



DIVE LAB XLDS PRESSURE GAUGE COMPARATOR

DLGCOMP31616 MW



Figure 1. Dive Lab Pressure Gauge Comparator

1.0 Dive Lab Pressure Gauge Comparator

The Dive Lab pressure gauge comparator was originally designed to allow comparison of all the high and low pressure gauges installed or used with the Dive Lab Extreme Lightweight Diving System (XLDS), including the pneumofathometer gauges. The comparator can also be used to compare other “CLEAN” life support gauges. The comparator system is a small suitcase size system that weighs approximately 38 lb, and unlike deadweight testers where the gauges need to be pressurized with water then after testing cleaned and dried. The Dive Lab Comparator simply uses divers breathing quality air or high grade nitrogen as a test media. Testing gauges in place with air or nitrogen allows fast, easy comparison of all system gauges without having to remove them from the system eliminating system generated contamination from breaking fittings loose as well as reducing wear on pipe thread components. The system comes with two high precision digital test gauges, which have a certified full scale accuracy of 0.05% and allow for an unsurpassed level of on site (in the field) accuracy normally only achieved within a laboratory test facility setting.

2.0 System Components

The basic system consists of a high pressure manifold and regulator assembly, which acts as the foundation and mounting structure for the test gauges and whips. The comparator assembly has a maximum rated working pressure of 5000 psig but can also be used to accurately deliver very low gas pressures, making it suitable for comparing diver pneumofathometer gauges as well as other gauges used for diver and breathing quality air use. All Comparators made after March 2015 have dual use interface whip assemblies which are rated for both low pressure and high pressure; 5000 psig service. This simplifies things. The gauge comparator flow has been limited so that things pressurize slowly.

WARNING

Always wear eye protection when working with the gauge comparator. A ruptured gauge or hose could pose a serious hazard, which could result in bodily harm.

DANGER

Never use oxygen or oxygen enriched gases to supply the gauge comparator. Using oxygen enriched gases could lead to a fire or explosion resulting in great bodily harm or death. Divers breathing air or a supply of high grade nitrogen is the only gas that should be used for gauge comparison.

WARNING

Do not use the comparator system to compare gauges that have been used for non diver breathing gas applications.

CAUTION

Always open valves slowly. Even though the the gauge comparator has restrictors built-in to limit flow, always open valves slowly while operating.

WARNING

Persons using this equipment should have basic knowledge and experience working with high pressure air. Anyone using this equipment should call Dive Lab Inc, if they have any questions regarding the gauge comparator or any questions remotely involved. Please call (850) 235-2715 or E-mail Dive Lab: divelab@divelab.com

2.2 Basic Comparison Rational

Quite often there is confusion in the terms calibration and comparison as it refers to pressure gauges and other instruments. The term calibration primarily refers to comparing and physically adjusting a gauge or instrument to a know standard or condition. The term comparison refers to observing the differences between a gauge. Dive Lab produces the gauge comparator to allow users to accurately “compare” diving system gauges to an extremely accurate set of gauges that have a full scale accuracy of 0.05%. The basic rule for accurate comparison is the master gauge being used to compare system gauges should have a certified accuracy of at least four times greater than the gauges being compared. Other than physically zeroing diver depth gauges to compensate for atmospheric pressure, making physical adjustments to system gauges is not covered and should not be attempted by persons that have not received form gauge calibration training.

2.3 Computing Allowable Error

Typically, most mechanical (analog) gauges that have a diameter less than three inches have a stated accuracy between 2-3% full scale. Some gauge manufactures claim a 3-2-3 accuracy meaning that the first one third has up to a three percent possibility of error plus or minus, and the middle third of the scale has a two percent possibility of error plus or minus. Finally, the last third could be out of tolerance by three percent. This means a 5000 psig gauge with a 3% accuracy could be out of tolerance plus or minus by 150 psig. To determine the allowable error simply multiply the manufactures stated accuracy as a decimal by the range of the gauge. Example, a 600 psi gauge analog gauge with a stated accuracy of 2% would go like this, 2% = .02 as a decimal, multiply .02 by 600 psi. Looks like this, $.02 \times 600 = 12$ psig.

3.0 XLDS HP Gauge Comparator Configuration and Set Up

There are several ways the comparator can be used to compare the gauges on the XLDS. The procedure explained herein is the way Dive Lab currently recommends the XLDS gauges be compared, However, this is not the only configuration, or way that the gauges can be compared, but we believe this procedure is a simple and efficient way to compare the HP, LP and pneumofathometer (pneumo) gauges contained in the XLDS system. As persons using the system gain experience, other methods may be employed.

- 3.1 On the gauge comparator, insure the gauge comparator regulator has been backed off counter clockwise and the manifold inlet valve and vent valve have been shut.
- 3.2 On the XLDS RDC console, back out fully Red, Green, and Yellow regulators counterclockwise until the hand wheels spin freely.
- 3.1 On the gauge comparator, insure the gauge comparator regulator has been backed off counter clockwise and the manifold inlet valve and vent valve have been shut.
- 3.2 On the XLDS RDC console, back out fully Red, Green, and Yellow regulators counterclockwise until the hand wheels spin freely.
- 3.3 On the XLDS RDC console, remove the protective caps from each of the diver umbilical supply fittings on ALP-1R, ALP-2G, ALP-3Y valves.
- 3.4 Check shut, the three pneumo valves Red, Green and Yellow.
- 3.5 Check shut the two cross connect valves, XC-1 and XC2.
- 3.6 Check shut the diver umbilical supply valves ALP-1R, ALP-2G.
- 3.7 Remove the 5000 psig digital test gauge and the test whip assemblies from their protective bags.

NOTE

Make sure you have the 5000 psig gauge, which is the digital test gauge that does not have a relief valve like the low pressure gauge. The HP test gauge is made by 3D Industries and has a chrome case. Older comparators use a 5000 psig Druck gauge.



Figure 2. Accu Cal Plus 5000 psig Test Gauge

- 3.8 Remove the high pressure whip assemblies from the protective storage bag. There has been several configurations of high pressure supply whips, in vararing lengths four feet and longer with older (pre-2016) models, the supply whip is made up of two whip assemblies whip assemblies coupled together. The other test whip assembly consists of a small block assembly that has ports to attach up to three standard 5000 psig submersible pressure gauge whips that can be adapted from -4 AN to whatever is needed. Dive lab has provided ZCO swivel fittings for attachment to the XLDS system. When testing the XLDS HP gauges these two assemblies are secured together and attached to outlet elbow of the test manifold to the inlet of each XLDS regulator HP ZCO fitting on the XLDS as shown in Figure 3 below.



Figure 3. XLDS HP Gauge Interface Whip Configuration

- 3.9 The third whip assembly is the high pressure supply whip assembly that sends air from the test source (usually a SCUBA cylinder) to the inlet of the comparator HP regulator. This whip is 48 inches long and has a DIN / "A" Yoke assembly on one end for the supply source and a female ZCO fitting on

the other end that attaches to the male ZCO male fitting on the manifold regulator as shown in Figure 4 below.



Figure 4. HP Supply Whip Assembly Connected

4.0 XLDS HP Gauge Comparison Procedure

- 4.1 Remove the protective plugs from both the 5000 psig digital test gauge, and the gauge comparator ZCO attachment point on the top of manifold, then attach and secure the 5000 psig digital test gauge to the female ZCO fitting located on the top middle of the manifold as shown in Figure 5.
- 4.2 Attach the double whip (96") assembly. Attach one end of the whip to 90° Male outlet fitting on the bottom of the test manifold and the other end to the male ZCO fitting of the black block assembly.



Figure 5. HP Supply Whip Configuration to the XLDS

- 4.3 Attach the three HP whips with female ZCO fittings, one to each of the XLDS HP regulators as shown in Figure 6.



Figure 6. Attachment to the HP System

- 4.4 Remove the protective cap from the ZCO fitting on the main gas supply whip. The main gas supply whip has a DIN/Yoke assembly on one end that attaches to cylinders up to 4250 psig if using DIN fittings and the other end mates to the inlet of the regulator on the test manifold. Secure the DIN or "A" Yoke (whichever is in use) to the supply source.

5.0 Comparing the XLDS HP Gauges

- 5.1 Press the "ON" button on the HP digital gauge, then if necessary zero the gauge by holding in on the zero button in accordance with the gauge instruction manual.
- 5.2 Slowly open the SCUBA cylinder valve or HP source supply and pressurize the supply whip. The the cylinder supply pressure will be read at the inlet side of the hand loader.
- 5.3 Slowly Load the regulator to the maximum supply that the XLDS will be used at, based on the maximum supply pressure used. This will normally be 3500 psig but could be as high as 4250 if DIN fittings are used or up to 5000 psig if other appropriate fittings are used.
- 5.4 Slowly open the manifold inlet valve one half to one one full turn.

NOTE

The pressure on Red, Green, and Yellow divers XLDS HP gauges will slowly start rising and it may take 15-20 seconds to reach full pressure. It is best to exercise the XLDS gauges by pressurizing and depressurizing at least two to three times from zero to the maximum supply pressure that will be used, then back to zero. Exercising the gauges several times helps clean corrosion (verdigris) from the gauge gears.

- 5.5 When comparing the HP gauges, check the gauges in at least 500 psig increments or smaller. Use the comparison log sheets to document how the gauges compare to the master gauge.
- 5.6 To pressurize the system, use the gauge comparator HP hand loader to slowly bring the pressure up to the XLDS Gauges as read on the 5000 psig digital gauge then compare the gauges being checked. Use the hand loader and the manifold vent valve as necessary to manipulate the pressure and compare all HP gauges.

6.0 XLDS Low Pressure Gauge Comparison

- 6.1 Once all HP gauges have been compared and documented, back off the hand loader on the comparator and then vent the system and leave the vent valve open.
- 6.2 With zero pressure on the comparator, remove the 5000 psig digital gauge at the ZCO fitting on the comparator manifold and plug the manifold gauge fitting with one of the ZCO O-ring plugs as shown in Figure 7.



Figure 7. Plug installed in comparator.

- 6.3 Install the 5000 psig HP gauge with the 3/8-ZCO adapter in Green Divers manifold as shown in Figure 8.



Figure 8. HP Gauge Installed for XLDS Low Pressure Gauge Comparison

- 6.4 On the XLDS, insure the Red, Green, and Yellow Divers pneumo valves are shut, and the pneumo female quick connects are open.
- 6.5 On the XLDS, open the cross connect valves XC-1, and XC-2 this will allow all three LP gauges to be compared at the same time.
- 6.6 On the comparator, adjust the hand loader so that you have between 400-420 psig on the HP digital test gauge, then shut the comparator vent and slowly open the comparator inlet valve to supply pressure to the XLDS.

NOTE

When comparing the XLDS LP gauges it is not necessary to compare them at a pressure greater than 400 psig.

- 6.7 On the XLDS, slowly Load Red Divers hand loader until the pressure on Red LP gauge reads 400 psig.

NOTE

If the relief valve on the any of the XLDS circuits lifts, loosen the lock nut on that relief and rotate the cap in "Clockwise", approximately 1/2 to 1 turn to keep the relief from lifting.

7.0 Cycling the Low Pressure Gauges

- 7.1 After pressurizing Red, Green and Yellow LP gauges to 400 psig on the XLDS, shut the comparator inlet valve and slightly open Red Divers outlet valve; LP-1R this will vent all gauges. After the gauges read zero, shut ALP-1R and slowly open the comparator manifold inlet valve and re-pressurize the three XLDS LP gauges again. Repeat this process at least three times to cycle the gauges, then back off on red divers regulator until the hand wheel spins freely.
- 7.2 Using Red Divers regulator, slowly load the pressure as read on the 5000 PSI digital test gauge to 50 psig. Use the pneumo valve, and Red Divers regulator to reach the pressure. Once the digital gauge reads 50 psig, lightly tap on each gauge with your finger to finalize the reading, then record the comparison on the LP gauge sheet. Repeat this procedure in 50 psig increments to 400 psig.
- 7.3 Once the gauges have been checked from zero to 400 psig use Red Divers regulator and pneumo valve to check the gauges from 400 psig to zero in 50 psig increments logging each reading.

NOTE

Due to the flow restrictor in the comparator, the pressure will equalize slowly.

NOTE

The 600 psig XLDS LP gauges have a stated accuracy of 3% full scale which means they can be out tolerance as far as 18 psig. $.03 \times 600 = 18$ psig. Using a LP gauge comparison form, document the comparison of Red, Green, and Yellow Divers LP gauges in no less than 50 psig increments to 400 psig. Record the results on the LP gauge comparison record sheets

- 7.4 Check at 50 psig increments by slowly loading the comparator regulator as required, using Red Divers hand loader to supply pressure to the three pneumo circuits and ALP-1R or the pneumo valve to vent as

necessary allowing you to dial in the exact pressure needed.

NOTE

This procedure requires a little practice.

- 7.5 Once the LP gauges have been compared, re-set the relief valves as necessary to the required pressure and tighten the lock nut on each relief, and then back off on Red Divers Regulator until the hand wheel spins freely.
- 7.6 On the comparator manifold, back off the regulator counterclockwise until the knob spins freely then open the manifold vent and vent any pressure until there is zero pressure on the comparator manifold.
- 7.7 ALP-1R vent off the pressure on Red, Green, and Yellow LP circuits until the LP gauges read zero.
- 7.8 Shut XC1 and XC2 cross connect valve.
- 7.9 Check shut ALP-1R, ALP-2G, and ALP-3Y.
- 7.10 Check shut Red, Green and Yellow pneumo valves.
- 7.11 Re-install the 5000 psig gauge onto the gauge comparator manifold. Then reinstall the 3/8" port plug on Green Divers LP manifold.

8.0 Comparing the XLDS Depth Gauges

- 8.1 With the 5000 psig test gauge back onto the calibration system manifold, connect the male QD pneumo plug "T" adapter to Red Green and Yellow female QD sockets at shown in Figures 9 and 10.



Figure 9. XLDS Pneumo Male QD Plug



Figure 10. XLDS Pneumo QD



Figure 13. The Druck® 300 psig Gauge Installed for Pneumo Gauge Comparison

NOTE

The XLDS pneumo plug adapter ties all three gauges together for comparison.

8.2 Attach the LP gauge adapter to Red Divers manifold as shown in Figure 9. TAttach the 300 psig Druck® gauge as shown in figure 10.

NOTE

The 300 psi gauge is only used for comparing pneumo gauges.

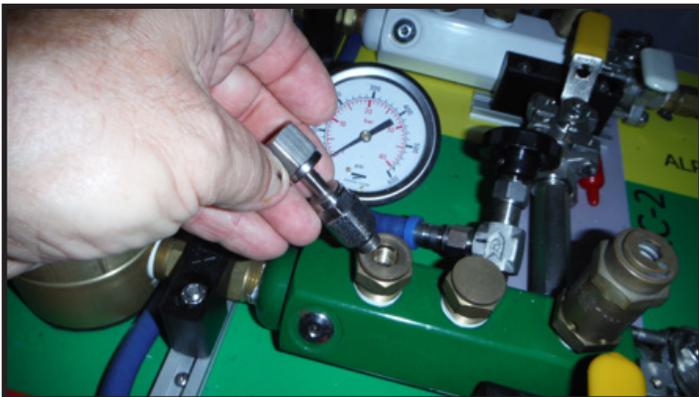


Figure 11. LP and Pneumo gauge XLDS Manifold Adapter

8.3 Check shut Red, Green and Yellow pneumo valves.
 8.4 Open the cross connect valves XC-1 and XC-2.
 8.5 On the gauge comparator manifold, shut the vent valve, open the manifold valve and slowly load the comparator regulator to 100 psig as read on the HP digital gauge.

CAUTION

On the XLDS Console do not load more than 90 psig on Red Divers manifold or damage to the diver's depth gauges could result. 90 psig will allow enough pressure to compare gauges to a depth of 202 fsw.



Figure 12. Pneumo Gauge with Manifold Adapter, Relief Valve and Fine Control Valve

8.6 Very slowly load Red Divers regulator until the Druck® digital gauges reads no more than 90 psig.

NOTE

Because the XLDS is being supplied only 100 psig from the comparator it helps prevent over pressurizing the XLDS pneumo valves.

⚠ CAUTION

Pressure should be supplied to the three depth gauges by slowly, and carefully opening Red Divers pneumo valve to introduce pressure to the three depth gauges at the same time. To vent pressure off, use the fine vent knurled knob located on the LP gauge assembly as shown in Figure 10.

8.7 Exercise the pneumo gauges by pressurizing to 200-225 fsw at least 3 times, then vent the gauges to zero and adjust each gauge face for zero using a small screw driver. See Figure 14.



Figure 14. Adjusting to Zero

NOTE

The 300 psig test gauge reads out in PSIG. Use the pressure conversion column on the far right of the test sheet. Check the depth gauges down (Descending depth) at 5, 10, 15 and 20 feet then check in 10 foot increments to the maximum depth the system will be used. Document the comparative readings on the depth gauge test sheet. Check the gauges both in both descending and ascending.

- 8.8 After completing pneumo gauge comparison, back off on the hand loader and vent the system.
- 8.9 Insure there is zero pressure on Red, Green, and Yellows LP gauges, then attach the three leg QD adapter.
- 8.10 Crack open Red, Green and Yellow Divers pneumo valves approximately $\frac{1}{4}$ turn.



DIVE LAB, INC.
DEPTH GAUGE COMPARISON
 Document# TGC0014

Test Gauge Used: _____ Date Last Certified: _____

System Ser#: _____ System Ser#: _____ System Ser#: _____

FSW	DOWN	UP	PASS/ FAIL	FSW	DOWN	UP	PASS/ FAIL	FSW	DOWN	UP	PASS/ FAIL	SUBJECTIVE PRESSURE PSIG
5				5				5				2.225
10				10				10				4.45
15				15				15				6.67
20				20				20				8.9
30				30				30				13.35
40				40				40				17.8
50				50				50				22.25
60				60				60				26.7
70				70				70				31.15
80				80				80				35.6
90				90				90				40.05
100				100				100				44.5
110				110				110				48.95
120				120				120				53.4
130				130				130				57.85
140				140				140				62.3
150				150				150				66.75
160				160				160				71.2
170				170				170				75.65
180				180				180				80.1
190				190				190				84.55
200				200				200				89

Date: _____

Remarks: _____