EXTREME LIGHTWEIGHT DIVING SYSTEM
RAPID DEPLOYMENT CONSOLE
(XLDS RDC-3 AND RDC-2)

MAINTENANCE MANUAL

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Document XLDS Guide
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Definitions of Signal Words Used in this User's Guide

DANGER
This word indicates an imminently hazardous situation, which if not avoided, will result in death or serious injury.

WARNING
This word indicates a potentially hazardous situation, which if not avoided, could result in death or serious injury.

CAUTION
This word indicates a potentially hazardous situation, which if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTICE
This word indicates a special attention or required action for basic operation.

Document XLDS Guide
Revised July 17, 2019

SECTION ONE: GENERAL INFORMATION

General Information

The Extreme Lightweight Diving System (XLDS), is a combination of assemblies and components, designed and engineered as a complete surface supplied diving system, allowing for rapid set-up and deployment. The System was designed and engineered by Dive Lab, Inc., primarily for Military and Paramilitary use, and is intended to meet specific performance goals and engineering requirements. The XLDS is available in two models, the XLDS-RDC-2 (two (2) diver) and XLDS-RDC-3 (three (3) diver). Both the two and three diver Systems, consist of four major sub-assemblies, that work as a complete diver supply system, primarily intended and designed for use with Kirby Morgan Helmets and Full Face Masks, but will also work with other demand mode equipment, as outlined in the User Guide.

Definitions

RDC-2: Rapid deployment, 2 Diver Control Console

RDC-3: Rapid Deployment, 3 Diver Control Console

XLDS: Extreme Lightweight Diving System

ICS: Intermediate Compensating System

SCUBA: Self Contained Underwater Breathing Apparatus

UMBILICAL: Consists of air, communications/ strength member and Pneumofathometer hose that supports the diver

HIGH PRESSURE: Pressure supplying the reducing regulators usually above 400 PSIG

LOW PRESSURE: The air being supplied to the reduced pressure circuit, normally 325-375 PSIG for the intermediate system, and up to 250 PSIG for conventional surface supplied diving using 3/8" Umbilicals

PNEUMO QD: Pneumofathometer Quick Connect

OB: Over Bottom

PSIG: Pounds per Square Inch Gauge

PSIG OB: Pounds per Square Inch Gauge Over the Bottom Pressure

RMV: Respiratory Minute Volume

WOB: Work Of Breathing

EGS: Emergency Gas System

LPM: Liters Per Minute

FSW: Feet Salt Water

RMV: Respiratory Minute Volume

BPM: Breaths Per Minute

SSOCS: Surface Supplied Oxygen Control System

Advantages

- Lightweight and portable
- Rapid set-up and deployment
- Ease of operation
- HP and LP cross connect capabilities for added redundancy and safety
- Low maintenance
- Durable / Reliable
- Certified performance capabilities
- Modular System, allows the use of various high-pressure supply sources
- Performance based on a minimum HP supply pressure of 400 PSIG

Performance of the XLDS system is certified by Dive Lab Inc. The XLDS user guide lists the helmets and full-face masks and diver worn systems that may be used with the XLDS and the specifications and limitations of use. For conventional surface supplied air diving, both the 2 and 3 diver RDC, and HP supply may be used with many conventional helmets and full face masks providing the maximum flow and pressure requirements are met.

SECTION ONE: GENERAL INFORMATION

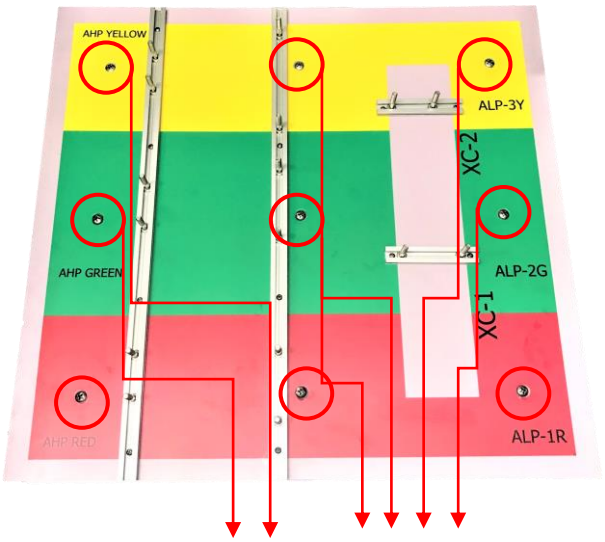
The User Guide

This User Guide explains in detail system start up, operation and shut down procedures, as well as basic care, maintenance and troubleshooting. The guide defines the necessary support equipment requirements and performance specifications. The designation XLDS denotes the use of a two or three diver system. Consisting of a two or three diver air control console (RDC 2 or 3), ultra-lightweight ¼" I.D. umbilicals, and a man worn intermediate compensating system (ICS).

Whenever the XLDS is referred to in this user guide, it refers to the entire system.
Both the 2 and 3 diver RDC units can also be used for conventional surface supplied diving using standard 3/8" (9mm) I.D. umbilicals.

FOUNDATION PLATE SCREWS

The RDC main foundation plate has nine (9) ¼-20 screws with nylon lock nuts that join the foundation plate to the case enclosure. These nine screws pass through soft silicone donut type shock mounts designed to allow the foundation plate to shift, and move, as the case is banged around. IMPORTANT! Do not over tighten these screws! It is normal for the screws to be loose, so that the foundation plate which holds the manifolds can absorb shock and impact. The Nylock nuts do not allow the screws to loosen.



IMPORTANT! Do not over tighten these screws!

CLEANLINESS

Keep the interior of the RDC clean and wiped down. Wiping down the interior components with a solution of mild dish detergent and water will minimize corrosion and keep the system looking good.

SHUT DOWN

When the console is being shut down, ensure all pressure has been vented and all valves are shut. Keep inlet and outlet ports capped whenever the system is not in use. The same for all umbilical connections.

Ensure comm box is removed before console is closed for storage.

When closing the lid of the console box make sure you push in on the spring latch as shown below.

PUSH IN OR DOWN ON THE SPRING

Detailed instructions of shut down procedure is found in Section Five, OP-4 Post Dive/Shutdown & Inspection.

SECTION TWO: CONCEPT AND INTENDED USE

Intermediate Surface Supply Concept

XLDS operates as an intermediate compensated system. The XLDS system uses a specially designed 1/4" main gas umbilical assembly, that reduces the weight and bulk of the umbilicals to approximately half that of the lightest assemblies normally used for surface supply diving. The umbilicals are supplied air from the console, at pressures between 350-375 PSIG (24-26 bar), to a volume compensated pressure control system, worn by the diver, known as the diver worn intermediate manifold compensating regulator system (ICS). The manifold is integrated with a 0.8 liter accumulator and manifold regulator system, which reduces high velocity medium pressure breathing air (350 PSIG), from the umbilical, to between 150-170 PSIG and supplies it to the helmet or full face mask being used.

During inhalation, the ICS delivers breathing air to the demand helmet or full-face mask with minimal pressure drop, allowing for low inhalation effort. During the exhalation cycle, the system quickly builds pressure for the next inhalation cycle. Breathing performance of the system allows breathing rates of up to 90 RMV to depths of 100 FSW, and up to 75 RMV to depths of 132 FSW, with most model KMDSI helmets and band masks, and at 75 RMV to 165 FSW when using the KMDSI EXO- 26 BR. Both the positive and non-positive pressure AGA^{TM} FFM, can be used at work rates of 75 RMV, to depths of 150 FSW.

Conventional Surface Supplied Diving

The surface air control consoles (RDC-2 and RDC-3) can also be used as conventional air control console, for demand mode surface supplied diving, with demand mode Helmets and Masks. When reference to conventional surface supplied diving is given, it refers to the RDC-2 or RDC-3 console used with standard umbilicals and over bottom tracking of supply pressures, no more than 200-250 PSIG OB. When the RDC-2 or RDC-3 consoles are used for conventional air diving, supply pressure can be regulated to each diver, IAW the operational pressure and supply requirements, dictated by the UBA being used, and IAW the recommended performance specifications as outlined in this user guide. When using with conventional 3/8” umbilicals, the RDC relief valves, should be reset to relieve between 290-300 psig, verse the 390-400 psig setting, when using with the XLDS system.

Currently the RDC-2 and RDC-3, are certified by Dive Lab, for use with all properly maintained current production models of KMDSI Band Masks, Helmets, and Full Face Masks properly configured for conventional surface supplied diving. Other equipment may be used, contact Dive Lab for additional information.

SECTION TWO: CONCEPT AND INTENDED USE

XLDS Major Subsystems

Both the XLDS RDC-2 and RDC-3 share the same basic subsystems and components laid out in a similar fashion. These include:

- High Pressure Supply System
- Rapid Deployment Control Console (RDC)
- 1/4" Ultra Light Umbilicals
- Intermediate Manifold Compensating System (ICS)
- Emergency Gas System (EGS)
- Performance Certified UBA Helmet / Full Face Mask System

DANGER

When the RDC-2 or RDC-3 is used as the XLDS, the Consoles must be configured and operated with the complete XLDS system only. It must be used within the guidelines of the operational specifications of the user guide. Only demand mode Helmets and Mask models, that have been certified by Dive Lab, for use with the complete system should be used. Failure to follow the instructions in the Guide may result in serious injury or death.

DANGER

All Divers using the XLDS and associated man worn equipment, must be medically fit. All users must have a current diving medical exam, by a physician knowledgeable in the requirements of diving physicals.

DANGER

Only persons properly trained in the practice of surface supplied diving and surface supplied diving operations should use this equipment. Failure to have proper training and experience could result in injury or death.

DANGER

The XLDS-RDC-2, and XLDS-RDC-3 high-pressure systems, should not be used with pure oxygen, or oxygen enriched breathing gases, with an oxygen percentage greater than 21% by volume. Use of oxygen or oxygen enriched breathing gases in the high-pressure systems, may result in fire or explosion, resulting in serious injury or death.

WARNING

The Lightweight System must only be used with properly maintained and serviced Helmets, Masks, Emergency Gas Systems, and support equipment, as outlined in this User Guide.

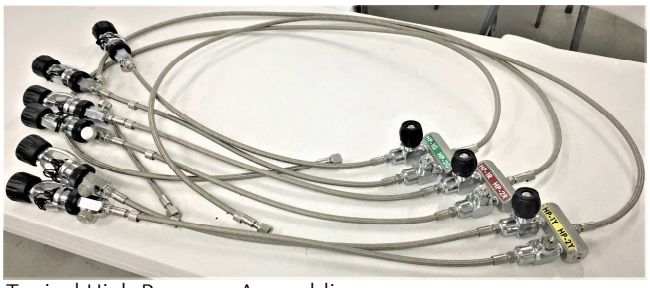
High Pressure Supply

The High-Pressure Supply System is for air diving only, and is not designed or intended for breathing gases with an oxygen content greater than 21% oxygen by volume however the system has provisions for integration of pure oxygen or oxygen enriched gas for in water decompression, using a separate Dive Lab system known as the Surface Supply Oxygen Control Console System (SSOCS). The SSOCS that can be interfaced with the reduced pressure Manifold. The oxygen system is intended for use to a maximum depth of 50 FSW, for decompression purposes only.

The HP air supply system is rated for up to 5000 psig service with properly rated fittings. The HP system should only be supplied with breathing quality air via sources at supply pressures of 400 PSIG or greater capable of supplying at least 500 LPM. Typical air supply sources include standard single or double SCUBA Cylinders, Fire Fighting Cylinders, and/or any high-pressure supply up to 4350 psig, if DIN fittings are in use.

The standard High-Pressure Air Supply System for both the RDC-2 and RDC-3 for each diver circuit consists of two SCUBA "A" Yokes / DIN combination connections with Bleed Valves, and short (12"-18") whips. Each set of Yokes sends air via the short Whips, to an isolation valve on a small manifold block used for supply, isolation and air switching. From the Junction Block air travels via a 6' to 25' long whip, to the console pressure regulators. On the RDC-3 the third diver (Yellow Diver), is the standby.

Each HP supply assembly quickly connects to the Regulator Inlets through the use of 72" long whips, ZCO O-ring fittings. The "A" Yokes are rated for 3500 psig and the DIN fittings, are rated for 4350 PSIG service. Other configurations of supply whips and fittings are available. The flow capability of the high-pressure system, enables standard SCUBA Cylinders, to be used as low as 380 PSIG, before Cylinder switch-out is necessary. Other supply whips and configurations, can be used, providing they can provide the proper volume.



Typical High Pressure Assemblies

Special Purpose High Pressure Assembly

High Pressure Assembly with Gas Storage Cylinders

Rapid Deployment Air Control Console

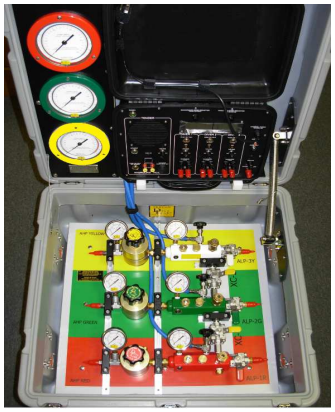
The breathing gas control console regulates and controls the divers breathing air as well as pneumofathometer air for depth sensing. Both the two and three diver console (RDC-2, RDC-3), have one complete circuit for each diver laid out in a simple fashion, and the components used in each console, are the same. The Supply to each diver's circuit, starts with a VCO O-ring fitting, or # 4 37° JIC fitting, attached to a stainless steel Street "T", connected to each diver's pressure regulator. The regulator is rated for a maximum inlet supply pressure of 5000 PSIG, and a maximum outlet pressure of 400 PSIG. Reduced air pressure passes through a one-way valve, allowing air to only travel into the Manifold. Each manifold assembly contains a 0-600 PSIG, reduced pressure gauge, Pneumofathometer supply valve, relief valve (set to relieve between 390-400 psig), and diver supply valve. Each manifold has a 1/2" NPT, 1/2"-20, and 3/8"-28 straight thread gauge calibration port, and a main supply cross connect, which allows intermediate air from either circuit, to be lined up to the other divers reduced pressure circuit(s). Each diver's low-pressure (ALP) supply valves, are quick acting quarter turn valves. The manifold is the foundation, that holds all gas train components, and secures to a 1/2" thick high density polyethylene plastic foundation plate, that is through bolted to the console box, making the piping system secure.

The pneumofathometer gauges on the 2 and 3 Diver Console, are mounted in the console lid, along with or without an installed diver intercom (Optional). The 3 Diver Console can be equipped with several different diver intercom units (optional), but does not have a diver intercom integrated into box. Both 2 and 3 RDC's are normally equipped with index locking quick connect fittings, for attaching the pneumofathometer and breathing air supply Umbilicals.

XLDS System Restrictions

The XLDS with 1/4" umbilicals and diver worn manifold compensating system, has a normal umbilical restriction, to a maximum length of 330' (100 meters). Special custom hoses can be manufactured on a case by case basis, with certain depths limitations.

When RDC-2 or 3 is used as a standard control console with 3/8" umbilicals, umbilical length should be restricted to 600' (200 meters) or less, and a maximum diving depth of 220 fsw. The system must only be operated and used within the guidelines of this user guide, and the operation specifications described in this guide.



XLDS RDC-3

XLDS RDC-2

SECTION THREE: CONFIGURATION AND USE

Ultra-Light Umbilicals

The XLDS umbilicals have been specially designed for use with the manifold compensating system, and RDC-2 or RDC-3, and are not intended to be used for conventional surface supplied diving. The umbilical assembly is comprised of four major components, that are twisted together to form the complete umbilical assembly, breathing gas hose, communications /strength member, pneumofathometer hose, and 20' grab line. The divers end has a "D" ring with snap shackle, which is attached to the communication/strength, and grab line for securing to the diver worn harness.

The 1/4" I.D. supply umbilical has a design pressure of 1500 psig, and is rated for a normal maximum system working pressure of 400 psig. Both ends have SS swaged 1/4" MPT fittings, which connect to a 6" adapter hose, that has 1/4" FNPT on one end, and 9/16 O_2 strait thread on the other. The topside end connects to a 9/16" O_2 fitting on the outlet of each divers control valve ALP1R, ALP2G, ALP-3Y on the RDC. At the divers end, the umbilical to ICS interface hose attaches to a 9/16" CGA O_2, male fitting on the ICS one way valve.

Pneumo hook-up

Standard XLDS Umbilical 300 ft.

Communication Strength Member

The communication / strength member contains four (4) wires, for communications and a polyester strength member. The assembly is encased in a polyurethane jacket. The strength member has a safe lifting capacity of 800 lbs, and a minimum breaking strain of 2200 lbs.

Pneumofathometer Hose

The Pneumofathometer Hose is made from black nylon plastic, 3/16" I.D. rated, for a maximum internal pressure of 200 PSIG.

Grab Line

The Grab Line is twisted into with the first 20 feet of Umbilical at the diver's end, to allow for easier handling by the tenders, and to aid in lifting if necessary. The Line is standard 3/8" or 1/2" braided nylon.

Diver Worn Harness and Manifold Compensating System

The diver worn intermediate compensating system (ICS), was designed to allow 1/4" I.D. air supply umbilicals, to be used with standard demand mode helmets and masks. The system allows divers the ability to dive to depths, previously only attainable when using heavy 3/8" Umbilicals, and large support systems. The ICS system with accumulator cylinder attaches to the right side of the modified Atlantic Diving Equipment, or Miller Bell Harness, and fits securely behind the right arm, in a specially fitted holster. The umbilical attaches to the ICS, which reduces the normal umbilical supply of 350 psig, to between 150-170 psig, over ambient pressure to the demand mode helmet or mask being used.

Because the manifold volume tank receives medium pressure high velocity air from the umbilical, the system is capable of providing the necessary peak flows, required to attain respiratory work rates (RMV), as high as 75 RMV, with specified helmets and masks to depths of 190 FSW.

ICS/EGS Manifold Compensating System with 6 cu. Ft. surge bottle

Harness Assembly and ICS Assembly

XLDS-RDC-3 Specifications

- Box Weight 87 lbs.
- Outer Dimensions Length 28 inches
- Width 27 inches
- Height 15 inches
- Number Diver Circuits 3, Red, Green, Yellow
- Max Depth: Using 1/4" I.D. Umbilical one continuous length up to 330' long, 165 fsw
- Maximum High Pressure Supply 3000-5000 psig
- Minimum Console Supply Pressure 375 psig
- Maximum Low Pressure Outlet Pressure: 375- 400 psig
- Low Pressure Relief Setting: 400-420 psig
- High Pressure Gauges: 3, 0-5000 psig
- Low pressure Gauges: 3, 0-600 psig
- Pneumofathometer Gauges: 3, 0-250 fsw

Surface Supply Console Flow Capability with 300 foot long 1/4" umbilicals and ICS

- Minimum Flow: with 800 psig HP supply and Reducer, set static to 350 psig 700 slpm (scfm)

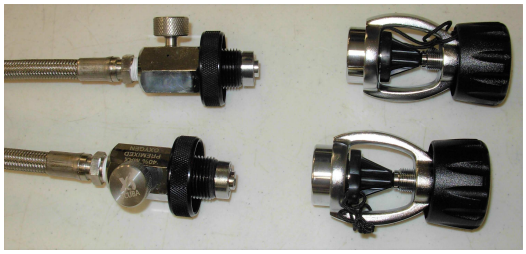
- Minimum Flow: 400 psig HP supply, reducer set static to 350 psig, 550 slpm (scfm)

Work of Breathing Performance

Work of breathing performance data is based on one diver, breathing from a HP supply of 400 psig, with the SCC regulator, set static at 350 psig. The I.P. of the ICS set between 150-170 PSIG. Umbilical length, 300', maximum depth 132 fsw.

High Pressure Air System

The standard high-pressure air attachment to SCUBA cylinders, are either DIN or SCUBA "A" Yokes, rated for a maximum supply pressure of (4350 psig DIN), (3500 psig A-Yoke). All standard RDC-2 and RDC-3 Whips, are rated for a maximum working pressure of 5000 psig, or as marked on the Whip. Other Whips up to 25 feet in length, can be used, providing they have a minimum I.D. of 0.112. Whips over 25 feet in length, should have a minimum I.D. of 0.160.



DIN Yoke Assembly

WARNING

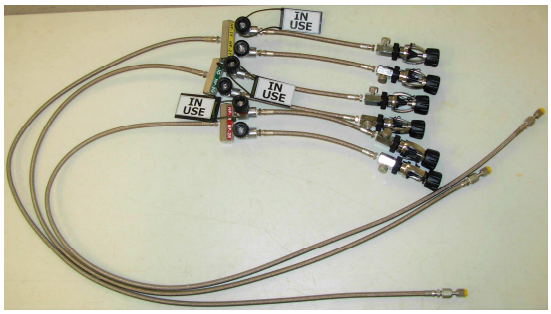
The HP whips supplied are rated for 5000 psig service, but should not be used at pressures greater than 3500 psig, with the "A" Yoke or 4350 psig with DIN fittings, and up to 5000 psig with other properly rated fittings.

CAUTION

Ensure the Cylinder Valve Outlet opening is pointing away, in a safe direction, then slightly crack open and shut each Cylinder Valve momentarily, to dispel any dust or dirt, which may be present in the Valve Orifice.

Each divers' circuit comes standard, with two cylinder attachment whips and yokes, which attach to a routing block and shut-off valves. Each supply system allows attachment, to two single SCUBA cylinders, or two sets of twin SCUBA cylinders, if twin cylinders are being used. Each divers' circuit, should always be set-up with each yoke attached to a fully charged cylinder, and only one cylinder supply should be on line at a time, so that when the gas supply reaches approximately 400 psig, it can be secured and the other supply opened.

By keeping the system set-up in this manner, the depleted cylinder(s) can then be changed out, and a full cylinder placed in the ready, without interruption of breathing air. Prior to attaching the cylinders, each HP circuit should be inspected, for signs of damage.



HP Whip Assembly - 3 Diver

Diver Intermediate Compensating Manifold Gas Flow

The divers' umbilical snap shackle attaches to D ring on the left side of the harness. The Umbilical connects to the male CGA O2 fitting, on the compensating manifold one way valve. The one way valve allows the umbilical gas to supply the manifold regulator and accumulator. The manifold regulator reduces the umbilical supply to a normal supply pressure, between 150-170 psig over ambient. Air then travels up a 5/16" intermediate whip, to the helmet or mask being used. The manifold is also equipped with a multi-turn EGS Valve, for interface with the emergency air system.

WARNING

Under no circumstance should the XLDS diving system EVER be used without a fully functioning man worn emergency gas system.

Emergency Gas System

The emergency gas system is attached to the modified harness. The emergency gas system is made up of a good quality first stage SCUBA regulator, and high-pressure cylinder. Cylinder capacity must be selected based on the depth, and potential hazards that may be encountered. It is strongly recommended that the cylinder capacity be sufficient, to allow a normal ascent to the surface, or to a place of safety where breathing gas can be restored. The regulator used with the cylinder, should be equipped with a relief / bleed valve. The bleed valve allows excess pressure to vent from the EGS supply whip, in the event the first stage develops a minor leak. Without the bleed valve, a minor first stage leak, could cause the pressure within the EGS to rise, above the maximum safe working pressure of the LP supply whip causing the whip to rupture, resulting in loss of the EGS system. The XLDS comes standard with either a 30 or 40 C.F. emergency cylinder which fits the standard system cylinder straps. If larger diameter cylinders are to be used the longer cylinder retaining straps will be required.

EGS Assembly and ICS Manifold Compensating System

General Cleaning / Inspection Procedures

Prior to commencement of system work, a clean area should be established and tools to be used must be clean and free of grease and oil. Persons performing repairs and overhauls should be trained and experienced.

Cleaning Solution

All components of the XLDS and RDC should be cleaned using a detergent like Simple Green® diluted, with clean filtered water at a ratio of 1 and 1/2 ounces of detergent to each gallon of water. Regular hand washing type dish detergent, or Non-Ionic Detergent may also be used by mixing at a ratio of, one tea spoon per gallon of water. All components must be thoroughly rinsed with condition fresh water filtered to 5 micron or less. After rinsing, take a sample of the final rinse water in a clear container and perform a shake test to check for suds, re-rinse components if suds are observed during shake test.

Corrosion

Parts showing corrosion should be cleaned with detergent and water to remove as much old lubricant as possible, and then acid cleaned by immersion in a 50/50 solution of white vinegar and water for up to 4 hrs. Re-clean parts using the detergent solution and rinse thoroughly.

Inspection

After cleaning, the parts should be inspected for obvious contamination and re-cleaned as necessary and carefully inspected for signs of wear and damage.

Drying

All parts should be left to air dry in a clean controlled space, or dried using nitrogen or divers' air. A hair dryer set on a low heat is also an effective way of drying parts. When parts are dry, inspect using a bright light. Complete a final visual inspection and if any contamination is found, the components must be re-cleaned.

Control of Cleaned Components

All parts cleaned should be protected by sealed airtight designated containers or individually bagged as necessary until reinstalled in the system. All attempts should be made to maintain Foreign Material Exclusion (FME) of all parts and components, during all phases of the repair/overhaul process.

Cleaning and Handling of O-rings

All O-rings used in the XLDS and RDC will be cleaned using a detergent solution then thoroughly rinsed, dried and sealed, in an appropriate container. Once cleaned, all O-rings should only be handled while wearing gloves. O-rings should not be lubricated, until they are staged, and ready to be installed into the components.

Lubrication

Lubricant applied to O-rings and components, must be done sparingly. The recommended lubricant is Christo-Lube®.

Pipe Threads

Pipe thread fittings in high- and low-pressure breathing gas systems, are often used as an alternative to straight thread O-ring or welded fittings due to cost, complexity, and selection.

Pipe thread fittings offer an attractive alternative to large bend radius welded, or compression joint systems, and can produce exceptionally strong, reliable, compact systems.

However, shock and vibration especially in portable systems can cause movement between joints resulting in leaks. Unlike O-Ring fittings,

minor pipe thread fitting leaks will not suddenly or drastically increase because of the natural locking nature of pipe threads. Teflon tape is used both as a lubricant and a sealant. As a lubricant, the tape keeps the threads from galling. As a sealant the tape produces a gas tight seal. Unlike pipe fittings, minor Leaks in O-Ring fittings cannot be tolerated, because the seal is made by the O-Ring only, between two surfaces and leakage will normally increase rapidly especially if there is any movement of the fittings. In some cases, parts of the O-Ring may extrude causing sudden massive leakage or total failure of the O-ring seal.

Unlike O-rings, the pipe threads use sealing tape which will usually show up as a minor leak and will not progress significantly as long as there is no movement of the fitting. Very minor leakage in pipe thread fittings is common, should be expected, and does not pose an operational hazard in "AIR SYSTEMS", or a significant reduction in operational capability as long as the leaks are minor, can be identified and quantified. All leaks should be repaired as soon as possible / practical. It should be understood, that in portable fast response systems like the XLDS which can be subjected to shock and vibration during transport minor leaks may result that may have to wait before repairs can be made.

The only way to remedy leaks in pipe thread fittings, is to depressurize the system, disassemble the joint, remove old sealing tape, brush clean and inspect the threads for damage, and then re-tape and re-make the joint. Because this is often impractical to accomplish in the field, minor leakage during system use, can be an acceptable alternative to field repairs in order to safely continue with diving operations until re-sealing can be accomplished.

WARNING

Never tighten fittings or components while the system is pressurized. Attempting to tighten fittings, while the system is pressurized, could result in component failure, resulting in serious injury or death.

Checking and Quantifying Leaks

There is a full system step by step test procedure for pressure testing. XLDS RDC Console Annual Pressure /joint Tightness Testing Test which should be done annually, but can also be done at any time leakage is suspected. However, as a quick field check if necessary, complete a check as described herein to quantify leakage.

Checking for Leaks Quick Check: To check for leaks, ensure the umbilical supply valves, pneumofathometer valves, and cross connect valves are shut, then slowly open each cylinder HP supply valve, and each supply block valve approximately 1/4 -1/2 turn, and pressurize each HP circuit, using at least a 3000 PSIG supply pressure. Load each regulator to 350-400 PSIG and allow the system to settle for at least one minute then secure the cylinder valves only, and record the high and low pressures and the time. Allow the system to sit for ten minutes, then check the gauges. If there has been any loss of pressure, apply soapy water solution to all joints and fittings to identify the leaks. Very minor leaks at pipe threaded joints, that cause a drop of gauge pressure of no more than 10 PSIG in ten minutes, with the supply isolated at the HP blocks as noted on each of the high-pressure gauges, do not require immediate re-sealing. Pressure loss in excess of 10 PSIG, represents a gas loss in excess of 3 liters in ten minutes, and should be corrected before the system is used. This leakage is

acceptable for pipe thread fittings and joints only, O-ring and or any other types of leakage must be repaired prior to use. Use the Dive Lab Appendix A2.1A Pressure/Joint Tightness procedure.

NOTICE

The purpose for the allowable leakage, is to allow continued use of the system to be used, until repairs can be made.

NOTICE

The ¼ turn cross connect and umbilical supply valves, will sometimes show slight leakage at the packing nut, under the handle. This is common, and will only require light tightening of the packing nut, using 9/16 wrench. Tighten just enough to stop the leak.

Teflon Tape

When making up pipe fittings of 1/4" or smaller, for best results, use three (3) mil thickness Teflon® tape. The tape used should be 1/4" wide. Half inch (1/2") wide, three (3) mil tape on 1/4" or smaller pipe threads, can be used but will not stretch and form to the small diameter threads, as well as 1/4" tape. Normally, 1-1/2 wraps applied under tension, is all that is required on brass to brass fittings, however for stainless fittings we recommend up to two and a half (2-1/2) wraps to achieve a tight seal. The tape should be applied under tension, starting 1-1/2 to 2 threads back, from the start of the fitting. In addition, we recommend applying a small amount of Christ Lube over the Teflon® tape.

Making up 3/8" to 1/2" Pipe Fittings

When making up three eighths (3/8"), or half inch (1/2") pipe fittings, three (3) mil thickness Teflon tape, or six (6) mil thickness tape, half inch (1/2") wide may be used. If three (3) mil is used, use two (3) to four (4) wraps. If six (6) mil is used, use one and a half (1-1/2) to two (2) wraps. Apply tape under tension starting one and a half (1-½) to two (2) threads back from the start of the threads.

Torque/Tightening

Pipe threads should be tightened using good engineering practice. Tighten pipe threads securely, but do not over tighten. Normally pipe threads should engage at least 1 ½ to 2 full turns by hand, followed by at least 2 full turns by wrench.

RDC Regulator

The standard regulators used for the RDC, are Aqua Environments® model 873 piston type hand loaded regulator of a balanced poppet, designed for high flow with a minimum effect on outlet pressure. The poppet assembly is contained in a cartridge, with internal filtration for easy in-field changing. The regulator is NOT intended for oxygen, or oxygen enriched gas mixtures. The regulator should be used with filtered breathing quality air only.

Specifications

· Maximum inlet pressure 5000 PSIG (340 BAR)
· Outlet pressure 0 - 400 PSIG
· Flow coefficient (Cv) 0.8
(equivalent to 0.23" orifice)
· Rise of outlet pressure with drop of inlet
pressure 10 PSIG/1000 PSIG
· Materials – body and cap – aluminum
· Internals – brass, stainless
· Seals – KEL-F, Buna, Viton
· Fittings – ¼" FNPT inlet
½" FNPT outlet
· Size – 3" dia. x 6" long

SECTION FOUR A: RDC REPAIR / MAINTENANCE / OVERHAUL

Installation

Use only Teflon tape on inlet and outlet threads of the aluminum regulators never use lubricant on aluminum threads used in high pressure piping systems. Avoid over tightening of pipe threads. Pipe thread fittings should thread in approximately 1 ½ to 2 threads by hand, and 2 threads by wrench. Normal torque, applied with an 8-12 inch long wrench, is ample.

The inlet (HP) is on the left, when facing the adjusting knob with the two gauge ports upward. The ½" port is the outlet. The ¼" port adjacent to the ½" port, is the LP that is plugged with a pipe plug. The port to the left is a HP outlet port and is also plugged.

The HP inlet port is directly on the opposite side of the regulator body, opposite the large ½" port.

CAUTION

An outlet gauge and relief valve set no higher than 400 psig, should be connected to LP manifold.

Operation

Outlet pressure is adjusted by rotating the regulator hand wheel, to the desired value, as read on the outlet gauge. When reducing the pressure, the regulator will not vent the LP manifold, because of the check valve at the outlet of the regulator. It will vent slightly, when first backed off via the vent hole near the cap. This is normal. To lower the manifold pressure, vent the umbilical pressure to below the new setting, then increase pressure to the new setting.

Figure 1

CAUTION

Maintenance and Repair

As with any regulator or valve, particulates or moisture, can plug or freeze the internal filter or valve seat. This can occur, when air compressor supply dryers are not adequate, or are not used regularly. The regulator should be overhauled, at least every three years. Systems in continuous use, may require overhaul more often. The user should establish time intervals for changing the valve cartridge, filter, and any upstream dryers, based on experience and service conditions. Back-up systems should be used in very critical applications, since field maintenance is hard to ensure. The poppet cartridge (2) is a factory assembled item, and should be replaced as an assembly. Always keep at least one spare cartridge on hand for repairs. In all cases, the unit can be returned to Dive Lab for repair. Maintenance or repairs, should only be done by qualified personnel, allowing the drawings and parts lists herein.

Trouble Shooting

The number one cause of leakage in the high-pressure regulator, is a dirty corroded HP seat, due to dirt or moisture in the air supply. If

leakage occurs through the regulator, or out the regulator vent, allow the inlet and outlet pressure, to equalize by shutting off the inlet. If leakage continues after the inlet and outlet equalize, the vent seat (8) or piston seal (6) is leaking. Replace both. If leakage stops, when the inlet and outlet pressure equalize, the poppet cartridge item (2) is leaking. Replace. Consult Dive Lab, if necessary.

NOTICE

Overhaul of the regulator should be limited to cleaning and changing the HP cartridge assembly as well as the upper piston assembly.

Regulator Overhaul

1. Do not use silicone or Christo Lube, on threaded high, or low-pressure inlet outlet fittings. Use Christo Lube MCG 121 on O-rings, on the bearing (13) and (12), and on threads between items (16) and (17), and between (1) and (18).

2. The regulator internal components, can be overhauled, with the bottom end of the regulator in place. The regulator bottom, need not, be removed from the system.

3. Remove the regulator adjustment knob (15) and stem (16), as an assembly.

Figure 2

4. Apply several wraps of electrician's tape or equivalent, around the upper housing (18) to prevent scratching, then using a "clean dedicated" oil filter wrench, to loosen the upper body (18), then remove by hand.

NOTICE

Aqua Environments regulators made after 2015 have a small hole on each side of the regulator body, to allow for using a spanner wrench instead of an oil filter wrench.

Figure 3

Figure 4

5. Remove items (14), (12), (13), (10), (11), as a stack, place these items in a small, clean container.

NOTICE

The above items are outside of the breathing air system. If the items show no signs of dirt and corrosion, cleaning is not required. If in doubt, clean and re-lubricate with Christo lube, or food grade Silicone grease.


Figure 5

6. Carefully remove the piston housing, clean and inspect all components. Lightly lubricate new O-rings on new service kit. Figure 6.


Figure 6

7. Remove low pressure piston assembly.


Figure 7

8. Remove high pressure valve assembly, in regulator body.


Figure 8

9. Inspect regulator body for damage and/or corrosion. If nothing found install new kit.

NOTICE

If the housing is heavily corroded, remove it in accordance with the procedures, listed in the one-way valve removal section.

10. Install NEW high pressure valve assembly, in regulator body. Tighten to 80-100 inch lbs.


Figure 9

11. Install NEW low pressure piston assembly.


Figure 10

NOTICE

Packing the vent seat area with Christo Lube, is done to secure the seat during assembly.


Figure 11

4. Lay the stop ring (9) down on top of the lower regulator body (1) as shown so the bevel is down, see Figure 13 & 14. Carefully place the piston housing assembly over the bevel ring into place. Use care not to drop the seat.

Figure 12

Figure 13

Figure 14

5. Lubricate, then stack the following items: Spring Pad (11), Spring (10), Brass Washer (14), SS Washer (12), Bearing (13), SS Washer (12), Brass Washer (14).

NOTICE
Make sure the top washer (14), has the tapered hole bevel facing up, for smooth engagement to the stem (16).

Figure 15

6. Ensure the lower body threads have been lightly lubricated, then carefully load the top of the body, down onto the lower body snug with moderate force, using the oil filter wrench.

7. Liberally lubricate the end of the stem (16), as well as the threads, and secure into the top of the body.

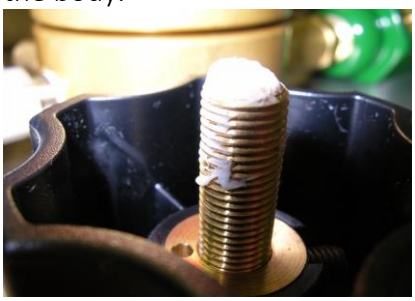


Figure 16

8. The regulator should now be tested for proper operation.

Low Pressure Umbilical Supply Valves / Cross-Connect Valves Overhaul

The quarter turn valves used for the LP cross connect and umbilical supply are very reliable, and require only minimal maintenance.
The valve is made of 316 stainless steel, and have a rated working pressure for the XLDS of 400 psig. The valve should be overhauled at least every five years, or whenever the valve does not operate smoothly, or if any leakage occurs. The valve is

simple to disassemble and service, however, the person performing service must be knowledgeable and properly trained. The cross-connect valve and the umbilical supply valve, use the same components, except for the nylon locking nuts. Overhaul is done in the same manner.

Preliminary

Ensure all high-pressure gas supplies have been disconnected, and all pressure has been vented. Open each diver circuit pneumofathometer valve, to ensure the system is vented, then open each umbilical supply valve. Ensure the work area and all tools are clean.

The two and three diver RDC units are disassembled and reassembled in the same manner, therefore, this procedure will work for both with only minor variation. It is strongly recommended that you take pictures of pneumo hose routing.

Tools and Components Needed

3/8” Open End Wrench
9/16” Open End Wrench
1/2” Open End Wrench
Torque Wrench 0-250 inch lbs.
3/8” Socket short
7/16 Socket
9/16 Socket
1/2” Socket
Christo Lube®
Overhaul Kit PN# 1XL8RK
Brass Pick Set
Needle Nose Pliers
Thread Locker Compound-Medium Strength

NOTICE

Removing the entire manifold system from the foundation plate (1), allows easier access to the valves. Removing the entire manifold system, is very quick and easy.

1. Loosen and remove the hose fittings on Green, Red and Yellow divers’ pneumofathometer valves (11).

Figure 17

2. Loosen and remove all the 7/16” lock nuts, from each of the clamp blocks (21), then remove the blocks and rubber strips. There are 8 blocks on the three diver, and 5 blocks on the two diver consoles.

Figure 18

3. Lift the two or three diver manifold assembly from the box, as a whole. Place the manifold on a clean flat work table.


Figure 19

4. Using the 1/2” wrench, loosen then remove the valve handle retaining nut (12), from each valve being disassembled, then remove the lock washer (13) and handle (11).


Figure 20

5. Using the 9/16” wrench, loosen then remove stem cap (7) from each valve.

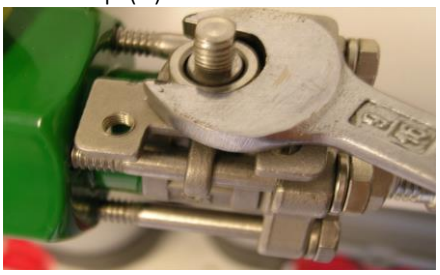


Figure 21

6. If the cross connect valves are being serviced, loosen and remove the 4 bolts (9) and nuts (10). If the umbilical supply valves are being serviced, remove the bolts and nut (25).

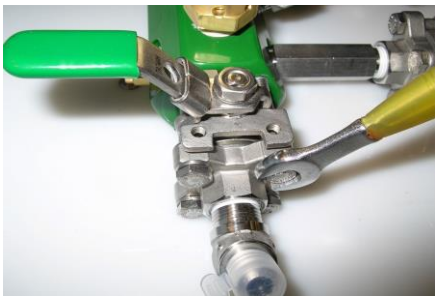


Figure 22

7. Remove the center section (1).


Figure 23

8. Press in on one side of the ball until one of the plastic end seals (6), until the other pops free, then rotate the ball (5), until the slot is parallel, with the center section then, the ball will fall free.

NOTICE
Take care not to scratch the ball. If the ball is scratched, it will not seal and must be replaced.


Figure 24

9. Push down on the stem shaft (40), and work to one side, until it pulls free, then remove the old stem washer (3).

Figure 25

10. Using a brass pick from the outside of the valve, pull up and remove, the two white packing discs (2) rings and discard.

Figure 26

11. Clean and inspect the ball (5), stem (4), stem cap (7) and center body section (1). If the Ball (5), center section (1) or stem (4) shows signs of damage from scratching, pitting, corrosion or wear, replace the complete center section.

12. Apply a light coat of Christo Lube® on the exterior of the new packing, and insert the packing into the valve center body (1).

13. Lightly lubricate the stem shaft, and install the Teflon® stem washer (3), then slide the valve stem (4), up into the new packing (2), from inside the valve center body (1). Make sure it is pressed all the way up, into place.

Figure 27

14. Install the stem cap (7), hand tight only.

15. Install the ball (5), so the groove is centered with the stem, then lightly lubricate the white plastic ball seals (6), and install with the concave sides in, against the ball. Ensure the plastic seals are properly seated.

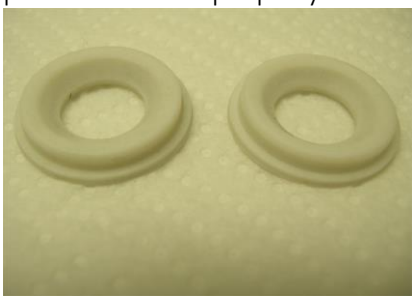


Figure 28

16. If the valve is an umbilical outlet valve ALP-1R, ALP-2G, ALP-3Y, apply a drop of thread medium or low setting thread locking compound to each bolt, at the start of the thread, then install the lock-washers and bolts (25, 27), and slowly draw up, evenly tighten in an X pattern into the end of the manifold, in three steps 10 inch lbs., 30 inch lbs., and finally torque to 60 inch lbs.

NOTICE

If the valve was a cross connect valve, reinstall the 4 bolts (9), so that the head of the bolt faces green diver manifold.

Install the lock nuts (10), lightly tighten using an X pattern 180˚aparting, then torque to 60 inch lbs.

17. Torque stem cap (7) to 60 inch lbs., operate the stem with the handle several times, to ensure smooth operation, then re-torque to 60 inch lbs.

Figure 29

18. Re-install the manifold in the box, making sure each clamp block, has the rubber strip installed. Tighten all clamp blocks to 40 inch lbs.

19. Reinstall the pneumofathometer fitting to each pneumo valve, and lightly tighten.

20. Perform a pressure test of the LP system.

Check Valve / One Way Valve

Each regulator is attached to the manifold, via a 1/2" brass male pipe thread (MPT), one-way valve. This same valve with a 1/2" elbow, can also be installed on the manifolds, for use if an LP supply is to be used. The one-way valves should be disassembled, inspected, and cleaned, and the sealing O-ring (5), at least every 5 years if the console is being used with HP air only, and once a year, if used with LP compressors, or whenever the valve fails a sealing/leak test.

Overhaul of the valve is limited to cleaning the body, spring and poppet, and replacing the O-ring (5).

NOTICE

The valve body need not be removed, unless it is severely corroded, contaminated or damaged. To remove the body, use a 12 inch long piece of PVC pipe 3” diameter, to hold the regulator body, and a 7/8” open end wrench, to turn the one-way valve body.

CAUTION

The threads that join the two halves of the one-way valve body, should not be over-tightened. The valve body haves, should be tightened to between 100-120 inch lbs.

Tools and Materials Needed

7/16” Socket
5/8” Open End Wrench
7/8” Wrench (2)
Torque Wrench 0-250 inch lbs.
Torque Wrench Crows Foot Adapters
3/8” Socket Short
Christo Lube®
O-Ring PN# 1XL25R
Brass Pick
Needle Nose Pliers
Flashlight
3” Diameter 12 Inch Long Piece of PVC Pipe (used as a Regulator Holder)
¾”-1”Tube Brush

Preliminary

To remove the valve from the manifold and regulator, the complete manifold system must be unbolted from the foundation plate (1), and removed from the console.

Ensure the work area and all tools are clean. Ensure the gas supplies have been disconnected, and all pressure has been vented. Open each diver circuit pneumofathometer valve, to ensure the system is vented. The two and three diver

SECTION FOUR A: RDC REPAIR / MAINTENANCE / OVERHAUL

RDC units are disassembled, and reassembled in the same manner, so this procedure will work for both with only minor variation.

1. Loosen and remove the hose fittings on Green, Red, and Yellow Diver pneumofathometer valve (11). (Same picture as the three way valve).

Figure 30

2. Loosen and remove all the 7/16" lock nuts, from each of the clamp blocks, then remove the blocks and rubber strips. There are 8 blocks on the three diver, and 5 blocks on the two diver consoles.

Figure 31

3. Lift the complete two, or three diver manifold assembly from the box as an assembly. Place the manifold on a clean, flat, work table then remove the hand loader knobs.

Figure 32

4. Position the regulators, so they hang over the edge of the work bench, and using two 7/8" wrenches, loosen and separate, the one-way valve, by turning counter - clockwise.

NOTICE

Use care when separating the valve, so the spring and poppet don't fall free.

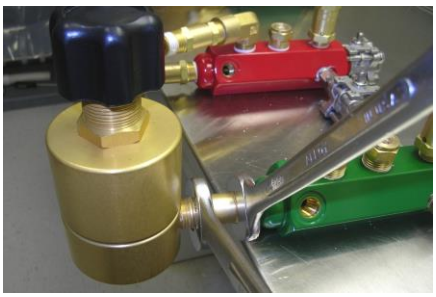


Figure 33

5. Remove the spring (3), and poppet/spring housing (2), then using the flashlight, carefully inspect the insides of each half, for corrosion and contamination.

NOTICE

Remove the O-ring using a brass, or plastic pick only. The use of steel picks or screw drivers could scratch the seat, causing the valve to leak.

Figure 34

6. Using the brass pick, remove the O-ring (5).

SECTION FOUR A: RDC REPAIR / MAINTENANCE / OVERHAUL

NOTICE

If the body (4), spring (3), and poppet/spring housing (2), are clean and free of corrosion, cleaning will not be necessary, and simply lubricating and installing the new O-ring, is all that is required. Skip steps 7 and 8 and continue to step 9.

Figure 35

7. Using 12” long piece of 3” diameter plastic (PVC) pipe, hold the regulator, while turning the check valve body counter-clockwise, with the 7/8”wrench.

Figure 36

8. Using a 7/8” wrench, while securely holding the manifold assembly, remove the other half of the one-way body, from the manifold, by rotating it counter-clockwise.

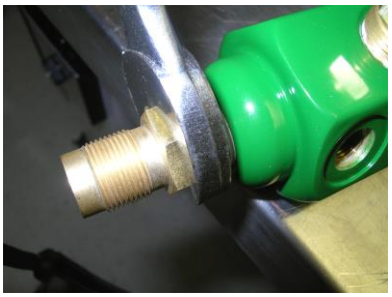


Figure 37

9. Using the tube brush and detergent solution, carefully clean the interior surfaces. After cleaning, inspect for corrosion, and soak if necessary in a 50/50 solution, of vinegar and water.

10. After cleaning, rinsing, and drying the body, inspect using a bright light for damage in the form of pitting or galling. Check the spring for corrosion. If the valve shows any signs of damage, replace the entire valve.

11. Lightly lubricate the new O-ring (5), and install in the regulator side of the body, use the poppet as a tool, to position the O-ring into place, then load the poppet/spring housing (2), and spring into place, and carefully re-connect, the two valve body halves. If the entire valve assembly had been removed, reassemble, then re-tape each end and thread into the manifold first but only lightly tighten, then install the regulator body hand tight.

12. Install the PVC pipe over the regulator, and using the 7/8” inch wrench, loosen the two valve halves. Tighten the regulator side of the valve until almost tight, then tighten the valve halves to check for alignment.

13. After checking alignment, alternate the tightening of the valve body halves, until the regulator is upright and level, and the joints are tight.

14. After all manifold repairs have been made, load the manifold assembly back onto the foundation plate, replace all rubber strips and securing blocks, then tighten all nylon nuts to 30 inch lbs.

15. Reinstall the pneumofathometer hoses, and tighten, using good engineering practice.

16. Perform a leak check, by pressurizing the low pressure system, to at least 350 psig, and then secure and bleed down the high pressure supply system. The low pressure circuit should lose 10-20 psig, as the one way valve shuts, and then should hold pressure with no leakage, hold for at least 5 minutes.

Pneumofathometer Valve Lubrication

Preliminary

There are two types of Pneumofathometer valves, which have been used on the XLDS. On units made prior to 2010, a brass Hy-Lok® angle valve, with a metal to metal seat was used. On units made after 2011, a stainless steel Hy-Lok valve was used, which employs a soft seat stem. These valves will operate for many years, and require lubrication only once a year. If repair is needed the repair is limited to replacement of the packing, and stem only. The valve can be sent to Dive Lab, for a complete overhaul, if necessary.

NOTICE
The two and three diver RDC units use the same model valve, and are disassembled and reassembled in the same manner.

Tools and Components Needed

9/16” Open End Wrench
5/8’’Open End Wrench
Torque Wrench 0-250 inch lbs.
5/8” Crow Foot Adapter for the Torque Wrench
11/16” Open End Wrench
8-10” Adjustable Wrench
3/32” Allen Wrench
10x Magnifying Glass
Teflon Tape
Packing PN# 1XL6-4RK
Soft Stem PN# _____
Christo Lube
Lint Free Cloth

1. Disconnect all gas supplies. Ensure the system is vented and the LP gauges read zero.

2. Using the 5/8” wrench, loosen and remove the bonnet nut (3), by rotating counter-clockwise.

Figure 38

3. Unscrew (back out) the valve handle counter-clockwise, and pull the knob (8), and stem (4) free.

Figure 39

4. Inspect the seat area in the valve for damage, corrosion and contamination. If the valve is free of corrosion and damage, wipe the threads of the stem (4), clean with a clean lint free cloth, lightly lubricate the stem threads, and packing area with Christo Lube®, and reinstall into the body.

NOTICE
Thread stem (4) in, by hand lightly, until it bottoms out, then engage the bonnet packing nut (3), and hand tighten only at this time.

5. Back the stem out one to two turns, then torque the packing nut (3) to 15-20 inch lbs.

6. Test operate the valve without pressure, then perform a seat tightness test by installing the valve back in the system and loading the regulator to 350 psig, then checking the discharge end of the pneumofathometer fitting for leaks, by placing the end of the QD fitting in a glass of clean fresh water, for at least one minute, to check for bubbles.

Replacing the Valve Packing / Stem

1. In the unlikely event, the valve packing and or stem need to be replaced, ensure the system is depressurized, remove the valve knob (8), using the 3/32"Allen wrench, remove the knob set screw (8), and knob (7).

2. Loosen and remove the bonnet nut (6).

3. Remove the stem (2).
4. Remove the spacer (5), plastic packing (4), and washer (3), then wipe the stem clean, and inspect for damage in the form of scratches, corrosion and damaged threads. Replace the entire valve stem, if the stem is damaged. Look down into the valve body (1), for signs of damage. If the valve stem seating area shows any damage, the entire valve assembly should be replaced.

Reassembly

5. Lightly lubricate the stem shaft and threads, then install the washer (3), the plastic packing (4), then the spacer (5).

6. Thread stem (2) in by hand lightly, until it bottoms out, then engage the bonnet packing nut (6), and hand tighten only at this time.

7. Back the stem out one to two turns, then torque the packing nut with the 9/16" adapter to 50 inch lbs., to set the packing, then loosen and re-torque to 25 inch lbs.

8. The valve should be tested after any work is done. Ensure the valve is shut, then load the regulator to 350 psig, and check the discharge end at the female QD fitting for leaks by placing the open end of the QD, in a glass of water for at least one minute, to check for bubbles.

Removing / Replacing Pneumo Valve

1. Using a 9/16" open-end wrench, remove the pneumofathometer supply hose, for the valve being removed.

2. Using the 11/16" open end wrench on the valve body, remove the valve by turning counter-clockwise.

New Valve Installation

1. Tape the end of the valve with Teflon tape. Starting two threads back apply 2 full wraps.
2. Ensure the threads in the manifold are clean of old Teflon tape, and the threads are not galled or damaged, then install the pneumo

body, and tighten securely using an open end 11/16 wrench ensuring proper alignment, for the hose and fitting.

3. Re-Install the hose and tighten, using a 9/16 open end wrench. Torque the hose fitting to 50-inch /lbs.

4. Check the valve for seat tightness and leaks, by first closing the valve, then slowly load the regulator to 350 psig.

5. Place the open end of the QD fitting in a glass of water, to check for seat leaks, for at least one minute.

High Pressure Supply Valve Overhaul

There are two types of high-pressure supply valves that have been used on the Dive Lab HP routing blocks. All systems made before January of 2012 used Sherwood® line valves, model #YVA3010. After 2012, Thermo® line valves became standard. See Figure 40.

Figure 40 Thermo & Sherwood Line Valves

Disassembly and assembly procedures are the same for both valves. These valves are normally used for high-pressure air transfer systems, and are durable, reliable, and require minimal service. Overhaul of the valve is limited, to replacing the sealing washer (20), soft seat (3), stem packing (5). The valve should be overhauled at least every five years, and/or whenever damage or wear is suspected/found, or if the valve does not operate properly.

Figure 40-1 **Top:** Sherwood Valves Exploded View
Bottom: Thermo Valves Exploded View

NOTICE

The valve can be disassembled in place, and does not require removal from the block and hose, providing the valve body and internal body seat, does not show signs of contamination, and/or damage.

Preliminary

1. Ensure the HP supply whips are disconnected from the cylinders, and the system has been vented.

2. Open both HP valves, HP-1, HP-2.

3. Ensure the work area is clean, and all tools are clean.

Tools and Components needed

- 10” or Large Adjustable Wrench Or Vice
- 0-250 inch lb Torque Wrench
- 11/16” Open end Wrench
- 11/16” Crows Foot Adapter
- 1/4 “ Tube Brush
- 10x Magnifying Glass
- Brass Pick

- ¼-3/8" Flat Blade Screwdriver
- Christo Lube
- Soft Good Kit PN#3XL89RK

Disassembly

1. Open the valve being serviced fully, counterclockwise.
2. Remove the slotted retaining nut (10).

Figure 41

3. Remove the spring (9).

Figure 42

4. Holding the valve body (1), in a vice or with the adjustable wrench, loosen the bonnet packing nut (7), by turning counter-clockwise, then remove with the stem (3).

Figure 43

5. Rotate the soft seat (5) counter-clockwise and remove.

Figure 44

6. Using the brass pick, remove the copper sealing washer (2).

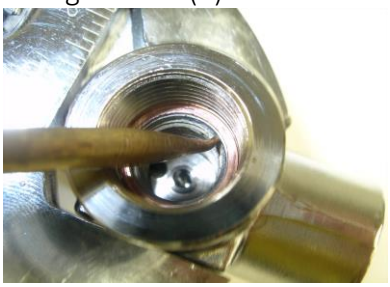


Figure 45

7. Using the pick, remove thin packing washer (4), packing (6), and discard.

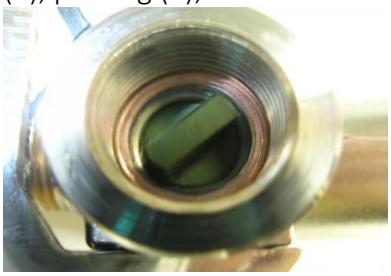


Figure 46

Cleaning and Inspection

NOTICE

If the valve body shows signs of corrosion and or contamination, the valve should be removed from the HP block, and the HP hose for cleaning.

CAUTION

Use care, not to scratch the valve body seat area, when cleaning.

1. Place the valve body, and all valve components, in a solution of detergent and warm water, and carefully clean with the tube brush. Corroded parts should be soaked in a 50/50 solution of vinegar, and water for 1–3 hours, then re-clean, thoroughly rinse, and inspect for corrosion and damage. If the body or stem, shows any signs of damage, the entire valve should be replaced.

NOTICE

Lubrication should be done sparingly, on the stem shaft, and packing nut threads only.

2. After all interior and exterior surfaces have been cleaned, dried and inspected, install the new seat (5), and thread it all the way down, using the flat blade screw driver.

3. Install the thin copper washer (2), in the body.

4. After inspecting the stem, lightly lubricate the stem shaft (3), then install the new washer (4), packing (6), into the packing nut (7), apply a small amount of Christo lube on the packing nut threads.

Figure 47

5. Engage the cap nut (7) threads into the body (1), and lightly turn the stem, until it engages the slot in the soft seat. Then tighten the bonnet nut by hand, until it bottoms out.

Figure 48

6. Back out one-two turns counterclockwise on the stem, then using the torque wrench, torque the packing nut (7) to 150 inch lbs.

Figure 49

7. Place the knob (8) on the stem, and rotate the valve shut. Then pull the knob off, leaving the stem and packing nut visually exposed.

Figure 50

8. Perform a leak test on the valve, using full system pressure. The simplest test, is to shut both valves on the HP block, attach HP supply gas to the valve to be tested, and slowly pressurize to the maximum HP supply pressure, 4350 psig for DIN and 3500 psig for "A" Yokes.

   At the same time, spray the valve stem and packing nut, with soapy water to identify any

packing leaks. Hold test pressure for at least one minute. If any leakage is found, repair or replace the valve.

9. Upon successful test, install the knob (8), spring (9), and retaining nut (10), then tighten the retaining nut, until the slot is flush, with the end of the stem.

Relief Valve Cleaning Inspection and Overhaul

The Relief valve used in all RDC units, purchased before 2011, is the Circle Seal® 0-400 psig, adjustable brass body relief. RDC consoles sold after 2011, use the Hy-Lok SS angle relief. Both valves are very rugged and dependable, and can be easily serviced by trained persons. Dive Lab strongly recommends, only factory trained technicians service this component. Overhaul is limited to cleaning and replacing the soft seat. If any other damage is found, the valve should be replaced. The following procedure covers overhaul of the Circle seal valve, followed by the overhaul procedure for the Hy-Lok SS angle relief.

Figure 51 (Old Relief PN# 1XL7-4RK)

NOTICE

The valve can be disassembled in place, and does not require removal from the manifold block, providing the valve does not show signs of contamination, corrosion and /or damage.

Preliminary

1. Ensure the HP supply whips are disconnected from the cylinders, and the system has been vented.
2. Ensure the work area is clean, and all tools are clean.

Tools and components needed

- 1” Open End Wrench (2 each)
- 0-250 inch lbs. Torque Wrench
- 5/16” Allen Wrench
- 1/16” Allen Wrench
- Needle Nose Pliers
- 10x Magnifying Glass
- Brass Pick
- Small Blade Pocket Knife or Exacto Knife
- Christo Lube
- New O-Ring PN# 1XL7-4RK
- Flashlight
- Nylon Tooth Brush
- Tweezers
- Low Lint Rags/Wipes
- Loctite® 222

Disassembly and overhaul in place

1. Using one of the 1” inch wrenches to hold the base of the valve, loosen the cap (9).

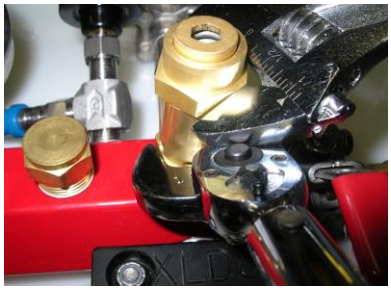


Figure 52

2. Using the 5/16” Allen wrench, loosen and remove the spring housing (8), spring (7), spring pad (6), seat assembly (2, 3, 4, 5).

Figure 53

Figure 54

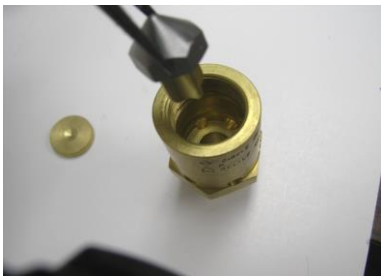


Figure 55

3. Inspect all components for contamination, corrosion and damage. If the internal and external body shows corrosion or appears contaminated, remove for cleaning and further inspection, using the 1" wrench on the base of the body.

4. Using the 1/16" Allen wrench, loosen and remove the set screw (2), then unscrew the seat guide (3), from the pad guide (5), counter- clockwise.

5. Using the brass pick, remove the O-ring (4), and discard.

Figure 56

6. Place all components in a clean container of detergent and water, and clean using the nylon brush, then rinse and dry. After cleaning, inspect for corrosion and damage, re-clean as necessary. Pay particular attention to the seat area in the valve body. Any nicks or dings in this area, will cause valve leakage.

7. Replace any components in question or the entire valve.

Reassembly

1. Lightly lubricate a new O-ring (4), then place in the pad guide (5), then assemble the pad guide, seat guide together and secure.

NOTICE
The O-ring (4), is the seat material that makes the seal against the seat, in the main body. The O-ring is captured between items 2 and 4.

2. Apply a small amount of thread locking compound on the Allen set screw (2), and tighten snugly, while holding the pad guide (5).

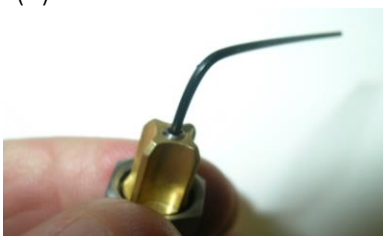


Figure 57

3. Using the needle nose pliers or tweezers, install the soft seat assembly, so the stainless point end is pointing up.

4. Place the spring pad (6), so that the machined out area for the spring faces up, then install the spring (7), and thread the spring cap (8) into the valve body (1), until the threads disappear, then install the spring cap (8), and run it down until it bottoms out by hand.

Figure 58

5. Loosen the spring cap (8), about 1/8 of a turn, and slowly run the spring cap in, using the 5/16 Allen wrench, until there is about 3/16" of an inch protruding through the main cap (9). The valve is now ready for adjustment.

Figure 59

Adjusting the Relief

NOTICE

The relief can be set between 250-410 psig, to accommodate different system configurations. To adjust, the relief needs to be installed in the RDC, or attached to a clean adjustable air source. This procedure uses the installed RDC regulator, to set.

1. Slowly open an HP air cylinder, approximately 1-2 turns, and pressurize the HP system.

2. Slowly bring pressure to the manifold, by rotating the regulator adjustment knob in, until the LP gauge reads the desired relief pressure setting.

NOTICE

If the relief starts venting before the desired relief setting is reached, slowly rotate the spring cap (8) clockwise, using the 5/16" Allen wrench, until the relief holds at, or just below, the desired setting Then hand tighten the main cap (9), and back the regulator off one – two turns.

3. Slowly vent the pressure, below the desired set pressure, using the pneumo valve. Then slowly load the regulator, while watching the gauge, to determine where the relief lifts at.

4. Repeat steps 2 and 3 until the desired setting is achieved. Once adjusted, hold the spring cap with the Allen wrench, and tighten the lock nut counter-clockwise, with the 1" wrench, until snug. Tighten using the force of three fingers on the wrench. Or torque with torque wrench, to 50 inch lbs.

NOTICE

The working pressure of the LP system is well above the maximum relief setting, obtainable using this 0-410 psig relief. The system will not be damaged by setting the relief in place. The relief has been sized to more than accommodate the maximum flow, of the HP system.

Hy-Lok SS Angle Relief Overhaul

As of January of 2011, the relief valves being installed in the XLDS RDC consoles is the Hy-Lok® Model RV2MF SS, similar in operation and adjustment to the Circle Seal®, 0-400 psig adjustable brass body relief. This valve is very rugged and dependable, and can be easily serviced by trained persons. Dive Lab strongly recommends, only factory trained technicians service this component. Overhaul is limited to cleaning, and replacing the soft goods. If any other damage is found, the valve should be returned to Dive Lab, for repair.

Figure 60 (Hy-Lok Angle Relief)

NOTICE

The relief valve can be overhauled in place, however for best results it is easiest to remove the relief valve from the manifold if performing an overhaul, so that the valve can be properly cleaned.

Preliminary

1. Ensure the HP supply whips are disconnected from the cylinders, and the entire RDC console has been vented.

2. Ensure the work area is clean, and all tools are clean.

Tools and Components Needed

- 3/4" Open end Wrench (2 Each)
- 0-250 inch lbs. Torque Wrench
- Crows Foot Wrench ¾"
- 5/16 Allen Wrench Socket For Torque Wrench
- Needle Nose Pliers
- 10 x Magnifying Glass
- Brass Pick Set
- ¼" Wooden Dowel or Plastic Rod (Blunt Ends)
- 3/32" Allen Wrench
- Christo Lube
- Soft Goods Kit PN# 1XL7RK
- Teflon Tape
- Flashlight

Disassembly and Overhaul

1. Using one of the 13/16 and ¾ in wrenches, hold the base of the valve, loosen the bonnet (5), and remove.

2. Using the two 3/4" wrenches, loosen the lock nut (2), and then remove the cap (1). Then drop out the spring (3), and spring disk (4).

3. If the valve body is to be removed, remove it at this time, using the 13/16 wrench.

4. Remove the bonnet O-ring (6), and stem (8).

5. Using the brass pick, carefully fish out the O-ring (7), internal to the bonnet.

NOTICE

The O-ring can be difficult to remove and requires manipulation with the O-ring pick and the 6/32" Allen wrench from the bottom end of the bonnet.

Figure 61 Bonnet O-Ring

6. Using the 5/16 Allen wrench, loosen and remove the stem seat (9), then using the pick remove the O-ring (10), and body seat (11).

7. Discard the three old O-rings, then clean all the parts and blow or air dry. After drying, carefully inspect all components, for signs of damage and contamination. Re-clean as necessary.

Reassembly

1. Lightly lubricate the three new O-rings (10, 7, 6), and set aside.

2. Install the body seat (11), O-ring (10), then using the blunt end of the dowel, press down on the O-ring, and body seat to fully seat the O-ring around the body seat.

3. Using the 5/16" Allen socket, reinstall the stem seat, then torque the stem seat to 150 inch lbs.

4. Install O- ring (6) onto the bonnet (5).

5. Using the 3/32" Allen wrench and the dull O-ring pick carefully install O-ring 7 into the Bonnet.

NOTICE
This O-ring can be difficult to install take care not to cut the O-ring.

Work the O-ring into the groove, with the Allen wrench from the bottom of the bonnet, and with a dull O-ring pick at the groove end.

6. Install the bonnet into the body, and torque to 150 inch lbs. Using the ¾ inch wrench, and crows foot with torque wrench.

7. Install stem (8), and disc (4), and spring (3).

8. Then install the lock nut (2) and cap (1) tighten, the cap approximately 6 turns, by hand.

9. If the relief valve had been removed from the manifold, re-tape the pipe threads, reinstall and tighten using good engineering practice.

Adjusting the Relief

NOTICE
The relief can be set between 250-410 psig to accommodate different system configurations. To adjust, the relief needs to be installed in the RDC, or attached to a clean adjustable air source. This procedure uses the installed RDC regulator to set.

1. Ensure the RDC regulator is backed off counter-clockwise, and all RDC valves are shut.

2. Reinstall the HP supply whip to the manifold and line up HP air source of at least 500 psig, to the regulator for the circuit to be tested, and slowly open an HP air cylinder.

3. Slowly bring pressure to the manifold by rotating the regulator adjustment knob clockwise (in), until the LP gauge reads the desired relief pressure setting.

NOTICE

If the relief starts venting, slowly rotate the cap (1) clockwise until the relief stops venting. If the relief does not vent at the desired set pressure back off counter-clockwise on the cap until the relief starts venting at the desired pressure.

4. Once the relief is set, retest, by slowly venting the manifold slightly using the pneumo valve, until the LP pressure reads 20-30 psig less than the desired set pressure. Slowly load the regulator, while watching the gauge to determine where the relief lifts. For XLDS use with the ICS and ¼" umbilicals, set the reliefs to start lifting at a pressure between 390-400 psig. For use with standard 3/8-1/2" umbilicals, set the reliefs to start relieving at 300 psig.

5. Repeat steps 4 and 5 until the desired setting is achieved. Once adjusted, hold the spring cap with the Allen wrench, and tighten clockwise with the 1" wrench until snug.
   Do Not Over Tighten!

NOTICE

The working pressure of the LP system, is well above the maximum relief setting, obtainable using this relief. The system will not be damaged by setting the relief in place. The relief has been sized to accommodate the maximum flow, of the HP system.

Figure 62

ICS Regulator Assembly / Components Overhaul Procedure

The ICS should be overhauled using the guidance provided in this procedure. In normal use, the ICS regulator should be completely overhauled, at least every 36 months or less. Units used in severe conditions such as fuel oil, contaminated waters, and dusty dirty environments, or units being used more than 200 dives a year, may require more frequent overhaul.

Tools and Materials Required

- 8" Adjustable Wrench
- Open-end Wrenches, 5/16, 9/16, 3/8", ¾" 1" 7/8", 5/8"
- Crows Foot Wrench 5/8', ¾, 7/8", 1"
- Soft Jaw Vice
- #2 Flat Blade Screwdriver
- 250 in lbs. Torque Wrench
- Sink or Basin
- 5/32 Allen Wrench
- ¼" Plastic Dowel 4-6 inches long
- Brass O-Ring Pics
- White Vinegar
- Teflon® Tape
- Christo Lube®
- Food Grade Silicon Grease
- Detergent
- Fresh water
- Basin or Sink
- Lint Free Cloths

Lubrication

XLDS components that require lubrication, should be lubricated with Christo Lube®. Food grade silicone, should be used for packing the regulator piston assembly (38). Christo Lube® may also be

used, however the amount of Christo Lube required, makes using it in this application costly.

NOTICE
All parts can be cleaned using an ultrasonic sink if available. Hand cleaning using a sink or basin is also acceptable. Followed by a good rinsing drying and inspection.

ICS Disassembly

1. Detach and the remove the ICS cylinder, and regulator from the back pack, by removing the mount plate screws (34, 33), washers (31, 32), and mount plate (30).

2. Slowly open the EGS valve, to ensure the cylinder is empty.

3. Unscrew and remove the cylinder from the ICS regulator, and set aside. Inspect the cylinder threads, for signs of damage and corrosion.

4. Visually inspect the interior of the cylinder, for signs of corrosion damage. If any corrosion is/was present, clean the cylinder with warm soapy water, rinse, dry and re-inspect. Replace any cylinder, that shows signs of pitting or thread damage. Ensure the cylinder is with hydro test date. Any cylinder that is out of date, or within 3-6 months of being out of hydro, should be sent out for retesting and certification.

5. Remove the helmet or FFM interface whip assembly, and set aside.

6. Remove the one way valve (8), and set aside.

7. Remove the environmental sleeve (18) and set aside.

8. Remove regulator end cap (17), using the adjustable wrench, then pull the piston, and spring assembly (38) free, and set aside.

Figure 63

Figure 64

9. Remove the ½”-20 port plug (28), using a 5/32 Allen wrench, remove the O-ring (27), from the plug.

10. Remove the bottle adapter Nylock nut and washer (25, 23).

11. Pull the bottle adapter (24) free, then using the pick, carefully remove the upper and lower internal O-rings (22), O-ring 26 and O-ring 21.

12. Insert the 3/8’’ wooden or plastic dowel into port, and push to remove the HP seat assembly (15).

13. Run the 5/32" Allen wrench through the holes, at the base of the ICS shaft (20), to use as a wrench, to loosen the shaft counter-clockwise. Unthread and remove, then remove the O-ring (19).

14. Using the 11/16 adjustable wrench, loosen and remove the EGS valve assembly (4), set aside for disassembly later.

15. Disassemble the regulator piston assembly (38), consisting of items 2 thru 14. Start by holding the flats on the poppet shaft (2), with the 5/16 wrench, and turning the nut (14) counter-clockwise, using a ¼" nut driver, until it fall free.

16. Once the nut is free, separate the assembly, by pulling on the piston (10), and spring pad (7).

17. Using the O-ring pick, carefully separate, extract all soft goods, while being careful not to scratch the metal components. Discard all O-rings, but do not discard any of the white shims (9).

Cleaning / Inspection of the ICS Regulator

1. Wipe off as much old lubricant as possible from components, using a lint free cloth.

2. Using the detergent solution, and a soft bristle brush, clean all metal parts and components to remove all traces of dirt, debris and old lubricant. Use a brass brush to remove corrosion.

3. After drying carefully inspect for signs of dirt, contamination, corrosion and damage. Look for pitting and crevice corrosion, and worm tracking, which could cause sealing problems. Replace any damaged components.

4. Check all threaded components for signs of galling. Replace any components, which show any signs of galling or damaged threads.
Carefully check the poppet assembly (2), for signs of damage, especially around the cone area. The cone area should be free of scratches and pitting. If the cone is scratched, it can often be re-surfaced, using 1200 grit cloth, or polishing compound. If the scratches do not remove easily, it is best to replace the poppet. After cleaning and inspecting components, containerize to prevent contamination and set aside.

Figure 65 (Poppet Cone Seat)

EGS Valve Cleaning and Overhaul

NOTICE

The EGS valve is manufactured by Kirby Morgan. The valve will go for many years without the need to replace components, as long as it is kept clean, and lubricated. Normally a good cleaning inspection, and re-lubrication is all that is needed to maintain serviceability.

Disassembly

1. Using the flat blade screwdriver, loosen and remove the valve handle retainer nut (8), then remove the spring (7), and knob (6).

2. Loosen and remove the packing nut (3), then remove the washer (5), and unscrew the stem (4), counter-clockwise and remove.
3. Remove all the old Teflon® tape from the pipe threads on the body.

4. Clean all parts, using detergent solution.

5. Corrosion should be removed, using 50/50 white vinegar and water, then blow or air dry.

6. Carefully inspect all components for signs of contamination, corrosion and damage. Inspect the pipe threads of the valve body, for signs of damaged threads. Replace the valve, if the valve body is damaged in any way.

7. Carefully inspect the valve stem for signs of corrosion and damage, replace the stem if any damage is present.

8. Inspect the packing nut for signs of cracking, damaged threads, and corrosion. Replace the nut if any damage is found. The packing in the nut need only be replaced, if the Teflon® packing shows deep grooves, or appears worn or damaged. To replace the packing, carefully slice a groove horizontally in the old packing, then peel the packing out, using needle nose pliers, and a small screwdriver. Clean the packing nut to remove old lubricant, and any corrosion. Install the new packing into the packing nut, and set aside.

NOTICE

The new packing will be loose, until the nut is run down, and seated for the first time.

9. Lightly lubricate the threads of the stem with Christo Lube®, then install the washer (5), and packing nut (3), with packing (2). Apply a small amount of lubricant on the stem shaft, threads, and packing nut threads, then rotate the stem clockwise, until it bottoms out in the valve body. Thread the packing nut onto the body threads, and tighten to 50 inch lbs.

NOTICE

If the packing was replaced, torque to 65 inch lbs. to seat the new packing, then slightly loosen, and torque to 50 inch lbs. Install the knob, spring and retainer nut, then tighten retainer nut until the stem protrudes, through the end of the nut.

10. Wrap the pipe threads of the EGS valve with two and a half wraps of Teflon tape, starting 1½ - 2 threads back, keeping the tape under tension.

Figure 66

NOTICE

All items on the XLDS system that require lubrication are lubricated with Christo Lube®, because Christo Lube has superior lubrication properties. However, the piston assembly (38), is normally packed with silicone for environmental protection, it is also acceptable to use the silicone, for lubricating the ICS O-rings 12, (11), (5), and (6), because these may come in contact with the silicone grease used to pack the spring cavity of the piston assembly (38). All other XLDS components, that require lubrication, should be lubricated with Christo Lube® only.

Reassemble ICS regulator

NOTICE

Prior to re-assembling the ICS regulator assembly, install the EGS valve assembly in the pipe thread port, on the regulator body, and securely tighten, so that the EGS knob points straight out away, from the ICS regulator body.

1. Lay out all the new O-rings for the ICS regulator, and lightly lubricate them then lay them on a clean surface. Use the ICS regulator exploded view drawing, and this procedure for reinstallation.
2. On the bottle adapter, install the two internal O-rings (22).

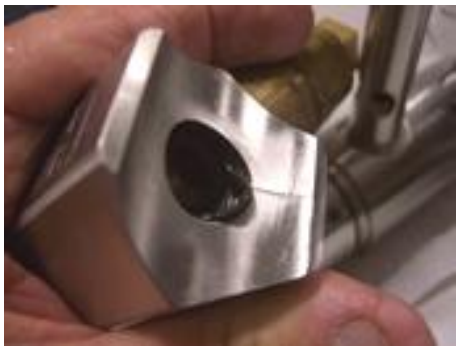


Figure 67

3. Install O-ring (26), on the ICS bottle adapter threads.
4. Install O-ring (19) in the groove at the end of the ICS shaft (20), then apply a light amount of lubricant to the threads, and thread the shaft into the regulator body (29), and tighten snugly using the small 5/32 Allen wrench, through the holes in the side of the shaft, to act as a wrench.

Figure 68

5. Install O-ring (21) on the regulator body groove, which encircles in the ICS shaft, then lower bottle adapter onto the regulator body, while ensuring the O-ring is captured in the groove, and that the Dive Lab logo faces out.
6. Install the washer (23) and Nylock nut (25), and lightly tighten, ensuring that the O-ring between the bottle adapter, and the regulator body stays in the groove, then torque to 150 inch lbs.
7. Install the cylinder O-ring (26).
8. Install a new O-ring (27) on the ½" - 20 port plug (28), install the plug at the end of the regulator body, and tighten using the 5/32 Allen wrench.

Reassemble the Piston Assembly

1. Re-assemble the piston assembly (38). Start by holding the poppet shaft (2), and installing the small disc (3), with the stepped portion facing away from the cone, then drop on the O-rings (4) and (5).

NOTICE

Item (6), on the piston assembly is a small flat washer, which is flat on one side, and is slightly dished on the other side.

2. Install the small plastic washer (6), into the spring pad recess on the large diameter end of the spring pad (7), with the flat side of the washer against the spring pad, and the concave area facing out toward O-ring (5).

3. Install the second O-ring (5), into the O-ring groove, in the small end of the spring pad (7).

4. Install the spring (8), shim(s) (9).

NOTICE

Install the same amount of shims, which were on the piston, when disassembled. Align the assembly, so the piston is bottomed against the flat on the poppet stem. Apply some extra lubricant around the threaded area of the poppet shaft, and recessed area in the top of the piston.

This lubricant will aid in getting the O- ring (12) in place.

5. Install O-ring (12) into the recess area of the top of the piston, and work it into the recess then install the washer (13), and nut (14), then tighten the nut until it bottoms out against the piston.

6. Slightly moisten O-ring (16), with Christo Lube on the new seat (15), then install the seat into the large opening end of the regulator body, then press it in using the 3/8” wooden dowel. Figure 69.

NOTICE

Install the new seat with O-ring into the regulator body with the cone side of the seat facing down, toward the ½”-20 port. While it might appear that the cone side of the seat, and the cone on the poppet shaft should go together, this is not the case. The flat side of the seat, is the side that seals against the poppet.

Figure 69

7. Pack the piston assembly spring with Silicone grease. Ensure the grease gets worked in around the coils, so that the entire spring area is filled with grease.

Figure 70

Figure 71

8. Insert the piston assembly into the bore of the piston cap (17), and press the piston assemble all the way down.

Figure 72

9. Wipe clean any excess grease from the cone and disc using the lint free cloth.

10. Insert the piston assembly with the piston into the regulator body, and thread the piston cap into the body, until it bottoms out then tighten to 150 inch lbs.
11. Install the rubber environmental sleeve.

12. Ensure the cylinder has been properly cleaned, inspected and is within hydro date, then reinstall on the ICS bottle adapter, and tighten snuggly by hand.

13. Reinstall the mount plate and fasteners onto the ICS body, and mount securely to the harness.

ICS Testing

Tools and Equipment Needed

- Intermediate Pressure Gauge 0-300 psig
- Shims 4XL62-22 (2)
- Silicon Grease
- 8” Adjustable Wrench
- 1” Crows Foot Wrench
- Torque Wrench 0-250 inch lbs.
- ¼” Nut Driver

Preliminary

After the entire ICS has been assembled, the ICS needs to be tested for proper intermediate pressure, and to ensure there are no leaks. Then attach the ICS attached to the RDC console, in the normal configuration, so that it can be checked with the normal supply pressure of 350 psig. For the intermediate pressure check, the ICS will need to be attached to a helmet or mask or to FFM. For the flow test, the flow meter will be in place of the helmet, of full face mask.

1. Line up the RDC console with umbilical to one of the divers circuits, ensuring that the HP air supply is at least 1000 psig.

2. Attach the umbilical to the ICS inlet, then attach the intermediate pressure gauge to the helmet outlet whip, and snug by wrench.

3. Load the RDC regulator to 350 psig, and bring up pressure to the ICS.

4. The pressure on the ICS pressure gauge should read between 150-170 psig. Open and close the EGS valve a couple times, to check for a stable lock up pressure.

5. Secure air at the RDC outlet, then bleed down the umbilical to zero, through the ICS/EGS valve then secure the EGS valve and bring

pressure back up, and check the intermediate lock up again. This cycling test helps set the seat, and distributes the silicone grease around the spring cavity.

NOTICE

It is normal for the grease to squirt out, after cycling a newly overhauled ICS regulator. Wipe off excess grease.

6. If the ICS is intermediate pressure is above 170 psig, remove one shim (9), from under the piston. If the pressure is below 150 psig, add one shim (9), between the piston and spring.

Figure 73

NOTICE

A maximum of three shims may be used only. If three shims do not restore the proper pressure range the spring (8), should be replaced. For adding or removing shims, refer to the disassembly and reassembly section, of the ICS regulator overhaul.

System Flow Test

Preliminary

A flow test is done on the complete ICS and umbilical system, to ensure system capability. It is important that the RDC pressure gauges are accurate, to ensure an accurate test. All RDC LP gauges should be cross connected, and compared to with a master gauge, at least every 24 months or anytime accuracy is in question.

Figure 74

1. After successful ICS pressure set up/test, remove the ICS intermediate pressure gauge, and attach the flow meter to the ICS, to helmet supply whip.

2. With a minimum of 1000 psig HP supply, and a static pressure of 350 psig on the RDC, open the umbilical supply valve, allowing flow through the flow meter. Allow the flow to stabilize, then take the reading at the widest point of the float.

3. Record the following **before** flow starts.
   Room temperature_____ °F
   LP supply set pressure _____ psig (350 psig)
   HP supply pressure _____psig
   (minimum of 1000 psig prior to start of flow)

Record the following **during** flow.
HP pressure _____ psig
LP supply discharge pressure _____ psig
Flow _____ slpm

NOTICE

A maximum of three shims may be used only. If three shims do not restore the proper pressure range the spring (8), should be replaced. For adding or removing shims, refer to the disassembly and reassembly section, of the ICS regulator overhaul.

If the flow is below 670 slpm, please contact Dive Lab at 850-235-2715 office / 850-258-7717 cell, or email us at divelab@divelab.com

One-way Valve Cleaning and Overhaul

Disassembly of the One-way Valve / Tools Required

- Drawing 7023 O & M Manual
- Soft Jaw Vice
- 1 inch Open-end Wrench Attachment on Torque Wrench
- 8”-12” Adjustable Wrench
- (If no vise is available, use an additional backup 1 inch Open-End Wrench)
- Soft Goods Kit PN# 525-330
- Christo Lube®
- Lint Free Cloths
- Fresh Water
- Detergent
- Small Nylon Brush

Figure 75

Following are the steps to disassemble and inspect the one-way valve assembly (68).

1. Remove the one-way valve assembly from the ICS bottle adapter (24), using the 1 inch open end wrench. Remove O-ring (6).

2. Remove the cap (4), poppet (9), O-ring (8), and spring (3), discard the O-rings back up ring, and spring. Do not remove the cage (2). (The cage should never be removed.) The function of the cage is to prevent the poppet O-ring (63), from blowing out of place during high flows. The newer style one-way valves have a brass cage, which is machined into the body. The older style SS cage is acceptable, and the flow performance is the same.

3. Clean all the metal components, then rinse parts and blow, or air dry. Remove any corrosion by soaking in the 50/50 vinegar solution, and brushing with a brass or stainless brush. Re-clean after using the vinegar solution, then rinse thoroughly and inspect for signs of contamination, corrosion, and damage. When finished, air or blow dry all components, then lay out on a clean surface for reassembly.

4. Lightly lubricate the two new O-rings (8, 6), then install O-ring 6, and split ring 5, on the cap 4. The split ring mounts in the groove closes to the hex.

5. Install the O-ring (8), on the poppet (9), then set the poppet into the cap 4 and holding upright, lower the body (1), over the spring and cap assembly then thread together and torque to 150 inch lbs.

6. Install the thread sealing O-ring (6), on the body (1).

7. Install Teflon tape on the umbilical adapter, then install into the cap and tighten securely.

8. Install the one way assembly into the bottle adapter, and torque to 150 inch lbs.

9. Test by opening the EGS valve, then try to blow air into valve then suck back. The valve

should allow flow when blowing, but should not allow any air to pass, when sucking.

Cleaning / Inspection of the ICS Manifold Block

NOTICE
A maximum of three shims may be used only. If three shims do not restore the proper pressure range the spring (8), should be replaced. For adding or removing shims, refer to the disassembly and reassembly section, of the ICS regulator overhaul.

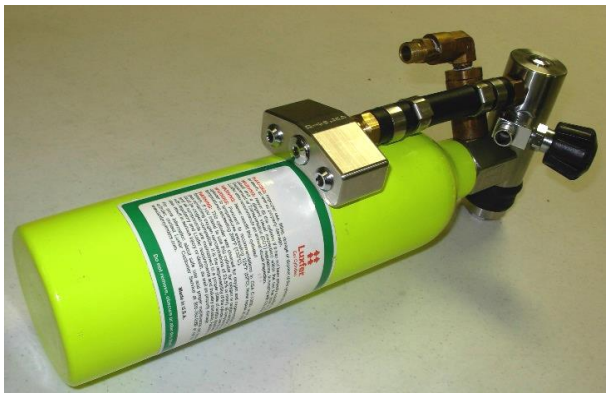


Figure 76 Manifold Mounted on ICS

Figure 77 ICS Manifold Assembly, Part #4XL002

The manifold has three 3/8”-24 LP ports, used for inflator whips, and one ½”-20 port, used for the helmet or full face mask supply whip.

Figure 78, shows the hose configuration for a full face mask (green hose), for helmets the center hose is the same 34” long 3/8” gates hose, which is used on all XLDS systems. To the right and left of the green hose, is the BC inflator hose, and the dry suit inflator hose. If the inflator hose is not needed, a 3/8”-24 (small bore scuba) plug is installed.

Maintenance consists of removal from ICS, inspection, cleaning, replace O-rings and reinstall on ICS regulator.

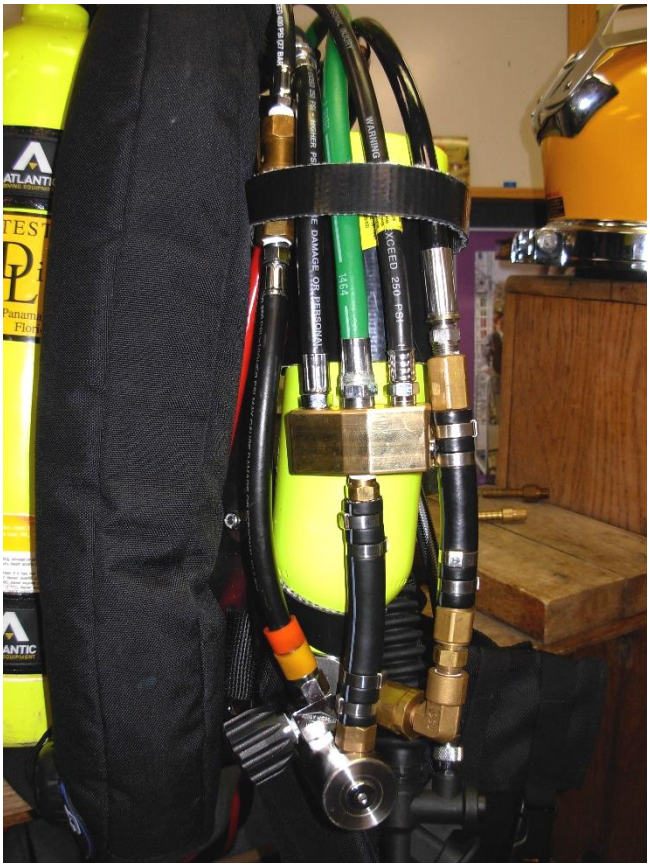


Figure 78 ICS Manifold Hose Routing

1. Remove all inflator hoses and helmet/full face mask hose.
2. Remove ICS manifold assembly from ICS regulator. Figure 77.

3. Using a 5/32" Allen wrench, remove any remaining port plugs.

4. Check all threaded components for signs of galling. Replace any components, which show any signs of galling, or damaged threads.

Figure 79

5. Carefully check manifold assembly, for signs of damage, especially around the hose.

Figure 80 ICS Manifold Interface Hose

6. Clean manifold assembly, in accordance with XLDS cleaning procedure.

7. Install new O-rings on port plugs or hoses, 3/8"-24 small bore (inflator hoses), use a -010 O-ring. The center hose, helmet/full face mask hose and the O-ring on the fitting that screws into the ICS uses a -013 O-ring. Figure 81 and 82.

8. Port plugs are torqued to 15 in. pounds, LP inflator hoses are 40 in. pounds, helmet/full face mask hoses are 40 in. pounds, and the fitting that screws into the ICS is 50 in. pounds.

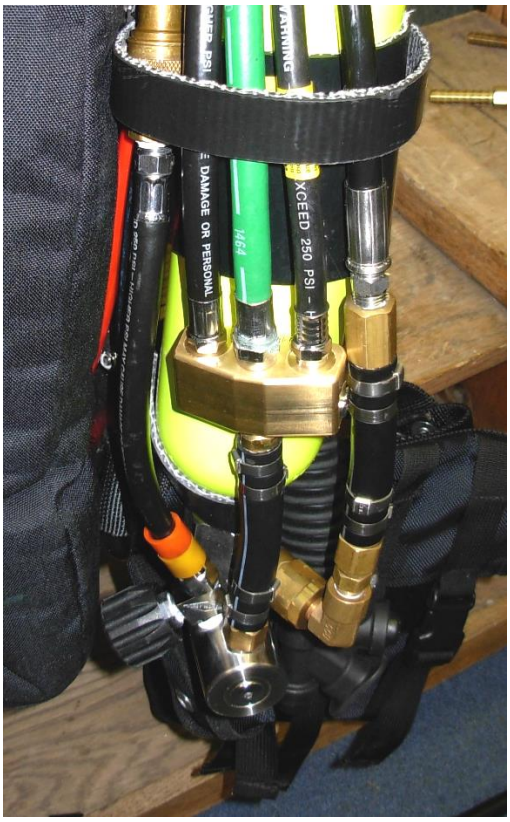


Figure 81 (ICS Manifold Complete / Full Face Mask Configuration)

Preliminary

After the entire ICS has been assembled, the ICS needs to be tested for proper intermediate pressure, and to ensure there are no leaks. Then attach the ICS attached to the RDC console in the normal configuration, so that it can be checked

with the normal supply pressure of 350 psig. For the intermediate pressure check, the ICS will need to be attached to a helmet, mask or to FFM. For the flow test, the flow meter will be in place of the helmet, or full face mask.

1. Line up the RDC console with umbilical to one of the divers circuits, ensuring that the HP air supply is at least 1000 psig.

2. Attach the umbilical to the ICS inlet, then attach the intermediate pressure gauge to the helmet outlet whip, and snug by wrench.

3. Load the RDC regulator to 350 psig, and bring up pressure to the ICS.

4. The pressure on the ICS pressure gauge, should read between 150-170 psig. Open and close the EGS valve a couple times, to check for a stable lock up pressure.

5. Secure air at the RDC outlet, then bleed down the umbilical to zero through the ICS/EGS valve, then secure the EGS valve and bring pressure back up, and check the intermediate lock up again. This cycling test helps set the seat, and distributes the silicone grease around the spring cavity.

NOTICE
It is normal for the grease to squirt out, after cycling a newly overhauled ICS regulator. Wipe off excess grease.

6. If the ICS is intermediate pressure is above 170 psig, remove one shim (9), from under the piston. If the pressure is below 150 psig, add one shim (9), between the piston and spring.

Figure 82

Figure 83

NOTICE
A maximum of three shims may be used only. If three shims do not restore, the proper pressure range the spring (8), should be replaced. For adding or removing shims, refer to the disassembly, and reassembly section of the ICS regulator overhaul.

System Flow Test

Preliminary

A flow test is done on the complete ICS, and umbilical system to ensure system capability. It is important that the RDC pressure gauges, are accurate to ensure an accurate test. All RDC LP gauges, should be cross connected and compared to with a master gauge, at least once a year or anytime accuracy is in question.

1. After successful ICS pressure set up/test, remove the ICS intermediate pressure gauge. Attach the flow meter to the ICS to helmet supply whip.

2. With a minimum of 1000 psig HP supply, and a static pressure of 350 psig on the RDC, open the umbilical supply valve allowing flow through the flow meter. Allow the flow to stabilize, then take the reading at the widest point of the float.

3. Record the following **before** flow starts.
   Room temperature_____ °F
   LP set pressure _____ psig, (350 psig)
   HP supply pressure _____psig
   (minimum of 1000 psig prior to start of flow)

4. Record the following **during** flow.
   HP pressure _____ psig
   LP discharge pressure _____ psig
   Flow _____ slpm

NOTICE
With a minimum HP supply of 1000 psig and Static LP supply of 350 psig, the LP gauge should drop to approximately 320-330 psig, and the flow should read no less than 670 slpm.

If the flow is below 670 slpm, contact Dive Lab Inc. at 850-235-2715 office or email us at divelab@divelab.com

Cleaning / Inspection of the Dive Lab Integrated Harness with Buoyancy Wing

NOTICE
The Dive Lab Integrated harness, is a surface supplied diving harness, with integrated buoyancy wing and fixed weight pockets, which can hold up to 30 lbs. of weight. It gives the diver the ability to control buoyancy in the water column, air is provided through a BC power inflator connected to the ICS. Heavy duty weight pockets attached to the harness eliminate the need for a separate weight belt. This harness is standard on all XLDS systems manufactured after 2012, older systems can be upgraded, by just purchasing the integrated harness only.

Figure 84 Dive Lab Integrated Harness part #4XL69C

The harness has an integrated stainless-steel back plate, in which the cylinder mounting bracket, buoyancy wing, weight pockets, and ICS are mounted to.

Figure 85 Breakdown of Dive Lab Integrated Harness

Very little maintenance is required, washing harness assembly with mild dish detergent and rinsing with fresh water (post dive), inflate and check for leaks, is all the normal maintenance required for the harness assembly.

Corrective maintenance is mainly repair/replace the buoyancy bladder due to puncher, repair / replace power inflator.

To Remove Buoyancy Bladder

Remove EGS cylinder, remove thumb screws or bolts that hold the cylinder bracket in place, remove bracket and buoyancy wing.

Unscrew power inflator assembly from buoyancy wing, unscrew dump valve assembly, and blanking plug. Figure 89-90.

Figure 86 Removing Dump Valve Assembly

Figure 87 Removing Power Inflator Assembly

Locate zipper on inside of ring of buoyancy wing. Unzip the outer cover, remove bladder. Inspect bladder, make repairs as necessary, if bladder has punchers a bladder repair kit can be purchased from Dive Lab. Follow kit instructions to make repairs on the bladder.

The power inflator Figure 90, requires normal post dive cleaning and rinsing, when air starts to leak by the actuator button, the inflator assembly will need to be serviced and or replaced, contact Dive Lab.


Figure 88 Unzipping Buoyance Wing Outer Cover


Figure 89 Bladder Removed From Outer Cover


Figure 90 Power Inflator

Inspect harness and back plate Figure 92, for signs of damage. Because webbing is riveted in place, it cannot be repaired by the user. Contact Dive Lab, if serviceability is in question.


Figure 91 Harness Assembly

Inspect ICS restraining straps for serviceability and damage, if serviceability is in question replace them.

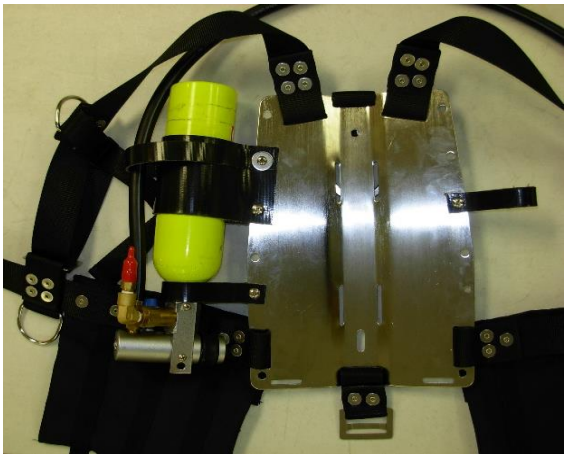


Figure 92

The original XLDS divers harness was a modified Miller Bell Harness Figure 93, it did not have stainless steel back-plate or provisions for a buoyance wing. Dive Lab replaced the Miller Harness in 2012, with the current one, which offers greater flexibility. The Miller Harness is still supported, and can be replaced if necessary.

Figure 93 Original Miller Bell Harness

Maintenance for the Miller harness is simple. Inspect for serviceability and damage. Repair or replace as necessary. Like the harness with integrated buoyancy wing, the Miller harness is assembled using rivets. Because webbing is riveted in place, it cannot be repaired by the user. Contact Dive Lab if serviceability is in question.

End of Section Four A

XLDS System Pressure Gauge Comparison

RDC Gauge Comparison

Dive Lab recommends all XLDS system gauges as well as support gauges be compared at least every 24 months using certified master gauges. This includes the RDC Red, Green, and Yellow Diver HP, LP and diver pneumofathometer gauges, as well as EGS submersible pressure gauges, and any other pressure gauges used to support the system. Dive Lab strongly recommends performing the RDC gauge comparison in place if possible, using the Dive Lab Gauge Comparator System or similar clean gas system.

Performing in place gauge comparison significantly reduces the possibility of damaging gauges and fittings, and introducing system generated contamination in the form of Teflon® tape and metal particles due to component removal and re-installation. Guidance: Dive Lab Gauge comparator system manual Revision 4, 2018.

If the gauges are to be removed and sent out for comparison care must be taken to ensure the gauges are correctly removed, handled, and protected from damage and contamination. The gauge ports must be free of old Teflon® tape and particles. To help clear any debris from the system, flow air thru the manifolds and / or the pneumo “T”s after the gauges are removed to help keep the Teflon tape and foreign particles from entering the system while using a brass pic, and /or 3/8” round nylon tube brush to remove old tape. Cover all exposed ports and safeguard the system until gauges are ready for installation.

If the gauges are to be removed and sent out for comparison care must be taken to ensure the gauges are correctly removed, handled, and protected from damage and contamination. The gauge ports must be free of old Teflon® tape and particles. To help clear any debris from the system, flow air thru the manifolds and / or the pneumo “T”s after the gauges are removed to help keep the Teflon tape and foreign particles from entering the system while using a brass pic, and /or 3/8” round nylon tube brush to remove old tape. Cover all exposed ports and safeguard the system until gauges are ready for installation.

Re-installation of gauges must be done carefully. The threads of the gauges must be clean and carefully wrapped with Teflon® tape two wraps, starting 1 ½ to two threads back from the end of the gauge stem. Lightly apply Christo Lube over the Teflon tape to assist in lubrication of threads during reinstallation. Install the gauges at approximately two turns by hand and two turns with a 9/16 wrench. Perform a Liquid leak test of all joints disturbed using detergent and water.

Submersible Pressure Gauges

Submersible pressure gauges used with the EGS system should be compared to a gauge of known accuracy at least once every 24 months or whenever accuracy is in question. The gauges should be compared to a test gauge having an accuracy of at least 0.25% full scale. Allowable error for the submersible gauges is no more than 3% full scale. For a 5000 psig gauge this would be + or – 150 psig.

ICS 300 psig Intermediate Test Gauge Comparison

The ICS Intermediate Pressure Gauge is a 0-300 psig gauge that has a full-scale accuracy of 3% or less. This means the maximum error could be up to 9 psig over the full scale. However, in most cases these model gauges are rarely more than two to three psig off in the 100-200 psig range.

XLDS System Pressure Test Procedure

A pressure test of the XLDS RDC with HP supply system should be completed at least once a year or whenever system tightness integrity is in question.

Pressure / Joint Tightness Testing

NOTICE

Prior to performing the pressure/joint tightness tests, ensure all the RDC gauges have been compared to master gauges of known accuracy. Ensure comparison has been properly documented using comparison test sheets.

WARNING

When performing any type of pressure tests eye protection should be worn at all time. Testing should be done in a clear secure area occupied by the test personnel only.

Perform a pressure / joint tightness test of the complete RDC and HP and LP supply systems to the maximum system pressure normally used. Document and use the Dive Lab RDC Pressure Test / Joint Tightness Test Procedure A2.1A. Perform the high pressure test using a minimum of 3000 psig, or to the maximum intended "use" supply pressure which could be as high as 3500 psig if using "A" yokes, up to 4350 psig using DIN connections, and to a maximum of 5000 psig with other properly rated fittings and supply whip components. The low-pressure circuits for Red, Green, and Yellow Diver's should be tested using a test pressure of between 350-400 psig and held for 10 minutes, zero leakage allowed as shown on the RDC HP and LP gauges. Document the testing on the XLDS RAPID Deployment console Annual Pressure /Joint Tightness Test Checklist A2.1A sheet.

XLDS Annual Relief Valve Lift Check

The relief valves should be set to start relieving at a pressure of 390-400 psig as read on each of the diver LP gauges.

NOTICE

Early RDC's (pre-2011) used brass Circle Seal® relief valves. XLDS systems after 2011 all have stainless steel Hy-Lok® angle relief valve. Both models adjust in a similar fashion. Lift testing the reliefs will not damage the system and can be done on a routine basis if desired.

Brass and Stainless Versions:

1. Attach the HP supply to the circuits being tested. Slowly bring up pressure to the manifold by rotating the regulator adjustment knob clockwise (in), until the LP gauge reads the desired relief pressure setting.

NOTICE

Quite often if a relief has not been lifted for a long period, the relief may stick, and can go as high as twenty psig over the set pressure before it lifts. Lightly tapping on the top of the relief will often jog it free.

2a. Brass Circle Seal Relief: For the Brass Valve, If the relief needs to be adjusted proceed as follows, for the "Brass Relief", loosen the cap (9) using a 1" wrench, then adjust the housing (8) with a 5/16

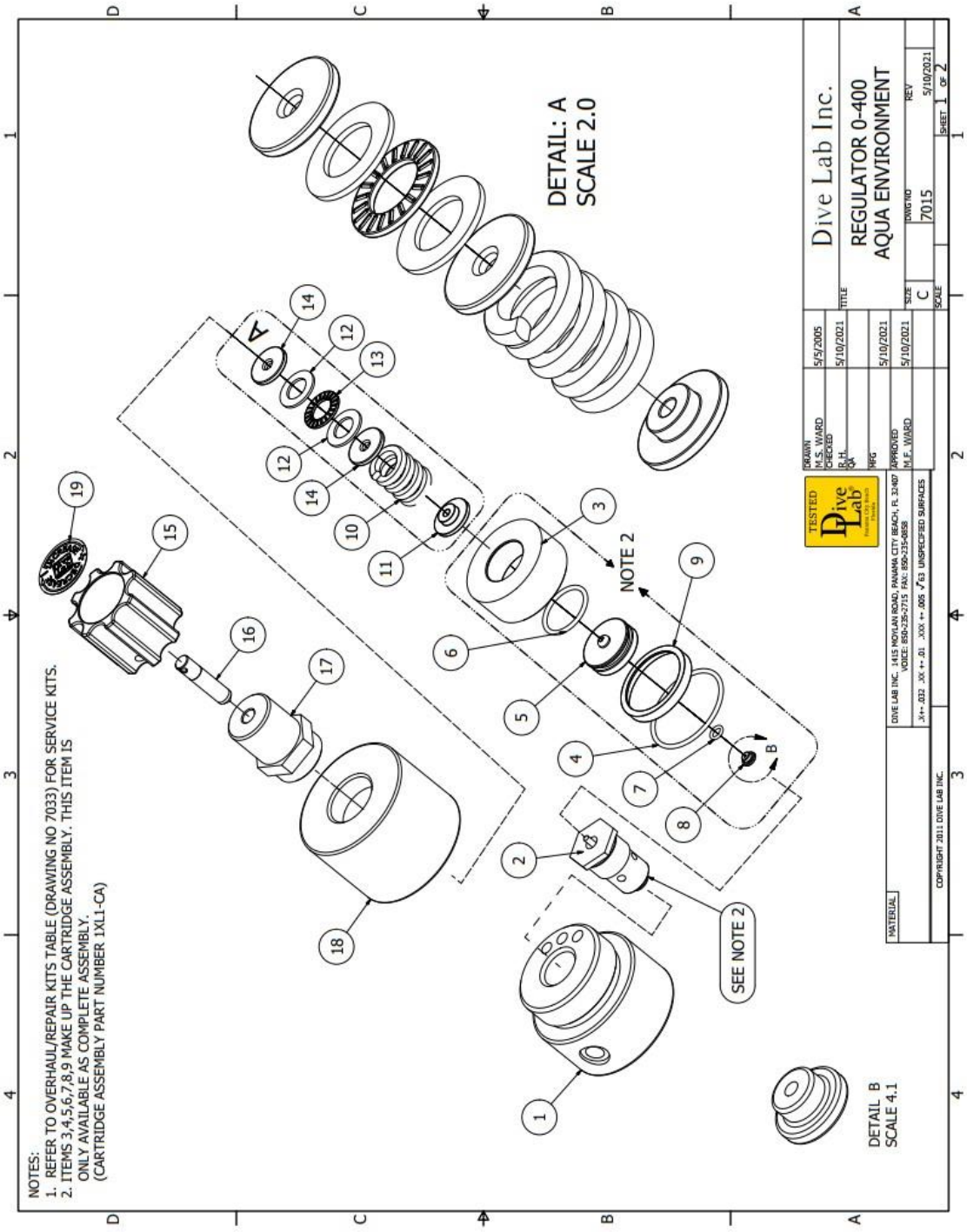
Allen wrench. Rotate out (counter clockwise) to reduce the set pressure, or "in," clockwise to increase the set pressure. Check the set pressure several times by slowly increasing the supply pressure until the relief lifts then vent off the pressure through the pneumo valve. Then, while holding the position of the housing with the 5/16" Allen wrench, tighten the cap (9) with the force of three fingers on the wrench, or use a torque wrench and tighten to 40-50 inch lbs. Note the final lift pressure.

2b. Stainless Hy-Lok® Relief: to adjust the relief. Use two ¾" open end wrenches, one on the locknut (1), and one on the cap (2), then loosen the locknut (2). Adjust the cap (1) by rotating out (counter clockwise) to reduce the set pressure, or "in," clockwise to increase the set pressure. Check the set pressure several times by slowly increasing the supply pressure until the relief lifts then vent off the pressure thru the pneumo valve. Then, while holding the position of the housing with one ¾" wrench, snug the locknut (2) with the other ¾" wrench with the force of three fingers on the wrench, or use a torque wrench and tighten to 40-50 inch lbs. Note the final lift pressure.

End of Section Four B

Supplemental Information

Exploded View for Aqua Environment Regulator



Supplemental Information

XLDS O-Ring Chart

XLDS PART #	O-Ring Size	XLDS O-Ring Location
1XL15G	-013	1/2-20 Plug / Manifold 1/2-20 Plug / ICS Regulator
1XL15F	-011	3/8-24 Plug / Manifold Scuba Port Plug
1XL200	-010 V90	VCO Fitting / HP Inlet
1XL42	-110 H70	Pneumo Female QD x 1/4 FNPT / Console
1XL2-5	-111 90D	CV3-M8N-1/3-BRASS, Hy-Lok Check Valve 1XL2
1XL7A-6	-015 70D	Relief Valve
1XL7A-14	-106 90D	(Original) Relief Valve
1XL7A-8	-106 70D	Relief Valve
3XL25	-012 90D	Plug High Pressure 7/16-20 UNF/ High Pressure Junction Block
3XL29D	-112 90D	Viton / DIN Yoke
4XL62-72	-214 70D	ICS Regulator Tank
4XL62-5	-16	ICS Regulator
4XL62-10	-18	ICS Regulator
4XL62-9	-11	ICS Regulator
4XL62-28	-012	ICS Regulator
4XL62-25	-008	ICS Regulator
4XL62-24	-22	ICS Regulator
4XL62-7	-010	ICS Regulator
4XL62-16	-014 U70	Urethane / ICS Regulator
4XL80	-015 75D	Buna N / EGS Quick Connect
4XL80-2	-015	Backup Ring, Solid / EGS Quick Connect
6XL9	-112	DIN O-Ring Viton / EGS Tank Valve
6XL12	-015 90D	EGS & Sherwood Tank valve

NOTES / REMARKS: