

Dive Lab Pressure Gauge Comparator for Use with the Kirby Morgan KMAC Surface Supply Diving Console



Figure 1. Dive Lab Pressure Gauge Comparator

CONTENTS

- 1.0 Dive Lab Pressure Gauge Comparator, Page 2
- 2.0 System Components, Page 2
 - 2.1 Basic Comparison Rational, Pages 2-3
 - 2.2 Computing Allowable Error, Page 3
- 3.0 Gauge Comparator Configuration and Set-up, Pages 3-4
- 4.0 KMAC HP Gauge Comparison Procedure, Page 4
- 5.0 Comparing KMAC HP Gauges, Page 5
- 6.0 KMAC Low Pressure Gauge Comparison , Page 5
- 7.0 Comparing the KMAC Depth Gauges (Pneumo Gauge), Page 5-6
 - Depth Gauge Comparison Sheet, Page 7
 - Pressure Gauge Comparison Sheet, Page 8

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 LBS 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 easy, fast, 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

2.1 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 formal gauge calibration training.

2.2 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 Gauge Comparator Configuration and Set Up

There are several ways the comparator can be used to compare the gauges. This guide is generic in nature and will primarily explain how to perform in place comparison of the high and low pressure gauges on the Kirby Morgan KMAC surface supply diving console. In addition it will also demonstrate comparison of the diver depth gauge (Pneumo Gauges) This is basic instruction only, but 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 KMAC, back the regulator off fully clockwise until the hand wheels spin freely.

- 3.3 On the KMAC, remove the protective caps from each of the diver umbilical supply fittings.
- 3.4 Check shut, the two pneumo valves for Red and White divers.
- 3.5 Check shut the diver umbilical supply valves for Red and White Divers umbilical supply valves.
- 3.6 Remove the 5000 psig digital test gauge and the test whip assemblies from their protective bags.



Figure 2. Accu Cal Plus 5000 psig Test Gauge

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 that looks like the 300 psig gauge.

- 3.7 Remove the high pressure whip assemblies from the protective storage bag. Over the past couple years there has been several configurations of high pressure supply whips, in various lengths, four feet and longer. In some assemblies (pre-2016) models, the supply whip is made up of two 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 provides ZCO swivel fittings for attachment to the XLDS and various other fittings for specialty requirements.



Figure 3. KMAC Supply Interface Configuration

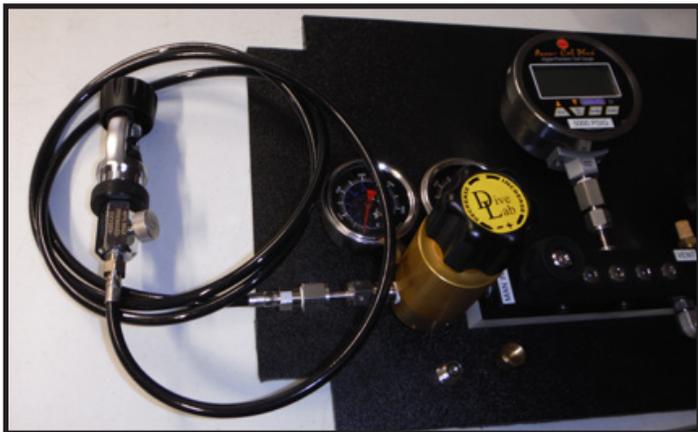


Figure 4. Standard HP Gauge Interface Supply to Comparator Whip Configuration

3.8 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 Figures 4 and 5.



Figure 5. HP Supply Whip Assembly Connected

4.0 KMAC 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 comparator outlet whip ZCO fitting to the outlet of the comparator manifold, and the other end with the small block and double whips to the KMAC as shown in Figure 5.



Figure 6. HP Supply Whip Configuration for KMAC HP and LP Gauge Comparison

- 4.3 Remove the two KMAC HP hose assemblies and attach the two HP whips with dash 4, 37 degree flare fittings to the KMAC as shown in Figure 6.
- 4.4 Attachment the HP system to a HP source of air. Remove the protective cap from the ZCO fitting on the main gas supply whip. 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 KMAC 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 Insure the comparator regulator is backed off counterclockwise and the supply and vent valves are shut.
- 5.3 Slowly open the SCUBA cylinder valve or HP source supply and pressurize the supply whip. The cylinder supply pressure will be read at the inlet side of the hand loader.
- 5.4 Shut the comparator vent valve and open the manifold supply valve.
- 5.5 Load the comparator regulator to no more than 3500 psig (max working pressure of the KMAC).
- 5.6 Exercise the gauges. Slowly open the manifold inlet valve one half to one one full turn.

NOTE

The pressure on the Digital test gauge as well as the other down stream gauges will slowly start rising and it may take 15-20 seconds to reach full pressure. It is best to exercise the 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.

- 5.7 When comparing the HP gauges, check the gauges in at least 500 psig increments or smaller. Use the comparison log sheet to document how the gauges compare to the master gauge.
- 5.8 To pressurize the system, use the gauge comparator HP hand loader to slowly bring the pressure up to the KMAC HP 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.

6.0 KMAC Low Pressure Gauge Comparison

- 6.1 Once the two a HP gauges have been compared and documented, back off the hand loader on the comparator and then vent the comparator.

- 6.2 Pre-load the KMAC regulator fully counterclockwise with no pressure up to the KMAC, this will allow full pressure (225-2500 psig) through the KMAC regulator.
- 6.3 Insure the pneumo hose connection points on the KMAC are uncapped, and both pneumo valve are shut.
- 6.4 Shut the vent valve on the gauge comparator then load the comparator regulator to 275 psig.
- 6.5 Use the comparator manifold supply valve to supply air along with one of the pneumo gauge supply valves on the KMAC to control pressurizing and depressurizing the KMAC LP valve for both exercising the gauge and controlling comparison.

NOTE

It is only necessary to compare this gauge at the highest KMAC regulator setting which will be between 225-250 psig. Document the comparison.

- 6.6 Compare the KMAC LP gauge to the 5000 psig digital gauge at no less than 25 psi increments by slowly loading the comparator regulator as required and venting using one of the KMAC pneumo vales as a vent.
- 6.7 Once the LP gauge has been compared, 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.
- 6.8 Back off the KMAC regulator clockwise fully then remove the two HP supply whips at the KMAC.
- 6.9 On the KMAC check shut both pneumo supply valves.

7.0 Comparing the KMAC Depth Gauges (Pneumo Gauge)

- 7.1 After comparing the KMAC HP and LP gauges reinstall the two short comparator whips to the KMAC pneumo hose fittings and the low pressure digital gauge assembly as shown in Figure 7 below.
- 7.2 On the gauge comparator manifold check shut the manifold supply and vent valve.
- 7.3 Check to insure there is zero pressure on the

comparator regulator outlet gauge, and the hand loader is backed off.

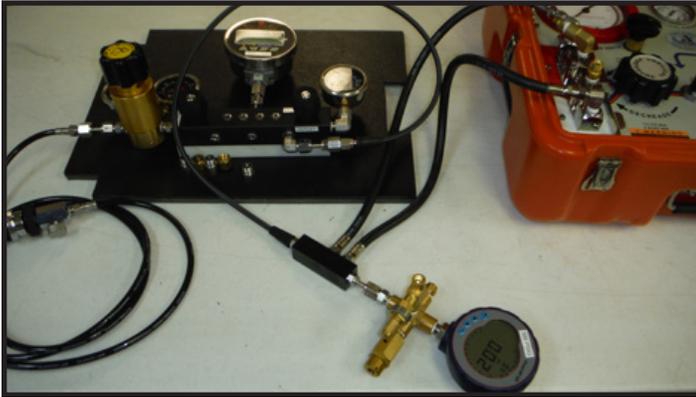


Figure 7. 300 psig Druck® Gauge Assembly Pneumo Configuration

- 7.4 Slowly open the manifold supply valve one quarter to ½ turn, then carefully and slowly load the regulator until the HP gauge reads 100 psig.
- 7.5 Very slowly load Red Divers regulator until the Druck® digital gauges reads no more than 90 psig.

⚠ CAUTION

Pressure should be supplied to the two depth gauges by slowly, and carefully opening Red Divers pneumo valve to introduce pressure to the two 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 8 .

- 7.6 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 8.
- 7.7 After completing pneumo gauge comparison, back off on the hand loader and vent the system.



Figure 8. 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 as they both descend and ascend.

- 7.8 Upon completion of comparison vent all pressure from the KMAC and the comparator, then cap and plug all fittings. Properly secure and stow all equipment to prevent damage and contamination.



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: _____

