



# **TDI / HOG Regulator Service Course**

## **D1 First Stage**

### **D1 Cold First Stage**

### **Classic 2<sup>nd</sup> Stage**

## **Authorized Technician Service Manual**



Presented by:

**SCUBA TUBE**

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<b>Revision History</b>		
<b>Revision</b>	<b>Date</b>	<b>Comment</b>
1.10	01 Dec 2009	Preliminary – not released
1.20	28 Feb 2010	First release
1.30	15 Mar 2010	Updated for 5 <sup>th</sup> port on second stage
1.40	26 Mar 2010	Added Hog Repair Station information
1.50	15 Feb 2011	Update HP seat assembly procedure.
1.60	27 Nov 2011	Updated photos and copyright information.
1.62		First version released by Edge/Hog.
1.63	02 Dec 2011	DEMA 2012 Version

**⚠ WARNING ⚠**

**Improper servicing can lead to serious injury or death.**

**Use of this manual is solely at your own risk.**

**Possession of this guide does not qualify any individual in the service of Edge/HOG regulators. This manual is only to be used as a guide by Authorized Edge/HOG Technicians who have successfully completed the TDI Edge/HOG Equipment Service course.**

**For more information about taking the Edge/HOG Equipment Service course and becoming an Authorized Edge/HOG Technician, visit Edge/Hog Gear at <http://www.edge-gear.com>.**

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## Copyright Notice

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## Introduction

This manual provides procedures for the service and repair of the HOG D1 first and second stage regulators. It is not intended to be used as an instructional manual for untrained personnel. The procedures outlined within this manual are to be performed only by personnel who have successfully completed the TDI Edge/HOG Equipment Service Course. If you do not completely understand all of the procedures outlined in this manual, contact Edge Gear to speak directly with a Technical Advisor before proceeding any further.

## TDI Edge/HOG Equipment Service Course

In conjunction with TDI (Technical Divers International), EDGE Dive Gear is offering certified technical divers (from any agency) the opportunity to attend HOG Regulator Repair Clinics, to buy parts and get service support from their local EDGE and HOG Dealer.

This is an entry level course certifying technical divers in the techniques required to inspect, maintain and service their own EDGE/HOG diving equipment. The course includes an in-depth look at how the equipment functions, basic repairs and cleaning for Nitrox use.

Upon successful completion of this course, graduates may:

1. Service and Maintain personally owned EDGE/HOG equipment.
2. Prepare EDGE/HOG equipment for use with Nitrox.

Notes:

1. The qualification is limited to equipment owned by the graduate only.
2. Graduates are required to maintain currency of their qualification current by:
  - a. Servicing a minimum of one (1) Edge/HOG regulator per year.
  - b. Purchase one (1) annual service kit from an EDGE/HOG dealer each year.
  - c. Attend an EDGE/HOG Service Clinic every five (5) years or upon purchase of a new product for which training has not been completed

For more information about the Edge/HOG Equipment Service Course, please visit Edge-Hog Gear at <http://www.edge-gear.com>.

## Hog Repair Station

This is a special sub-forum on ScubaBoard where Hog technicians can get in direct contact with other Hog technicians, Hog instructors and the manufacturer to get answers to questions they have about servicing Hog regulators. **The Hog Repair Station is the primary reference source for all technical questions you may have about servicing Hog regulators. This is also the place where technical bulletins, notices of running changes and product update information will be posted.**

Membership is free and mandatory to maintain your status as an authorized technician. Think of it as home for those certified to repair their own Hog regulators and those who teach them.

ScubaBoard > Manufacturers Forums > Q and A for Scuba Manufacturers > Edge Gear > Hog Repair Station

### How to gain access to the Hog Repair Station forum:

1. After you successfully complete the TDI course, send an email to [BossHog@Edge-Gear.com](mailto:BossHog@Edge-Gear.com) with your
  - a. Full name as it appears on your certification card
  - b. Your Instructors name
  - c. The date you took the class
  - d. Your TDI certification number
  - e. Your ScubaBoard screen name
2. If you aren't already a member of ScubaBoard, you will need to register. Go to [www.scubaboard.com](http://www.scubaboard.com) and sign up or sign in.
3. Go to the Hog Repair Station and request admission.  
<http://www.scubaboard.com/forums/hog-repair-station/>
4. You'll receive notice from ScubaBoard when access has been granted.
5. Log back in and you will be able to see the forum contents.
6. Post a "howdy" in the forum so we know you've made it that far.

## TDI Oxygen Equipment Service Technician Course

In the TDI Edge/HOG Equipment Service Course, you will learn some of the basics of oxygen servicing the HOG D1 first stage for oxygen use. In the TDI O2 Equipment Service Technician Course, you will expand upon these repair skills and more fully learn the proper techniques and protocols of preparing scuba equipment for use with breathing gases other than air. The course covers topics such as:

- Oxygen compatible system components
- Cleaning chemicals
- Oxygen cleaning of cylinders valves and regulators

The TDI Equipment Service Technician manual brings you through the process in a logical manner while your instructor takes you through the practical exercises; the manual also acts as great reference material.

For more information about the TDI Oxygen Equipment Service Technician course, please visit [www.tdisdi.com](http://www.tdisdi.com)

## **A Little Help, Please**

Edge/HOG is breaking new ground by offering Technical divers the opportunity to learn how to service their regulators and offering them the access to parts and expertise that other manufacturers don't permit.

This is a new venture for us – creating this course has required a big effort and we want to do everything we can to make it work for you – the DIY geek who actually wants to learn how to work on his equipment.

So, how about a little constructive feedback? After the class is done, after you've had a chance to lovingly fondle your certification card, but before you forget everything, we would appreciate it if you took a little time to help us make the class better for the next guy. Please send your comments to [BossHog@Edge-gear.com](mailto:BossHog@Edge-gear.com)

- What did you like about the class?
- What didn't you like about the class?
- What could we do to make it more valuable to students?
- What could we do to make it more fun?

## Warnings, Cautions & Notes

Pay special attention to information provided in warnings, cautions, and notes that are accompanied by any of these symbols:



**Indicates a procedure or situation that may result in serious injury or death if instructions are not followed correctly.**



**Indicates any situation or technique that will result in potential damage to the product, or render the product unsafe if instructions are not followed correctly.**



Is used to emphasize important points, tips, and reminders.

## Nitrox Use

The D1 first stage, when properly cleaned and assembled is certified by Edge Gear for use with enriched air nitrox (EAN) up to 100% oxygen at 2400 psi or 80% oxygen at 3000 psi. This regulator should not be exposed to a partial pressure of oxygen in excess of 165 atmospheres under any circumstances.

The service procedures used in this manual are sufficient for use with EAN40 to pressures as high as 3000 psi. Use with mixes richer than EAN40 or pressures greater than 3000 psi requires special oxygen servicing protocols not used in this manual.

## Scheduled Service

HOG regulators should be overhauled on an annual basis and all annual service parts replaced. Regulators in commercial or heavy use should be inspected regularly and may require more frequent service.

## General Guidelines

In order to correctly perform the procedures outlined in this manual, it is important to follow each step precisely and in the order given. Read the entire manual to become familiar with all procedures before attempting to disassemble the regulator, and to learn which specialty tools and replacement parts will be required. Keep the manual open beside you for reference while performing each procedure. Do not rely on memory.

All service and repair should be carried out in a work area specifically set up and equipped for the task. Adequate lighting, cleanliness, and easy access to all required tools are essential for efficient and safe work.

The regulator body may need to be secured in a vise when removing certain threaded parts. NEVER SECURE THE REGULATOR BODY DIRECTLY IN A VISE. Instead, install a vise mounting tool into a high pressure port, then secure the vise mounting tool in the vise.

As the regulator is disassembled, reusable components should be segregated and not allowed to intermix with non-reusable parts or parts from other units. Delicate parts, including inlet fittings and crowns which contain critical sealing surfaces, must be protected and isolated from other parts to prevent damage during the cleaning procedure.

Use only genuine HOG parts provided in the first-stage overhaul parts kit. DO NOT attempt to substitute a HOG part with another manufacturer's, regardless of any similarity in shape or size.

Do not attempt to reuse mandatory replacement parts under any circumstances, regardless of the amount of use the product has received since it was manufactured or last serviced.

When reassembling, it is important to follow every torque specification prescribed in this manual, using a calibrated torque wrench. Most parts are made of either marine brass or plastic, and can be permanently damaged by undue stress.

## General Conventions

Unless otherwise instructed, the following terminology and techniques are assumed:

- When instructed to remove, unscrew, or loosen a threaded part, turn the part counterclockwise. Lefty, loosy.
- When instructed to install, screw in, or tighten a threaded part, turn the part clockwise. Righty, tighty.
- When instructed to remove an o-ring, use the finger pinch method if possible, or use a brass or plastic o-ring removal tool. Avoid using hardened steel picks, as they may damage the o-ring sealing surface. All o-rings that are removed are discarded and replaced with brand new o-rings.
- The following acronyms are used throughout the manual: MP is Medium Pressure; HP is High Pressure; IP is Intermediate Pressure.
- Numbers in parentheses reference the key numbers on the schematics. For example, in the statement, "...remove the o-ring (17) from the...", the number 17 is the key number to the HP plug o-ring.

## Preliminary Inspection

Periodically and prior to each service, a preliminary inspection should be made to determine as much as possible about the condition of the regulator and any problems that may need to be addressed.

1. A pressurized immersion test of the entire unit to check for air leakage.
2. Checking for stable intermediate pressure that is within the acceptable range.
3. Checking for cracking effort that is within the acceptable range.
4. Checking for smooth operation of the control knob and venturi switch.
5. A visual inspection of the filter for debris or discoloration.
6. A visual inspection of the exhaust valve to see that it is in good shape and that it's resting against a clean surface.
7. A visual inspection of the mouthpiece looking for tears or holes.
8. Pulling back hose protectors and checking that the hoses are secure in the hose crimps.

If a regulator fails item #1, 2, 3 or 4 the entire regulator should be overhauled before being returned to service. If a regulator fails 5, 6, 7 or 8 it will be up to the technician's discretion whether or not a full overhaul is required.



## First Stage Disassembly

### **NOTE**

**Before beginning disassembly, refer to the schematic which lists all mandatory replacement parts. These parts should be replaced with new parts and must not be reused under any circumstances.**

### **CAUTION**

**Use the pinch method wherever possible to remove o-rings. If a tool must be used, plastic or brass should be used – NEVER use a dental pick or any other steel instrument to remove o-rings. Even a tiny scratch on a sealing surface can result in leakage and failure of the regulator; once a sealing surface has been damaged the part must be replaced with new.**

1. Note the position of all hoses on the first stage for ease of reassembly.
2. Remove the hoses from the first stage using an appropriate open end box wrench or adjustable wrench. Inspect the hose o-rings and replace if they show any signs of wear or deformity.
3. Insert the First Stage Handle tool (Scubatools SKU 20-115-100 or similar) securely in a high-pressure port. Be careful not to cross thread the port – if you do, the body must be replaced.

### **CAUTION**

**Placing the regulator body directly in a vise may result in the crushing or distortion of the body, rendering it inoperable or unsafe to use. Use the handle tool.**

Steps 4 - 5 apply only to the D1 Cold version (Figure 1). If you have a standard D1, skip to step 6.

4. Using a hook spanner, loosen the environmental cap (34) from the diaphragm cap (17), remove by hand and set aside. Use a gentle pulling motion (do not jerk) on the hook spanner and an old diaphragm or other piece of rubber under the hook spanner to prevent damage to the cap finish.
5. Remove the silicone disk (33), and the transmitter (32) from the regulator and set aside.



6. Using a 6mm hex key, unscrew the Adjustment Screw (18) two full turns to reduce the main spring (16) tension.



7. Using the hook spanner, loosen the diaphragm cap (17) from the main housing (10), remove and set aside. Be careful not to let any remaining spring tension pop the cap off. Use a gentle pulling motion (do not jerk) on the hook spanner and an old diaphragm or other piece of rubber under the face spanner to prevent damage to the cap finish.



8. Locate the spring carrier (14), two clear spring washers (15) and the main spring (16) and set aside.
9. Unscrew the adjustment screw (18) from the diaphragm cap (17) and set both parts aside.

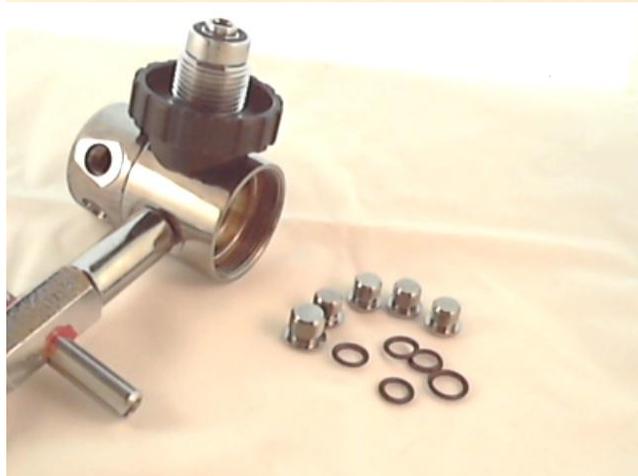


10. Put your hand loosely over the MP side and, using a blast of LP air through the second HP port, loosen the diaphragm (12) and diaphragm washer (13) from the MP shoulder of the main housing (10). The diaphragm and diaphragm washer usually will not come completely out of the main housing, if they don't a pick can be used to gently pull them completely free. Discard both the diaphragm and diaphragm washer.



11. Locate the lifter (11) and set aside.

12. Remove any port plugs (29, 31) from the turret (20) and the main housing (10). Remove the o-rings (28, 30) on the port plugs and discard.



13. Using a 6mm hex key, unscrew the turret bolt (27) from the turret (20). Carefully lift the turret bolt from the turret, taking care not allow the valve spring (22) to eject the assembly. Discard the HP seat (21). Set the the valve spring (22) aside.



14. Place the turret bolt (27) on a flat surface with the balance chamber facing up. Carefully remove the Viton o-ring (23) from the balance chamber, **using extreme care not to scratch or nick the interior sealing surface**. Remove the thrust washer (25), the two Viton o-rings (24) and (26) from the exterior of the turret bolt and discard the o-rings. Set the turret bolt aside.



15. Remove the turret (20) from the main housing and set aside. Locate and discard the Viton o-ring (19).



16. Remove the o-ring (1) from the DIN lockdown screw (2) and discard.
17. Use a 6mm hex key to remove the DIN lockdown screw (2) from the DIN inlet (6). Remove the o-ring (4) from the DIN lockdown screw and discard. Set the DIN lockdown screw aside. If the entire DIN assembly comes off, it can be disassembled by inserting a 7mm hex key in the DIN inlet and a 6mm hex key on the DIN lockdown screw and unscrewing.
18. Remove the DIN wheel (5) from the DIN inlet (6) and set aside.



19. Remove the o-ring (24) and the DIN filter (3) from the DIN inlet (6) and discard.



20. Use a 7mm hex key to unscrew the DIN inlet (6) from the main housing (10). Set the DIN inlet and the saddle (8) aside.
21. Remove the o-ring (7) from the main housing (10) inlet port and discard.



22. This ends the disassembly of the first stage.



## First Stage Cleaning



**Do not place plastic and rubber parts in acid solutions. Doing so can alter the physical properties of the component, causing it to prematurely degrade and fail or break. If an acid solution is used, parts should be rinsed and soaked in a base solution, such as baking soda mixed with water, to neutralize the acid.**

### **Cleaning Brass and Stainless Steel Parts**

Pre-clean all parts in warm, detergent water (a mixture of liquid dishwashing detergent and warm water) using a nylon bristle tooth brush. Remove as much soil and old lubricant as possible.

After pre-cleaning, thoroughly clean brass and stainless steel parts in an ultrasonic cleaner filled with detergent water. If there are stubborn deposits, household white distilled vinegar (acetic acid) in an ultrasonic cleaner will work well. DO NOT place plastic, rubber, silicone or anodized aluminum parts in vinegar.

Remove parts from the ultrasonic cleaner and rinse with fresh water. If tap water is extremely "hard," place the parts in a bath of distilled water to prevent any mineral residue. Agitate lightly, and allow to soak for 5-10 minutes. Remove and blow dry with low pressure (25 psi) filtered air, and inspect closely to ensure proper cleaning and like-new condition.

If no ultrasonic cleaner is available, parts should be hand washed again in a tub with a fresh detergent solution. Be prepared for the process to take significantly longer and to require hand cleaning with a toothbrush.

### **Cleaning Anodized Aluminum, Plastic & Rubber Parts**

Anodized aluminum parts and parts made of plastic or rubber, such as box bottoms, box tops, dust caps, etc., may be soaked and cleaned in a solution of warm water mixed with mild dish detergent. Use only a soft nylon toothbrush to scrub away any deposits. Rinse in fresh water and thoroughly blow dry, using low pressure filtered air. DO NOT place plastic, rubber, silicone or anodized aluminum parts in vinegar.

### **Cleaning Hoses**

If buildup of corrosion is severe, it is permissible to soak only the hose fittings in the ultrasonic cleaner as needed, and not allow any solution to enter the hose. Rinse in fresh water and allow to dry with the cleaned ends hanging down. Dry them completely by blowing filtered air through them prior to installing onto the regulator.

### **Oxygen Servicing**

Oxygen servicing is not a casual thing. Before attempting oxygen cleaning, you should seek training through a recognized agency. The TDI Oxygen Service Technician course is designed to provide you with the knowledge, skills and experience to safely and effectively oxygen clean regulators. The process for servicing a HOG D1 for oxygen service is two-fold: make sure all trace hydrocarbons are removed from all parts and use only oxygen compatible components

## **⚠ WARNING ⚠**

**DO NOT ATTEMPT OXYGEN CLEANING WITHOUT PROPER TRAINING. NO MATTER WHAT YOU'VE READ ON THE INTERNET, IT IS STRONGLY RECOMMENDED THAT PRIOR TO ATTEMPTING OXYGEN SERVICE OF A REGULATOR YOU TAKE THE TDI OXYGEN SERVICE TECHNICIAN COURSE.**

**SELF-IGNITION AND CATASTROPHIC FAILURE OF THE REGULATOR MAY OCCUR IF ALL HYDROCARBONS ARE NOT REMOVED PRIOR TO EXPOSURE TO HIGH-OXYGEN CONTENT GAS, RESULTING IN SERIOUS INJURY OR DEATH.**

Removing trace hydrocarbons can be difficult to accomplish and even harder to verify so careful and thorough cleaning is required. After pre-cleaning, cleaning and rinsing the first stage parts (as outlined previously) the following steps should be meticulously followed:

1. The entire wash station and work area should be broken down and washed down with detergent and water, rinsed well with clean water, then allowed to dry. The work area should be covered with clean, lint-free towels.
2. Tools should be carefully cleaned, either in a dishwasher or by hand-washing.
3. Powder-free exam or surgical gloves should be worn at all times to avoid getting body oils on any parts or surfaces.
4. Used detergent solutions should be discarded and fresh solutions prepared. Only "clean" detergents free from perfumes and coloring agents (such as Crystal Simple Green) should be used.
5. All parts, especially the first stage high-pressure parts and including the replacement parts, should be re-cleaned in an ultrasonic cleaner or carefully hand scrubbed with a detergent solution. Examine each part to make sure there is no visible lubrication residue or corrosion present. If necessary, repeat the cleaning process. Permanent corrosion which can not be removed renders the part unsuitable for oxygen service.
6. Rinse all parts thoroughly with clean water. Allow the parts to stand in the rinse water for at least 15 minutes to remove any residue. Rinse water should be changed immediately before use and frequently during the cleaning.
7. After careful cleaning and thorough rinsing, all parts should be subjected to a water break test to look for hydrocarbon or detergent residue. In the water break test, the parts are submerged in a tub of clean water, agitated and allowed to stand for at least five minutes. At the end of five minutes, a bright light is turned on over the water and the surface of the water is carefully examined for any oily or colored sheen. If you see rainbow colors or anything floating on the surface of the water, steps 1 through 7 must be repeated.



**Results of an oxygen fire – can you find the tank?**

8. Only low-pressure hyper-filtered (OCA) air should be used to blow dry parts after cleaning to avoid contamination by standard Grade E air.
9. All of the parts in the HOG annual service kit are oxygen compatible, within the limits specified by the manufacturer. Remember, rubber (Buna or Nitrile) is not suitable for oxygen service, only Viton or EPDM is acceptable.

## **First Stage Pre-assembly Inspection**

All parts should be closely inspected prior to reassembly. Close inspection is best accomplished by using strong magnification under bright lighting. Pay particular attention to the following:

1. First Stage Main Housing: Inspect all cavities for any cracks, nicks, scratches, pitting, or any defects in the plating. Pay particular attention to the sealing edge of the valve cone and the diaphragm seating shoulder.
2. Main Spring & Valve Spring: Inspect for signs of permanent corrosion, including pitting or cracks in the surface of the metal.
3. First Stage Ambient and Environmental Chamber Bodies: inspect the interior sealing area and O-ring sealing groove for any nicks, scratches, pitting, or any defect of the chrome plating.
4. First Stage DIN Retainer: Examine the condition of the threads and the O-ring sealing groove at the base for any nicks, scratches, pitting, or any defect of the chrome plating.
5. First Stage DIN Wheel: Examine the condition of the threads for any signs of damage.
6. First Stage Balance Chamber: Carefully examine the interior sealing area under the o-ring for any nicks, scratches, pitting, or any defect of the chrome plating.

If any parts show damage or excessive wear, they must be replaced with new.

## **First Stage Lubrication and Dressing**

Wear powder-free exam or surgical gloves when handling and lubricating o-rings. Keeping internal parts free from skin oils and other contaminants is important when running enriched air nitrox through a first stage. All o-rings should be lubricated with an oxygen compatible lubricant such as Christo-Lube® MCG-111, Tribolube® 66 or 74, or Krytox® GPL 205.

Dress the o-rings with a very light film of grease and remove any visible excess by running the o-ring between thumb and forefinger. Avoid applying excessive amounts of grease, as this will attract particulate matter that may cause damage to the o-ring.



## First Stage Assembly

1. Insert the lifter (11) into the hole in the main housing (10).



### **⚠ WARNING ⚠**

**DO NOT LUBRICATE THE MAIN BODY DIAPHRAGM SHOULDER, DIAPHRAGM, DIAPHRAGM WASHER OR THE DIAPHRAGM CAP WASHER SHOULDER. LUBRICATION AT THIS JOINT CAN CAUSE THE DIAPHRAGM TO DISLodge, CREATING A CATASTROPHIC FAILURE OF THE FIRST STAGE WHICH COULD CAUSE SEVERE PERSONAL INJURY OR DEATH.**

2. Insert the diaphragm (12) in the main housing and carefully seat it on the diaphragm shoulder. Use your finger or a blunt pick to gently work the diaphragm into position, taking care not to scratch the sealing surface or the threads. **DO NOT LUBRICATE THE DIAPHRAGM.**



3. Insert the diaphragm washer (13) on top of the diaphragm and carefully seat it on the diaphragm. Use your finger or a blunt pick to gently work the diaphragm into position, taking care not to scratch the sealing surface or threads. Set the regulator aside. Please note: there are two service kits available: one with a thin diaphragm (grey on one side, black on the other) that comes with a thrust washer, a second with a thick diaphragm (black on both sides) that does not come with a thrust washer. The thin diaphragm should be used with a thrust washer, the thick diaphragm should not. The flimsy thrust washer installed at the factory should not be reused under any circumstance.



4. Screw the adjustment screw (18) one full turn into the main diaphragm cap (17) being careful to orient it correctly.
5. Stack the following in the adjustment screw (18): one spring washer (15), the main spring (16), one spring washer (15) and the spring carrier (14).



6. Holding the regulator with the MP side facing down in one hand, screw the diaphragm cap assembly hand tight into the main housing (10).
7. Using the hook spanner, tighten the diaphragm cap (17) into the main housing until it seats solidly. The joint should be tight but will not set hard due to the soft diaphragm material – don't overtighten. Set the regulator aside.



8. Place a small dab of lubrication on the interior sealing surface of the turret bolt (27) balance chamber. Lubricate the 006V85 o-ring (23) and, pinching it between your fingers, insert it into the turret bolt balance chamber. Use a thin plastic dowel to make sure the o-ring seats fully and squarely inside the balance chamber.



9. Lightly lubricate the 014V85 o-ring (24) and seat it on the middle shoulder of the turret bolt (27).
10. Lightly lubricate the 019V70 o-ring (26) and seat it on the large shoulder at the base of the turret bolt (27).
11. Place the Thrust Washer (25) on top of the o-ring (26) so that both sit squarely.
12. Place the valve spring (22) on top of the narrow shoulder on the turret bolt (27).
13. Lubricate the narrow tip of the HP seat (21) and insert it through the valve spring (22) into the turret bolt (27) balance chamber. Press lightly on the HP seat to make sure it moves smoothly in and out of the balance chamber. Set the turret bolt assembly aside.



14. Lubricate the 024V70 o-ring (19) and place it on the main housing (10) turret shoulder.



15. Place the turret (20) on the main housing (10) turret shoulder, making certain that the o-ring (19) doesn't extrude and that the turret sits squarely on the shoulder.



**! CAUTION !**

**WHEN INSERTING THE TURRET BOLT THROUGH THE TURRET INTO THE MAIN BODY HOUSING, IT IS CRITICAL THAT YOU MAINTAIN A STRAIGHT ALIGNMENT UNTIL THE TURRET BOLT IS SCREWED TIGHTLY IN PLACE. FAILURE TO MAINTAIN ALIGNMENT CAN RESULT IN DAMAGE TO THE HIGH PRESSURE SEAT OR DAMAGE TO THE MAIN BODY KNIFE EDGE REQUIRING REPLACEMENT OF ONE OR BOTH PARTS.**

16. Holding the turret (20) in place on the main housing (10) with one hand, face the turret straight down and insert the turret assembly up through the opening in the end of the turret, **maintaining a straight alignment of all components.** Compress the spring until you can thread the turret assembly into the main body housing. Hand tighten, making sure that the thrust washer (25) and o-ring (26) seat fully and squarely into the turret bolt (27) without extruding.



## **⚠ WARNING ⚠**

**USE A CALIBRATED QUALITY TORQUE WRENCH TO TIGHTEN THE TURRET BOLT IN PLACE. FAILURE TO CORRECTLY TIGHTEN THE TURRET BOLT CAN RESULT IN IT COMING LOOSE, RESULTING IN THE TURRET DETACHING FROM THE MAIN BODY IN A CATASTROPHIC FAILURE WHICH CAN RESULT IN SEVERE INJURY OR DEATH. OVERTIGHTENING THE TURRET BOLT CAN RESULT IN THE BRASS THREADS STRIPPING RESULTING IN SEVERE DAMAGE TO THE REGULATOR OR IN THE TURRET DETACHING FROM THE MAIN BODY IN A CATASTROPHIC FAILURE WHICH CAN RESULT IN SEVERE INJURY OR DEATH.**

17. Using the torque wrench, tighten the turret bolt (27) to 175 inch pounds (14.5 foot pounds, 19.7 Newtons).



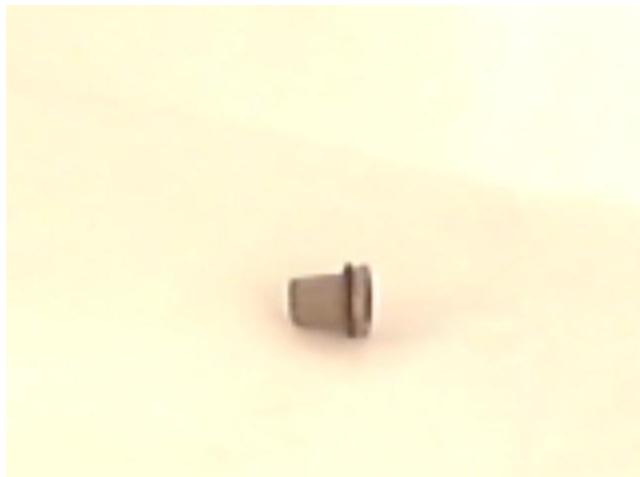
18. Lubricate a 011V85 o-ring (7) and seat it on the shoulder at the narrow end of the DIN inlet (6).



19. Place the saddle (8) over the narrow end of the DIN inlet (6) and hand screw the assembly into the main housing (10) DIN inlet port until it seats.
20. Torque the DIN inlet to 120 inch pounds (10 foot pounds, 13.5 Newtons).



21. Place the S-8-N85 (4) o-ring on the shoulder of the DIN filter (3).
22. Insert the DIN filter into the DIN inlet, small end in toward the main housing.



23. Place the DIN wheel (5) over the DIN inlet (6) with the threads facing away from the main housing (10).



24. Lightly lubricate a 013V85 o-ring (24) and seat it on the shoulder of the DIN locking screw (2) next to the threads. Be careful not to damage the o-ring or the threads during this process.
25. Insert a 112V85 o-ring and seat it in the groove on the face of the DIN locking screw (2). DO NOT LUBRICATE THIS O-RING OR THE GROOVE.
26. Screw the DIN locking screw (2) into the DIN inlet (6) and torque to 80 inch pounds (6.7 foot pounds, 9.1 Newtons).



27. Install the o-rings (28) and (30) on the port plugs (29) and (31) and install the port plugs in the turret and main body housing in the same ports they were removed from.



**The D1 First Stage is now assembled and ready for adjusting.  
The D1 Cold First Stage must be adjusted before assembly can be completed.**

**PROCEED TO ADJUSTMENT**

28. The D1 Cold environmental cap (34), silicone disk (33) and transmitter (32) are not installed until after the D1 Cold regulator IP has been adjusted. Set them aside until the second stages have been reassembled and installed.



## Second Stage Disassembly

1. Using an appropriate open end box wrench or adjustable wrench, remove the hose from the second stage.
2. Remove two o-rings from the ends of the hose. Be careful not to damage the interior sealing surface on the second stage end of the hose when removing the o-ring. NOTE: the -010V70 o-ring on the second stage end of the hose is not included in the service kit. Recycle if you can, replace if you aren't sure.



3. Use a snip to remove the tie-wrap from the mouthpiece. Remove the mouthpiece and set aside for inspection and cleaning.

NOTE: You will find the second stage serial number under the mouthpiece.



4. Use a  $\frac{3}{4}$ " wrench to remove the nut from the adjustment tube (19) and set aside for inspection and cleaning.
5. Remove the brass heat sink (7) from the adjustment tube (19) and set aside for inspection and cleaning.
6. Remove the o-ring (6) on the adjustment tube and discard.



7. Unscrew the aluminum ring (22) from the main housing (1) and remove for inspection and cleaning.
8. It is normally not necessary to disassemble the purge button (25), purge spring (27) and HOG decal (28) from the solid cover (26). If, however, the purge button doesn't operate smoothly or there is any sign of damage, it can be disassembled by pinching the four feet on the inside of the solid cover together and extracting the purge button through the front of solid cover. Watch for the spring which may try to eject the button.
9. Separate the solid cover (26) from the aluminum ring (22) and set both parts aside for inspection and cleaning.
10. Gently remove the diaphragm (9) from the main housing (1) and set aside for inspection and cleaning.
11. Holding the second stage in your hand with the mouthpiece facing away from you, gently depress the lever arm (16) with your thumb and use the palm of your left hand to press gently on the adjustment tube (19) so that it begins to slide out of the main housing (1) to the right. Remove the adjustment tube from the main housing, taking care not to bend or distort the lever arm or the deflector knob (10).



12. Holding the adjustment tube (19) in your hand, gently slide the deflector arm off the adjustment tube, away from the knob end. Be careful, the adjustment knob pin (18) can easily drop out of the adjustment tube and get lost.
13. Remove the o-ring (11) from the deflector arm and discard. Set the adjustment tube, deflector arm and adjustment knob pin aside for inspection and cleaning.
14. If the adjustment knob pin (18) didn't drop out when you removed the deflector arm, gently turn the adjustment knob (23) until it does. Set aside for inspection and cleaning.



15. Unscrew the adjustment knob (23) from the adjustment tube (19) taking care not to allow the main spring (13) to pop the internal pieces out of the tube.
16. Remove the o-ring (17) from the adjustment knob and discard.
17. Remove the o-ring (6) from the adjustment tube and discard.



18. Gently turn the adjustment tube (19) with the open side facing down and catch the balance cylinder (24), main spring (13), and piston (20) as they fall out. If all three parts do not fall out easily, it may be necessary to jiggle the lever arm (16) to loosen them up.
19. If necessary, the lever arm (16) can be removed from the adjustment tube (19) to remove the piston (20). Observe the orientation of the lever arm on the adjustment tube before starting, then gently spread the legs apart with your fingers until the piston drops out. It should not be necessary to completely remove the



lever arm, but should that happen, inspect the legs to make sure they aren't bent or distorted and reattach.

20. Remove the LP seat (12) and the two o-rings (21) from the piston (20) and discard. Be careful not to damage the piston when removing the o-rings.



21. Using a 3/16 hex key, unscrew the orifice (14) from the inlet side of the adjustment tube (19). The hex key will not completely remove the orifice, so use a chop stick or plastic rod to press it out from the other end. Be careful not to damage the knife edge of the orifice.



22. Remove the o-ring (15) from the orifice. Discard the o-ring, set the orifice aside for inspection and cleaning.

23. The deflector pad is sealed into the main housing (1) and should not be removed.



24. Under normal conditions, it should not be necessary to remove the exhaust valve (3) or the exhaust cover (4). A visual inspection of the exhaust valve can be made to verify that it is in good condition with no folds or tears and is sitting flat against the sealing surface on the main housing (1) without further disassembly. If removal is necessary, use a flat blade screwdriver inserted through the right side of the exhaust port to press open the flange on the exhaust cover and pop it open. Remove the exhaust valve by pulling it free from the main housing.



25. This concludes the disassembly of the second stage.

**Proceed to Second Stage Cleaning**



## Second Stage Cleaning

### Cleaning Brass and Stainless Steel Parts



**Do not place plastic and rubber parts in acid solutions. Doing so can alter the physical properties of the component, causing it to prematurely degrade and fail or break. If an acid solution is used, parts should be rinsed and soaked in a base solution, such as baking soda mixed with water, to neutralize the acid.**

Pre-clean all parts in warm, detergent water (a mixture of liquid dishwashing detergent and warm water) using a nylon bristle tooth brush. Remove as much soil and old lubricant as possible.

After pre-cleaning, thoroughly clean brass and stainless steel parts in an ultrasonic cleaner filled with detergent water. If there are stubborn deposits, household white distilled vinegar (acetic acid) in an ultrasonic cleaner will work well. DO NOT place plastic, rubber, silicone or anodized aluminum parts in vinegar.

Remove parts from the ultrasonic cleaner and rinse with fresh water. If tap water is extremely "hard," place the parts in a bath of distilled water to prevent any mineral residue. Agitate lightly, and allow to soak for 5-10 minutes. Remove and blow dry with low pressure (25 psi) filtered air, and inspect closely to ensure proper cleaning and like-new condition.

If no ultrasonic cleaner is available, parts should be hand washed again in a tub with a fresh detergent solution. Be prepared for the process to take significantly longer and to require hand cleaning with a toothbrush.

### Cleaning Anodized Aluminum, Plastic & Rubber Parts

Anodized aluminum parts and parts made of plastic or rubber, such as box bottoms, box tops, dust caps, etc., may be soaked and cleaned in a solution of warm water mixed with mild dish detergent. Use only a soft nylon toothbrush to scrub away any deposits. Rinse in fresh water and thoroughly blow dry, using low pressure filtered air. DO NOT place plastic, rubber, silicone or anodized aluminum parts in vinegar.

### Cleaning Hoses

If buildup of corrosion is severe, it is permissible to soak only the hose fittings in the ultrasonic cleaner as needed, and not allow any solution to enter the hose. Rinse in fresh water and allow to dry with the cleaned ends hanging down. Blow filtered air through them prior to installing onto the regulator.

### Oxygen Servicing

It should not be necessary to oxygen clean the D1 second stage – the partial pressures of oxygen the unit is exposed to do not represent a significant fire hazard, so long as the unit is maintained and serviced according to the normal schedule.

## Second Stage Pre-assembly Inspection

All parts should be closely inspected prior to reassembly. Close inspection is best accomplished by using strong magnification under bright lighting. Pay particular attention to:

1. Second stage main housing: inspect all areas for cracks, especially around the holes where the adjustment tube passes through the body, the mouthpiece shoulder and the exhaust cover.
2. Exhaust valve and cover: look closely to make sure that the exhaust valve is pliable, not torn or punctured and sitting flat against the sealing surface.
3. Mouthpiece: examine the mouthpiece carefully, especially the bite wings and the material where the mouthpiece mounts to the main housing for any tears or punctures.
4. Diaphragm: gently tug on the diaphragm while holding it up to a bright light to check for pinholes or tears and soft flexibility.
5. Adjustment knob: check to make sure that the adjustment knob hasn't been bent or cracked.
6. Orifice: using high magnification and bright light, check the knife edge of the orifice for any nicks, dings, cracks, permanent corrosion or other damage.
7. Valve spring: inspect under magnification for signs of permanent corrosion, cracks or bending.
8. Lever arm: inspect to make sure the legs are straight.
9. Piston/poppet: inspect for wear or damage, especially the seating grooves where the two tiny o-rings sit.

Any parts that show damage or excessive wear must be replaced.

## Second Stage Lubrication and Dressing

All o-rings should be lubricated with an oxygen compatible lubricant such as Christo-Lube® MCG-111, Tribolube® or Krytox®.

Dress the o-rings with a very light film of grease and remove any visible excess by running the o-ring between thumb and forefinger. Avoid applying excessive amounts of grease, as this will attract particulate matter that may cause damage to the o-ring.

## Second Stage Assembly

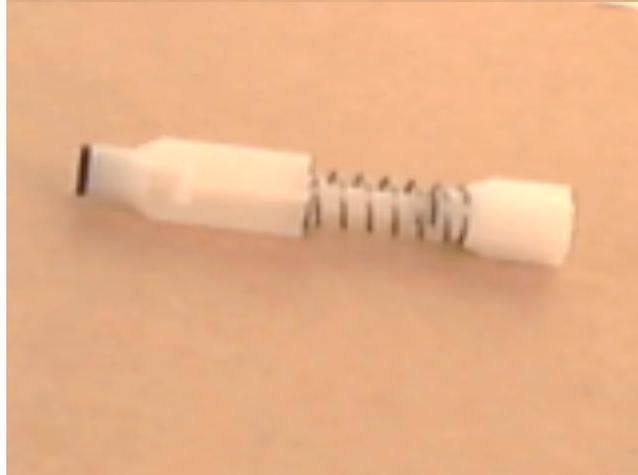
1. Lubricate and install the O-ring (17) into the groove on the small end of the adjusting screw (23), and set the adjusting screw aside.



2. Without lubrication, install a new LP seat (12) into the piston/poppet (20) by pressing the stem inward until the lip of the seat is seated evenly on all sides. Next, lubricate and install the two small o-rings (21) onto the opposite end of the piston/poppet. Make sure there is no gap between the seat and the piston stem.



3. Fit one end of the main spring (13) over the open end of the balance cylinder (27), and then insert the stem of the shuttle valve into the opposite end. While holding these items together, press the counterbalance cylinder and shuttle valve together, compressing the spring slightly, so that the balance cylinder seals over the small o-ring on the stem of the piston/poppet.



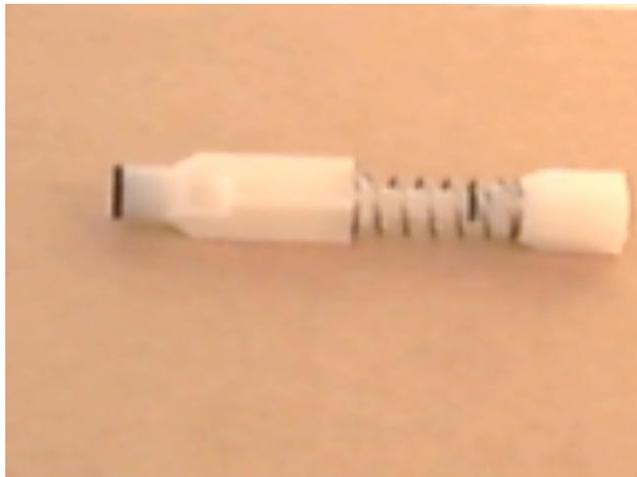
4. Install the o-ring (6) onto the grooved flange of the adjustment tube (19).



5. If the lever (16) was removed, lay the valve spindle lengthwise with the threaded inlet facing to the right (3 o'clock) and the outlet port facing toward 6 o'clock. While holding the lever standing up, perpendicular to the spindle, insert one arm into one of the square holes that are located near the flange, and then hold it securely in place while rotating the lever slightly over the spindle until the other arm fits into the opposite square hole. Closely examine the shape and position of the lever to ensure that the arms have not become stretched or bent during installation.



6. Hold the adjustment tube horizontally with the male threaded inlet end facing left, and positioned so that the lever dangles down. While holding the piston/poppet and spring by the counterbalance cylinder, align the piston/poppet beside the adjustment tube so that the two retaining ears which engage the arms of the lever are facing directly up; opposite of the lever.



7. Slide the piston/poppet and balance cylinder straight into the barrel of the spindle while being careful to avoid disturbing the alignment of the piston/poppet. The lever should bounce slightly as the two retaining ears engage.



8. While holding the adjustment tube secure, mate the adjusting knob (23) into the open end of the adjustment tube, and hold it pressed inward while turning it clockwise until the threads are engaged. Watch to ensure that the lever rises initially as the adjusting knob is installed into the adjustment tube. If the lever does not rise, the arms are not properly engaged with the piston/poppet. Disassemble and repeat steps 6-8 before proceeding.



9. Test the assembly function by turning the adjustment knob fully in and depressing the lever – it should spring back into an extended position smoothly. Test the assembly function again by unscrewing the adjustment knob several turns and bouncing the lever several times to make sure the poppet and spring move smoothly and easily.



10. Insert the adjustment knob pin (18) into the hole in the adjustment tube, next to the grooved flange. It may be necessary to turn the adjustment knob in or out a few turns – until you can see daylight through the hold. Hold the pin centered in place, and then turn the adjusting knob completely out counter-clockwise until it stops. This will hold the pin securely in place to prevent it from falling out while installing the adjustment tube into the case.



11. Install the o-ring (11) onto the deflector knob (10).
12. While holding the valve lever depressed against the spindle, fit the deflector knob over the threaded inlet with the plastic lever facing toward the adjusting knob. Gently pass it over the spindle until it is seated against the opposite end, and then slowly release the lever to prevent it from springing up.
13. Be careful not to turn the external adjusting screw while installing the deflector knob onto the adjustment screw. It is very important to keep the screw turned completely out counter-clockwise, in order to hold the retaining pin in place.



14. Install the o-ring (15) onto the orifice (14), and carefully insert the threaded end of the orifice into the inlet end of the adjustment tube. Gently press it in further with a blunt instrument until it stops.
15. Apply a 3/16" hex key to the head of the orifice, and turn the orifice clockwise to engage the threads. Continue turning the orifice clockwise only until the lever begins to drop slightly.



16. Orient the main housing with the exhaust valve facing down, at 6 o'clock. While holding the lever depressed, guide the inlet end of the adjustment tube through the opening in the right side of the case and into the opening on the opposite side, until the lever can stand up. Check to ensure that the deflector knob is correctly aligned to fit in its groove outside the main housing, and the valve lever is facing straight up. Carefully guide the adjustment tube completely to the left until the flange is seated flush against the inside of the main housing, and the arms of the lever are positioned inside the retaining tabs on either side.



17. While holding the adjustment tube securely seated inside the case, fit the o-ring (6) down over the threaded inlet of the adjustment tube.



18. Fit the heat sink (7) over the threaded inlet of the adjustment tube, and then thread the nut (8) clockwise by hand onto the spindle until it is finger snug. Check again to ensure that the valve module is held secure inside the case with the flange and lever arms fitted inside the retaining tabs. Then, tighten the nut to no more than 50 inch-lbs.

19. Check the height of the lever to ensure that it stands perfectly level with the rim of the case, with a slight freeplay that does not exceed 1.0 mm. If necessary, apply a 3/16" hex key to adjust the orifice as needed to raise or lower the lever until it is level with the main housing rim.



20. If the exhaust cover (4) and exhaust valve (3) were removed, install a new exhaust valve by gently pulling the stem through the hole in the center of the support spokes until the barb has passed through and is securely seated against the opposite side. Gently turn the diaphragm outside the case to position the rib perfectly horizontal. Then, carefully snip off the excess material of the stem inside the case with a small pair of scissors. Install the exhaust cover onto the case by seating one of the seating flanges on the main housing and then popping the other side into place. You may need to use a blunt instrument to assist the seating flange into position.



21. Install the diaphragm (9) into the main housing with its raised center facing up, and check to ensure it is evenly seated onto the shoulder at the base of the threads.



22. If the purge button (25) was disassembled from the solid cover (26), fit the spring (27) over the four tabs of the purge button with the smaller diameter end facing down. Then, position the purge button inside the front of the case cover so that the logos on the decal and the cover are correctly aligned with each other. Press the purge button into place so that all four mating tabs are seated inside of the solid cover.



23. Place the solid cover (26) over the diaphragm with the support cone facing up, and press it down to ensure that it seated evenly on all sides.



24. Mate the aluminum ring (22) onto the main housing, and turn it clockwise by hand until snug. Apply the case cover tool (P/N AT31 or AT42) to tighten it further until the purge button logo is properly aligned.



25. Install the mouthpiece (5) onto the main housing (1), and lightly fasten a tie wrap (2) onto the groove of the mouthpiece with the head located on the right side of the mouthpiece. Pull the tie wrap sufficiently snug. Snip the extra length with a small pair of scissors or wire cutters.



**This concludes the reassembly of the second stage.  
Refer next to the Second Stage Adjustment section.**



## First Stage Adjustment

### Final Adjustment and Testing Procedures

1. Connect the intermediate pressure test gauge either to a quick-disconnect inflator hose, or to the female fitting of a second stage LP hose, depending on the connection of the test gauge. Check to ensure there are no open ports and that all hoses are securely connected at both ends, with no open fittings.



**Before testing intermediate pressure, it is important to connect the first stage to a fully assembled and properly adjusted second stage. This will provide a safety relief valve if the intermediate pressure exceeds 155-170 psi. If a properly adjusted second stage is not available, be sure to open the bleed valve of the test gauge before pressurizing. Failure to relieve intermediate pressure in excess of 400 psi may result in damage to the test gauge or LP hose.**

2. Check to ensure that the first stage adjustment screw (18) is correctly set to its preliminary adjustment; at least two full turns in.
3. Connect the first stage to a filtered air source of 500 psi, and slowly pressurize the first stage. While closely monitoring the IP test gauge to ensure that the intermediate pressure does not rise above 120 psi, slowly turn the knob of the bleed valve clockwise until it is shut.



**If a second stage is not connected to the first stage and the intermediate pressure rises above 200 psi, immediately reopen the bleed valve of the test gauge and shut off the air supply. Refer directly to the Troubleshooting section, and remedy as needed before proceeding further.**

4. When the intermediate pressure has stabilized below 120 psi, apply a 6mm hex key to turn the spring adjuster clockwise in small increments of adjustment. While turning the spring adjuster, it is important to simultaneously purge the second stage or briefly turn the test gauge bleed valve open and shut. Monitor the test gauge while adjusting in this manner until the intermediate pressure locks up between 115-120 psi.
5. When the intermediate pressure has been determined to be stable at 120 psi or less, increase the inlet pressure to 3,000 psi while checking the IP test gauge once again to ensure that the intermediate pressure does not rise above 135 psi. If the intermediate pressure rises above 135 psi, immediately purge the second stage, or re-open the bleed valve of the test gauge, and shut off the air supply. Refer to the Troubleshooting section, and remedy as needed.



**Failure to depressurize the regulator during adjustment can result in a false reading of the intermediate-pressure.**

6. Repeat the adjustment procedure in step 4 to adjust the first stage intermediate pressure to exactly 135 psi. Repeatedly purge the second stage or open and shut the test gauge bleed valve at least 100 times to ensure that the intermediate pressure locks up consistently and remains stable at 135 ( $\pm 5$ ) psi, with no signs of creeping or fluctuation.

#### 7. D1 Cold Final Assembly

- a. While the regulator is still pressurized with 3,000 psi, insert the stem of the transmitter (32) into the hex opening of the spring adjuster.
- b. Lay the silicon disk (33) inside the environmental end cap, and tamp it down past the threads to ensure that it seats evenly against the sealing surface.
- c. Mate the environmental cap (34) onto the diaphragm cap (17) and turn it clockwise by hand until snug. Apply the hook spanner to tighten the diaphragm cap clockwise until it is completely snug and flush with the diaphragm cap.
- d. Cycle the regulator to ensure that the intermediate pressure has not dropped below 135 psi. If necessary, depressurize the regulator and disassemble the environmental kit to reset the intermediate pressure, and repeat steps 6-7.



8. After performing the second stage overhaul and adjustment procedures, connect the first and second stage regulators to perform the following tests:
9. **External Leak Test** – Connect the regulator to a cylinder which contains 2,500 - 3,000 psi, and open the cylinder valve to pressurize the system. Submerge the cylinder and regulator in a test tank of fresh water, and observe closely for five minutes to check for escaping bubbles. If a steady stream of bubbles is present, the system must be disassembled to check sealing surfaces, assembly sequence, and component positioning to correct as needed.

### **CAUTION**

**Before disassembling to correct any leaks, rinse the entire regulator thoroughly with fresh water and blow out all residual moisture with filtered, low-pressure (30 psi) air. Disassemble and remedy the problem, referring to the troubleshooting section.**

10. **Subjective Breathing Test** – Depress the second stage purge to ensure that the volume of airflow is adequate to clear the second stage. Then, breathe deeply from the mouthpiece. A properly serviced and adjusted regulator should deliver a smooth, uninterrupted airflow upon

deep inhalation; without excessive effort, hesitation, or freeflow. If any problems occur, refer to the troubleshooting section.

This concludes the annual service procedures for the HOG D1 first stage regulator.



## Second Stage Adjustment

### Final Adjustment and Testing Procedures

Prior to adjusting and testing the HOG second stage regulator, the accompanying first stage must be correctly serviced, adjusted to a stable intermediate pressure of 135 psi (+/- 5 psi), and fully tested. Refer to the corresponding first stage service procedures before attempting to perform the adjustment and testing of the second stage.

1. Thread the male fitting of the IP hose into the preferred low pressure port of the first stage, and tighten to 40 inch-pounds ( $\pm 2$ ).
2. Turn the second stage adjustment screw completely out counter-clockwise, and set the venturi lever to the "MIN" position.
3. Connect the first stage to a filtered air source of 3,000 psi.
4. Turn the second stage adjustment screw exactly one full turn ( $360^\circ$ ) clockwise.
5. Slowly open the air supply valve to fully pressurize the regulator.
  - a. If airflow can immediately be heard when the regulator is pressurized, depressurize and purge the system. Disconnect the IP hose and remove the case cover, diaphragm cover, and diaphragm to re-check the height of the lever. The lever should be set at a height level with the rim of the case, with approximately 1.0 mm freeplay. If the lever is set too low or too high, apply a 3/16" hex key through the inlet to adjust the crown seat – either counter-clockwise to raise or clockwise to lower the lever. When the lever is set correctly, re-install the diaphragm, diaphragm cover, and case cover, and connect the IP hose to the second stage.
6. When no airflow can be heard after the regulator has been pressurized, slowly depress the purge button to verify whether a strong airflow can be initiated when the button has traveled no more than 2mm.

#### **NOTE**

If a strong purge cannot be initiated by depressing the purge button a maximum distance of 2mm, it will be necessary to adjust the seat crown slightly counter-clockwise. Excessive travel of the purge button indicates that the lever is set too low.

7. Depress the purge button sharply several times to ensure that leakage or freeflow does not occur.

#### **NOTE**

If a slight leak occurs after sharply purging the second stage, it will be necessary to adjust the seat crown slightly clockwise, being careful to adjust only as far as needed to create a seal between the seat crown and rubber seating, without raising the lever too high.

8. Move the venturi lever to the "MAX" position and depress the purge button sharply. This should initiate a strong, continuous freeflow that can be eliminated by turning the venturi lever back to the "MIN" position.
9. To test the setting of the orifice, turn the second stage adjustment screw completely out counter-clockwise to initiate a slight flow of air, and then slowly turn it back in clockwise to verify that the airflow has stopped completely before it has been turned 1 full turn. If more

than 1 turn is required to shut off the airflow, it will be necessary to readjust the crown as described in step 5.

10. When all adjustments have been satisfactorily performed, tighten the IP hose fitting to a torque measurement of 40 inch-lbs ( $\pm 3$ ).

#### **Negative Inhalation Leak Test**

1. Shut the air supply off and bleed the system down. Gently inhale on the second stage, you should be able to create a vacuum in the case and feel the lever move but not be able to breathe in. Don't overdo it – you can collapse the exhaust or primary diaphragm with too much negative pressure.

#### **External Leak Test**

2. After disconnecting the regulator from the flow bench, connect to a scuba cylinder filled to approximately 3,000 psi. Open the cylinder valve to re-pressurize the regulator, and submerge the entire system in a test tank of clean water.
3. Observe any bubbles arising from the submerged regulator over a five minute period. The recommended time is necessary due to slower bubble formation that occurs in smaller leaks. Bubbles indicate a leak, which requires that the system must be disassembled at the source to check sealing surfaces, assembly sequence and component positioning in order to correct the problem(s). Bubble streams will indicate the source of the leak. Before disassembling to correct any leaks, rinse the entire regulator thoroughly with fresh water and blow out all residual moisture with filtered, low-pressure (50 psi) air. Disassemble and remedy the problem, referring to Table 1 - Troubleshooting.

#### **Subjective Breathing Test**

1. While the regulator is connected to a cylinder containing 3,000 psi and pressurized, turn the second stage adjustment knob completely out counterclockwise to the full positive position, and verify that a slight leak of airflow is present.
2. Slowly turn the adjustment knob in clockwise to verify that the airflow stops between  $\frac{1}{2}$  to 1 turns.
3. Turn the adjustment knob completely in clockwise, and depress the second stage purge to ensure that an adequate volume of air needed to clear the second stage flows through the mouthpiece.
4. Turn the adjustment knob back to  $\frac{1}{2}$  to 1 turn negative, and breathe from the second stage. A properly serviced and adjusted regulator should deliver air upon deep inhalation without excessive inhalation effort, freeflow, or "fluttering" of the second-stage diaphragm. When exhaling, there should be no fluttering or sticking of the exhalation valve. If any of these problems occur, refer to Table 3 - Troubleshooting.

***This concludes the annual service procedures for the HOG Second Stage Regulators.***

<b>Troubleshooting – First Stage</b>		
<b>SYMPTOM</b>	<b>CAUSE</b>	<b>ACTION REQUIRED</b>
Restricted airflow/ high inhalation resistance through entire system.	<ol style="list-style-type: none"> <li>1. Cylinder valve not completely opened.</li> <li>2. Cylinder valve requires service.</li> <li>3. Filter is contaminated.</li> <li>4. Insufficient intermediate pressure</li> </ol>	<ol style="list-style-type: none"> <li>1. Open valve, check fill pressure.</li> <li>2. Connect to a different cylinder.</li> <li>3. Replace with new.</li> <li>4. See below.</li> </ol>
External air leakage 1. (Immersion Test) -or-hydrostatic diaphragm is abnormally distended or burst	<ol style="list-style-type: none"> <li>1. Turret plug loose.</li> <li>2. HP Plug loose.</li> <li>3. LP Plug loose.</li> <li>4. DIN connector loose.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace the static 013 O-Ring and tighten again</li> <li>2. Replace the static 904 O-Ring and tighten the plug again</li> <li>3. Replace the static 903 O-Ring and tighten the plug again</li> <li>4. Replace static 0110-Ring and tighten again.</li> </ol>
IP Drift (Creep)	<ol style="list-style-type: none"> <li>1. Lockup but over 5 psi drift</li> <li>2. Non-lockup</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace the HP Seat and Check the HP cone</li> <li>2. Replace the Dynamic 010 O-Ring, HP seat and check the HP cone.</li> </ol>
High or unstable intermediate pressure	<ol style="list-style-type: none"> <li>1. First stage improperly adjusted.</li> <li>2. HP valve seat damaged or worn.</li> <li>3. HP balance plug o-ring damaged or worn.</li> <li>4. HP balance plug damaged or worn.</li> <li>5. HP valve body sealing surface damaged or worn.</li> <li>6. Valve spring damaged or weakened.</li> </ol>	<ol style="list-style-type: none"> <li>1. Readjust spring adjustment.</li> <li>2. Replace HP valve seat.</li> <li>3. Replace o-ring.</li> <li>4. Replace balance plug.</li> <li>5. Replace main housing.</li> <li>6. Replace valve spring.</li> </ol>
Low intermediate pressure	<ol style="list-style-type: none"> <li>1. First stage improperly adjusted.</li> <li>2. Main spring damaged or weakened.</li> <li>3. DIN inlet loose.</li> </ol>	<ol style="list-style-type: none"> <li>1. Readjust spring adjustment.</li> <li>2. Replace main spring.</li> <li>3. Check for tight – re-torque if needed.</li> </ol>

<b>Troubleshooting – Second Stage</b>		
<b>SYMPTOM</b>	<b>CAUSE</b>	<b>ACTION REQUIRED</b>
Leakage or freeflow from second stage	<ol style="list-style-type: none"> <li>1. High first stage IP – should be 135 psi +/- 5 psi.</li> <li>2. LP seat damaged or worn.</li> <li>3. Orifice adjusted incorrectly or lever set too high.</li> <li>4. Lever bent.</li> <li>5. Orifice sealing surface damaged.</li> <li>6. Poppet/piston spring damaged or weakened.</li> </ol>	<ol style="list-style-type: none"> <li>1. Refer to first stage troubleshooting.</li> <li>2. Replace LP seat.</li> <li>3. Reset orifice preliminary setting and repeat adjustment procedures.</li> <li>4. Replace lever.</li> <li>5. Replace orifice.</li> <li>6. Replace spring.</li> </ol>
Low purge or excessive work of breathing.	<ol style="list-style-type: none"> <li>1. Low first stage IP – should be 135 psi +/- 5 psi.</li> <li>2. Orifice adjusted incorrectly, lever set too low.</li> <li>3. IP hose clogged or obstructed.</li> <li>4. Lever bent.</li> </ol>	<ol style="list-style-type: none"> <li>1. Refer to first stage troubleshooting.</li> <li>2. Reset orifice preliminary setting and repeat adjustment procedures.</li> <li>3. Clean or replace hose.</li> <li>4. Replace lever.</li> </ol>
Water entering second stage	<ol style="list-style-type: none"> <li>1. Hole in mouthpiece.</li> <li>2. Diaphragm damaged.</li> <li>3. Exhaust valve damaged.</li> <li>4. Deflector knob o-ring dirty, damaged or worn.</li> <li>5. Diaphragm improperly seated in main housing.</li> <li>6. Main housing damaged.</li> <li>7. Adjustment tube o-rings damaged or worn.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace mouthpiece.</li> <li>2. Replace diaphragm.</li> <li>3. Replace exhaust valve.</li> <li>4. Replace o-ring.</li> <li>5. Remove diaphragm, inspect carefully and reseal.</li> <li>6. Disassemble, check for cracks or broken plastic, replace if damage found.</li> <li>7. Replace o-ring.</li> </ol>

<b>Test Bench Specifications</b>		
<b>Test</b>	<b>Condition</b>	<b>Range</b>
Intermediate pressure	1.	1. 135 psi, +/- 5psi
Intermediate pressure creep	1.	1. No more than 5 psi in 15 seconds
Cracking pressure	1.	1. .8 – 1.2 with adjustment knob fully open. Closing the adjustment knob will add approximately 1.0
Vacuum leak test	1.	1. No leaks allowed
Bubble leak test	1.	1. No leaks allowed

<b>Torque Specifications</b>		
<b>Part</b>	<b>Description</b>	<b>Torque</b>
	DIN Inlet	120 inch pounds
	DIN Locking Screw	80 inch pounds
	HP Port Plug, LP Port Plug	40 inch pounds
	Turret Bolt	175 inch pounds
	HP seat plug	35 inch pounds
	Adjustment tube nut	Finger tight + a bit ;)

<b>First Stage Annual Service Kit</b>				
<b>Location</b>	<b>Part Number</b>	<b>Description</b>	<b>Count</b>	<b>Comment</b>
1	O-AS568-112-04	112V85 O-ring	1	
3	F-01-001-03	DIN Filter	1	
4	O-S-8-04	S8V85 O-ring	1	
7	O-AS568-011-04	011V95 O-ring	1	
12	P-01-002-01	Diaphragm	1	
13	P-01-002-02	Diaphragm Washer	1	
15	P-01-002-03	Spring Washer	2	
19	O-AS568-024-03	024V70 O-ring	1	
23	O-AS568-006-04	006V85 O-ring	1	
24	O-AS568-013-04	013V85 O-ring	2	
25	P-01-002-04	Thrust Washer	1	Turret
26	O-AS568-019-03	019V70 O-ring	1	
28	O-AS568-011-03	011V70 O-ring	4	
30	O-AS568-012-04	012V85 O-ring	2	
33	A-01-002-03-RD	Silicone Disk Red	1	

<b>Second Stage Annual Service Kit</b>				
<b>Location</b>	<b>Part Number</b>	<b>Description</b>	<b>Count</b>	<b>Comment</b>
2	A-02-010-12-BK	Nylon Tie	1	
6	O-AS568-015-01	-015V70 o-ring	2	
11	O-AS568-019-01	-019V70 o-ring	1	
12	A-01-011-08	LP seat	1	
15	O-AS568-010-01	-010V70 o-ring	1	
17	O-AS568-011-01	-011V70 o-ring	1	
21	O-EKM-2MX1M-05	Specialty o-ring	2	poppet

## Tools List

Many of the following items are available from ScubaTools.com. Where you purchase them is up to you but ScubaTools has a long-standing reputation for quality and convenience. They are expensive, however. For the latest prices and tools, visit [www.scubatools.com](http://www.scubatools.com).

### ScubaTools.com

- Scuba Regulator Savvy by Peter Wolfinger SKU 30-100-100 ..... \$29.00
- First Stage Handle SKU 20-115-100 ..... \$26.00
- Dual Drive Inline Adjusting Tool w/IP Gauge SKU 20-500-200 ..... \$62.00
- Christo-Lube SKU 15-710-111 ..... \$29.00
- O-ring Pick Set, Soft Brass SKU 10-102-100 ..... \$11.00
- O-ring Pick Set, 5 Pieces SKU 10-125-400 ..... \$7.50
- 3/8" Drive Dial Torque Wrench SKU 79-600-700 ..... \$160.00

### Local hardware store or the web

- Hook Spanner (at least one, two is better, any on this list work)
  - Gedore No. 40Z (20-22mm w/ 4mm pin works perfectly)
  - Williams No. 471 adjustable 3/4" – 2" w/ 1/8" pin works
  - Armstrong 34-305 adjustable reportedly works but I haven't tried it.
- 6" Adjustable wrenches – you'll need two. Recommended: the Hakuma Tools HT150B 6" Adjustable Bent Nose Thin Wrench are perfect but expensive and hard to find. El Cheapos with sloppy adjustments usually do not work well but quality adjustables will usually work, especially if you grind them down so that they are no more than 1/4" thick. Purists may prefer open face wrenches, however you will need a number of them in a variety of sizes and may want to grind their faces down to better fit small spaces.
- Lighted Magnifier – a headlamp with magnifiers works great but a lighted reading magnifier or lighted loupe is good, too.
- Torque Wrench Crow's Feet
- 18mm socket (for torque wrench)
- 4mm, 6mm, 7mm long hex bit sockets (for torque wrench)
- 4mm, 6mm, 7mm hex keys
- Imperial hex key set

### Other items needed

- Vise with soft jaws or flat face (optional)
- Nylon bristle toothbrush
- Two one-gallon plastic tubs (for cleaning)
- Vinegar
- Dish detergent
- Ultrasonic cleaner (optional)
- Crystal Simple Green (only required for oxygen service)
- Lint free towels
- Powder-free exam or surgical gloves

### Not required but recommended for anyone serious about regulator repairs:

- Ultrasonic Cleaner. Empty peanut butter jars and a toothbrush can usually get the job done but if you're serious about cleaning regulators, an inexpensive 2.5 Liter Ultrasonic Cleaner like [this one](#) from Harbor Freight is the way to go. Besides, your wife will think you're a hero and love you long time when you volunteer to clean all her jewelry...

## Dive Log

You fixed it? You dive it! The final step in becoming certified as a HOG Equipment Service Technician is to take the regulator you just serviced and go for a dive with it. This gives you a chance to answer that most important question: are you confident in your work? This also gives you a chance to go diving, which is, after all, what this is all about. A word of caution, however: it's a wise technician who does this checkout dive in a pool (or pool-like conditions) instead of jumping off the back of a boat on a 300 foot pinnacle dive. I'm just saying...

Fill out this log sheet (or your own, if you prefer), have your dive buddy sign off on it and send it to your instructor.

Diver Name: \_\_\_\_\_  
Certification Level: \_\_\_\_\_  
Agency: \_\_\_\_\_  
Certification Number: \_\_\_\_\_  
Email Address: \_\_\_\_\_  
  
Dive Date: \_\_\_\_\_  
Dive Location: \_\_\_\_\_  
Max Depth: \_\_\_\_\_  
Run Time: \_\_\_\_\_  
Temperature: \_\_\_\_\_  
Mix(es) used: \_\_\_\_\_

How did your HOG D1 regulator perform? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Buddy Name: \_\_\_\_\_  
Buddy Signature: \_\_\_\_\_

### Student Statement

I have completed all components of the TDI Edge/HOG Equipment Service Course and am comfortable with the material and my ability to safely and successfully service my HOG gear. I understand that I am not certified to repair gear for anyone other than myself and that I must service my gear at least once per year and attend periodic updates in order to maintain my certification.

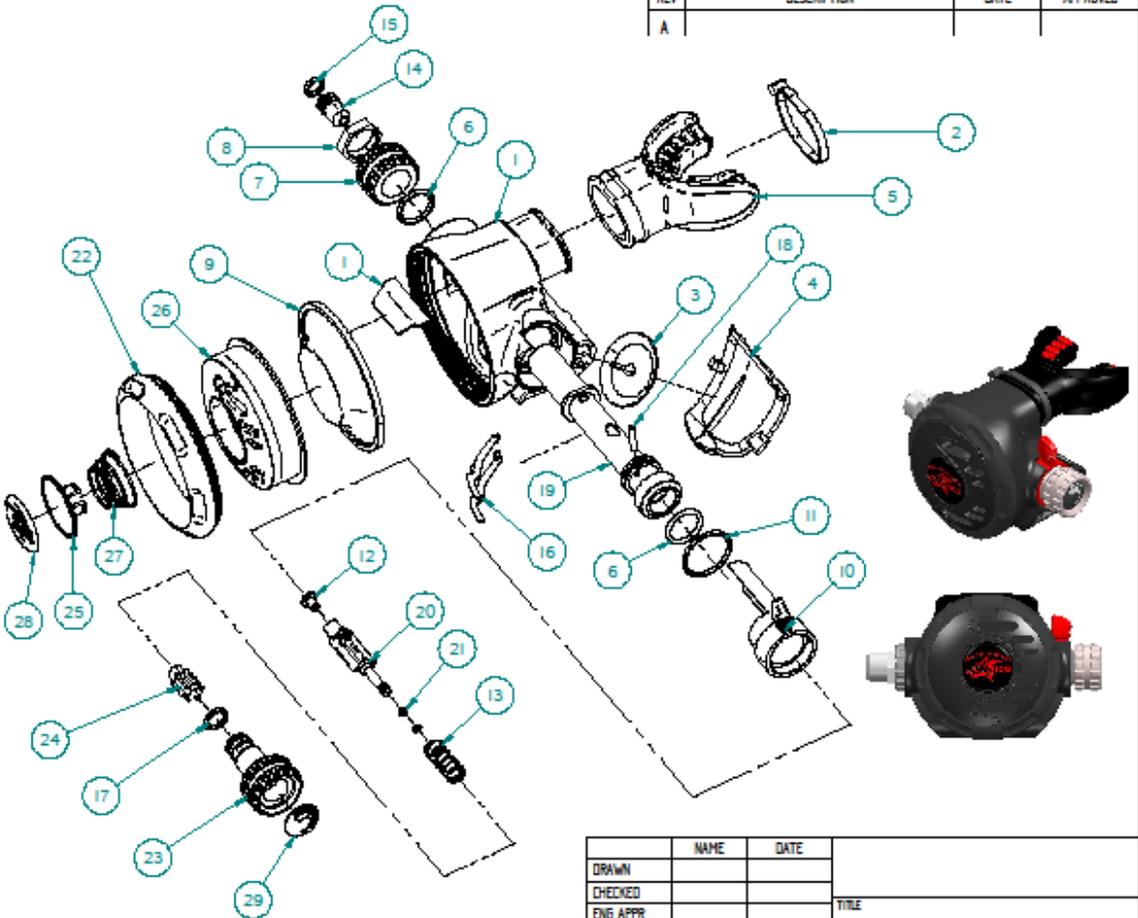
Student Signature: \_\_\_\_\_ Date: \_\_\_\_\_



## Schematic – D1 Second Stage

RO11-HOG VERSION-ADJUSTABLE			
NO	ITEM NO	DESCRIPTION	QTY
1	A-02-011-03	MAIN HOUSING	1
	A-02-011-02	DEFLECTOR PAD	1
2	A-02-010-12-BK	NYLON TIE	1
3	A-02-010-02-RD	EXHAUST VALVE	1
4	A-02-011-04	EXHAUST COVER	1
5	Z-10-00005-05-BK-RD	MOUTHPIECE-PS-RED	1
6	O-AS568-015-01	O-RING	2
7	C-02-011-13-PT	BRASS HEAT SINK	1
8	C-02-012-02-PT	NUT	1
9	B-02-011-01-RD	DIAPHRAGM	1
10	A-02-011-07-RD	DEFLECTOR KNOB-RED	1
11	O-AS568-019-01	O-RING	1
12	A-02-011-08	LP SEAT	1
13	D-02-011-01	MAIN SPRING	1
14	C-02-011-03	ORIFICE	1
15	O-AS568-010-01	O-RING	1
16	S-02-011-01	LEVER ARM	1
17	O-AS568-011-01	O-RING	1
18	C-02-011-05	ADJUSTABLE KNOB PIN	1
19	C-02-011-04-PT	ADJUST TUBE	1
20	A-02-012-06	PISTON	1
21	O-EKM-2MX1M-05	O-RING	2
22	C-02-011-14-01	ALUMINUM RING	1
23	C-02-011-30-PT	ALL BRASS ADJ. KNOB	1
24	A-02-012-09	BLANCE CYLINDER	1
25	A-02-011-17-BK	PURGE BUTTON	1
26	A-02-011-30-BK	SOILD COVER	1
27	D-02-003-02	PURGE SPRING	1
28	3Y-04-00036-01	HOG DECAL	1
29	3Y-04-00024-01	DECAL	1
30			

REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED
A			



	NAME	DATE			
DRAWN					
CHECKED					
ENG APPR					
MGR APPR					
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS ANGLES ±XX°			SIZE A3	DWG NO	REV A
2 PL ±XXX 3 PL ±XXXX			SCALE:	WEIGHT:	SHEET 1 OF 1