

Switchover Open Circuit Regulator Assembly (P/Ns 805-001 & 805-050) Maintenance Manual

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1.1 General Information

The Kirby Morgan Switchover Open Circuit Regulator Assembly, P/N 805-050 and our non-magnetic version P/N 805-001, is a high performance scuba regulator designed for professional divers. The regulator is a modified version of the balanced 455 regulator.

The switchover regulator is designed for use ONLY with our rebreather pod. It offers a wide range of adjustment that allows the diver to compensate for variations in workloads, as well as physical attitude and current.

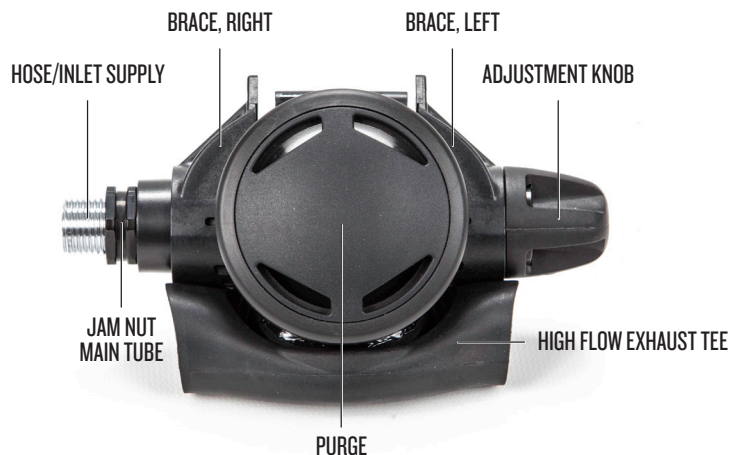
The regulator bias adjustment gives the diver the ability to fine tune the demand valve at any time prior to, or during the dive. The bias adjustment simply increases or decreases spring tension on the inlet valve assembly. The knob has approximately 4 ¼ turns from full in to full out position with a supply pressure of 135–150 PSIG. This bias device is not intended as a minimum or maximum device. The bias adjustment should be adjusted by

the diver so that it is at the easiest breathing for existing conditions.



NOTE

Diving with a bias setting higher than necessary will result in increased inhalation effort and could cause the diver to become exhausted. Diving with the bias adjusted so the regulator freeflows greatly increases air usage.



This manual is primarily to provide factory trained repair technicians the information needed to perform adjustments and corrective maintenance. We strongly recommend that service be done by Kirby Morgan trained/authorized technicians.

Those who elect to work on their own regulators should have the proper tools, training and experience in regulator designs and repair. A sound technical background associated with diver life support breathing components is also recommended. All repair parts should be genuine Kirby Morgan parts and should only be obtained from authorized Kirby Morgan dealers. All authorized Kirby Morgan dealers will be found on our website www.kirbymorgan.com under "Support."

1.1.1 Non-Magnetic Conformity

In addition to our standard assembly, we manufacture an assembly with non-magnetic designation.

- P/N 805-001 Switchover Regulator, Non-Magnetic

Refer to the corresponding blowpart drawings at the end of this module for part numbers specific to the non mag components used in the above assemblies.



NOTE

The label, "Non-Magnetic," found on components used in the assemblies above is based on tests performed at initial production startup of the products and NOT based on any ongoing testing.

If products with a non-mag designation are to be used where the equipment needs a low, or non-magnetic signature, **IT IS THE RESPONSIBILITY OF THE END USER** to apply any specialized testing, to determine if the equipment will pass any needed, low or non-magnetic requirements.

1.1.1.1 Maintaining and Repairing Non-Magnetic Designated Assemblies

The use of non-magnetic hand tools is crucial in keeping complete assemblies and associated components to a non-magnetic signature. Non magnetic tools are made of materials that do not contain iron (non-ferrous metals) and therefore the risk of a magnetism being created while the tool is in use is reduced. It is critical to understand that simply tightening a screw with the incorrect screwdriver can cause magnetism in the Non-Mag Switchover Regulator.

1.1.2 Use of Kirby Morgan Original Replacement Parts

Users of Kirby Morgan life support equipment are cautioned to always use Kirby Morgan original replacement parts. Parts manufactured by third party companies can cause improper function, leading to accidents.



Look for the Kirby Morgan logo on Kirby Morgan products. This is your assurance that you are getting genuine Kirby Morgan replacement parts.

1.1.3 Specifications

Second Stage Type: Downstream, balanced bias adjustable.

Second Stage Body: Glass fiber reinforced nylon

Other misc. parts: ABS + PC, PPO + GF, PPS, ABS, Titanium, POM, Nylon, polyurethane, 300 series stainless steel, liquid silicone, PP, Buna N and for military use (non/low magnetic) Inconel®.

Optimum intermediate working pressure: 140 PSI ± 15 PSI

1.2 Safety Precautions

Routine maintenance is the best way to ensure long regulator life and optimum performance.

NOTE: If possible, rinse while pressurized and attached to a tank. This will aid in preventing water from getting into the inlet valve. Purging the regulator after rinsing will aid in drying. Purging

the regulator may cause free flow. This is easily stopped by slightly blocking the main outlet port.

1. At a minimum, the regulator should be thoroughly rinsed with fresh clean water after every dive. Install blue cap with O-ring onto hose end of the regulator. Mild liquid dish soap can be used to remove grime. Avoid harsh cleaners.



2. If possible, the entire regulator should be soaked in fresh warm water, between 80-120 °F (26-49 °C), for 15 minutes or longer. Soaking in warm water will remove salt and mineral deposits more effectively than a fresh water rinse alone.

3. Allow the regulator to dry completely before storage. Do not leave the regulator sitting in direct sunlight. Shake the second stage to help remove water trapped inside.

⚠ CAUTION

During soaking do not depress the purge button on the second stage. Pressing the purge button can allow water to enter the inlet valve and possibly go into the critical balancing chamber. Water inside the balancing chamber will lead to improper regulator function, which could result in personal injury.

4. Turn the second stage regulator adjustment knob all the way out, away from the second stage body. This will help lengthen the life of the regulator seat.

5. Ensure the regulator is completely dry before storing. Store only in a clean, cool, dry place.

⚠ CAUTION

Never store the regulator while still connected to a SCUBA cylinder. Improper care or storage of underwater breathing equipment may lead to equipment malfunction, which could result in personal injury.

⚠ WARNING

DO NOT use cleaning solvents on any parts or components of this regulator. The use of solvents may lead to failure of the regulator parts and regulator malfunction, which could cause serious injury or death.

⚠ CAUTION

NEVER pressurize the first stage regulator without having a second stage attached. This can lead to a sudden burst of high pressure air, causing the hose(s) to whip about, which could cause personal injury.

1.2.1 Soft Good Kits

Always refer to M-48 appendices for scheduled maintenance. These can be located at the back of the user guides as well as under the support tab at KMDSI.com. While all individual parts in the rebreather POD and switchover regulator assemblies can be ordered separately, KMDSI has also created kits to be used for periodic, annual and when required service.

Guidelines

O-rings should be lightly lubricated with **oxygen compatible NON SILICONE lubricant ONLY**, for example, Christo-Lube®, Tribolube® or equivalent in accordance with the operations and maintenance manual. **NEVER USE SILICONE based lubricants.**

At a minimum all O-rings found in the switchover Open Circuit Regulator should be replaced at least once a year. Components might require replacement more often than yearly if the assembly use is extreme, or if used in waters containing oil or chemical contamination. Daily cleaning and inspections as well as performing the monthly inspection will identify the need more accurately than simply placing a number of hours between overhaul. Store spare O-rings, valves and soft goods in a cool, dark, dry place. Avoid prolonged exposure to temperatures above 90 °F (32 °C) and/or exposure to ultra violet rays. Do not lubricate exhaust valves. Lubricating valves can cause dirt to stick, allowing leakage.

⚠ WARNING

If the products to be used where the equipment needs to have a low, or non magnetic signature, IT IS THE RESPONSIBILITY OF THE END USER to apply any specialized testing, to determine if the equipment will pass any needed, low or non magnetic requirements.

The following is the overhaul kit available for the Switchover Regulator:

- Part #825-010, Rebreather POD Regulator Overhaul Kit

1.3 Scheduled Maintenance

Do not assume that a regulator is in good working order because of infrequent use. Prolonged or improper storage can still result in O-ring deterioration or internal corrosion that could result in poor performance.

1) The minimum maintenance suggested for all regulators is an annual inspection and service. However, regulators that are used frequently or under severely harsh environmental conditions should be serviced more often.

For example, a regulator used for frequent training purposes may require service every two to three months or more. Whenever a regulator has been inactive for longer than three months, it should be carefully inspected and checked for proper function prior to use.

1.4 Disassembly Procedures

1.4.1 General Information

Changes in regulator performance will be most noticeable when the second stage is out of adjustment or needs service. Careful set-up and adjustment of the second stage is essential to maximize the full performance potential.

Tools Required

- $\frac{3}{4}$ " , $\frac{13}{16}$ " Open Ended Wrench
- #3 Phillips Screwdriver
- Flat Blade Screwdriver
- USE ONLY oxygen compatible NON

SILICONE lubricant. For example, Christo-Lube® or Tribolube®

- Wooden Chop Stick or Wooden Dowel
- Pencil with an Eraser End

1.4.2 Switchover Regulator Disassembly Procedure

It is assumed that the LP supply is disconnected.

1. Remove exhaust whisker by pulling whisker away from regulator body
2. Remove the right brace.



3. Unscrew the cover ring with diaphragm cover from the regulator.

4. Remove the diaphragm.



5. Use a #3 Phillips screwdriver to unscrew the adjustment knob screw two complete rotations.

6. Use the #3 Phillips screwdriver and push down directly on the screw head to separate the two knob halves.



9. Carefully twist back and forth until lock clip moves up and out of its locating slot in packing nut assembly.



7. Remove the left brace.

10. Using a 13/16" open end wrench to break loose the packing nut assembly.

11. Remove packing nut by rotating counter clockwise.



8. Using flat-blade screwdriver, insert tip into small slot located near top of lock clip.

12. Remove the O-ring found on the outside of the packing nut.

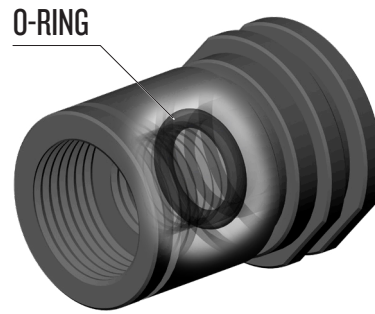


13. Turn the slot shaft into packing nut clockwise until free of packing nut.



Remove internal O-ring only if performing a complete overhaul.

14. **ONLY if performing a complete overhaul:** Using an O-ring pic, carefully remove the adjustment shaft O-ring from the packing nut and discard the O-ring.



15. Tilt regulator body so the hose/inlet side is pointing up. Collect balance spacer and spring. This may require light tapping of regulator body in palm of hand.



16. Remove O-ring on balance spacer. (Discard if performing a yearly overhaul)



17. Using $\frac{3}{4}$ " open end wrench remove the jam nut.



18. While lifting up on the lever arm press inward on the main tube so that the main tube moves slightly into the regulator body.



This causes lever arm to slide away from interior wall of regulator body, allowing for its removal.

19. Carefully lift out and remove one leg of the lever arm from its hole in the main tube, while start-

ing to pull the second leg out. This will make removal easier



20. Pull second leg out and free from hole, then remove entire lever arm from the main tube.

21. Tip regulator body so the inlet/hose side is up and adjustment side is pointing down and collect the inlet valve assembly.

22. Remove soft seat from inlet valve (discard if performing a complete overhaul).

23. Push the main tube towards the adjustment knob side of the regulator and slide it free from the regulator body.



24. Note position of bearing clip as reference for correct reinstallation. Remove bearing clip from main tube.



25. Remove O-ring from main tube (discard if performing a complete overhaul).



27. Remove the O-ring from the nipple.



26. Using a flat blade screwdriver, loosen the inlet nipple counter clockwise, enough so that it can be pushed out of the main tube using a wooden dowel, chop stick or sharpened end of a pencil. These items will prevent damage to the sealing edge of the nipple.



28. Carefully inspect exhaust valve to ensure that silicone is soft and properly seals against mating surfaces. Remove exhaust valve from regulator body.



If the valve is discolored, brittle or warped, replace valve.

29. Carefully inspect regulator body for damaged threads, or integrity damage.

**NOTE**

Earlier versions of the switchover open circuit regulator used a specially formulated adhesive to secure the exhaust flange to the regular body. If using this earlier version, be aware small surface cracks might appear in the adhesive material, but have no effect on the integrity of the bond. Current regulator bodies (post 2018) are molded as one piece components

Pay close attention to joints between exhaust and mounting adapters for damage or large cracks.

1.5 Assemble Switchover Regulator

Reference exploded drawing for each procedure. Clean and inspect all parts. Replace all O-rings and any other parts that show signs of wear or damage.

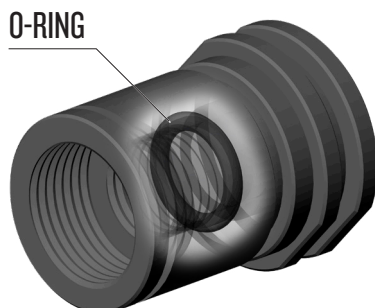
Tools Required

- $\frac{3}{4}$ ", $1\frac{3}{16}$ " Open Ended Wrench
- #3 Philips Screwdriver
- Flat Blade Screwdriver
- USE ONLY oxygen compatible NON SILICONE lubricant. For example, Christo-Lube® or Tribolube®.

1. Insert exhaust valve into regulator body. Ensure valve is installed correctly by applying slight pressure with your fingers.

1.5.1 Packing Nut Reassembly

1. Install O-ring onto packing nut.
2. Install O-ring into packing nut.



3. Apply a liberal amount of Christo-Lube® or equivalent non-silicone lubricant to the threads of the slot shaft.



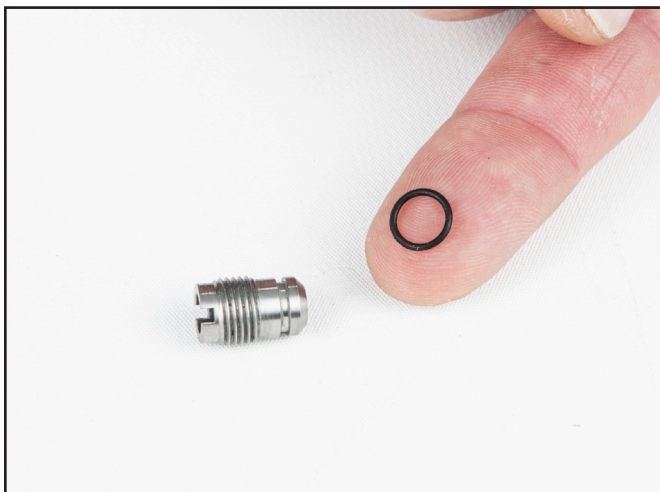
4. Insert slot shaft into the larger opening of the packing nut until resistance is felt.



5. Grab the slotted end of the slot shaft and turn the packing nut COUNTERCLOCKWISE to engage slot shaft threads into packing nut. Continue turning until the slot shaft stops. Set parts aside.

1.5.2 Adjustment Nipple Reassembly

1. Carefully inspect the sealing edge of the adjustable nipple using either a magnifying glass or using a fingernail against the edge while rotating the part to check for nicks or cuts.
2. VERY lightly lubricate the O-ring and install onto the adjustable nipple.



3. Lightly lubricate adjustable nipple threads and insert into the main tube. Use a flat blade screwdriver and rotate clockwise two full rotations **MAXIMUM**.

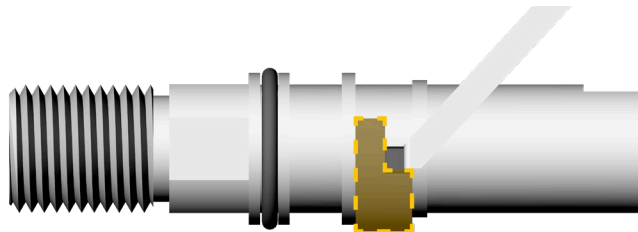
**NOTE**

If the nipple is threaded in too far, it could possibly damage the inlet valve seat when the inlet valve is installed.

4. Lightly lubricate and install O-ring onto the main tube end.

1.5.3 Main Tube Reassembly - Read this entire procedure step by step prior to reassembly and installation

1. Install bearing clip onto main tube. Use guide hole and the following photo for correct orientation.



2. Insert main tube into regulator body, long threads first and stop the travel of the main tube once the bearing clip is in the center of the regulator body.

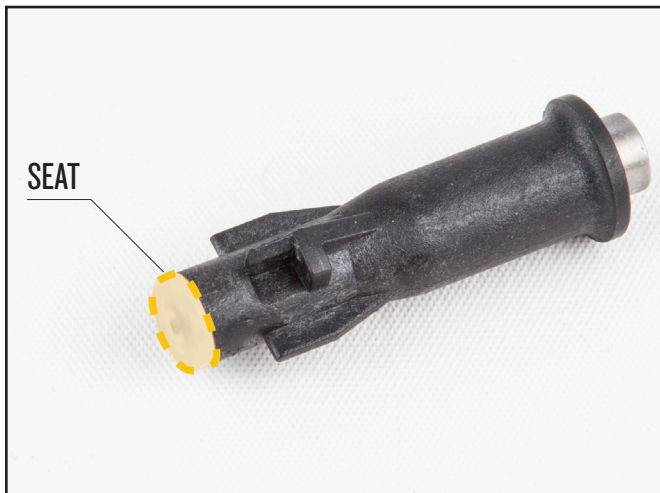


3. Install lever arm allowing it to snap into square holes on either side of main tube. With one hand on the adjustment side of the main tube, rotate main tube to assist in installation and locating each hole for the lever arm.

4. Once the lever arm is in place, using two fingers, press against the lever arm to ensure arms have not been bent outward during installation.



5. Install or inspect soft seat on inlet valve.



If installing a new seat

Check the balance hole in the seat to be sure it has no flash or is plugged in any way. Press the seat into the inlet valve. **DO NOT LUBRICATE THE SEAT.** Make certain there is NO space between these two parts. The seat must be pressed all the way into the inlet valve.



Study the features of the inlet valve assembly. There are four “wings” towards one end of the assembly and a bore that creates the balance chamber on the opposite end.

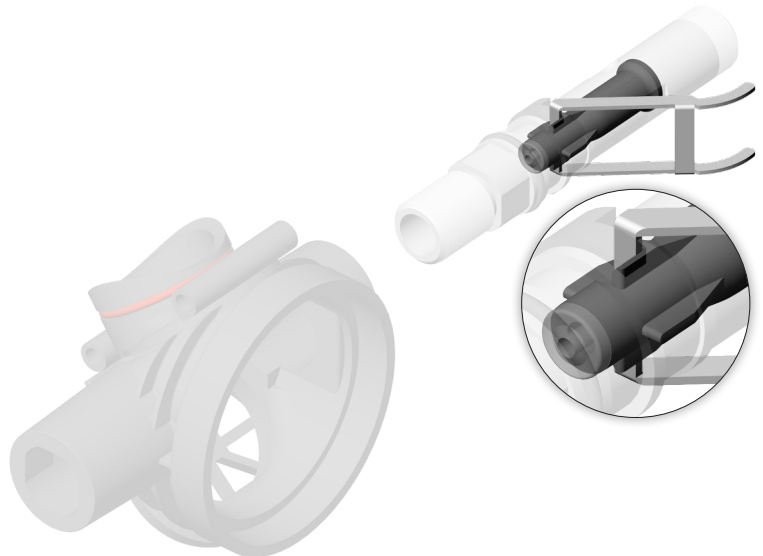
The wings that align with the lever arm are the two that have an additional wall for the lever arm to bear on. The valve assembly should be inserted into the main tube with these walls toward the bottom of the regulator tube.

6. Insert the inlet valve, soft seat first, into the main tube so the inlet valve wings will catch the correct position of the lever arm as noted above.

Testing correct inlet valve installation:

Using the balance spacer with the O-ring and spring installed, place into main tube, adjustment side.

If this is done properly, the lever should lift up once the spacer makes contact with the inlet valve. If it does not, the inlet valve has not been inserted correctly and the wings are not capturing the lever arm properly.



7. With the main tube still positioned in the center of the regulator body, use the eraser side of a pencil to gently and steadily push onto the inlet valve from the adjustment knob side of the main tube.



The lever arm should rise up toward diaphragm area with this increasing pressure.

8. **IMMEDIATELY STOP PUSHING** when engagement of the inlet valve wings and lever arm is felt. Remove pencil and once again use fingers to press

inward on lever arm legs into the main tube. Repeat step 6 to confirm correct lever action.

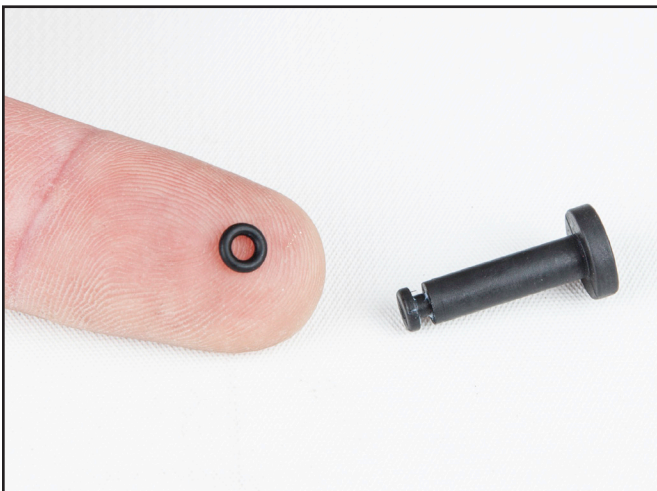
9. Slightly tilt regulator body with the adjustment knob side down, supply hose/ inlet side up. Inlet valve should remain in the main tube. If not, repeat steps 3 to 7.

10. Push/pull on the main tube to locate main tube to correct position (lever arm should be in the middle of the regulator body).

11. Install jam nut, main tube and tighten to 12 inch pounds.



12. Apply a slight amount of non-silicone lubricate where the O-ring resides on the balance spacer and insert spring onto spacer.



13. Insert the balance spacer and spring as one unit into main tube. Repeatedly gently push onto spacer to confirm lever arm moves up and down in conjunction with applied pressure.

14. Thread the packing nut onto the main until it stops.

15. Check operation of lever arm to ensure proper function (i.e. that it springs back up to raised position when depressed with thumb and released).

16. Tighten packing nut to 20 inch pounds using a torque wrench.

17. Press lock clip into groove in packing nut keeping top edge parallel with diaphragm area. Resistance should be felt when installing this clip from being formed, to provide a locking or jamming feature. If no resistance is felt, it could mean the part has lost its spring and should be replaced. Make sure clip is pressed completely into groove.

18. Turn adjustment nipple clockwise until lever arm drops just slightly.

1.5.4 Diaphragm and Adjustment Knob Reassembly

1. Install diaphragm, cover and cover ring. There should be no gap between cover ring and top of regulator body when installed correctly.



2. Turn slot shaft in (clockwise) toward regulator body until inner edge of slot just meets the packing nut.



3. Install left brace on the adjustment side of the regulator body.

4. Install male and female knob halves onto the slot shaft. Added pressure will be required to mate the two halves.



5. Install adjustment knob screw and tighten until snug. There should be no gap between knob halves.

6. Install right brace onto the inlet side of the regulator body.



7. Install exhaust whisker firmly in place, making sure orientation of outlet ports is correct, as shown.



1.5.5 Adjusting the Regulator

If cover and diaphragm have not been removed, do so prior to proceeding.

1. Turn adjustment knob of regulator in until it stops, then turn it back out three full turns.
2. Secure a regulated low pressure air supply of 135-150 psig to the switchover regulator.
3. Slowly turn on the air supply and check lever arm play. With the adjustment knob adjusted out three full turns, and gas pressure of 135-150 psig to the inlet valve, there should be $\frac{1}{8}$ inch of free play in the lever and no gas flow.
4. Depress several times, ensure a good flow and ensure the lever play does not change.

Criteria for optimal setting no more than $\frac{1}{8}$ inch of free play in the lever until gas is heard escaping from main tube. If criteria are met no adjustment is necessary.

1.5.5.1 If Adjustment is Necessary

There should be $\frac{1}{8}$ - $\frac{1}{4}$ inch free travel in the cover before gas flow starts. When the cover is fully depressed, a strong surge of gas must be heard.

If the purge cover has NO play, or play is greater than $\frac{1}{4}$ inch BEFORE GAS flow is heard, the demand regulator requires internal adjustment.



Adjustments need to be done with the adjustment knob out three full turns.

Evaluation of lever play can only happen with supply gas connected to the regulator and turned on. Adjustment knob needs to be turned out three full turns.

1. Turn off the gas supply; bleed off the pressure.
2. Remove the supply hose to expose the slotted end of the adjustment nipple.
3. Insert a flat head screwdriver into the slot end of the adjustment nipple
4. Make adjustments as necessary.

Whatever direction is needed, make the adjustment in very small increments and recheck after each adjustment. Usually $\frac{1}{8}$ " turn at a time or less will suffice.



Decrease lever play by turning nipple out (counter clockwise) of the main tube.

Increase lever play by turning the nipple in (clockwise) to the main tube.

If any problems are encountered that are not easily fixed it is recommended to perform a complete disassemble. Perform a meticulous inspection of the nipple's knife edge. If damage is found replace and reassemble.

1.6 Germicidal Cleaning Solutions

1. SaniZide Plus: P/N: 34805 (spray) or 34810 (gallon), Ready to use; do not dilute.

SAFETEC of America, Inc
1055 E. Delavan Ave.
Buffalo, NY 14215 USA
1-800-456-7077
www.safetec.com

2. MSA Confidence Plus: P/N 10009971 (32 ounces) Mix one ounce of concentrate with one gallon of fresh water.

3. Steramine™: Steramine Quaternary Sanitizing Tablets - 150 Sanitizer Tablets per bottle 1 Tablet per gallon of water - Makes 150 gallons of cleaning solution

<http://steramine.com>

CAUTION

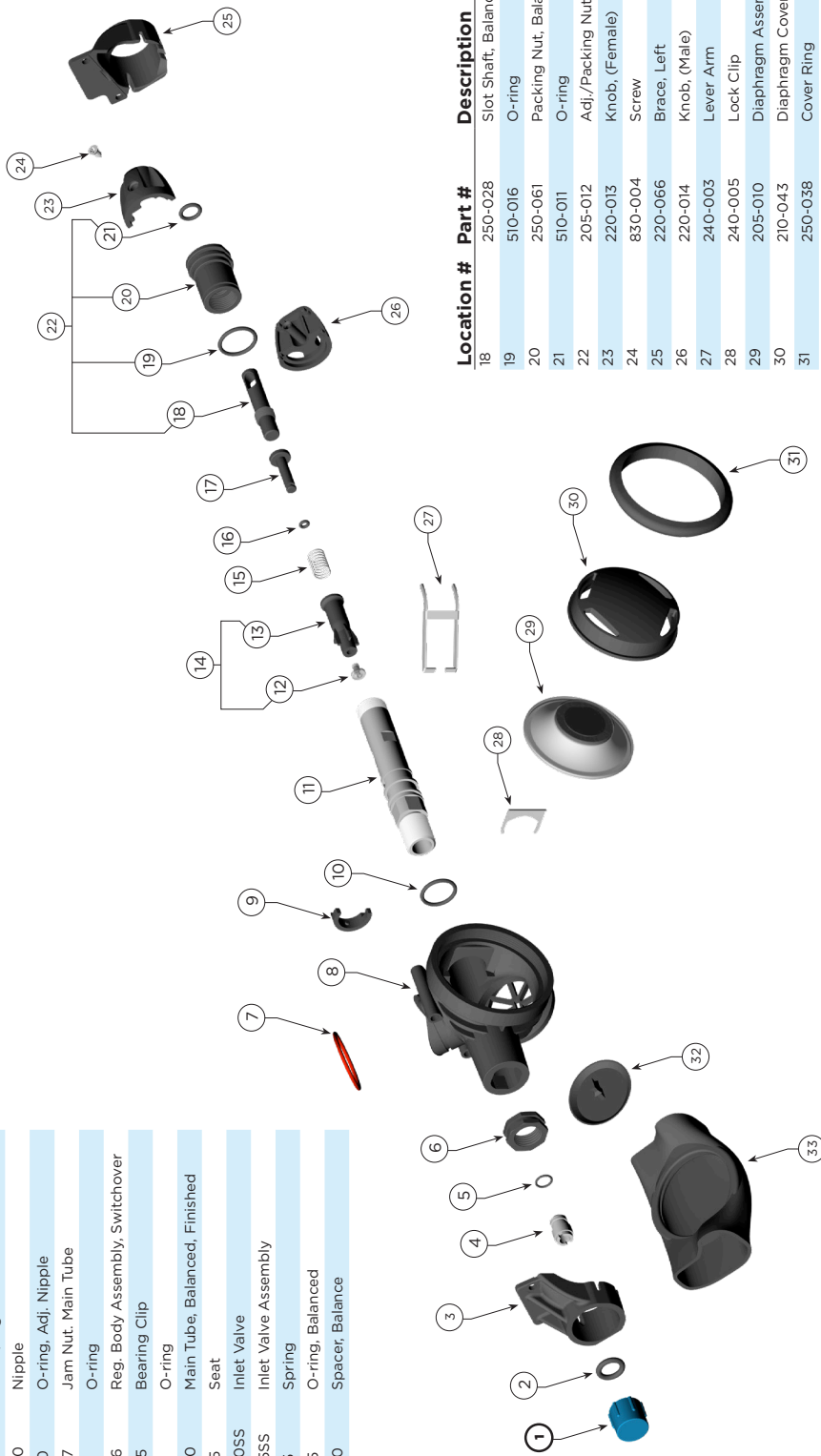
Failure to thoroughly rinse germicidal cleansing solution from the diving equipment may result in lung irritation and/or long-term degradation of rubber and silicone components.

1.7 Torque Specifications for the Switchover Open Circuit Regulator Assembly

Loc. #	Part #	Description	Torque in Inch Pounds	Torque in Newton Meters
6	250-057	Jam Nut, Main Tube	12	1.3
20	250-061	Packing Nut, Balanced Regulator	20	2.25
24	830-004	Screw	4	0.5

P/N 805-050 Regulator Assembly

Location #	Part #	Description
1	220-078	Cap, Threaded, Hose Inlet
2	410-151	O-ring
3	220-067	Brace, Right
4	250-060	Nipple
5	210-050	O-ring, Adj. Nipple
6	250-057	Jam Nut, Main Tube
7	810-124	O-ring
8	205-026	Reg. Body Assembly, Switchover
9	220-055	Bearing Clip
10	510-015	O-ring
11	250-050	Main Tube, Balanced, Finished
12	210-045	Seat
13	220-050SS	Inlet Valve
14	205-015SS	Inlet Valve Assembly
15	235-015	Spring
16	210-055	O-ring, Balanced
17	220-030	Spacer, Balance



Location #	Part #	Description
18	250-028	Slot Shaft, Balanced
19	510-016	O-ring
20	250-061	Packing Nut, Balanced Reg.
21	510-011	O-ring
22	205-012	Adj./Packing Nut Assy.
23	220-013	Knob, (Female)
24	830-004	Screw
25	220-066	Brace, Left
26	220-014	Knob, (Male)
27	240-003	Lever Arm
28	240-005	Lock Clip
29	205-010	Diaphragm Assembly
30	210-043	Diaphragm Cover
31	250-038	Cover Ring
32	810-136	Exhaust Valve
33	810-139	Hi Flow Exhaust Tee

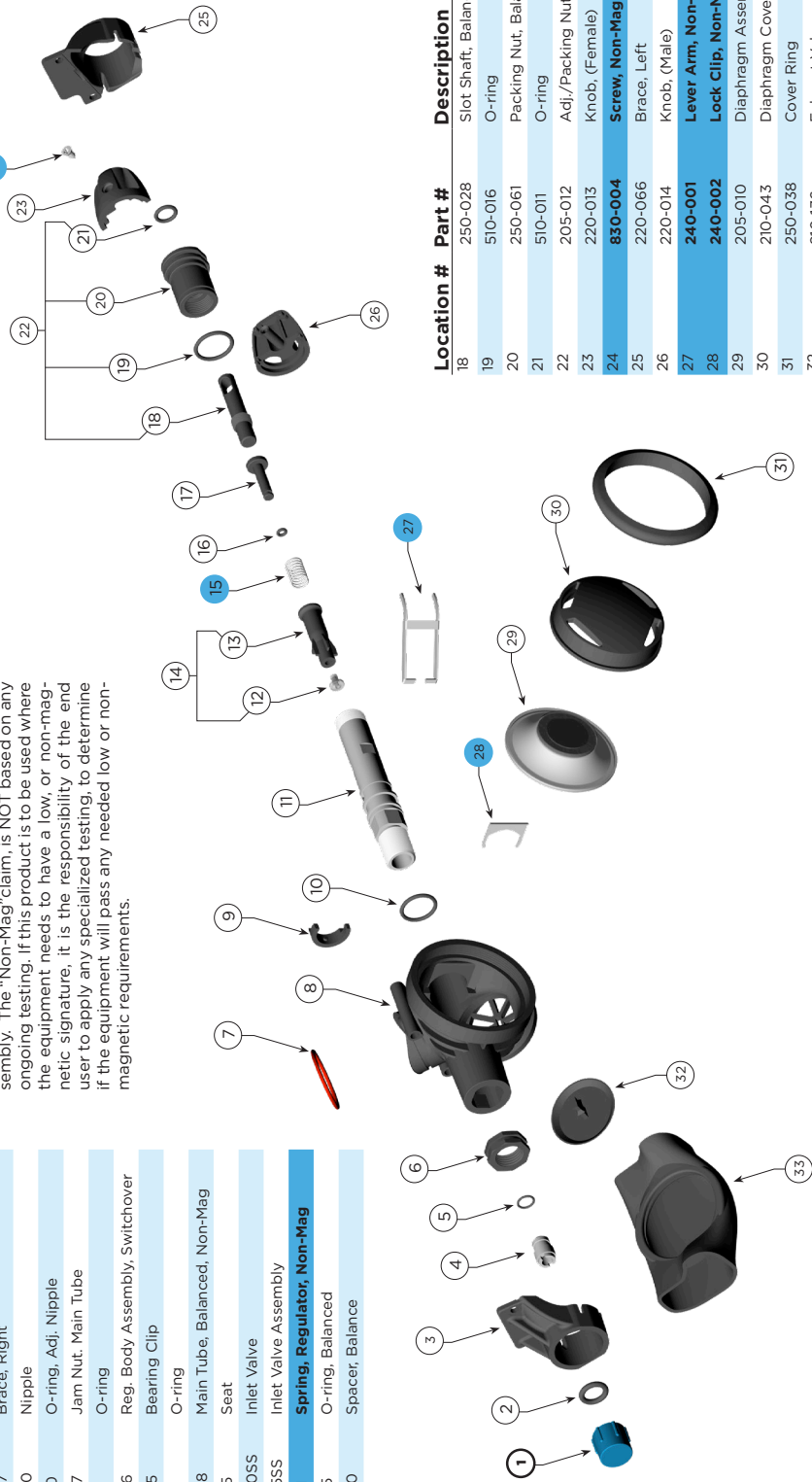
P/N 805-001 Regulator Assembly (Non-Magnetic)

Location #	Part #	Description
1	220-078	Cap, Threaded, Hose Inlet
2	410-151	O-ring
3	220-067	Brace, Right
4	250-060	Nipple
5	210-050	O-ring, Adj. Nipple
6	250-057	Jam Nut, Main Tube
7	810-124	O-ring
8	205-026	Reg. Body Assembly, Switchover
9	220-055	Bearing Clip
10	510-015	O-ring
11	250-048	Main Tube, Balanced, Non-Mag
12	210-045	Seat
13	220-050SS	Inlet Valve
14	205-015SS	Inlet Valve Assembly
15	835-011	Spring, Regulator, Non-Mag
16	210-055	O-ring, Balanced
17	220-030	Spacer, Balance

ALL components used in this assembly have a LOW or non magnetic signature.

 Denotes components with Non-Mag in its description.

NOTE: Although some components herein are labeled, "Non-Mag", this claim is based on tests performed at initial production startup of this assembly. The "Non-Mag" claim, is NOT based on any ongoing testing. If this product is to be used where the equipment needs to have a low, or non-magnetic signature, it is the responsibility of the end user to apply any specialized testing, to determine if the equipment will pass any needed low or non-magnetic requirements.



Location #	Part #	Description
18	250-028	Slot Shaft, Balanced
19	510-016	O-ring
20	250-061	Packing Nut, Balanced Reg.
21	510-011	O-ring
22	205-012	Adj./Packing Nut Assy.
23	220-013	Knob, (Female)
24	830-004	Screw, Non-Mag
25	220-066	Brace, Left
26	220-014	Knob, (Male)
27	240-001	Lever Arm, Non-Mag
28	240-002	Lock Clip, Non-Mag
29	205-010	Diaphragm Assembly
30	210-043	Diaphragm Cover
31	250-038	Cover Ring
32	810-136	Exhaust Valve
33	810-139	HI Flow Exhaust Tee