOW FITTING (19, 28)** straight out of the **COUNTERLUNG (30, 44) (FIG. 8)**. Inspect the mating surfaces of the fittings for damage. If damaged, replace the appropriate parts.

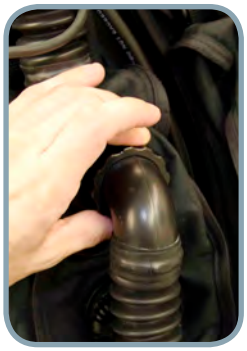


Fig. 7

Fig. 8

4. Disconnect the **BREATHING HOSES (31, 45)** from the Scrubber Head by turning the **PLASTIC NUT FITTING (34, 49)** all the way counter clockwise. Then simply lift the **HOSE (31, 45)** away from the Scrubber Head **(FIG. 9)**. Inspect the mating surfaces of the fittings for damage. If damaged, repair and replace the appropriate parts.

4. Unfasten the Velcro BCD Airway Retainer and Harness straps holding the Counterlungs.

5. Disconnect the Quick Releases and Velcro Attachment that connect the top of the **COUNTERLUNGS (30, 44)** to the Counterlung Mounting Yoke, as Shown. Inspect the Quick Releases and Velcro Fasteners for wear and damage, repair and replace as needed.

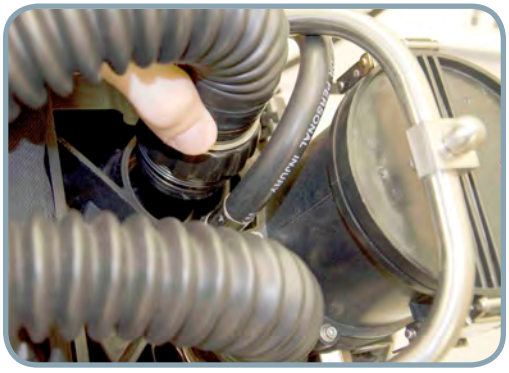


Fig. 9

**NOTE: The Quick Releases and Velcro Fasteners are sewn in place. In the field the COUNTERLUNGS (30, 44) and Counterlung Mounting Yoke can only be replaced. If shipment to the factory is possible, contact Hollis Customer Service for possible repairs of the existing COUNTERLUNG (30, 44) or Counterlung Mounting Yoke.**

6. Turning the **ADV MOUNTING NUT (52)** counterclockwise, remove the **ADV/MANUAL DILUENT ADDITION VALVE (52) (FIG. 10)**. Inspect mating surfaces and the **RUBBER GASKET (53)** for damage. The ADV/Manual Diluent Addition Valve is not serviceable. If damaged or faulty, replace with new. Otherwise, follow the PRISM 2 Service and Parts Replacement Schedule (Doc. 12-4092).

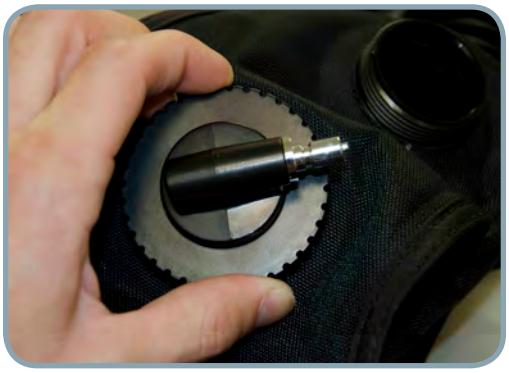


Fig. 10

7. Turning the **OXYGEN VALVE MOUNTING NUT (38)** counterclockwise, remove the **MANUAL OXYGEN ADDITION VALVE (38) (Fig. 11)**. Inspect mating surfaces and the **RUBBER GASKET (39)** for damage. The Manual Oxygen Addition Valve is not serviceable. If damaged or faulty, replace with new. Otherwise, follow the PRISM 2 Service and Parts Replacement Schedule (Doc. 12-4092).

Fig. 11

8. Grasp the base of the **OVER-PRESSURE VALVE (OPV) (40)** and **COUNTERLUNG (30)** material around the base. Then turn the **OVER-PRESSURE VALVE (40)** counterclockwise until it is free of the **COUNTERLUNG (30)**, as shown **(Fig. 12)**. A SI-TECH® attachment tool may be needed if overly tight. Inspect the **OPV (40)**, mating surfaces, and **O-RING (41)** for proper function and damage. The **OPV (40)** should rotate freely with a slight ratcheting function. If damage is found with any of these components, replace the appropriate parts.

**NOTE: A thorough cleaning should rectify any binding in the rotation of the OPV (40). At the time of this writing Hollis is using a SI-TECH® valve identical to those commonly used on Dry-suits. If the valve needs further service besides cleaning, refer to service procedures and/or recommendations from SI-TECH®. You may also simply replace the valve with a new one available from Hollis if you so choose.**

9. Visually inspect the **BREATHING HOSES (13, 21, 31, 45)**, **HOSE CLAMPS (17, 26, 32, 46)**, and **HOSE CLAMP COVERS (18, 27, 33, 47)** for wear and solid connection to fittings. Be sure to stretch and flex the **BREATHING HOSES (17, 26, 32, 46)** looking for cracks, holes, abrasions, and proper pliability. Replace as needed. To disassemble hose connection pull back the **SILICONE HOSE CLAMP COVER (18, 27, 33, 47) (Fig. 13)**. Then using the Oetiker clamp pliers disengage the **HOSE CLAMP'S (17,26,32,47) (Fig. 14)**. Now pull the **HOSE (13, 21, 31, 45)** off of the Connection Fitting.

Fig. 12

Fig. 13

Fig. 14

10. Lay the **COUNTERLUNGS (30, 44)** out and inspect the fabric for tears or obvious signs of abnormal wear. Shake and look inside the **COUNTERLUNGS (30, 44)** to ensure no foreign objects have become trapped in the **COUNTERLUNGS (30, 44)** during storage, service, or transport. Smell the **COUNTERLUNG (30, 44)**. It should not have any distinct odor. If an odor exist, this may be a sign of inappropriate chemical use and/or improper post dive care of the Breathing Loop. Replace or make repairs as necessary.

**NOTE: If an odor is detected in the COUNTERLUNGS (30, 44), counsel the owner on better care of the Breathing Loop.**

**CAUTION: While the COUNTERLUNGS (30, 44) are quite robust, one must never dive with COUNTERLUNGS (30, 44) that show signs of excessive wear or damage. Since COUNTERLUNG (30, 44) integrity failure during a dive would cause immediate and catastrophic flooding of the Breathing Loop.**

**NOTE: If the DRAIN VALVES (43, 54) do not leak due to heavy corrosion damage or need to be replaced, skip step 11.**

11. **ONLY** if replacing, remove and discard the **DRAIN VALVES (43, 54)**. Grip the drain spout in one hand, and pull the **DRAIN VALVE (43,54)** out with the other hand **(Fig. 15)**.

12. Leave the Breathing hoses connected to the DSV/BOV for Mushroom Valve Testing. Test the Mushroom Valves and Service the **DSV/BOV (1)** as described in the DSV/BOV section of this service guide.

13. Clean and disinfect all components of the Breathing Loop with chemicals currently approved by Hollis before reassembly.

**REASSEMBLY**

1. Place a **O-RING (41)** on the **OVER-PRESSURE VALVE (OPV) (40)**, as shown **(Fig. 16)**. Thread and tighten it clockwise into the counterlung fitting, until snug. **DO NOT** over-tighten.

Fig. 15

Fig. 16

2. Place a **RUBBER GASKET (39)** inside the Oxygen Addition Fitting of the right side **COUNTERLUNG (30)**. Start the **VALVE PLASTIC NUT (38)** of the **OXYGEN MANUAL ADDITION VALVE (38)**, threading clockwise. Then align the index of the **VALVE (38)** to orient the hose fitting, pointing upwards as shown. Continue threading the **PLASTIC NUT (38)**, until tight, while holding the valve in place **(Fig. 17)**. **DO NOT** over-tighten.

**NOTE: The RUBBER GASKET (53) should already be attached to the ADV/MANUAL DILUENT VALVE (52). If it is not, seat a new GASKET (53) onto the flange of the ADV/MANUAL DILUENT VALVE (52).**

3. Insert the **ADV/MANUAL DILUENT ADDITION VALVE (52)** through the hole in the **PLASTIC NUT (52)**. Start the **PLASTIC NUT (52)**, threading clockwise onto the Diluent Add Fitting of the Left Side **COUNTERLUNG (44)**. Then align the index of the **VALVE (52)** to orient the hose fitting, pointing upwards as shown. Continue threading the **PLASTIC NUT (52)**, until tight, while holding the **VALVE (52)** in place **(Fig. 18)**. **DO NOT** over-tighten.

**NOTE: If the Drain Valves were not removed, skip step 4.**

4. Insert the barbed fitting of the **DRAIN VALVE (43, 54)** into the drain spout, and push it into the drain spout until fully seated **(Fig. 19)**.

5. Position and fasten the Velcro panels of the **COUNTERLUNGS (30, 44)** to the Counterlung Mounting Yoke, as shown **(Fig. 20)**. Then fasten the quick release buckles of both **COUNTERLUNGS (30, 44)** to the Counterlung Mounting Yoke.

5. Lightly lubricate all **BREATHING HOSE FITTING O-RINGS (15, 20, 24, 29, 37, 51)** with Hollis approved lubricant. Then position them inside their respective O-ring grooves.

**WARNING: Before proceeding, the MUSHROOM VALVES (12, 23) must be inspected following the BOV/DSV section of this service guide.**

**NOTE: If BREATHING HOSES (13, 21, 31, 45) were not removed from their respective fittings then skip to step 8.**

Fig. 17

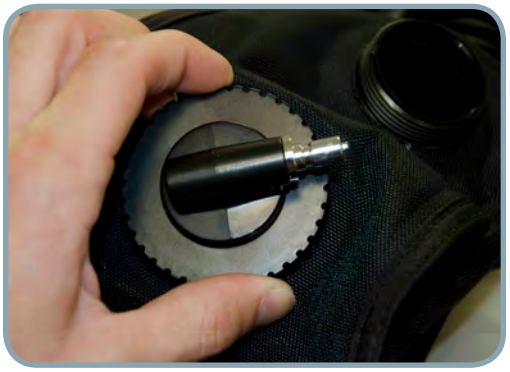


Fig. 18

Fig. 19

Fig. 20

6. Reinstall the **INHALATION DIAPHRAGM CAGE (22)** into the end of the **LEFT SIDE BREATHING HOSE (21)**. Using Clamp Pliers attach **HOSE CLAMPS (26)** to secure the **HOSE (21)**. Ensure that the **CLAMPS (26)** have their **PROTECTIVE SLEEVE (27)** installed over them. No **HOSE CLAMP (26)** should be exposed.

7. Install all remaining **HOSES (13, 21, 31, 45)** to their respective fittings, using Clamp Pliers to fasten the **CLAMPS (17, 26, 32, 46)**. Ensure that all **CLAMPS (17, 26, 32, 46)** have their **PROTECTIVE SLEEVES (18, 27, 33, 47)** installed over the **HOSE CLAMPS (17, 26, 32, 46)**. No **HOSE CLAMP (17, 26, 32, 46)** should be exposed.

8. Run the **BREATHING HOSES (31, 45)** at the top of the **COUNTERLUNGS (30, 44)** to their respective ports on the Scrubber Head. Thread the **FITTINGS (34, 49)** into their ports, clockwise until hand tight **(Fig. 21)**. **DO NOT** over-tighten.

**CAUTION: The captive O-ring, not torque, seals the fitting. Excessive torque will only serve to make the hoses difficult to remove or even damage the fitting.**

**WARNING: Ensure that the BREATHING HOSE (21) with the INHALE DIAPHRAGM CAGE (22) has the 6-sided hex ELBOW FITTING (28). See the section on BOV/DSV in this service guide for further information.**

8. Attach the **FORWARD INHALATION-SIDE BREATHING HOSE (21)** to the Inhalation (Diver's Left-Side) **COUNTERLUNG (44)**. Start the threads clockwise. Then adjust and seat the elbow into the proper orientation, about 135° **(Fig. 22)**. Tighten the fitting until hand tight. **DO NOT** over-tighten.

**CAUTION: The captive O-ring, not torque, seals the fitting. Excessive torque will only serve to make the hoses difficult to remove or even damage the fitting.**

**NOTE: At the time of this writing, production units have a silver index mark for the correct orientation of the FITTING (28) (FIG. 23).**

Fig. 21

Fig. 22

Fig. 23

9. Attach the **FORWARD EXHALATION-SIDE BREATHING HOSE (13)** to the Exhalation (Diver's Right-Side) **COUNTERLUNG (44) (FIG. 24)**. Start the threads clockwise. Then adjust and seat the elbow into the proper orientation, about 225°. Tighten the fitting until hand tight. **DO NOT** over-tighten.

**CAUTION: The captive O-ring, not torque, seals the fitting. Excessive torque will only serve to make the hoses difficult to remove or even damage the fitting.**

**NOTE: At the time of this writing, production units have a silver index mark for the correct orientation of the FITTING (19) (Fig. 23).**

**WARNING: Before proceeding, the Exhalation MUSHROOM VALVE (12) and BOV/DSV (1) must be serviced and inspected following the BOV/DSV section of this service guide.**

**NOTE: If the Breathing hoses (13, 21) are not already installed on the DSV/BOV after service of the DSV/BOV, do so now. Otherwise, skip steps 10 and 11.**

10. Thread the Forward **EXHALATION BREATHING HOSE COUPLING (16)**, clockwise, onto the **BOV/DSV (1)** (Arrow Head Side). Ensure the **BOV/DSV (1)** is oriented as shown **(Fig. 25)**. Then tighten hand tight. **DO NOT** over-tighten.

**CAUTION: The captive O-ring, not torque, seals the fitting. Excessive torque will only serve to make the Hoses difficult to remove or even damage the Fitting.**

11. Thread the **FORWARD INHALATION BREATHING HOSE (21)** coupling, clockwise, onto the **BOV/DSV (1)** (Arrow Tail Side). Ensure the **BOV/DSV (1)** is oriented as shown **(Fig. 26)**. Then tighten hand tight. **DO NOT** over-tighten.

**CAUTION: The captive O-ring, not torque, seals the Fitting. Excessive torque will only serve to make the Hoses difficult to remove or even damage the Fitting.**

**NOTE: If the BOV/DSV (1) is not fitting to the hose couplings, the BOV/DSV (1) is not oriented to the correct side, or the INHALATION MUSHROOM CAGE (22) was installed on the wrong hose. Reread the BOV/DSV section of this service guide.**

Fig. 24

Fig. 25

Fig. 26

**POSITIVE PRESSURE TEST REPEATED (to check for component integrity after reassembly)**

1. Ensure all Breathing Loop components are connected and properly tightened as described in the above sections.

2. Rotate the **OVER-PRESSURE VALVE (OPV) (40)** body clockwise until it is fully closed.

3. Close the **DSV/BOV (1)**.

4. Using a **regulator first stage** and **Diluent LP QD hose** attached to the **ADV/MANUAL DILUENT VALVE (52)**, fill the **COUNTERLUNGS (30, 44)** with pure breathing gas, until gas vents from the **OVER-PRESSURE VALVE (OPV) (40)**. The **COUNTERLUNGS (30, 44)** should be full and firm to the touch.

5. Listen for any air escaping. Also look for any deflation of the **COUNTERLUNGS (30, 44)**.

6. Let the unit stand for 5 minutes inflated. Look again for any deflation or loss of **COUNTERLUNG (30, 44)** fullness.

7. Any escaping air or deflation means the breathing loop has failed The Positive Pressure Test.

**NOTE: The Shearwater Secondary can be used as a digital gauge to verify pressure loss. With positive pressure applied and the DSV closed, the Oxygen Sensor readings should raise to about 0.22 ~ 0.23 $PO_2$. If the Oxygen Sensor readings start to drop back to 0.21 $PO_2$ after 1 minute, there is a positive pressure leak**

8. If the unit passes step 7, open the **DSV/BOV (1)**. There should be a rush of air released. If that is not the case, the Breathing Loop has lost gas - failed the test.

**NOTE: Be aware that if the ambient temperature and introduced gas temperature are not matched the unit may falsely fail the Positive Pressure Test. Avoid this by allowing the unit and breathing gas supply tanks to reach room temperature before performing the test.**

9. If the Breathing Loop has failed this test, repair/replace any leaking component found during this test. Repeat the test as necessary to find the source of failure.

## NEGATIVE PRESSURE TEST

**NOTE: This test differs from a Positive Pressure Test but is no less critical. Parts that pass a Positive Pressure Test may fail in a negative (vacuum) state. Much like a Mushroom Valve opens and closes, a damaged O-ring may leak under internal pressure and close with the presence of external pressure. Depending on the nature of the problem the opposite may be true. Hence there is a need to complete both tests.**

**WARNING: Ensure that the gas inside the Breathing Loop is safe (non-toxic, adequate oxygen, no foreign objects, or off-gassing chemicals/materials) before attempting to pull a negative pressure on the Breathing Loop with your lungs.**

1. Open the **DSV/BOV (1)** to release any positive pressure from the Breathing Loop. Squeeze any additional volume from the **COUNTERLUNGS (30, 44)**, removing as much gas as possible.

2. With the **DSV/BOV (1)** in your mouth, inhale with your mouth, and exhale from your nose. Repeat this until no more gas is present in the Breathing Loop and the **COUNTERLUNGS (30, 44)** are fully collapsed.

3. While the Breathing Loop is fully collapsed, with the **BREATHING HOSES (13, 21, 31, 45)** shortened, and the **DSV/BOV (1)** is still in your mouth, close the **DSV/BOV (1)**.

4. Allow the system to sit for one minute.

5. Look for any signs of vacuum loss. Have the **COUNTERLUNGS' (30, 44)** fabric relaxed or the **BREATHING HOSES (13, 21, 31, 45)** expanded (lengthened)? This or any other sign of vacuum loss means the system has failed the test.

**NOTE: The Shearwater Secondary can be used as a digital gauge to confirm vacuum loss, increase of pressure. With vacuum applied and the DSV closed, the Oxygen Sensor readings should drop to about 0.19 $PO_2$. If the Oxygen Sensor readings start to creep back up to 0.21 $PO_2$ after 1 minute, there is a negative pressure leak.**

6. The final check is to open the **DSV/BOV (1)**. A brief and sudden rush of air should be observed as the internal Breathing Loop pressure equalizes with ambient pressure. Non-occurrence is a sure sign that there is a leak.

7. If the Breathing Loop has failed this test, repair/replace any leaking component found during this test. Repeat the test as necessary to find the source of failure.

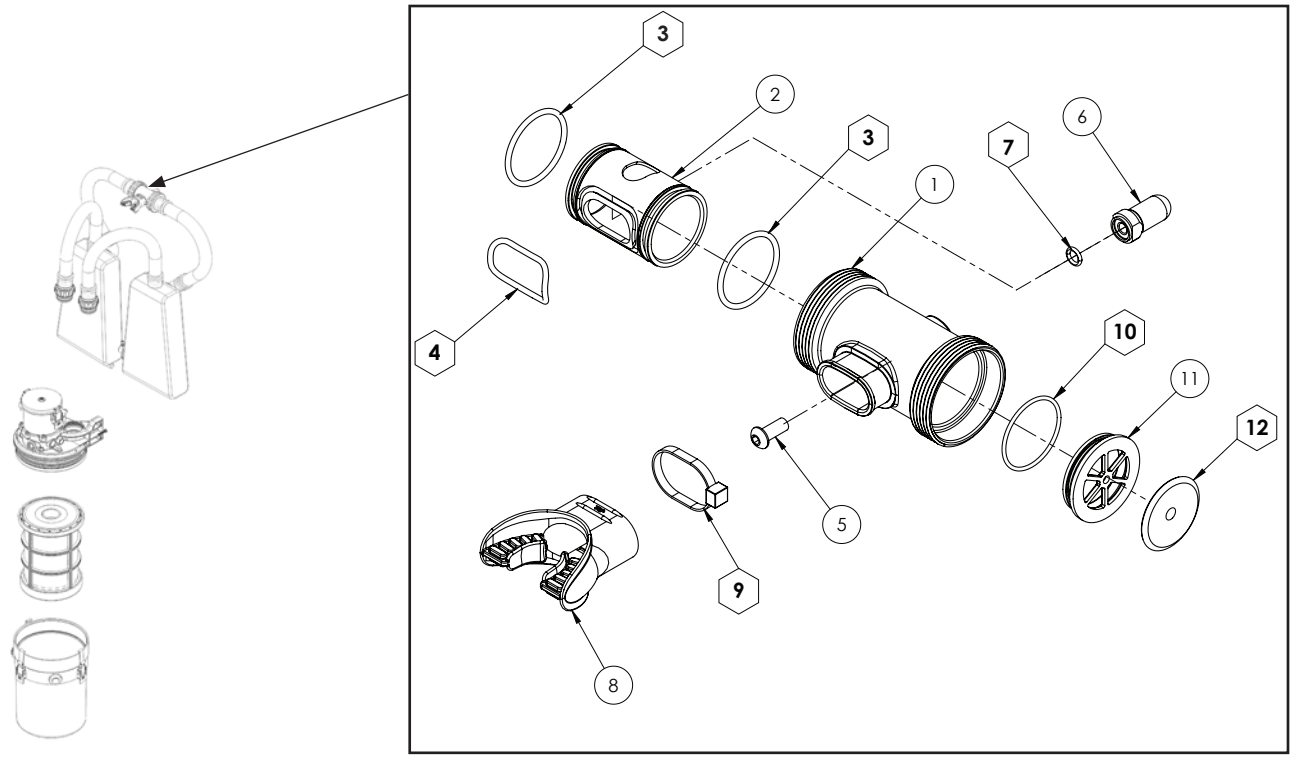
**DISASSEMBLE AND DISINFECT PARTS**

1. Follow the proceeding subsection Disassembly to break down the Breathing Loop.

2. Clean the components with Steramine™ solution.

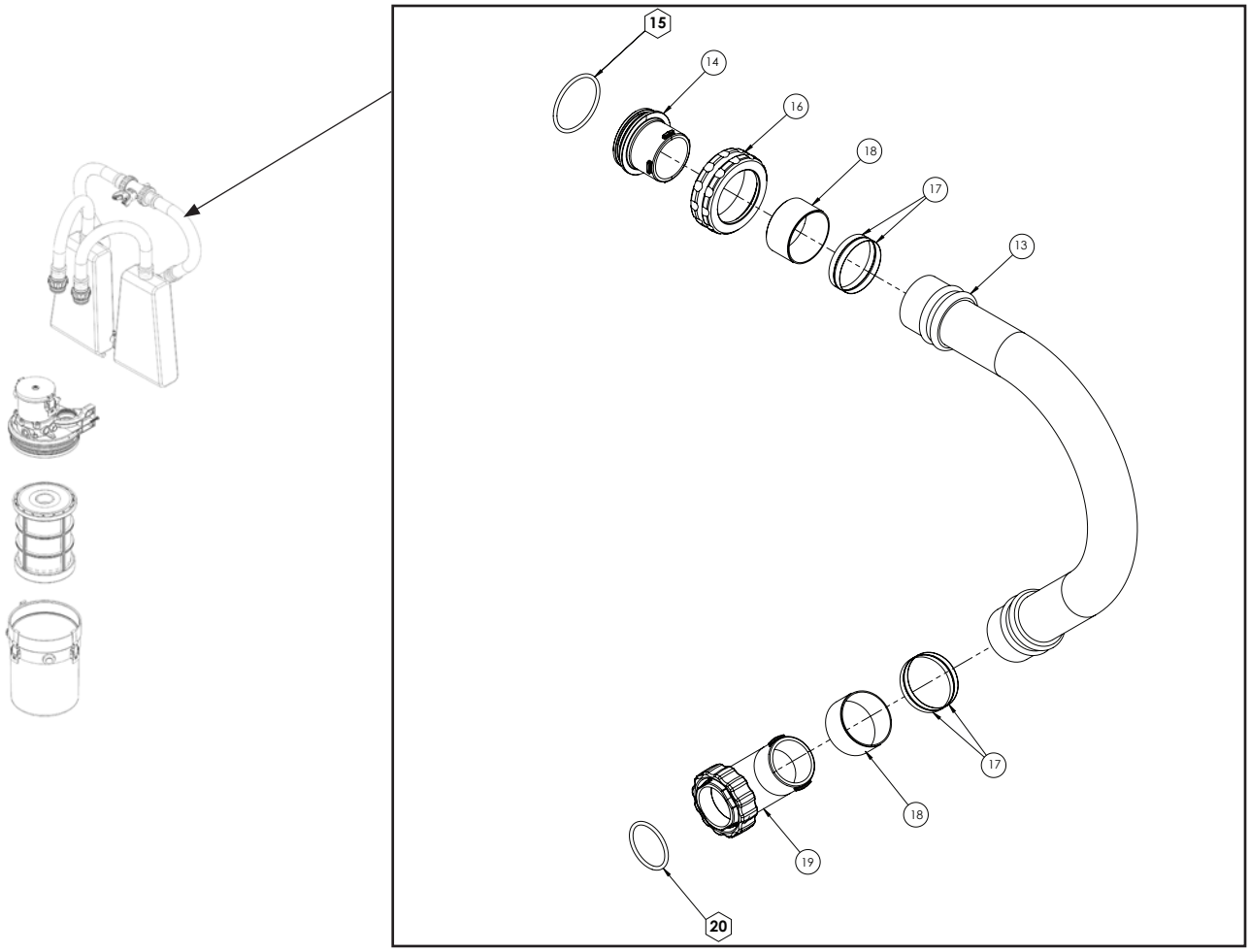
3. Drain the components, and hang them to dry.

# DIVE SURFACE VALVE (DSV) DIAGRAM



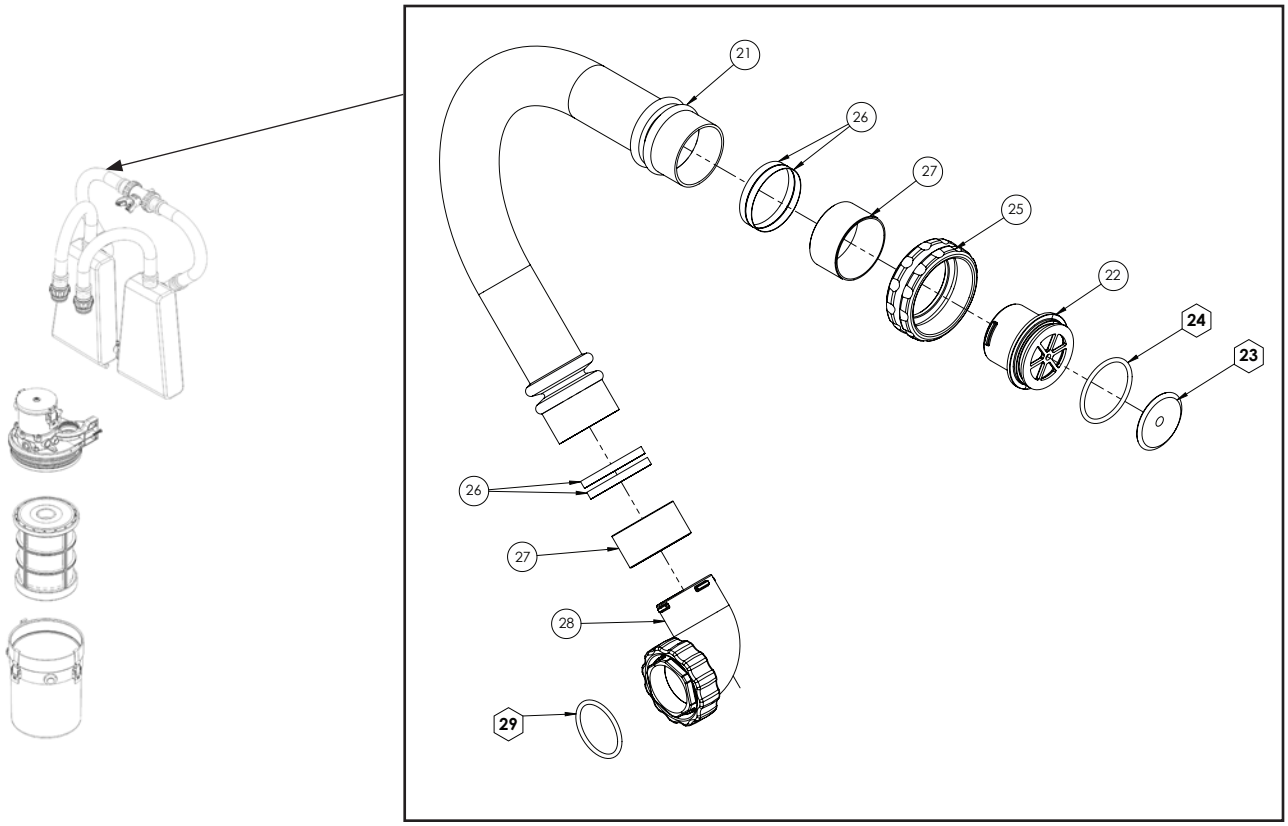

| DIA. | CAT. | P/N | DESCRIPTION | NOTES |
|---|---|---|---|---|
| 1 | c | 27762 | BODY, DSV | |
| 2 | c | 27760 | BARREL | |
| **3** | **a** | **22-126** | **O-RING** | **QTY: 2** |
| **4** | **a** | **29136** | **O-RING** | |
| 5 | c | 27350 | SCREW | |
| 6 | c | 27761 | KNOB | |
| **7** | **a** | **22-010** | **O-RING** | |
| 8 | b | 27031 | MOUTHPIECE | |
| **9** | **a** | **21978** | **TY-STRAP** | |
| **10** | **a** | **22-028** | **O-RING** | |
| 11 | c | 27763 | HOLDER, OUTLET | |
| **12** | **a** | **27765** | **MUSHROOM VALVE** | |

# EXHALATION HOSE ASSEMBLY DIAGRAM



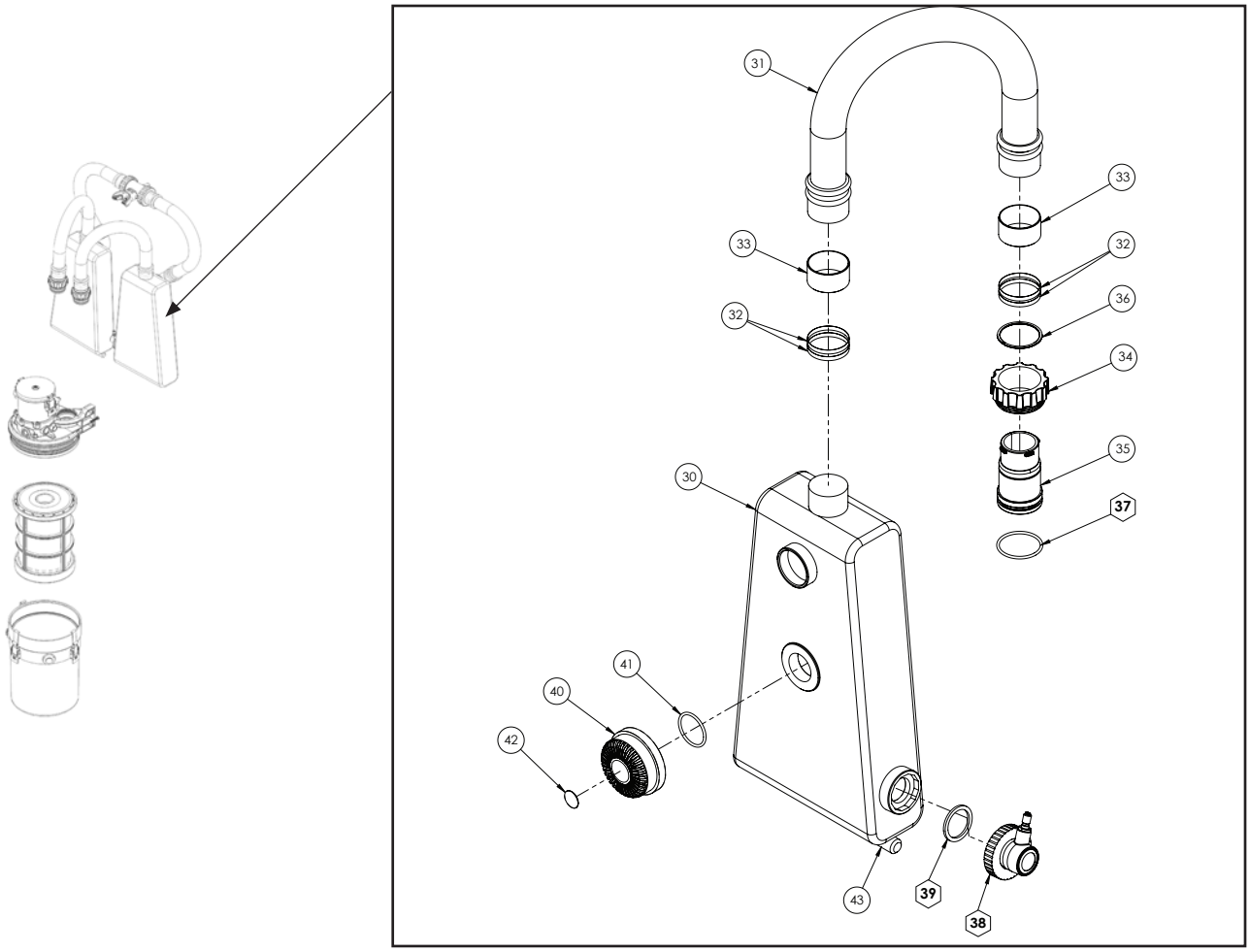

| DIA. | CAT. | P/N | DESCRIPTION | NOTES |
|---|---|---|---|---|
| 13 | b | 28330.14 | HOSE, BREATHING | |
| 14 | c | 27768 | ADAPTER, HOSE OUTLET | |
| **15** | **a** | **22-130** | **O-RING** | |
| 16 | c | 27766 | NUT, CHROME | |
| 17 | c | 28333 | HOSE CLAMP | QTY: 4 |
| 18 | b | 28364 | COVER, HOSE CLAMP | QTY: 2 |
| 19 | c | 27805 | ELBOW ASSY., EXHALE | |
| **20** | **a** | **22-125** | **O-RING** | |

# INHALATION HOSE ASSEMBLY DIAGRAM



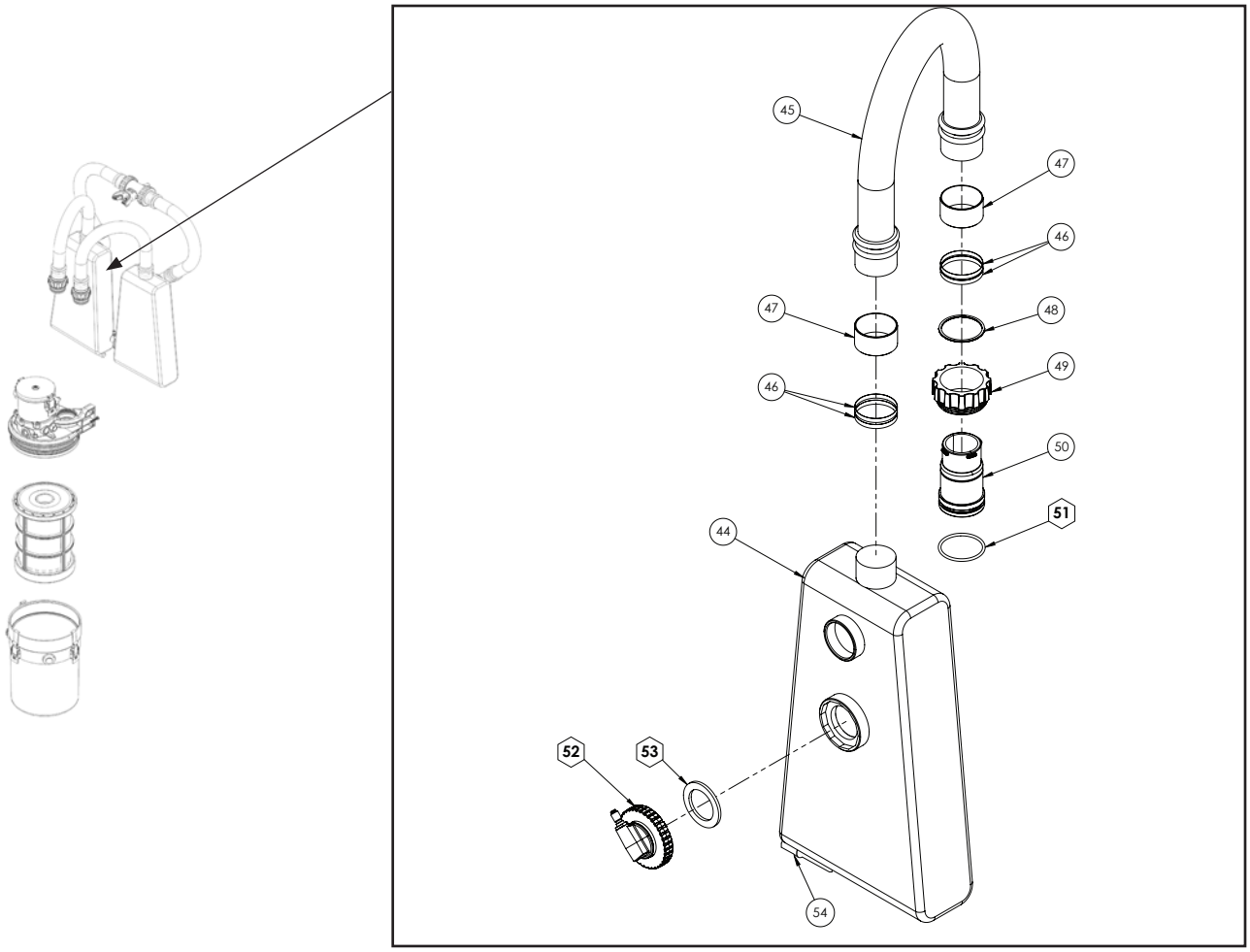

| DIA. | CAT. | P/N | DESCRIPTION | NOTES |
|---|---|---|---|---|
| 21 | b | 28330.14 | HOSE, BREATHING | |
| 22 | c | 27764 | HOLDER, INLET | |
| **23** | **a** | **27765** | **MUSHROOM VALVE** | |
| **24** | **a** | **22-128** | **O-RING** | |
| 25 | c | 27765 | NUT, CHROME | |
| 26 | c | 28333 | CLAMP | QTY: 4 |
| 27 | b | 28364 | COVER, HOSE CLAMP | QTY: 2 |
| 28 | c | 27806 | ELBOW ASSY., INHALE | |
| **29** | **a** | **22-125** | **O-RING** | |

# EXHALATION COUNTERLUNG ASSEMBLY DIAGRAM




| DIA. | CAT. | P/N | DESCRIPTION | NOTES |
|---|---|---|---|---|
| 30 | c | 28133 | COUNTERLUNG, EXHALE | |
| 31 | b | 28330.14 | HOSE, BREATHING | |
| 32 | c | 28333 | CLAMP | QTY: 4 |
| 33 | b | 28364 | COVER, HOSE CLAMP | QTY:2 |
| 34 | c | 27813 | NUT, CHROME | |
| 35 | c | 27770 | ADAPTER, HOSE | |
| 36 | c | 28992 | RETAINING RING | |
| **37** | **a** | **29235** | **O-RING** | |
| **38** | **a** | **27960** | **O2 ADDITION VALVE** | |
| **39** | **a** | **219045** | **GASKET** | |
| 40 | c | 24664 | OPV, LP | |
| 41 | b | 22-125 | O-RING | |
| 42 | c | 24558 | HOLLIS LOGO, BUTTON | |
| 43 | c | 23237 | ORAL VALVE, METAL | |

# INHALATION COUNTERLUNG ASSEMBLY DIAGRAM




| DIA. | CAT. | P/N | DESCRIPTION | NOTES |
|---|---|---|---|---|
| 44 | c | 28134 | COUNTERLUNG, INHALE | |
| 45 | b | 28330.14 | HOSE, BREATHING | |
| 46 | c | 28333 | CLAMP | QTY: 4 |
| 47 | b | 28364 | COVER, HOSE CLAMP | QTY: 2 |
| 48 | c | 28992 | RETAINING RING | |
| 49 | c | 27813 | NUT, CHROME | |
| 50 | c | 27770 | ADAPTER, HOSE | |
| **51** | **a** | **29235** | **O-RING** | |
| **52** | **a** | **27961** | **DILUENT ADD VALVE** | |
| **53** | **a** | **28080** | **GASKET** | |
| 54 | c | 23237 | ORAL VALVE, METAL | |

# 2. DIVE SURFACE VALVE (DSV)

## Tools Required

**Standard Tools**

magnifying lens
inspection light
dowel or rounded tool handle

**Specialty Tools**

| | |
|---|---|
| P/N 220.9102 | Tribolube 71 |
| P/N 220.9101 | Christo-Lube MCG 111 |
| P/N TBD | Oetiker clamp pliers |
| P/N TBD | STERAMINE™ cleaner |
| P/N TBD | Retaining Nut Tool |
| P/N TBD | O-ring removal tool (plastic) |

## TROUBLESHOOTING

| SYMPTOMS | POSSIBLE CAUSE | TREATMENT |
|---|---|---|
| failed Mushroom Valve checks | obstructed or damaged **MUSHROOM VALVES (12, 19)** | clean /replace **MUSHROOM VALVES (11)**, clean **VALVE HOLDERS (9,15)** |
| leaking gas out of Breathing Loop | worn **O-RINGS (3, 4, 7, 18, 20)** | replace **O-RINGS (3, 4, 7, 18, 20)** |
| rough barrel operation | dirty barrel mating surfaces | clean/lubricate/replace **O-RINGS (3, 4)** |
| water entering barrel | 1. Mouthpiece **TY-STRAP (9)** loose or missing<br>2. bad O-rings<br>3. Leak in Breathing Loop | 1. replace **TY-STRAP (9)**<br>2. replace O-rings<br>3. see section on the Breathing Loop |

## MUSHROOM VALVE CHECKS (STEREO CHECKS)

The one way mushroom valves control the direction breathing gas flows through the Breathing Loop. Functional Mushroom Valves ensure that all exhaled gas passes through the Scrubber to remove $CO_2$ before it is breathed again. The following is a description of a Mushroom Valve Test that will help you evaluate and diagnose any problems before disassembly of the DSV and Hose Assembly.

1. Clean and disinfect the DSV and **HOSES (13, 25)**.

2. Set the DSV to surface mode by Closing the Mouthpiece.

3. Start the test by breathing into the **INHALATION HOSE (13)**. Your breath should flow out the **EXHALATION HOSE (25)**. Then try to breathe in. You should not be able to. If you can breathe in, check the **MUSHROOM VALVE (19)**, **INLET HOLDER (17)**, **CLAMPS (14)**, and **HOSE (13)** for damage.

4. Next, reverse the hose assembly and test. With the **EXHALATION HOSE (25)** in your mouth you should be able to inhale but not exhale this time. If you can exhale through the assembly, check the **MUSHROOM VALVE (12)**, **O-RINGS (10, 20)**, **FITTINGS (11, 21)**, **CLAMPS (24)**, **BODY (1)**, and **HOSE (25)** for damage.

**DISASSEMBLY**

1. Slide the **SILICONE HOSE CLAMP COVER (15, 23)** off of the **HOSE CLAMPS (14, 24)** on the **INHALATION HOSE (13)** and **EXHALATION HOSE (25)**, where it mounts to the DSV.

2. Using hose clamp pliers, remove the **HOSE CLAMPS (14, 24)** from the **INHALATION HOSE (13)** and **EXHALATION HOSE (25) (FIG. 1)**.

3. Gently pull the **INHALATION HOSE (13)** off of the **HOSE INLET HOLDER (17) (Fig. 2)**.

4. Turning counterclockwise, remove both **HOSE NUTS (16, 22)** from the DSV.

5. Inspect the **HOSE NUT (16, 22)** threads for damage. Clean and/or replace them as needed.

6. Pull the **HOSE INLET HOLDER (17)** and **HOSE OUTLET ADAPTER (21)** straight out of the DSV **(Fig. 3)**.

7. With the rounded handle of a screw driver, similar hand tool, or dowel press the **OUTLET HOLDER (11)** from the DSV **(Fig. 4)**.

8. Inspect the seating surface on the **OUTLET HOLDER (11)** and **INLET HOLDER (17)**. The surfaces should be smooth and provide a good sealing surface for the Mushroom Valves.

9. If the **MUSHROOM VALVES (12, 19)** require replacement, it may be removed by grasping it at the Flange and pulling it straight out, snipping the Retainer Stem if necessary. Discard.

10. Remove the **O-RINGS (10, 18, 20)** from the **OUTLET HOLDER (11)**, **OUTLET ADAPTER (21)** and **INLET HOLDER (17)**. Discard.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

11. Turning counterclockwise, remove the **KNOB SCREW (5)**, **KNOB (6)**, and **O-RING (7)** using a 5/32" Allen Driver. See **(Fig. 5)**. Inspect the **O-RING (7)** for any signs of decay. Discard if found.

12. Using your thumbs, press the **BARREL (2)** out of the DSV **BODY (1)** in the same direction as the arrow molded on the DSV **BODY (1) (Fig. 6)**.

13. Remove the three **O-RINGS (3,4)** from the grooves of the **BARREL (2)** and discard.

14. Inspect the O-ring channels and the **KNOB (6)** O-ring mounting face for nicks, gouges, and other damage that would prevent the **O-RINGS (3, 4, 7)** from sealing properly. If damage is found the **BARREL (2)** must be replaced.

15. Snip the plastic **TY-STRAP (9)** that holds the **MOUTHPIECE (7)**, and remove the **MOUTHPIECE (8)**. Inspect the condition of the **MOUTHPIECE (8)** to ensure that it is supple and free of any tears or damage. Discard if found.

16. Clean all DSV Assembly parts and inspect for cracks and other damage.

**NOTE: Metal DSV Assembly parts may be cleaned in a sonic bath. Plastic components should be cleaned in Simple Green®.**

**REASSEMBLY**

1. Lubricate **O-RINGS (3,4)** with Hollis approved lubricant and install them into the Stainless Steel Barrel **(Fig. 7)**.

2. Lightly lubricate the internal walls of the **BODY (1)** with Hollis approved lubricant.

3. Being Careful not to pinch any **O-RINGS (3,4)**, slide the **BARREL (2)** the opposite direction of the molded arrow into the **BODY (1) (Fig. 8)**.

4. Turn the **BARREL (2)** so the mouth opening is aligned with the mouth opening on the DSV **BODY (1)**.

Fig. 5

Fig. 6

Fig. 7

Fig. 8

5. Holding the **KNOB (6)** in one hand, place the **O-RING (7)** in the groove as shown **(Fig. 9)**.

6. Turning clockwise, tighten the **KNOB SCREW (5)** with a 5/32" Allen Driver **(Fig. 10)**. **DO NOT** over-tighten.

**NOTE: If replacing the MUSHROOM VALVES (12, 19), ensure not to place damaging stress on the VALVE HOLDER (11, 17).**

7. If removed, replace the **MUSHROOM VALVES (12, 19)** by gently pulling the Retainer Stem through the **VALVE HOLDERS (11,17)** until the Retaining Flange is completely inside the Valve Holders and properly seated **(Fig. 11)**.

8. Lightly lubricate the **HOLDER O-RINGS (10, 18, 20)** with Hollis approved lubricant, and install the **O-RINGS (10, 18, 20)** in the grooves of the **INLET HOLDER (17)**, **OUTLET HOLDER (11)**, and **OUTLET ADAPTER (21)**.

9. Press the **OUTLET HOLDER (11)** into the arrowhead side of the **BODY (1)**, as shown **(Fig. 12)**.

Fig. 9

Fig. 10

Fig. 11

Fig. 12

10. Press the **INLET HOLDER (17)** and **OUTLET ADAPTER (21)** onto their respective sides of the **BODY (1) (Fig. 13)**.

**NOTE: The INLET HOLDER (17) and OUTLET ADAPTER (21) are not interchangeable. They will only fit together on their correct sides .**

11. Thread the **DSV NUTS (16, 22)** clockwise onto the **BODY (1)** and tighten. **DO NOT** over-tighten.

12. Install the **INHALATION HOSE (13)** onto the **INLET VALVE HOLDER (17)** until the nodes seat in the first corrugation ring, as shown **(Fig. 14)**.

13. Install two **HOSE CLAMPS (14)** with hose clamp pliers **(Fig. 15)**.

14. Slide the **Silicone Hose Clamp Cover (15)** over the **HOSE CLAMPS (14) (Fig. 16)**.

15. Repeat steps 12 - 14 for the exhalation side components.

16. Install the **MOUTHPIECE (8)** onto the DSV **BODY (1)** with a **TY-STRAP (9)**.

Fig. 13

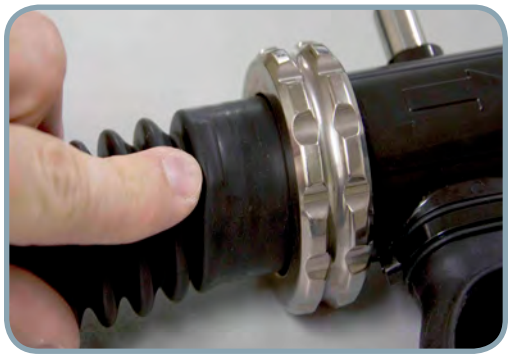
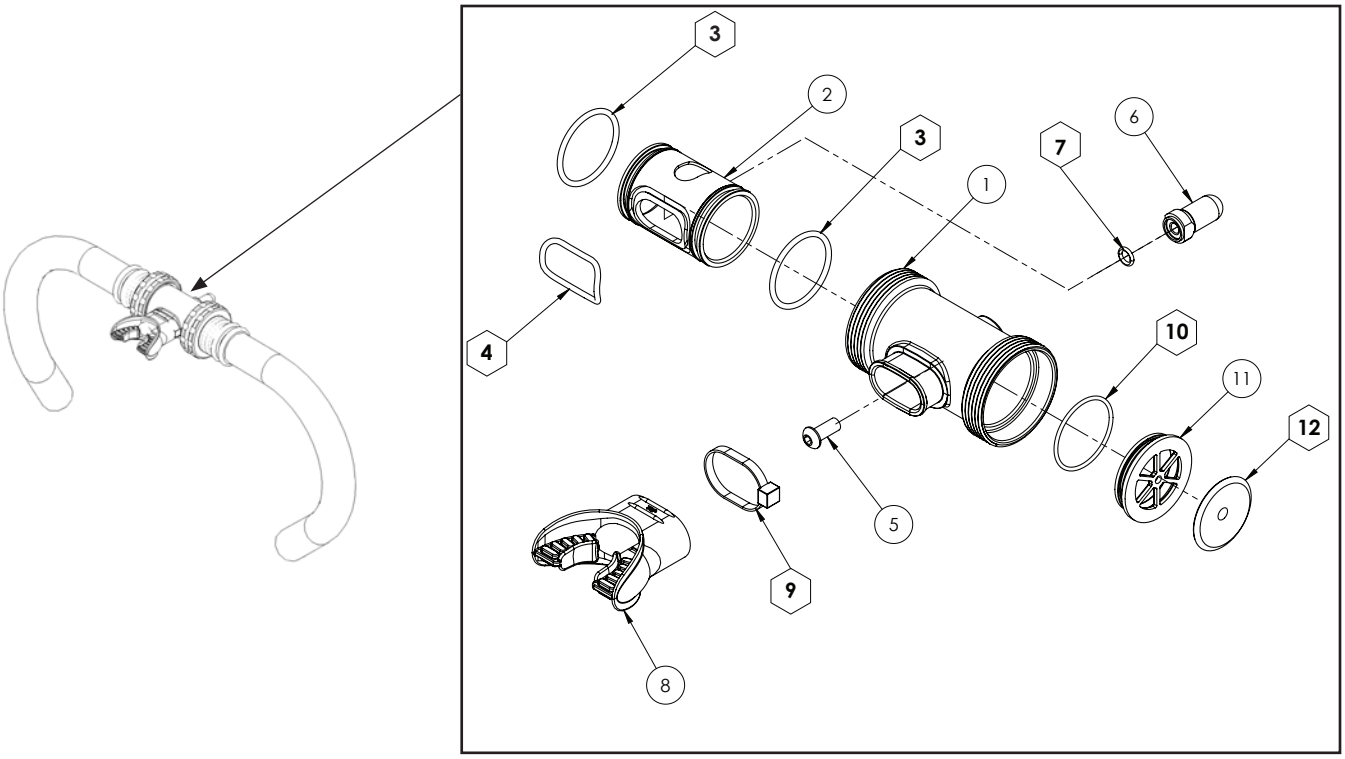


Fig. 14

Fig. 15

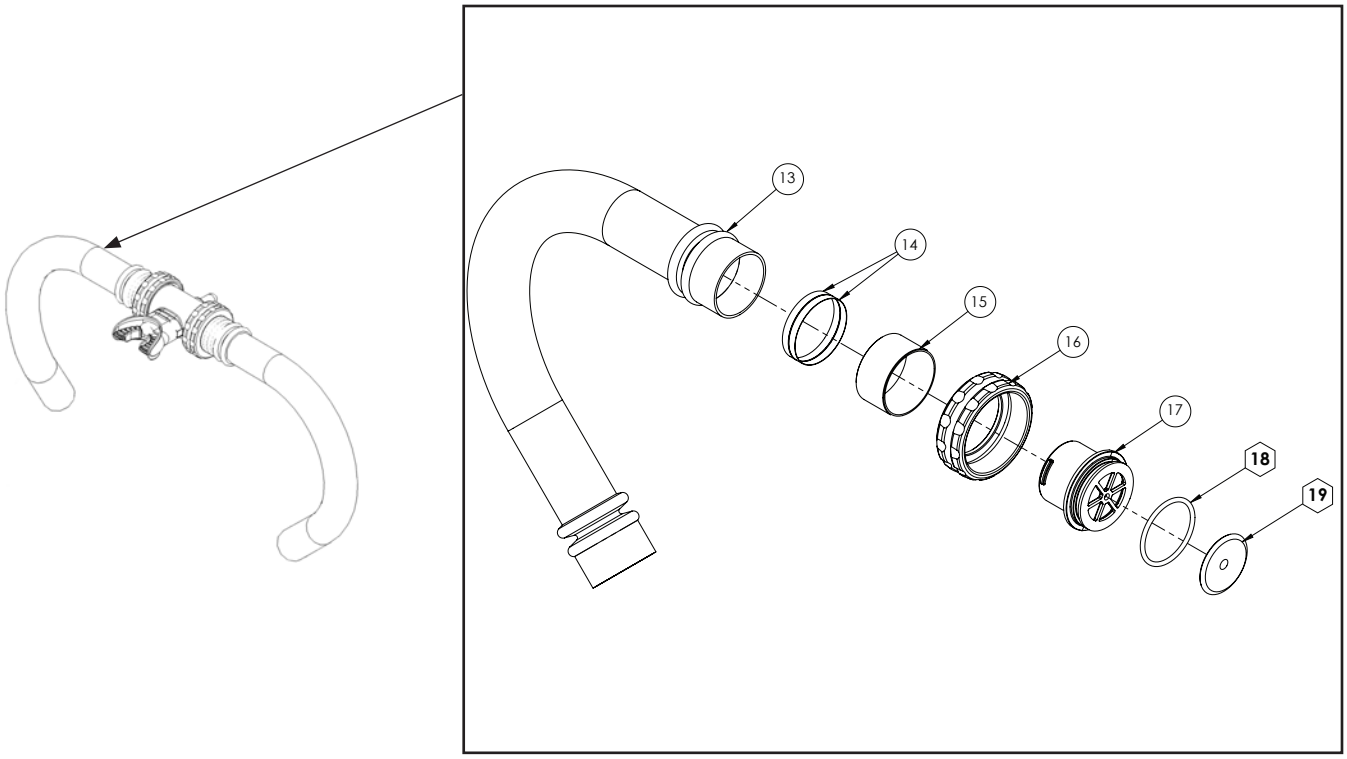
Fig. 16

# DIVE SURFACE VALVE (DSV) DIAGRAM



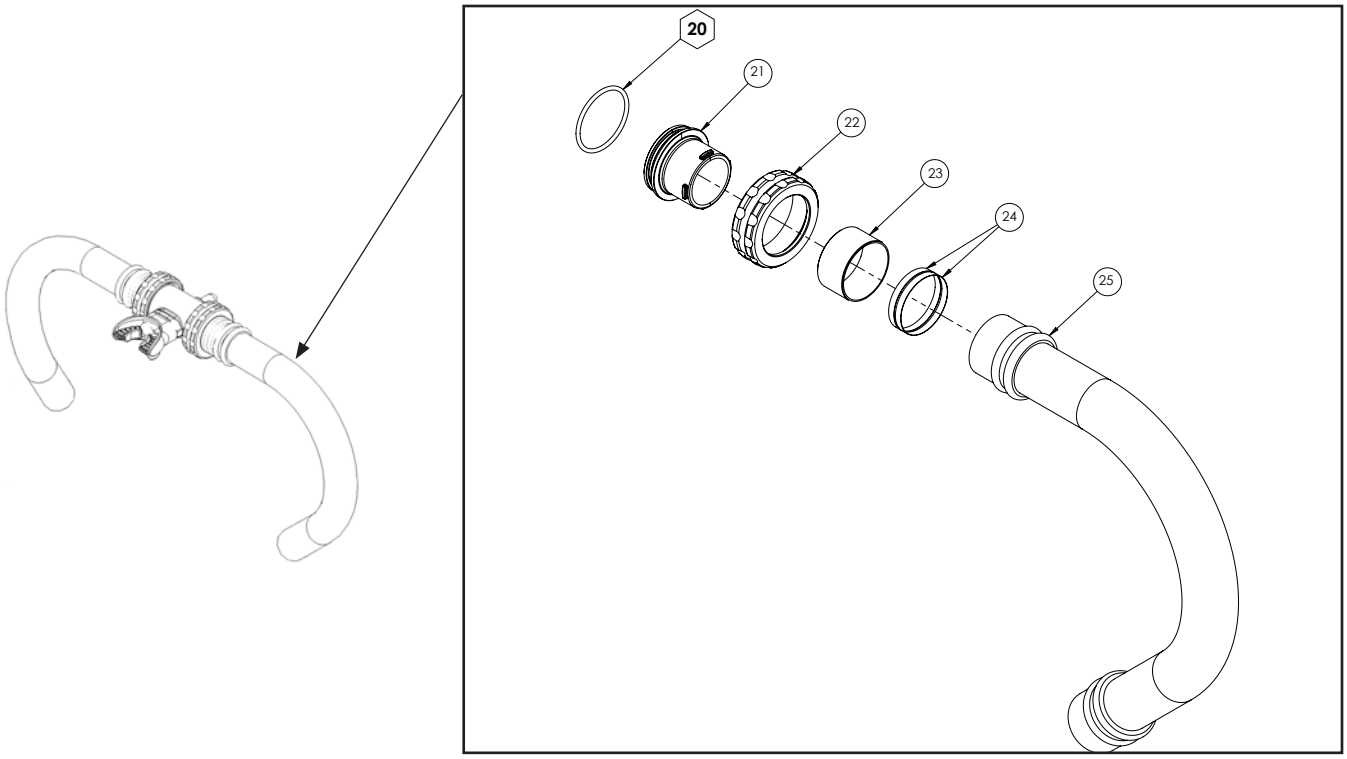

| DIA. | CAT. | P/N | DESCRIPTION | NOTES |
|---|---|---|---|---|
| 1 | c | 27762 | BODY | |
| 2 | c | 27760 | BARREL | |
| **3** | **a** | **22-126** | **O-RING** | **QTY: 2** |
| **4** | **a** | **29136** | **O-RING** | |
| 5 | c | 27350 | SCREW | |
| 6 | c | 27761 | KNOB | |
| **7** | **a** | **22-010** | **O-RING** | |
| 8 | b | 27031 | MOUTHPIECE | |
| **9** | **b** | **21978** | **TY-STRAP** | |
| **10** | **a** | **21978** | **O-RING** | |
| 11 | c | 27763 | HOLDER, OUTLET | |
| **12** | **a** | **27765** | **MUSHROOM VALVE** | |

# INHALATION HOSE DIAGRAM




| DIA. | CAT. | P/N | DESCRIPTION | NOTES |
|---|---|---|---|---|
| 13 | b | 28330.14 | HOSE, BREATHING | |
| 14 | c | 28333 | CLAMP | QTY: 2 |
| 15 | b | 28364 | COVER, HOSE CLAMP | |
| 16 | c | 27766 | NUT | |
| 17 | c | 27764 | HOLDER, INLET | |
| **18** | **a** | **22-128** | **O-RING** | |
| **19** | **a** | **27765** | **MUSHROOM VALVE** | |

# EXHALATION HOSE DIAGRAM




| DIA. | CAT. | P/N | DESCRIPTION | NOTES |
|---|---|---|---|---|
| **20** | **a** | **22-130** | **O-RING** | |
| 21 | c | 27768 | ADAPTER, HOSE OUTLET | |
| 22 | c | 27760 | NUT | |
| 23 | b | 28364 | COVER, HOSE CLAMP | |
| 24 | c | 28333 | CLAMP | QTY: 2 |
| 25 | b | 28330.14 | HOSE, BREATHING | |

# 3. SCRUBBER BUCKET, SCRUBBER BASKET, & SCRUBBER O-RINGS

## Specifications

**Torques**

| | | |
|---|---|---|
| P/N 28084 | Screw (Latch Keeper) | 9 in/lbs (1.02 N-m) |
| P/N 24787 | Screw (Head Plate) | 9 in/lbs (1.02 N-m) |

## Tools Required

**Standard Tools**

magnifying lens
inspection light
1/16" Allen driver
3/8" socket driver
5/64" Allen driver
3/8" open end wrench
nylon brush (for cleaning threads & basket)
white vinegar
1 pair of rubber gloves
paper towels
1 painter's or surgical mask
lint free cloth or towel

**Specialty Tools**

| | |
|---|---|
| P/N 220.9102 | Tribolube 71 |
| P/N 220.9101 | Christo-Lube MCG 111 |
| P/N TBD | STERAMINE™ cleaner |
| P/N TBD | O-ring removal tool (plastic) |

## TROUBLESHOOTING

| SYMPTOM | POSSIBLE CAUSE | TREATMENT |
|---|---|---|
| **SCRUBBER CANISTER (15)** not sealing properly to the **RED $CO_2$ SEAL (28)** | 1. worn/broken Spring Assembly in the bottom of the Scrubber Bucket<br>2. dirty or damaged **RED $CO_2$ SEAL (28)** | 1. replace Spring Assembly<br>2. clean or replace **RED $CO_2$ SEAL (28)**. |
| absorbent dust caking on threads and other parts | 1. crushed or dusting absorbent | 1. Clean parts with vinegar. Then rinse thoroughly with fresh water. |
| damaged **LATCH (9)** or **RETAINER ASSEMBLY (7)** | 1. abuse or excessive wear | 1. replace stainless steel **RETAINER BAND ASSEMBLY (7).** |
| a gas leak between the **SCRUBBER BUCKET (1)** and the **SCRUBBER HEAD (22)** | 1. bad **O-RINGS (25)**<br>2. damaged sealing surface of the **SCRUBBER BUCKET (1)** | 1. replace **O-RINGS (25)**<br>2. Inspect the **SCRUBBER BUCKET (1)** sealing surface for scratches, grooves, and dings. If found, replace the **SCRUBBER BUCKET.(1)** |

## DISASSEMBLY

**WARNING: The $CO_2$ absorbent material used in the Scrubber is caustic. Take steps to protect yourself and your working environment from the effects of airborne dusting of the material, eye, and skin contact. Good protection would include gloves, eye protection, and a dust mask. See Material Safety Data Sheets for the absorbent material for further safety recommendations before working with the Scrubber Bucket Assembly.**

Fig. 1

1. While pressing the safety lock flush, release the **LATCHES (9) (FIG. 1)**.

2. Pull the **SCRUBBER BUCKET (1)** straight off the Scrubber Head.

3. Remove the two **O-RINGS (25)** from the Scrubber Head **(Fig. 2)**. If more than twelve months old, discard. If less than twelve months old, inspect for any signs of decay. Discard if found.

Fig. 2

**NOTE: Remove the INNER O-RING (25) first; so it slides easily over the OUTER O-RING (25) without seating in the groove.**

4. Remove the **RED $CO_2$ SEAL (28) (Fig. 3)**. If less than twelve months old, inspect the **RED $CO_2$ SEAL (28)** for signs of decay. Discard if found. If twelve months or more old, discard the **RED $CO_2$ SEAL (28)**.

5. Inspect the **RED $CO_2$ SEAL (28)** groove in the **HEAD PLATE (27)** for any scratches or damage to the mating surface. If damaged remove and discard.

Removing Head Plate

a. Turning counterclockwise, remove the **RETAINING SCREWS** (30) and **WASHERS (29)** with a 1/16" Allen driver **(Fig. 4)**.
b. Lift the **HEAD PLATE (27)** off the Scrubber Head.
c. Remove the **O-RING (26)**.
d. Inspect the **O-RING (26)** for wear and deterioration. Discard if found.

4. Remove the **SCRUBBER BASKET (15)** from the **SCRUBBER BUCKET (1) (Fig. 5)**.

5. Remove the **SPONGE PAD (6)**.

Fig. 3

Fig. 4

Fig. 5

**NOTE: If the Spring Assembly has seized, broken, or fails to hold the SCRUBBER BASKET (15) securely against the RED $CO_2$ SEAL (28), the Spring Assembly must be replaced. Otherwise, skip step 6.**

6. If removing the Spring Assembly, remove the **LOCKNUT (3)** counterclockwise with a 3/8" driver **(Fig. 6)**. Discard the **LOCKNUT (3)**. Inspect the **SPRING (5)** and **SPRING PAD (4)** for signs of decay, damage, or corrosion. Discard if found.

**NOTE: The LATCH KEEPER (23) only needs to be removed if damaged. If it is in good condition skip step 7.**

7. Turning counterclockwise, remove the **SCREWS (24)** using a 5/64" Allen driver **(Fig. 7)**. The **LATCH KEEPER (23)** should slide free easily.

**NOTE: The RETAINER BAND ASSEMBLY (7) only needs to be removed if damaged or badly corroded. If it is in good condition skip step 8.**

8. Turning counterclockwise with a 3/8" open end wrench, remove the **LOCKNUTS (14)** and **SCREWS (13)** from the **BAND ASSEMBLY (7) (Fig. 8)**. Discard the **LOCKNUTS (14)**. Then slide the **BAND ASSEMBLY (7)** off of the **SCRUBBER BUCKET (1)**.

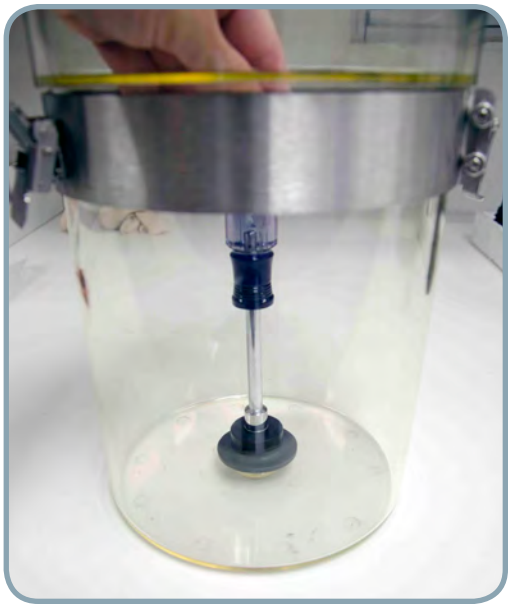


Fig. 6

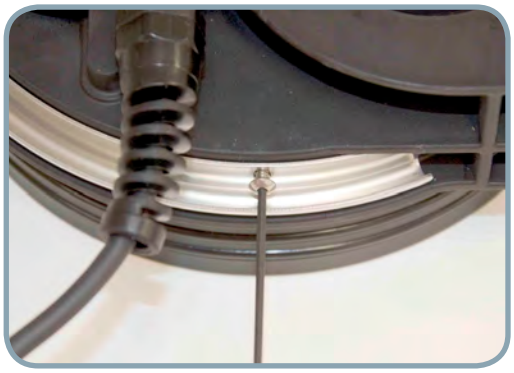


Fig. 7

Fig. 8

9. Turning counterclockwise, unscrew the **CAP (18)** from the **OUTER SCRUBBER BASKET (15) (Fig. 9)**.

**NOTE: If absorbent is caked on the threads of the CAP (18) and OUTER SCRUBBER BASKET (15), 100% white vinegar may be used to clean. Then rinse the part with fresh water to remove the vinegar.**

10. Remove the **LOWER FOAM PAD (20)**, and inspect it for deterioration. Discard if Found.

11. Turning counterclockwise, remove the **INNER BASKET (16) (Fig. 10)**.

12. Remove and inspect the **BASKET INNER O-RING (17)** for wear and deterioration. Discard if found.

**NOTE: If absorbent is caked on the threads of the INNER BASKET (16) and SCRUBBER BASKET (15), 100% white vinegar may be used to clean. Then rinse the part with fresh water to remove the vinegar.**

**CAUTION: Never use a screwdriver to clean the caked absorbent from the SCRUBBER BASKET (15) threads. Doing so may lead to damage of the mesh if the screwdriver slips.**

13. Remove the **UPPER FOAM PAD (19)**, and inspect it for deterioration. Discard if Found.

14. Inspect the **OUTER SCRUBBER BASKET (15)** and **INNER BASKET (16)** mesh for tears. Then inspect the O-ring sealing surface for scratches. Discard if found. **DO NOT** attempt to repair.

**WARNING: Never attempt to repair or dive a modified/repaired SCRUBBER BASKET ASSEMBLY (15, 16, 18). Doing so could lead to injury or death. Any material or repair failure would cause catastrophic $CO_2$ bypass. As well, any adhesive or patch may reduce gas flow decreasing the ability of the scrubber to function safely - leading to an unsafe work of breathing and/or reduction of ability to absorb $CO_2$.**

15. Inspect all parts and sealing surfaces for damage. Repair/replace as necessary **(Fig. 11)**.

16. Clean all parts.

Fig. 9

Fig. 10

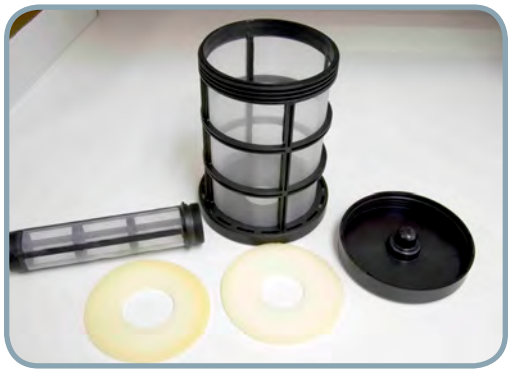


Fig. 11

## REASSEMBLY

**NOTE: Light application of DOW CORNING® 7 silicone to the threads of the SCRUBBER BASKET (15), INNER BASKET (17), and SCRUBBER BASKET CAP (18) will aid in the prevention of absorbent caking .**

1. Install the **INNER BASKET O-RING (17)** in the groove on the **INNER BASKET (16)**.

2. Turning clockwise, thread and tighten the **INNER BASKET (17)** into the **SCRUBBER BASKET OUTER (15) (Fig. 12)**. **DO NOT** over-tighten.

3. Place the **UPPER FOAM PAD (19)** (one with the larger center hole) over the **INNER BASKET (16)** and in the bottom of the **SCRUBBER BASKET (15)**.

4. Place the **LOWER FOAM PAD (20)** over the **INNER BASKET (15)**.

5. Thread the **SCRUBBER BASKET CAP (18)** onto the **SCRUBBER BASKET (15)** until snug **(Fig. 13)**. **DO NOT** over-tighten.

**NOTE: If the Spring Assembly was not removed, skip step 6.**

6. Place a **SPRING (5)**, **STRIKE PLATE (4)**, and **WASHER (2)** over the Center Stud of the **BUCKET (1)**. Tighten a **LOCKNUT (3)** onto the Center Stud of the **BUCKET (1)**, turning clockwise with a 3/8" driver. Tighten until only one thread is exposed **(Fig. 14 & 15)**.

**NOTE: If the HEAD PLATE (27) was not removed, skip step 7.**

7. Replace the **HEAD PLATE (27) (Fig. 16 & 17)**.

Replacing Head Plate

a. Install an **O-RING (26)** in the groove of the **HEAD PLATE (27)**.

b. Being careful not to pinch the **O-RING (26)**, press the **HEAD PLATE (27)** into the Exhaust Plenum of the **SCRUBBER HEAD (22)**.

c. Turning clockwise, tighten the **RETAINING SCREWS (30)** and **WASHERS (29)** to a torque of 9 in/lbs (1.02 N-m) with a 1/16" Allen driver. **DO NOT** over-tighten.

Fig. 12

Fig. 13

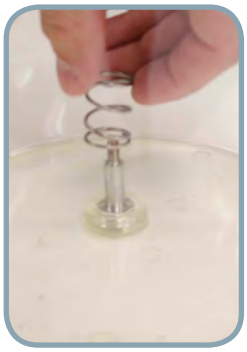


Fig. 14

Fig. 15

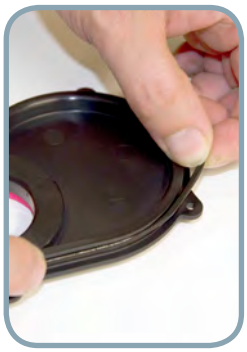


Fig. 16

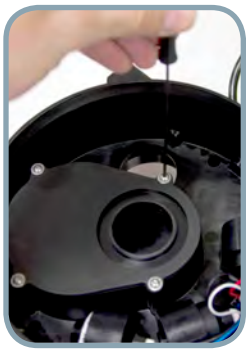


Fig. 17

8. Place a new **RED $CO_2$ SEAL (28)** into the groove of the **HEAD PLATE (27) (Fig. 18)**.

**NOTE: If the LATCH KEEPER (23) was not removed, skip steps 9 and 10.**

9. Slide the **LATCH KEEPER (23)** into place on the **SCRUBBER HEAD (22)**.

10. Turning clockwise, tighten the **RETAINING SCREWS (24)** to a torque of 9 in/lbs (1.02 N-m) with a 5/64" Allen driver. **DO NOT** over-tighten.

**NOTE: If the BAND ASSEMBLY (7) was not removed, skip steps 11, 12, and 13.**

11. Slide the **RETAINING BAND ASSEMBLY (7)** over the **SCRUBBER BUCKET (1)**.

12. Place both **SCREWS (13)** through the holes in the **RETAINING BAND ASSEMBLY (7)**.

13. Thread the **LOCKNUTS (14)** onto the **SCREWS (13)**, clockwise. Tighten them with a 3'8" open end wrench **(Fig. 19)**. **DO NOT** over-tighten.

11. Lightly lubricate and install the two **O-RINGS (25)** into the grooves on the **SCRUBBER HEAD (22) (Fig. 20)**.

**NOTE: It is easier to install the OUTER O-RING (25) first; so the INNER O-RING (25) slides over the outer groove without seating.**

12. Place the **SPONGE PAD (6)** back in the bottom of the **SCRUBBER BUCKET (1)**. Ensure that the **SPONGE PAD (6)** is aligned; so it will not interfere with the Spring Assembly operation.

Fig. 18

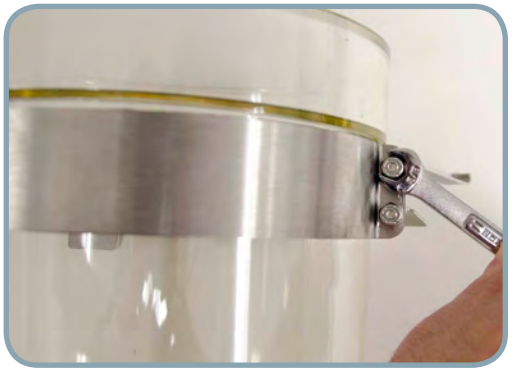


Fig. 19

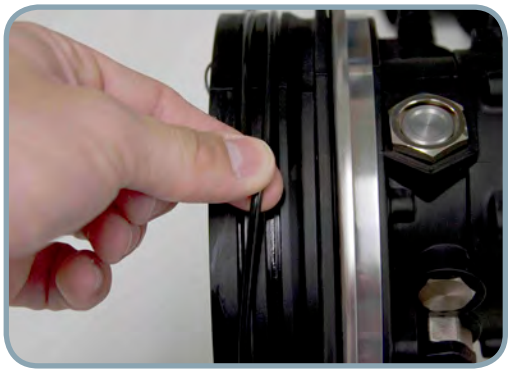


Fig. 20

13. Place the **SCRUBBER BASKET (15)** into the **SCRUBBER BUCKET (1)**. Ensure to align the centering hole with the Spring Assembly **(Fig. 21)**.

14. Being careful not to pinch the **O-RINGS (25)**, seat the **SCRUBBER BUCKET (1)** over the **O-RINGS (25)** and **SCRUBBER HEAD (22)**.

15. Latch the 3 **LATCHES (9)** to the **LATCH KEEPER (23) (Fig. 22)**.

Fig. 21

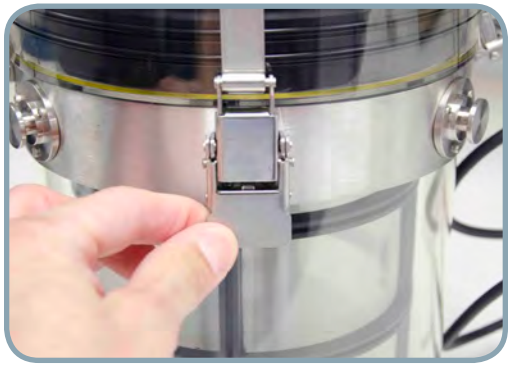
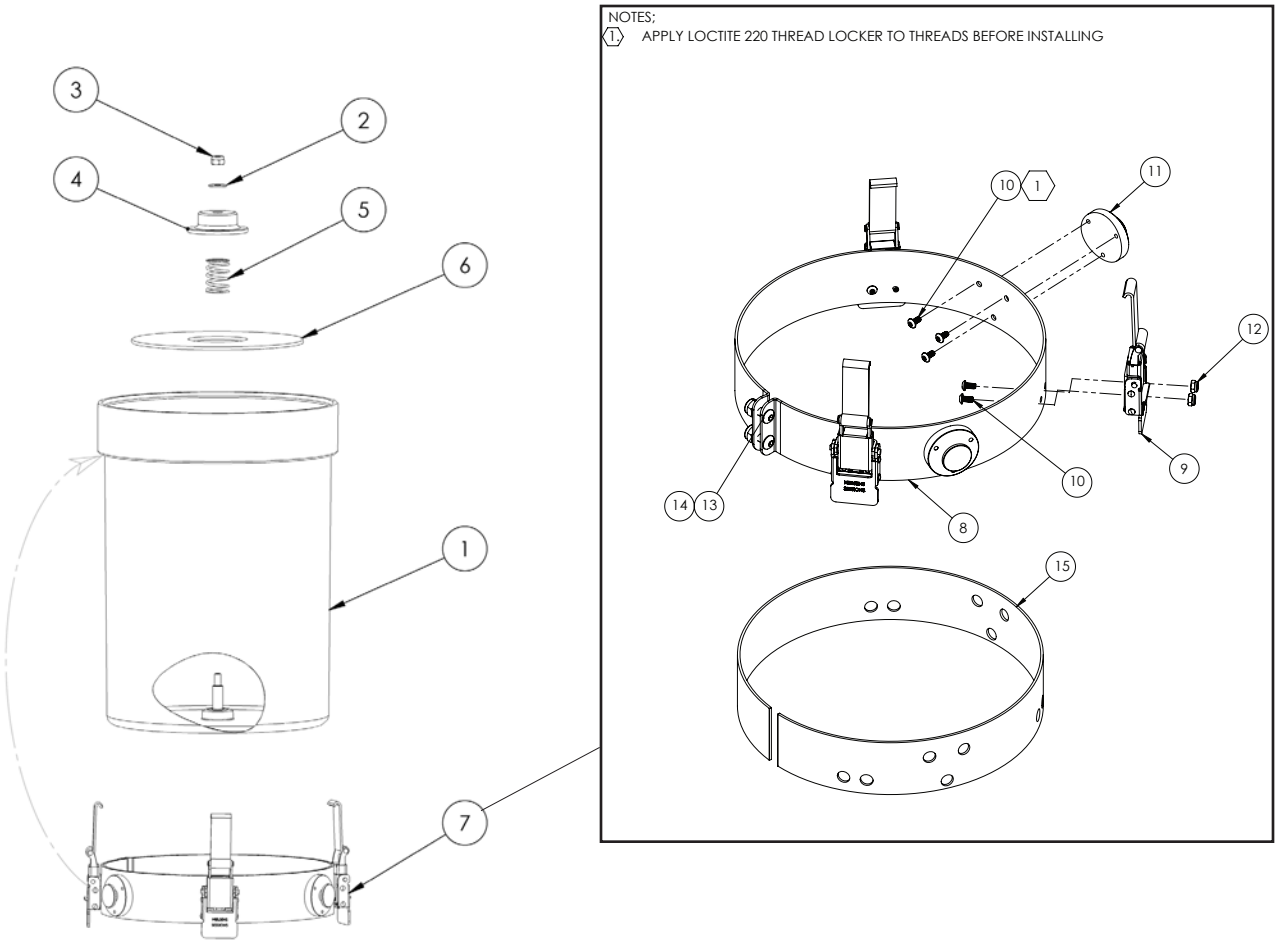


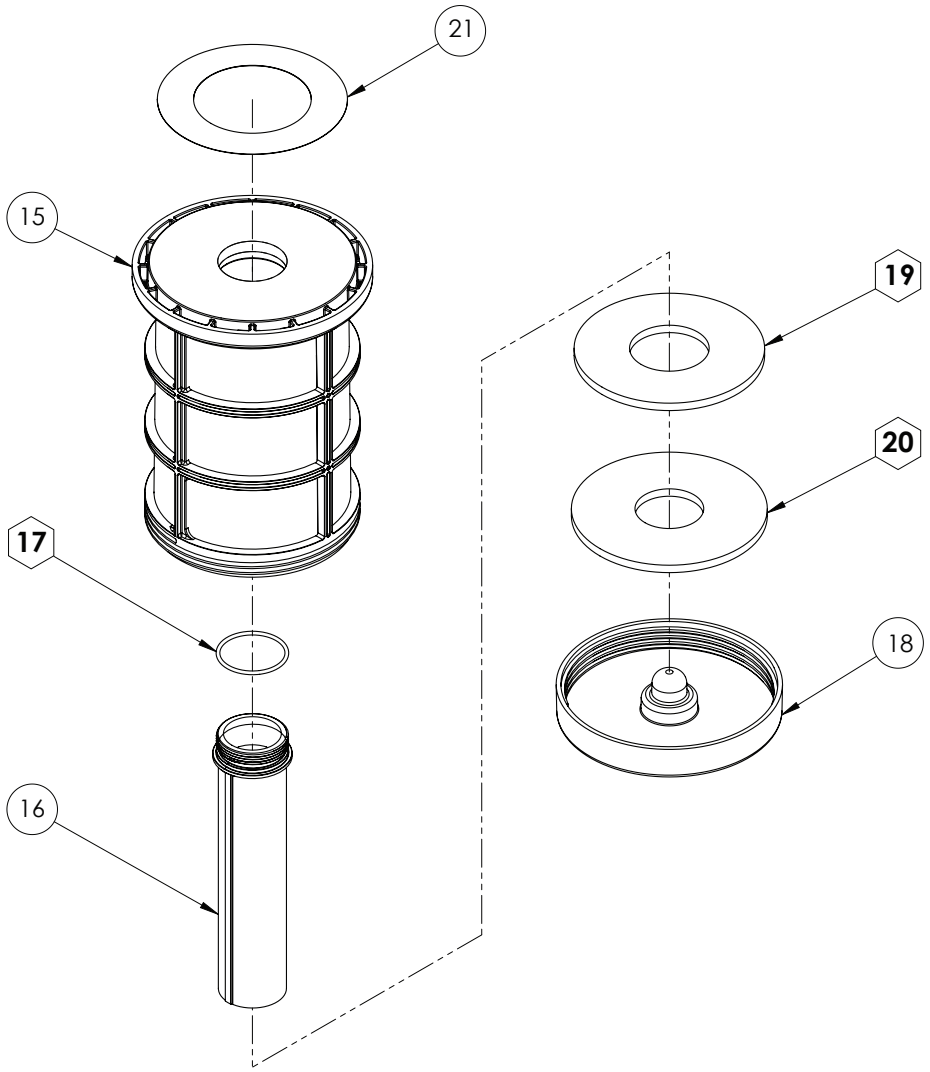
Fig. 22

# SCRUBBER BUCKET ASSEMBLY DIAGRAM



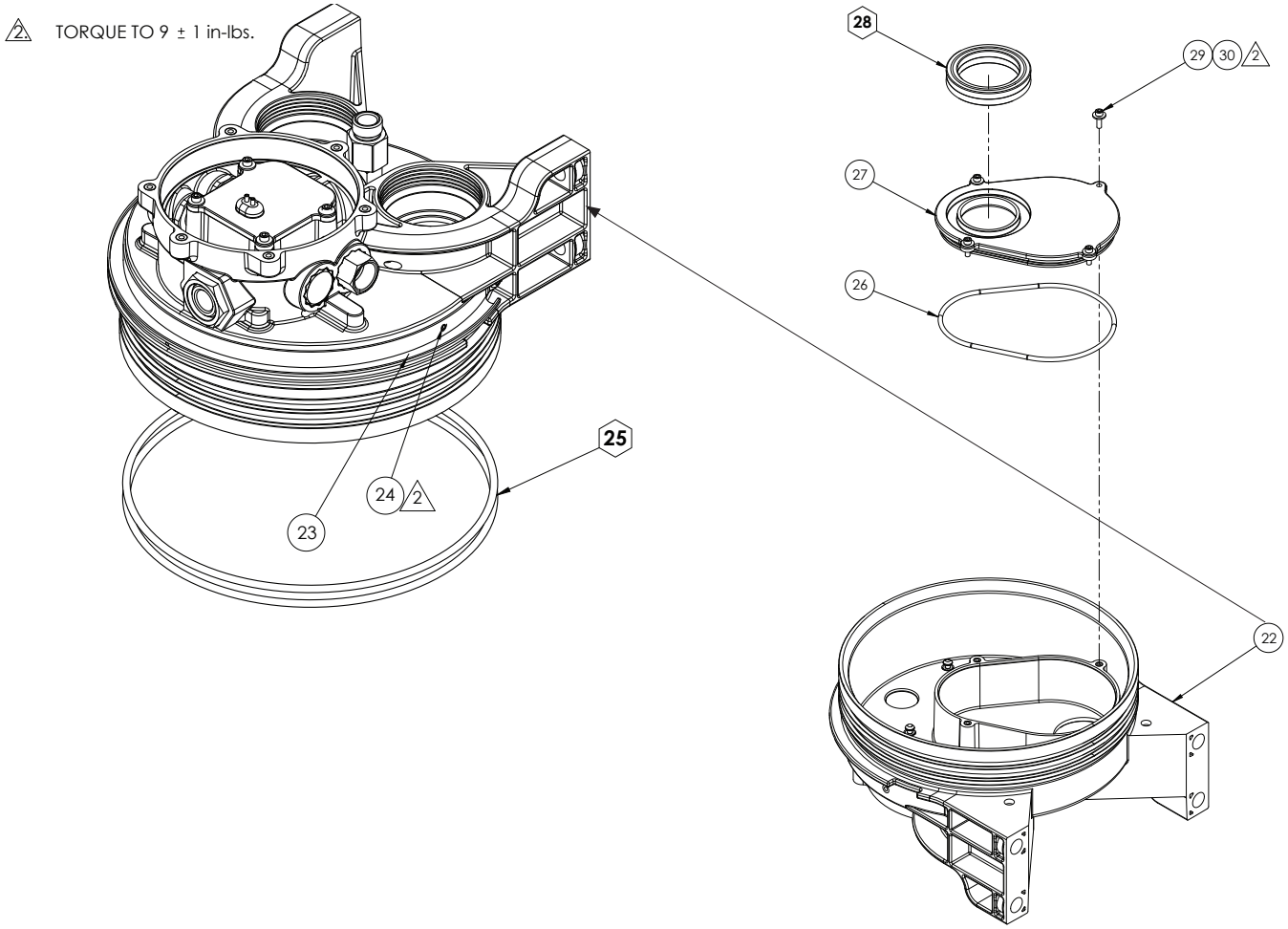

| DIA. | CAT. | P/N | DESCRIPTION | NOTES |
|---|---|---|---|---|
| 1 | c | 27986 | BUCKET & STUD ASSY. | |
| 2 | c | 224817 | WASHER | |
| 3 | c | 224819 | LOCKNUT | |
| 4 | c | 28354 | PAD, SPRING | |
| 5 | c | 28355 | SPRING, BUCKET | |
| 6 | b | 29227 | SPONGE PAD | |
| 7 | c | 27983 | BAND ASSY. | W/LATCHES & HARDWARE |
| 8 | c | 27984 | BAND, BUCKET | |
| 9 | c | 27980 | LATCH | QTY: 3 |
| 10 | c | 28847 | SCREW, BUTTON HEAD | QTY: 12 |
| 11 | c | 28220 | MOUNTING POST | |
| 12 | c | 24336 | LOCKING NUT | QTY: 6 |
| 13 | c | 224818 | SCREW, BUTTON HEAD | QTY: 2 |
| 14 | c | 224819 | LOCKNUT | QTY: 2 |
| 15 | c | 27982 | PAD | |

# SCRUBBER BASKET ASSEMBLY DIAGRAM




| DIA. | CAT. | P/N | DESCRIPTION | NOTES |
|---|---|---|---|---|
| 15 | c | 27749 | SCRUBBER BASKET, OUTER | |
| 16 | c | 27751 | SCRUBBER BASKET, INNER | |
| **17** | **a** | **22-133** | **O-RING** | |
| 18 | c | 27756 | SCRUBBER CAP | |
| **19** | **a** | **27869** | **FOAM PAD, UPPER** | |
| **20** | **a** | **27908** | **FOAM PAD, LOWER** | |
| 21 | c | 28977 | DECAL | |

# SCRUBBER O-RINGS DIAGRAM




| DIA. | CAT. | P/N | DESCRIPTION | NOTES |
|---|---|---|---|---|
| 22 | c | 27807 | HEAD ASSEMBLY | |
| 23 | c | 27816 | KEEPER, LATCH | |
| 24 | c | 28084 | SCREW, BUTTON HEAD | |
| **25** | **a** | **29137** | **O-RING** | **QTY: 2** |
| 26 | b | 22-153 | O-RING | |
| 27 | c | 27809 | HEAD PLATE | |
| **28** | **a** | **27810** | **SEAL, RED $CO_2$** | |
| 29 | c | 27569 | WASHER | QTY: 4 |
| 30 | c | 24787 | SCREW | QTY: 4 |

# 1. BATTERIES & PRESSURE RELIEF VALVE

## Specifications

### Torques

| | | |
|---|---|---|
| P/N 29048 | OP Valve | 35 - 40 in/lbs (4 - 4.5 N-m) |
| P/N 216748 | Screw (Latch) | 9 in/lbs (1.02 N-m) |

## Tools Required

### Standard Tools

magnifying lens
inspection light
O-ring pick
volt meter
12mm socket driver
snap ring pliers
dental tool

### Specialty Tools

| | |
|---|---|
| P/N TBD | Dow Corning Molykote 7 silicone |
| P/N TBD | O-ring removal tool (plastic) |
| P/N TBD | Deoxit Gold® GN5 cleaner |

## TROUBLESHOOTING

| SYMPTOMS | POSSIBLE CAUSE | TREATMENT |
|---|---|---|
| flooded battery compartment | 1. failed **O-RING (10, 11)** | 1. replace **O-RINGS (10, 11)**, clean compartment, and replace wiring |
| no power | 1. exhausted battery<br>2. corroded or damaged **BATTERY CABLE ASSEMBLY (8)**<br>3. flooded compartment | 1. replace battery<br>2. clean or replace **BATTERY CABLE ASSEMBLY (8)**<br>3. See above for causes and treatment. |

## DISASSEMBLY

1. Lift the **LATCHES (5)** while pressing the safety locks flush **(Fig. 1)**.

2. With the **LATCHES (5)** released, lift the **LID (12)** straight off of the **HOUSING (1)**.

3. Remove and disconnect the batteries from the **BATTERY CABLE ASSEMBLY (8).**

4. Remove the **O-RING (11)** in the groove of the **LID (12) (FIG. 2)**. Inspect the **O-RING (11)** for any signs of wear or deterioration. Discard if found.

Fig. 1

Fig. 2

5. Remove the **O-RING (10)** from the groove in the **HOUSING (1) (FIG. 3)**. Inspect the **O-RING (10)** for any signs of wear or deterioration. Discard if found.

6. Disconnect and remove the **BATTERY CABLE ASSEMBLY (8)** from the **BULKHEAD CONNECTOR (7) (FIG. 4)**.

7. Pull the **FOAM INSERT (9)** out of the **HOUSING (1)**.

8. Disconnect and remove the **BATTERY CABLE ASSEMBLY (8)**. Inspect the **BATTERY CABLE ASSEMBLY (8)** for any signs of wear or deterioration **(Fig. 4)**. Clean with DeoxIT® Gold GN5 or replace as appropriate.

**CAUTION: Some of the electrical connectors have thin precious metal plating. DO NOT scrape corrosion from contacts with a hard sharp object. DO NOT use abrasives, petroleum distillates, silicone based cleaners, erasers, combust able chemicals, or any other harsh cleaners. Hollis recommends the use of DeoxIT Gold® GN5 for cleaning the electrical contacts of the BATTERY CABLE ASSEMBLY (8) and BULKHEAD CONNECTOR (7).**

**NOTE: It is not necessary to remove the PRESSURE RELIEF VALVE (13) during regular service. It may simply be rinsed with water. It is designed to relieve internal pressure, due to failure of other components. If it is bubbling, refer to the Troubleshooting sections for the Oxygen Solenoid and Routing Board for the most probable cause. Unless removing it to replace due to bad corrosion or an actual failure, skip step 8.**

9. Turning counter clockwise with a driver and 12 mm socket, remove the **PRESSURE RELIEF VALVE (13) (FIG. 5).** Discard it.

**NOTE: The OVER-PRESSURE PLUG (2) at the bottom of the HOUSING (1) is not a wear item. DO NOT replace unless over-pressure has occurred, blowing it out of its port.**

Fig. 3

Fig. 4

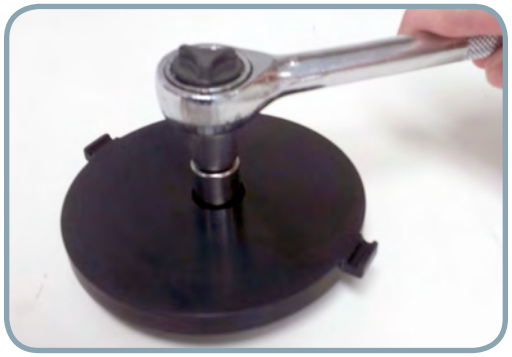


Fig. 5

## REASSEMBLY

**NOTE: If the INTERNAL OVER-PRESSURE PLUG (2) was still intact upon BATTERY HOUSING (1) disassembly, skip step 1.**

1. Ensure the plastic sealing surface is not damaged. Then press the new **O-RING (3)** and **OVER-PRESSURE PLUG (2)** into the port until fully seated with a dull instrument (dental tool) **(Fig. 6)**.

2. Plug the **BATTERY CABLE ASSEMBLY (8)** into the **BULKHEAD CONNECTOR (7)**.

3. Fit the **FOAM INSERT (9)** into the **HOUSING (1)**.

4. Connect new batteries to the **BATTERY CABLE ASSEMBLY (8)**. Then, ensuring that the wiring is not twisted or contorted, place the batteries into the cutout in the **FOAM INSERT (9)**.

**NOTE: If the PRESSURE RELIEF VALVE (13) on the LID (12) was not removed for replacement, skip step 5.**

5. Using a torque driver and 12 mm socket, tighten the **PRESSURE RELIEF VALVE ASSEMBLY (13)** clockwise to a torque of 35 to 40 in/lbs (4 to 4.5 N-m) **(Fig. 7)**. **DO NOT** over-tighten.

6. Lightly lubricate and seat the **COMPARTMENT O-RING (10)** in the groove of the **HOUSING (1)**, as shown **(Fig. 8)**.

7. Lightly lubricate and seat the **LID O-RING (11)** in the groove of the **BATTERY LID (12)**, as shown.

8. Align the tabs of the **BATTERY LID (12)**. Then press the **LID (12)** in place.

9. Engage and latch the two **RETAINING LATCHES (5) (FIG. 9)**.

Fig. 6

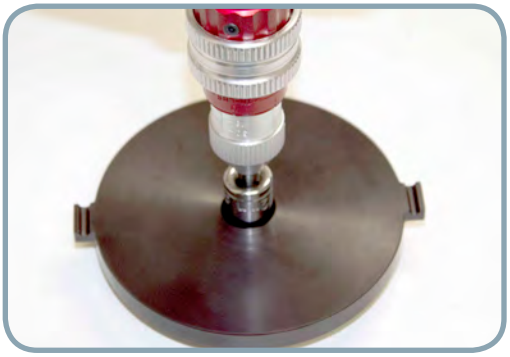


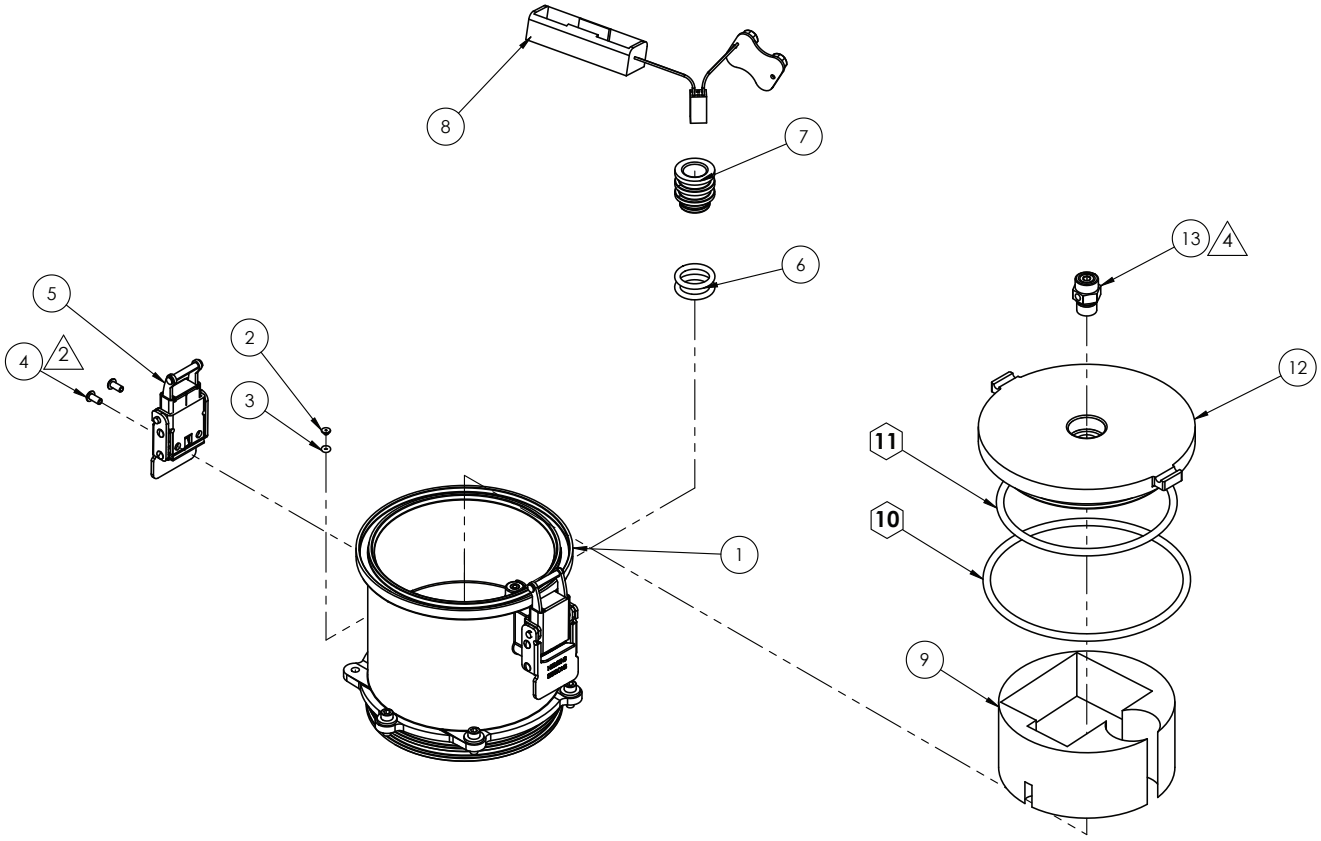
Fig. 7

Fig. 8

Fig. 9

# BATTERY HOUSING ASSEMBLY DIAGRAM

△2. TORQUE TO 9 ± 1 in-lbs.
△4. TORQUE TO 35/40 in-lbs.




| DIA. | CAT. | P/N | DESCRIPTION | NOTES |
|---|---|---|---|---|
| 1 | c | 28675 | HOUSING, ELECTRONICS | |
| 2 | c | 216823 | PRESSURE PLUG | |
| 3 | c | 22-003 | O-RING | |
| 4 | c | 27651 | SCREW | QTY: 4 |
| 5 | c | 27979 | LATCH | QTY: 2 |
| 6 | c | 22-113 | O-RING | QTY: 2 |
| 7 | c | 29223 | BULKHEAD CONNECTOR, BAT. | |
| 8 | c | 29221 | CABLE ASSY., BATTERY | |
| 9 | c | 28664 | BATTERY NEST, FOAM | |
| **10** | **a** | **22-239.50** | **O-RING** | |
| **11** | **a** | **22-235.50** | **O-RING** | |
| 12 | c | 28990 | COVER, ELECTRONICS | |
| 13 | c | 29048 | OP VALVE ASSY. | W/O-RING # 2V3-903 |

# 2. OXYGEN SENSORS

## Tools Required

**Standard Tools**

magnifying lens
inspection light
O-ring pick
volt meter
snap ring pliers
dental tool

**Specialty Tools**

| | |
|---|---|
| P/N 220.9102 | Tribolube 71 |
| P/N 220.9101 | Christo-Lube MCG 111 |
| P/N TBD | O-ring removal tool (plastic) |
| P/N TBD | Deoxit Gold® GN5 cleaner |

**TROUBLESHOOTING**

Oxygen sensors are both critical to a rebreather and quite possibly the most sensitive component. With proper care sensor issues can be greatly reduced or eliminated. Keep a few things in mind when servicing or counseling your customer's Prism 2 rebreather use.

1. Sensors are expendable, the diver is not.
The sensors from Hollis have a "Do not use after" date printed on the body. They should last around 12 months of use or 16 months from manufacture, whichever comes first. But regardless of the expected sensor life, they must be taken out of service whenever they fail to operate .

2. Sensors must acclimate for at least 12 hours after opening their packaging, exposing them to air.
Once opened the sensor's chemical reaction must reach a stable reaction rate before use or Prism 2 calibration.

3. Sensors are sensitive to extreme temperatures.
Storage of Oxygen Sensors below 32° F (0°) or above 100° F (37.8° C) can damage or greatly shorten the life of the sensor.

4. Sensors are sensitive to impact and shock.
At all times sensors must not be knocked around or mishandled. Sensors should be individually wrapped in bubble wrap when travelling. Alternately, leave the **OXYGEN SENSORS (7)** installed in their **SENSOR HOLDERS (6)** to insulate against shock. Then carry the **SCRUBBER HEAD (1)** inside the supplied "Blue Box" when travelling by air, to further insulate the **SCRUBBER HEAD (1)** and **OXYGEN SENSORS (7)** from shock.

5. Touching and contaminating the Teflon membrane face of the sensor can cause reduction in the signal output or destruction of the sensor. Oils from even freshly washed hands can clog the Sensor Membrane's pores. It is best to handle the sensor by its plastic sides.

6. Sensors chemically react with a finite amount of oxygen before exhausting their chemical reactivity.
Leaving high $PO_2$ gas in the Breathing Loop while not diving reduces sensor life. A diver should shut off the oxygen tank valve and electronics (to avoid constant solenoid activation) when in transport and after the dive day. The diver should also flush the high oxygen $PO_2$ gas out of the breathing loop after a sensor calibration and at the end of the diving day.

7. Electrical connectors can easily be damaged.
Never force or twist the Electrical connectors. **USE ONLY** DeoxIT® Gold GN5 to clean terminals.

8. Mixing brands and aged sensors with new may lead to a functional sensor being voted out.
**USE ONLY** Hollis sensors. **DO NOT** mix sensors close to the end of their service life with fresh sensors.

9. Oxygen Sensors may become "millivolt limited".
Validate Oxygen Sensors are not millivolt limited before use.

| SYMPTOM | POSSIBLE CAUSE | TREATMENT |
|---|---|---|
| no mV reading | 1. **SENSOR (7)** completely exhausted<br>2. defective **SENSOR (7)**<br>3. corroded or shorted **WIRING (5)** | 1. replace **SENSOR (7)**<br>2. replace **SENSOR (7)**<br>3. clean/repair **WIRING (5)** |
| erratic/irregular reading | 1. water on the membrane<br>2. loose/faulty/corroded connection<br>3. out of calibration<br>4. dirty Teflon membrane | 1. allow **SENSOR (7)** to dry<br>2. check connections/clean contacts/replace **WIRING (5)**/ **SENSOR (7)**<br>3. calibrate **SENSOR (7)**<br>4. replace **SENSOR (7)** |
| sensor voted out | 1. out of calibration<br>2. **SENSOR (7)** exhausted<br>3. **SENSOR (7)** defective | 1. calibrate **SENSOR (7)**<br>2. replace **SENSOR (7)**<br>3. replace **SENSOR (7)** |

**DISASSEMBLY**

1. There are three **OXYGEN SENSORS (7)** located on the underside of the Scrubber Head. To access the underside of the Scrubber Head the Scrubber Bucket and Scrubber Basket will need to be removed.

2. Begin by unlatching the 3 Neilson Sessions Latches that hold the scrubber bucket to the Scrubber Head.

3. Pull the Bucket Assembly off of the Scrubber Head. Set it aside.

4. The **SENSORS (7)** are held in place with **SILICONE RETAINERS (6)**.

5. Pull the **SILICONE RETAINER SLEEVES (6)** straight off the Scrubber Head **(Fig. 1)**.

6. Disconnect the **ELECTRICAL CONNECTOR (5)** from the **OXYGEN SENSORS (7)**.

7. Slide the **OXYGEN SENSORS (7)** out of the **SILICONE RETAINER SLEEVE (6) (Fig. 2)**.

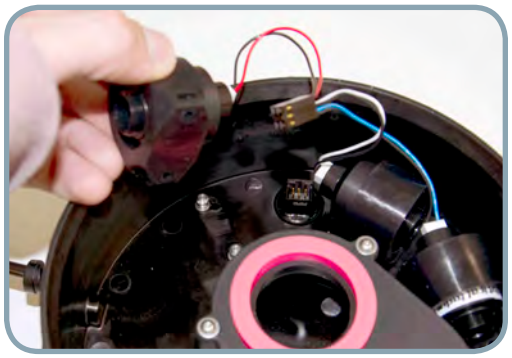


Fig. 1

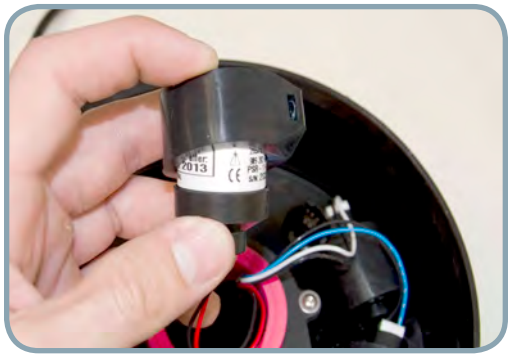


Fig. 2

**NOTE: The OXYGEN SENSORS (7) are interchangeable. Though for diagnostic reasons pay attention and note which SENSOR (7) corresponds to which readout position on the PRISM 2 Primary/Secondary Displays.**

| WIRE COLORS | $O_2$ READOUT ON PRIMARY/SECONDARY |
|---|---|
| RED/BLK | SENSOR # 1 |
| WHT/BLK | SENSOR # 2 |
| BLU/BLK | SENSOR # 3 |

8. Remove the **ELECTRICAL CONNECTORS (5)** from the **OXYGEN SENSORS (7)**.

**NOTE: A small flat blade screwdriver, preferably a jeweler's screwdriver, may be used to release the electrical connector locking mechanism without damaging the connectors.**

9. Inspect the **SENSOR (7)** contacts for damage or corrosion. Clean or discard the sensor as needed.

**CAUTION: The electrical connectors have thin precious metal plating. DO NOT scrape corrosion from contacts with a hard sharp object. DO NOT use abrasives, petroleum distillates, silicone based cleaners, erasers, combustible chemicals, or any other harsh cleaners. Hollis recommends the use of DeoxIT Gold® GN5 for cleaning the OXYGEN SENSOR (7) electrical contacts and the contacts on the WIRE HARNESS (5).**

10. Being careful not to physically damage the electrical connectors, remove and inspect the **WIRE HARNESS (5)** for corrosion and damage. Clean or discard as appropriate.

11. Inspect the **BULKHEAD CONNECTOR(4)**, that the **WIRE HARNESS (5)** plugs into, on the **SCRUBBER HEAD (1)** for corrosion or damage. Clean as appropriate.

**MILLIVOLT/LINEARITY TEST & CLEANING**

**WARNING: Any SENSORS (7) being used in the PRISM 2 unit must pass this Millivolt/Linearity Test.**

**TECHNICIANS ONLY:**

**NOTE: Any opened SENSORS (7) must have serial numbers, date of testing, and mV reading data results documented for the customer on a copy of the Hollis Rebreather Receiving and Final Inspection Form. You should retain the original copy for your records.**

**WARNING: The SENSORS (7) must be installed in the PRISM 2, tested, and pass the Final Inspection Procedure before returning the PRISM 2 unit to your customer for use. The Final Inspection Procedure may be found in the Receiving and Final Inspection Section of the PRISM 2 Service Guide.**

1. Visually inspect the **OXYGEN SENSOR'S (7)** electrical terminal, Teflon membrane, and plastic body for dirt, corrosion, or physical damage.

2. The terminals may be cleaned using Deoxit Gold™ GN5. Use the chemical sparingly and wipe any excess away with a clean lint free cloth. If the terminals are physically damaged the sensor **MUST NOT BE USED**.

3. The plastic body of the **SENSOR (7)** should be wiped clean with a lint free cloth. If needed, sparingly apply Blue Gold® to the lint free cloth to clean the plastic **SENSOR (7)** body **ONLY**. **DO NOT** expose the **SENSOR (7)** membrane or electrical terminals to the cleaner.

4. The Teflon membrane may be gently rinsed with distilled water **ONLY** if salt crystals are present. It must then be allowed to air dry.

**WARNING: DO NOT use compressed air to dry the delicate membrane surface, or the SENSOR (7) may be damaged.**

**WARNING: The membrane CAN NOT be cleaned if contaminated by any other contaminates besides salt crystals. Greases such as finger prints, Tribolube®, and other such contaminants can clog the pores of the membrane permanently, destroying the sensor. DO NOT use a sensor which has such contamination. Doing so would lead to inaccurate $PO_2$ output and a possibly life threatening Hyper oxic Incident for the diver.**

**NOTE: Newly opened SENSORS (7) require a minimum of 12 hours acclimation to the ambient atmosphere before their chemical reaction reaches a steady rate of millivolt output that may be used for testing or operation.**

5. Check the **SENSORS (7)** for correct millivolt output in air (1 ATA test) and in oxygen (1 ATA and 1.6 ATA test).

**CAUTION: When adding or bleeding pressure to the SENSORS (7), do so slowly to avoid damage to the SENSOR (7).**

6. Document the test results for your records, and to provide them to your customer.

| HEALTHY $O_2$ SENSOR RANGES | | |
|---|---|---|
| TESTING GAS | 1.0 ATA PRESSURE | 1.6 ATA PRESSURE |
| AIR | 8.5 - 14 mV | N/A |
| 100% OXYGEN | 40.6 - 66.9 mV | 65 - 107 mV |

**REASSEMBLY**

1. Connect the **WIRE HARNESS (5)** to the **BULKHEAD CONNECTOR (4)** on the underside of the **SCRUBBER HEAD (1)**.

2. Install a clean **OXYGEN SENSOR (7)** with sufficient remaining service life or a new **OXYGEN SENSOR (7)** into one of the **SILICONE RETAINER SLEEVES (6)**.

**CAUTION: Lubricant on the plastic sides of the OXYGEN SENSOR (7) may cause the sensor to slip out of its SILICONE RETAINER SLEEVE (6).**

**WARNING: Dirt or corrosion may cause irregular SENSOR (7) performance or failure. See the previous section for cleaning instructions.**

3. Attach the correct **WIRE HARNESS (5)** lead to the **SENSOR (7)**.

4. Align the holes in the **RETAINER SLEEVE (6)** with the mounting posts in the Scrubber Head, as shown.

**NOTE: A drop of Tribolube 71® or silicone applied to the holes in the SILICONE RETAINER SLEEVE (6) will ease installation.**

5. Press it securely in place.

6. Repeat steps 2 through 5 for the remaining two **OXYGEN SENSORS (7)**.

**NOTE: A Scrubber Bucket and Scrubber Canister Inspection and Service should be completed before step 7. See the section named Scrubber Bucket and Scrubber Canister in this service guide.**

7. Reinstall the Scrubber Bucket and Scrubber Canister assembly by sliding it back onto the **SCRUBBER HEAD (1)** and locking the 3 latches.

## RECOMMENDED SENSORS

Hollis PRISM 2's require Hollis brand oxygen sensors **(Fig. 3)**.
Connector style: Molex
MV Range: 8.5 - 14 mV (in air), 40 - 67 mV (in oxygen)

Fig. 3

## SENSOR CALIBRATION

(Shearwater Primary HUD Electronics)

This will calibrate the Primary HUD Display to oxygen. Tap the Piezo Switch one time to turn the Primary HUD on **(Fig. 3)**. The HUD will flash the green and red LEDs once, to test function. Ensure you are using a fresh battery. All three LEDs will flash orange (red and green) for 30 seconds if the battery needs to be replaced.

Close the DSV/BOV. Using the Manual Oxygen Addition Valve, fill the Breathing Loop with pure oxygen. Open the DSV/BOV, and collapse the Counterlungs with your hands. When the lungs are collapsed close the DSV/BOV quickly. Repeat this two more times. Then open the DSV/BOV just long enough to allow the Breathing Loop to settle to ambient pressure. With the DSV/BOV now closed, press the Piezo Switch three times within one second without lifting your finger off the button **(Fig. 4)**.

Fig. 4

CELL CALIBRATION ACCEPTED

If calibration of all three cells has been accepted, the Primary Display will illuminate all three LEDs in red for 5 seconds without blinking. If any cell has failed calibration, the LED corresponding to the failed cell will oscillate green then red, repeating continuously. until a successful calibration of that cell has been achieved.

CELL CALIBRATION FAILED

If all three sensors fail calibration, each LED will flash green then red, repeating continuously. It is rare that all three cells would fail calibration at the same time if they are within their expected service life, not damaged by mishandling, and the loop is fully flushed with oxygen. Usually, an accidental calibration in air or an incomplete loop flush with pure oxygen will cause all three sensors to fail concurrently.

Press and hold the Piezo Switch to turn the Primary HUD off.

## SENSOR CALIBRATION

(Shearwater Secondary Electronics)

This will calibrate the sensor displays to oxygen. Close the DSV/BOV. Using the Manual Oxygen Addition Valve, fill the Breathing Loop with pure oxygen. Open the DSV/BOV, and collapse the Counterlungs with your hands. When the lungs are collapsed close the DSV/BOV quickly. Repeat this two more times, or until the cell readings ($PO_2$ or mV) on the Secondary Electronics stabilize (stop increasing during $O_2$ injection. Then open the DSV/BOV just long enough to allow the Breathing Loop to settle to ambient pressure.

With the DSV/BOV now closed, select "Calibrate" in the Display **(Fig. 5)**, and the confirmation message will display. On the top line the millivolt reading will show **(Fig. 6)**. Good Oxygen Sensors should be in the range of 35 - 60 mV at Sea Level in 100% oxygen. The valid millivolt range for calibration is 30 - 70 mV. This scales with percentage of oxygen and barometric pressure. Pressing the Menu Button will prevent the calibration. Pressing SELECT will calibrate the sensor displays. The displays should now all read .98. If any display shows FAIL, the calibration has failed because the mV reading is out of range **(Fig. 7)**.

The system defaults to a calibration gas of 98% oxygen. This is to compensate for the difficulty in completely filling the loop with 100% oxygen and also to allow for water vapor. If you are using a calibration kit with no water vapor and 100% $O_2$, you can set the calibration gas to 100%. It can also be set to other values if pure oxygen is not available.

The calibration takes into account the altitude at which the computer was turned on. For example, if the altitude was 885 mBar or .87 ATA, then with a 98% calibration gas, the sensors would calibrate to .85.

**The "Calibrate" menu item will not display during a dive.**

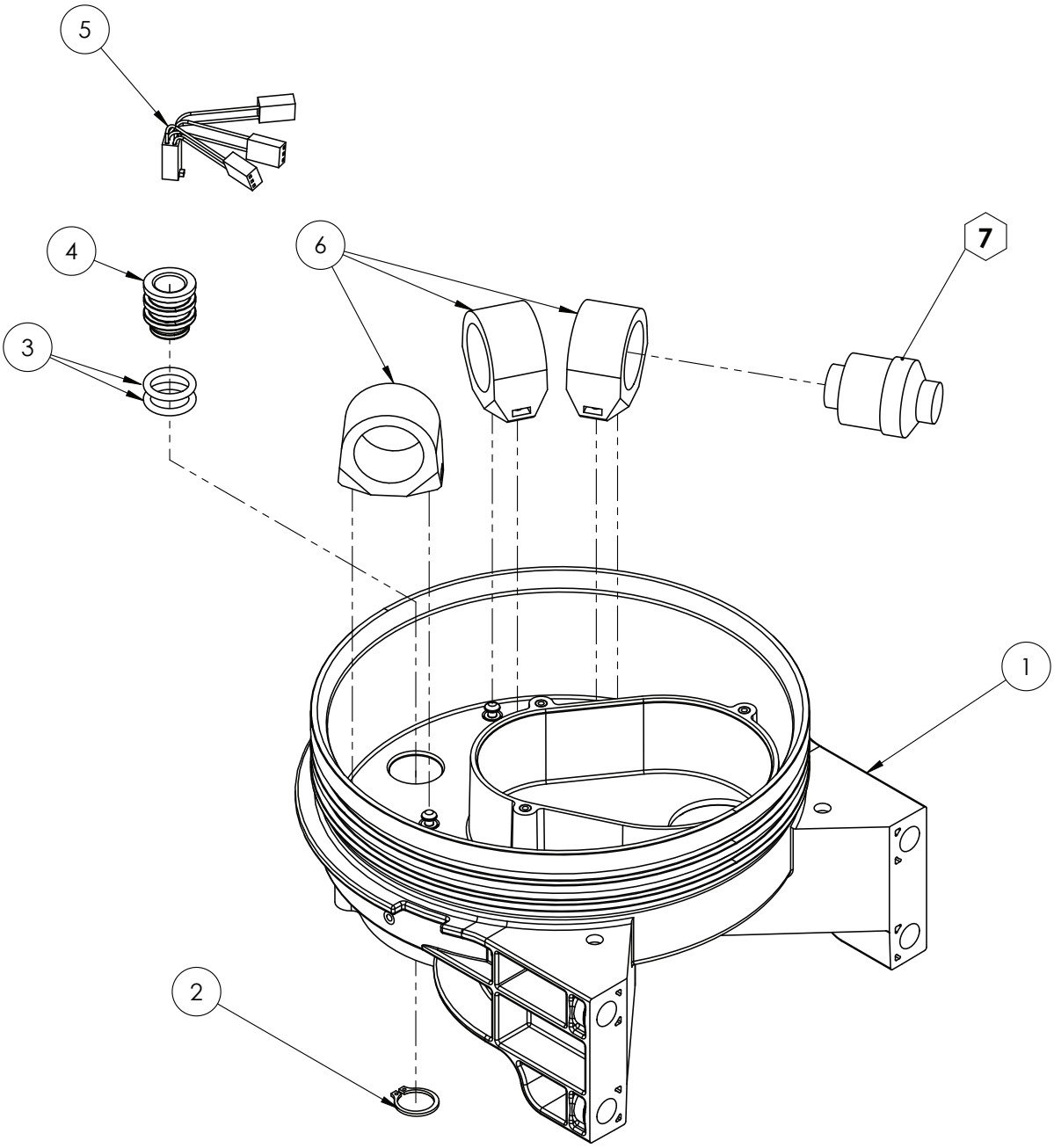
Cycle through the Menu with the left side button until "Turn Off" is displayed. Then press the right side button to turn off the Secondary Display.


Fig. 5


Fig. 6


Fig. 7

# SCRUBBER HEAD (SENSOR COMPONENTS) DIAGRAM




| DIA. | CAT. | P/N | DESCRIPTION | NOTES |
|---|---|---|---|---|
| 1 | c | 27807 | HEAD ASSEMBLY | |
| 2 | c | 27872 | RETAINING RING | |
| 3 | c | 22-113 | O-RING | QTY: 2 |
| 4 | c | 29224 | BULKHEAD CON., OXYGEN | |
| 5 | c | 29222 | CABLE ASSY., OXYGEN | |
| 6 | c | 28683 | HOLDER, SENSOR | QTY: 3 |
| **7** | **a** | **27946** | **OXYGEN SENSOR** | **QTY: 3, not shown** |