Dive Lab Umbilical Test Manifold User Information Guide

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Dive Lab Umbilical Test Assembly
1.0 General Information:

This informational guide was written to provide information and support for users of the thermoplastic ¼” lightweight umbilical assemblies used with the Extreme Lightweight Diving System (XLDS). Some of the information also applies to other types of umbilical assemblies as well however the main intent of this guide is to support the XLDS system.

The thermoplastic umbilical’s (also referred to as hoses) used with the Dive Lab Extreme Lightweight Diving System (XLDS) have an indefinite life span. The gas hose and communications / strength member is manufactured by Umbilical’s International®. The assembly should provide many years of service as long as it is properly used and maintained. All XLDS umbilical’s as well as all other surface supplied diving umbilical’s should be inspected on a regular basis to identify any damage and insure the umbilical is fully serviceable. Dive Lab recommends the full length of the XLDS umbilical’s be visually inspected at least monthly when used under good conditions or more often if used under harsh conditions where damage from sharp objects is possible. The fittings on each end should be visually inspected daily prior to attachment. The entire umbilical assembly should be visual inspection on a routine bases paying attention to the conditions and hazards that the umbilical is exposed to. Under extreme conditions such as sharp jagged metal or barnacles, inspection might be needed on a daily basis to be on the safe side. The inspection is intended to reveal damage of not only the breathing hose, but the pneumofathometer hose, and strength / communication cable, and interface connectors before the damage causes a failure.
For the breathing hose, and pneumofathometer hose, typical damage is in the form of cuts, kinks, dents, wrinkles, bulges or deformities as well as fitting slippage, stripped threads and wear. For the communications / strength cable, cuts and slices in the outer jacket as well as damage around the connectors and corroded pins and sockets. For XLDS ¼” I.D. gas supply hose if the hose has been severely kinked, the hose may / will show a dent and/or a wrinkle in the outer jacket. The XLDS gas supply hose is extremely tough and fairly kink resistant however, divers and tenders should always use care when taking a strain on the umbilical in the event the umbilical is fouled or snagged. The diver should strive to maintain a clean umbilical path and avoid ragged sharp surfaces. This can be difficult when diving around obstructions. Both the Diver and the Tender should work together and develop a second sense when it comes to umbilical management and be careful and not allow any tight bends or loops that could end in a kink or damage.

![Figure 1, Umbilical Kink](image_url)

Any type of umbilical that show suspicious signs of possible damage will need to be carefully inspected and tested. If the kink or damaged is near either end of the hose, the hose can be cut back and a new fitting installed. With the XLDS hose, if the hose has been severely kinked the outer jacket of thermo plastic hoses will show signs in the form of wrinkling which allows the hose to be easily folded over. Hoses that show these signs should be pressure tested and then flow tested IAW the procedure within this guide. Call Dive Lab and send pictures.

2.0 Abrasion Damage: Cuts and scrapes in the black urethane outer jacket of the XLDS breathing supply hose does not pose a significant problem providing the damage does not extend thru the polyester strength core fabric (white yarn looking material) that is in between the cover and main gas conduit core. The main gas conduit also known as the inner core or liner, is made of an extremely strong flexible thermo plastic known as Hytrel®. Minor cuts and slices in the outer jacket not exceeding 4 inches in length can be repaired by simply wrapping the affected area with a high quality vinyl tape extending at least one inch past the damaged area. Gouged areas where the outer cover is gone should be dried for at least 24 hours to remove any moisture from the polyester cords then apply a thin coat of flexible urethane sealant such as Shoe Goo®, or #3M 5200® available at any hardware store. The sealant is
intended to bond and help water proof the fibers before the vinyl tape is applied. The sealant should be allowed to dry for at least 3 hours before wrapping the area with vinyl tape. Repairs should be photographed and logged. The tape on the repaired areas should be removed for inspection and re-taping at least once a year and whenever the tape shows signs of degrading. It must be noted the outer jacket is just that, it is the skin that encompasses and backs up the polyester cord that surrounds the Hytrel® inner core. It is expected that it will receive some cuts, scrapes, and bruises. A little umbilical first aid can make the umbilical last many years as long as the cord and the inner core are protected. Call Dive Lab if you have any questions on repairs.

![Figure 2](image2.jpg)  
*Figure 2*

![Figure 3](image3.jpg)  
*Figure 3*

**3.0 Communication and Strength Member:** The communication and strength member used with the XLDS umbilical has a maximum safe design working load of 1000 lbs. The communication wires consist of two pairs of shielded twisted 20 gage wires that are intended to work with various diver intercom systems. The two twisted pairs of communication wires are wrapped in a metallic shield and encased in a Polyester / Kevlar® braid that is the main strength part of the assembly. The braid is covered in a tough red colored polyurethane jacket that waterproofs and protects the entire assembly. During use, minor cuts and scrapes are to be expected. If you do manage to damage the outer jacket it can repaired with urethane adhesive and vinyl tape in the same manner as the umbilical. Communication Strength members that show severe cuts or damage that compromises the polyester / Kevlar braid will need to be replaced.
4.0 Umbilical Testing History:

The basic procedure and guidelines for inspecting and testing umbilical’s originates and was adopted from maintenance procedures developed by the US Navy for fabric reinforced natural rubber air hose used for use deep sea diving helmets. Going back over 80 years the original deep sea diving hose was ½” I.D. and used steel wire for re-enforcement. The steel did not work well for the diving hose because salt water eventually gets thru outer jacket would corrode the wires weakening the hose and causing failures. As time went on, the steel wires were replaced with copper, which was later replaced with cotton fibers and eventually polyester and blends which provided for greater strength and longer life. Today’s thermoplastic hoses use a blend of carbon Kevlar, polyester and other hi-tech fibers and components. The umbilical components Dive Lab uses are made by Umbilical’s International Inc, and represent the very latest in technology.

For many years, (Since the start of US Navy Diving) all diving umbilical’s were assembled, configured, and tested at each diving command by the divers that were to be using them. Prior to 1985 umbilical’s were assembled by US Navy commands or by US Navy repair facilities. Prior to 1990 the only umbilical’s used in the Navy for helmets diving were made of fiber braid reinforced rubber ply hose made primarily by companies like Gates®, Swann® and GoodYear®. Whenever hose was procured it came with the manufactures batch number and date of manufacture and when the diving commands made up new umbilical’s they would take a short 3 foot sample install fittings, and pressurize it until it burst. In order for the sample batch to pass, the test piece had to burst at a pressure no less than four times the maximum working pressure of the hose as stated by the manufacturer. Once the “batch test piece” had passed burst testing a message would be sent out to all Navy Diving commands with the information of the umbilical batch so that the other commands that purchased the same brand of umbilical of the same
lot would not need to do the burst testing. Regardless, whenever an umbilical was assembled, and at scheduled intervals, the umbilical’s had to be pressure tested to twice the working pressure of the hose or twice the working pressure of the system the the umbilical was to be used with, whichever is less, and while pressurized, each end fitting received a pull with a force of 200 pounds. The actual burst and pull load strength of the umbilical comes from the fibers that are molded into hose. Without the fiber reinforcement the umbilical would not be nearly as strong and could not withstand any significant internal pressure. With rubber based hoses, the Navy required that once the hose reached 10 years of age it had to be removed from service and discarded.

In the early 1990’s the US Navy started also using twisted three-part thermoplastic umbilical’s and did not require burst testing of a sample of each lot and did not require removal from service after ten years in use providing the umbilical passed visual inspections, pressure and pull testing.

5.0 Testing XLDS Umbilical’s: XLDS umbilical’s should be pressure tested as a routine test at least once a year and/or whenever serviceability is in question. Pull testing of the end fittings is not recommended by Dive Lab or the umbilical manufacture. Historically Dive Lab has always performed a pull tested each end fitting of each new umbilical to 200 lbs concurrent with a proof pressure test of 800 psig which is twice the working pressure of the XLDS console. This test was done at Dive Lab on all new umbilical’s as well as older umbilical’s that have had new end fitting installed. Pull testing is no longer being done on the XLDS umbilical’s because experience at Dive Lab indicates that repeated pull tests can eventually cause leakage at or near the swaged area of the fitting. Manufactures of breathing gas hoses “do not” recommend pull testing of the end fittings to 200 lbs because pull testing can stretch and weaken the area under and around the crimp sleeve / hose barb, and could cause at the very least, back flow leakage thru the umbilical laminates under the crimp fitting causing leakage or pre-mature . Instead of pull testing, Dive Lab recommends a pressure test only to 2 times the working pressure of the hose or two times the maximum system operating pressure that the umbilical or hose will be subjected to. For the XLDS this would be 400 psig x 1.5 = 600 psig. The standard ¼” XLDS umbilical’s with 3/8” interface whips are rated for a maximum working pressure of 1500 psig, however the maximum normal discharge working pressure of the XLDS supply console is 390-400 psig due to relief settings. Dive Lab recommends using 2 times the normal working pressure of the system as the test pressure to be used for XLDS umbilical assemblies. (400 psig x 2 = 800 psig).

For standard 3/8”umbilicals used with LP compressors or surface supply consoles you simply use two times the maximum supply system pressure, or twice the working pressure of the hose whichever is less. Most surface supply HP consoles will deliver air or gas to a maximum of between 225-300 psig. To make things easy, you simply perform the umbilical pressure test at a pressure between 590 to 620 psig and hold that pressure for ten minutes. Before testing, mark the end of the fitting sleeve so should any fitting slippage occur it will be easily identified by the gap. If any fitting slippage is evident, the fitting will need to be replaced.

Note: The XLDS umbilical’s are rated for a working pressure of 1500 psig and the short 6” interface whips are rated for normal working pressure of 1100 psig. The maximum operating pressure of the XLDS is 400 psig. Dive Lab feels there is more than enough safety factor built into the system that the pressure test
alone will suffice. All standard 3/8” thermoplastic, umbilical’s designed and intended for surface supplied diving have a maximum working pressure of at least 400 psig and most rubber hoses have a working pressure above 400 psig and as high as 1100 psig. The Dive Lab Test manifold can also be used to test these as well as other types of umbilical’s and low pressure hoses. The manifold can be used up to 1300 psig based on the standard 1500 psig analog pressure gage however the relief valve will need to be re-set for a higher relief pressure before testing. In addition, tests manifolds manufactured after February 2015 also have straight thread ports that also allow testing of SCUBA whips using ½-20 and 3/8-24 straight thread fittings. Note: The test block has a one-way valve with a 250 psig spring. It requires at least 300 psig supply pressure before air can flow into the block. When testing low pressure SCUBA intermediate hoses that are being used at less than 200 psig, we recommend testing to no less than 1.5 times the working pressure of the hose and no more than 2 times the working pressure of the hose.

**Caution:** Always check the relief setting before starting any testing. To check the relief, simply cap the outlet of the manifold with the brass cap provided, and slowly pressuring with air to the required lift pressure and adjust the relief to lift at the desired lift pressure. See setting the relief 12.0.

**Warning:** Always secure the umbilical by securely whipping and tying using a secure line so that should the umbilical fail it will not whip about.

**Warning:** Never use any gas other than air or pure nitrogen for use as a pressure source. Using any gas containing oxygen greater than 23 % by volume could cause a detonation event that could cause bodily harm or death.

**Caution:** Always wear safety glasses and hearing protection when performing any pressure testing.

**Caution:** Perform testing in a clear secure area where all personnel can remain clear.

The Dive Lab umbilical test manifold has been designed to allow fast, easy, and safe pressure testing of the XLDS umbilical’s. The test manifold allows pressurization using air only, or air and water. The advantage of using air is the hose stays dry. Filling the hoses with water and pressurizing with air is the safest way in the event of a fitting failure, but regardless, during testing the umbilical should be restrained and eye and ear protection warn at all times when testing. Care must always be taken to insure the umbilical is securely restrained by binding it with rope in a manner that will contain and restrain the entire assembly. The test manifold HP hose that feeds air to the manifold is equipped with a very small orifice that limits how fast the high pressure air can enter the manifold so the system cannot be pressurized faster than the relief and relive the pressure. The manifold relief valve is set to relieve at 610-640 psig and is capable of relieving pressure much faster than it can be introduced.

**Caution:** Never substitute or replace the manifold test hose or other components without first checking with Dive Lab to insure compatibility.
Figure 5: Test Manifold ready to pressurize.

6.0 Testing Rational: The safest method of testing an umbilical is to pressurize the umbilical with water because if a fitting was to fail there would be no air in the umbilical so the stored energy is very small. This being said, testing using air with this system is also very safe providing the umbilical is properly secured and restrained. Testing with air is actually the easiest, simplest, fastest way to do the test because the umbilical does not need to be dried after testing. Using air does have the potential danger in the event of a fitting or hose failure, a very loud noise as well as the umbilical whipping about if not secured properly. However if properly secured and restrained, an umbilical failure during testing will not pose a significant danger providing hearing and eye protection are used and the area is secure.

Warning: A flailing, whipping umbilical can cause serious injury to persons standing close by. Regardless of the pressurization method, always securely tie the ends of the hoses being tested and tie the entire assembly (See Figure 5).

7.0 Conventional Hydraulic Testing: In order to use water as a test media a hydraulic pump is needed. A typical hydro pump with the necessary gauges, hoses, and fittings can be very costly and unless you have many different types of pressure testing to do on a regular basis, it might be difficult to justify the cost of a hydro pump system. If cost is not issue the hydro pump system is the best method because it will allow a broad range of pressure tests to be conducted. If umbilical’s and low pressure hoses are the only items that you need to test on a routine bases, the test manifold is a safe, simple, inexpensive and alternative to the hydro pump.
8.0 Test Manifold: The umbilical test manifold was primarily designed for testing the ¼” XLDS umbilical’s but can be used for testing conventional surface supply umbilical’s as well as other low and medium pressure hoses with the applicable adapters and test fittings. Testing with the umbilical test manifold can be done using air only, or with water and air. The test manifold was designed for fast, easy, and safe testing of diving umbilical’s as well as LP interface whips and hoses where the required test pressure does not exceed the working pressure of the assembly (1300 psig) based primarily on the 1500 psig gage.

![Flow limiting device](image1.png) ![Vent isolation valve](image2.png) ![Water Hose QD adapter](image3.png)

Figure 6, Flow limiting device Figure 7, Vent isolation valve Figure 7, Water Hose QD adapter

9.0 Tools and Materials Needed

- 5/8, 11/16, 7/8” open end wrench
- Garden hose and clean potable water supply (only if testing using water)
- Scuba cylinder charged with divers air to 1000-1500 psig.
- Safety glasses
- Hearing protection
- Line for securing the umbilical

10.0 Safety Precautions:
**Caution:** Before testing the umbilical, the umbilical should be secured with line as shown in figure (5) to prevent movement should in the event of a fitting or hose failure, the secured assembly will not be able to whip about. A whipping umbilical could cause great bodily harm.

**Caution:** Always wear safety glasses and hearing protection during pressure testing (ear defenders) as a precaution when performing any pressure testing.

**Caution:** Keep all unnecessary persons away from items being tested.

**11.0 Checking the Relief Setting:** It is best to always check the lifting pressure before testing umbilicals. If the manifold has not been used for a long period of time, or if it is unsure what the relief is set to lift at, the relief can be easily checked by capping the outlet fitting on the gage manifold and slowly pressurizing the assembly using a SCUBA cylinder that has at least 1000 psig or less of air pressure. Keep in mind most relief valves seats will stick slightly and during the first lift check the lift pressure may be up to 50 psig higher the normal setting. After lifting, the set pressure will usually return closer to the original setting. Even if the umbilical being tested is pressurized to 700 psig before the relief lifts or pressurization can be halted you will still be at a pressure under the standard 1.5 times the umbilical or hoses working pressure, well within what the umbilical can safely handle.

1. Cap the O29 fitting at the discharge end of the manifold as shown in figure 9
2. Attach the yoke to a SCUBA cylinder with a charged pressure of at least 800 psig but no more than 1500 psig.
3. Very slowly crack open the cylinder valve about 1/8th of a turn for one to two seconds then shut. Repeat this procedure while watching the gage on the test manifold until the pressure reads 600 psig. Then slowly increase the pressure until the relief starts venting.
   **Note:** If the relief has not started venting by the time the gage reads 650 psig, the relief will need to be adjusted. For adjustment proceed to 12.0

**12.0 Adjusting the Relief:**

1. After completing steps 1-3 in 4.2, to adjust the relief, loosen the adjustment lock nut on the relief using a 7/8” open end wrench.
2. Using a 5/16” Allen wrench slowly rotate the adjustment hex clockwise to increase the setting which will increase the pressure or counterclockwise to decrease pressure setting. Once the desired setting has been made tighten the lock nut against the body. Note: after tightening the lock nut check the lift setting one more time and readjust if necessary, then bleed down the yoke and whip assembly using the thumb bleed on the yoke, then vent off the block by loosening the cap on the outlet fitting using the 11/16 and 5/8” wrenches.
Figure 8  Adjusting the manifold relief

Figure 9.  Umbilical Adapter standard 9/16 oxygen one side and -8 AN other side. Note the cap that is intended for oxygen end only.
13.0 Testing Using Air Only: To perform pressure testing with air only, attach one end of the umbilical or hose to the outlet end of the test manifold, and the other end of the umbilical vent / isolation valve. Testing with air only means you do not fill up the umbilical and test assembly with water and you only use air. Using air has some advantages but keep in mind if a fitting were to come loose, there would be a lot of energy being released. Using air instead of water will identify very small leaks that might not be present when water is used as a test media. The pressurized umbilical can be immersed in water or sprayed with a solution of soapy water to help identify any leaks.

**Note:** A hand pump spray container containing a solution of mild dish detergent and water which can be sprayed on the fittings and hose to aid in identifying any leaks. In addition the entire umbilical can be immersed in water to identify any leaks.

Testing:

1. Securely make up and tie the umbilical and end components as shown in fig 5.

2. Attach the test manifold to the umbilical as shown in figure 5.

3. Attach the vent / isolation valve (14, 15) at the end of the umbilical then open the valve.

4. Attach a SCUBA cylinder that has diver breathing air only. Do not uses any other gas except divers breathing air at a pressure of between 800-1500 psig to the DIN / Yoke adapter and shut the bleed valve on the Din/ Yoke assembly. Lay the cylinder down on its side and attach the male QD plug to the male QD socket.

**Note:** The hose has a built in flow restrictor at the yoke end which allow for slow pressurization of the manifold and umbilical. In addition, the relief is set to relieve at between 625 and 650 psig and is capable of venting pressure faster than the scuba cylinder can deliver.

5. Slowly open the cylinder valve approximately ¼ - 1/2 turn allowing air to slowly pressurize the manifold and umbilical assembly until the manifold gage reads 600-625psig and then shut the valve.

6. Allow the pressure to stabilize for a minute or two then re-pressurize as necessary to get a final reading of 600-625 psig. Once the system pressure has stabilized, shut the cylinder valve, then open the bleed valve located on the yoke din assembly and vent the DIN / Yoke and hose assembly. Disconnect the whip if desired. Note and record the test start time and pressure, on the record sheet then allow the system to sit for ten (10) minutes, then record the stop time and stop pressure. If there has been any loss of pressure the cause of the loss must be identified and rectified then the test should be repeated until the pressure test is successful with zero pressure loss.

14.0 Testing Using Water:

To perform the 600 psig pressure test with water and air, first the umbilical need to be filled with clean fresh water using the garden hose adapter as shown in figure 7.

1. Securely make up and tie the umbilical and end components as shown in fig 5.
2. Attach the outlet of the test manifold to the umbilical as shown in figure 5.

3. Attach the vent / isolation valve (14, 15) at the end of the umbilical then open the valve.

3. Using a bucket or other suitable container, place the end of the umbilical with the vent / isolation valve in the bucket to avoid getting water everywhere.

4. Open the water supply and allow water to flow out the vent valve for at least one minute to eliminate as much air as possible then shut the vent valve then secure the water supply and remove the garden hose QD adapter.

5. Attach a SCUBA cylinder that has diver breathing air at a pressure of between 800-1500 psig to the DIN / Yoke adapter and shut the bleed valve on the Din/ Yoke assembly. Lay the cylinder down on its side.

**Note:** The hose has a built in flow restrictor at the yoke end which allows for slow pressurization of the manifold and umbilical. In addition, the relief is set to relieve at 625 and is capable of venting pressure faster than the scuba cylinder can deliver.

7. Slowly open the cylinder valve approximately ¼ - 1/2turn allowing air to slowly pressurize the manifold and umbilical assembly until the manifold gage reads 600-625 psig and then shut the valve.

8. Allow the pressure to stabilize for a minute or two then re-adjust the pressure as necessary to get a final reading of 600-625 psig. Note: Stabilization of the umbilical pressure usually takes 2-3 minutes because the umbilical stretches.

9. Once the system pressure has stabilized shut the cylinder valve then open the bleed valve located on the yoke din assembly and vent the supply then disconnect the whip.

10. On the test record sheet, note and record the test start time and pressure then allow the system to sit for ten (10) minutes, then record the stop time and stop pressure. If there has been any loss of pressure the cause of the loss must be identified and rectified then the test should be repeated until the pressure test is successful with zero pressure loss.

After successful completion of testing, the umbilical and manifold should be dried. The simplest way to dry the umbilical is to use the manifold with DIN/ Yoke assembly and using at least one full standard 80 cubic foot SCUBA cylinder charged to 3000 psig. To insure the umbilical is dry check for moisture by holding a cooled mirror or class in the flow path at the end of the umbilical with the air a reduced flow if any significant moisture is present it will show as condensation on the mirror or glass which means addition air flow will be needed to complete drying. **Note:** If drying a 3/8” umbilical it may require up to two SCUBA cylinders to completely dry the 3/8” umbilical.

After using the test manifold for drying, place the test manifold and components back in its case for safe storage.
**15.0 Test Manifold Care and Maintenance:** After using, if the manifold was used with water as a test media, the test manifold should be dried before storage. Normally this will be accomplished by running air thru it while drying an umbilical. The manifold assembly is made up of stainless steel and brass components and should require minimal maintenance. The relief valve is made of anodized aluminum and can be easily checked in place and adjusted as required. The relief will have a tendency to stick if the system has not been used for a long time so it is a good idea to do a lift check before testing the first umbilical.

**16.0 Gage comparison:** The gage should be compared to a gage of known accuracy at least once a year. The gage is a straight thread O-ring seal and can be easily removed for comparison or it can be compared in place.

Please address any questions on use, care and maintenance of the Umbilical Test System to Dive Lab Inc. [website](http://www.divelab.com) telephone 850-235-2715.
Umbilical / Pressure / Leak Test

XLDS QA Sheet  XLDSICSPRES060215MW

XLDS Umbilical Serial #______________  XLDS System serial # ____________

Visual Inspection of umbilical for cuts, slices, bulges, fitting slippage, excessive wear, signs of kinking, and any other signs of damage or deformity. _______ Pass _______ Fail

Remarks
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

Pressure Test

Test Media Used:   N2_____  Divers Air_____  Water ______

Start time ________  Start Pressure________

Stop Time ________  Stop Pressure________

Pass ________  Fail ________

Remarks:
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

Date__________  Print______________________________________________________________

Sign ____________________________________________________________