AQUA LUNG®

Authorized Dealer

SERVICE & REPAIR MANUAL



Titan

First Stage Regulator

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Doc. No. 7803-01

Table of Contents

Introduction 3

Warnings, Cautions, & Notes 3
Scheduled Service 3
General Guidelines 3

Initial Inspection Procedure 4

External Inspection 4
Immersion/ Leak Test 4
Intermediate Pressure Test 5

Disassembly Procedures 6

Reassembly Procedures 10

Final Adjustment and Testing Procedures 14

Table 1 – Troubleshooting Guide 16

Table 2 – Recommended Tool List 17

Table 3 – Standard Parts Replacement Schedule – Titan First Stage 18

Table 4 – Torque Specifications 18

Table 5 – Test Bench Specifications 19

Procedure A – Cleaning & Lubrication 20

Table A – Recommended Lubricants & Cleaners 21

Schematic Drawing 22

Doc. #7803-01

AQUA LUNG

Service & Repair Manual - Titan First Stage Regulator

Introduction

This manual provides factory prescribed procedures for the service and repair of the Titan first stage regulator. 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 received factory authorized training through an Aqua Lung Service & Repair Seminar.

If you do not completely understand all of the procedures outlined in this manual, contact Aqua Lung to speak directly with a Technical Advisor before proceeding any further.

Warnings, Cautions, & Notes

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

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

A **CAUTION** 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.

A **NOTE** is used to emphasize important points, tips, and reminders.

Scheduled Service

Regulators should be given the same care and maintenance as life support equipment. It is therefore important to perform scheduled overhaul service for the Titan, complete with second stages, according to the procedures outlined in this manual; at least once a year with normal or infrequent use.

NOTE: A unit that receives heavy or frequent use, such as in rental, instruction, or commercial applications, should be serviced at least twice each year - or more often - depending on the conditions of use and the manner in which it is maintained. (Refer to the care and maintenance procedures outlined in the Regulator Owner's Manual.)

GENERAL GUIDELINES

1. In order to correctly perform the procedures outlined in this manual, it is important to follow each step exactly in the order given. Read over the entire manual to become familiar with all procedures before attempting to disassemble or service the Titan first stage, 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.
2. 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 maintaining a professional repair facility.
3. Before beginning any disassembly, it is important to first perform the Initial Inspection procedure, and refer to Table 1 - Troubleshooting to determine the possible cause of any symptoms which may be present.
4. As each individual regulator is disassembled, reusable components should be segregated to prevent them from mixing with non-reusable parts or parts from other regulators. Delicate parts, and those which contain critical sealing surfaces, must be protected and isolated from other parts to prevent damage during the cleaning procedure.
5. Use only genuine Aqua Lung parts purchased directly from Aqua Lung when servicing any Aqua Lung product. Substitution with another manufacturer's parts constitutes an after-market modification of the product, and renders the original warranty null and void.
6. 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.
7. When reassembling, it is important to follow every torque specification prescribed in this manual, using a quality torque wrench. Most parts are made of either marine brass or plastic, and can be permanently damaged by undue stress caused by overtightening.

Initial Inspection Procedure

EXTERNAL INSPECTION

1. Visually inspect the sintered filter to check for any signs that contaminants may have entered the system, such as moisture, rust, aluminum oxide, or charcoal.

NOTE: A green discoloration positively indicates that moisture has entered the regulator, and internal corrosion is therefore likely to be found in the first stage. A white or rust colored residue usually indicates that the regulator has been used with a corroded aluminum or steel cylinder. Advise the customer of the proper methods for maintaining the regulator, and the possible need to obtain service for their cylinder.

2. Slide back the hose protector(s) to inspect the condition of the LP hose at its fittings and along its length. Check closely for any signs of blistering or abrasion, or corrosion of the fittings.
3. Closely examine the finish of the first stage to check for any scratches, dents, or other signs of damage to the plated finish.

CAUTION: Do not clean any parts which show damage to their plated finish inside an ultrasonic cleaner. Ultrasonic vibration may cause further damage to the finish.

4. Closely examine all other parts of the first stage for any other signs of external damage or corrosion.
5. If present, examine the external diaphragm of the DRY environmental protection kit to determine whether moisture has entered the sealed chamber above the main diaphramg.

IMMERSION/ LEAK TEST

1. While the regulator is fully assembled and connected to a second stage, connect the first stage to a cylinder that is filled with 3,000 psi. Check to ensure there are no open ports or hoses, and slowly open the cylinder valve to pressurize the regulator. If obvious leakage occurs, including freeflow from the second stage, shut off the air supply and proceed directly to the section titled, Disassembly Procedures.
2. If leakage cannot be heard, or if the source of leakage detected audibly is not obvious, immerse the entire system in fresh water and observe closely for up to one minute to check for the formation of bubbles. Pay particularily close attention to the area of the spring retainer, and to all hoses along their length and at their fittings on both ends.
4. Locate the source of any leakage found and refer to Table 1 – Troubleshooting to determine its possible cause.
5. Turn the cylinder valve shut and depress the second stage purge button to depressurize the regulator before performing the next procedure.

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INTERMEDIATE (OVER-BOTTOM) PRESSURE TEST

1. Depress the second stage purge button once again to ensure that the system is not pressurized. Connect the intermediate pressure test gauge either to a quick-disconnect inflator hose, or to the female fitting of a second stage IP hose, depending on the connector of the test gauge.

NOTE: Whenever possible, Aqua Lung strongly recommends that a fully assembled and properly adjusted second stage should be connected to the first stage before pressurizing to test intermediate pressure. This will provide a safety relief valve in the event that the intermediate pressure exceeds 155-170 psi.

CAUTION: If a second stage is not connected to the first stage, turn the bleed valve knob of the test gauge counterclockwise to ensure that it is open before pressurizing. Failure to relieve intermediate pressure in excess of 400 psi may result in damage to the test gauge or rupture of the IP hose.

2. Slowly open the valve of the supply cylinder only as far as necessary to pressurize the first stage. While closely monitoring the IP test gauge to ensure that the intermediate pressure does not rise above 200 psi, slowly turn the knob of the bleed valve clockwise until it is completely shut.

CAUTION: If a second stage is not connected to the first stage and the intermediate pressure continues to rise above 200 psi, immediately reopen the bleed valve of the test gauge and shut the valve of the supply cylinder. Proceed directly to perform the Disassembly Procedures, outlined in the next section.

3. Note the intermediate (over-bottom) pressure indicated by the test gauge, and briefly purge the second stage or open and shut the bleed valve of the test gauge to ensure that lockup is achieved without “creeping” or fluctuating back and forth.
4. If the intermediate pressure “creeps” up or otherwise fluctuates after cycling the regulator, wait for it to stabilize (if possible) before making a final note of the intermediate pressure.

NOTE: Correct intermediate pressure for the Titan first stage is 135 (±5) psi, with an inlet pressure of 3,000 psi.

5. Turn the cylinder valve shut and depress the second stage purge button to depressurize the system before attempting to perform any disassembly.

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Disassembly Procedures

NOTE: Before performing any disassembly, refer to Table 3, which references all mandatory replacement parts. These parts must be replaced with new, and must never be reused - regardless of the age of the regulator or how much use it has received since it was last serviced.

CAUTION: To prevent damage to critical sealing surfaces, use only a plastic or brass O-ring removal tool (P/N 9440-22) when removing O-rings. Once an O-ring sealing surface has been damaged, the part must be replaced with new in order to prevent the possibility of leakage. DO NOT use a dental pick, or any other type of steel instrument.

1. Before disassembling the first stage, remove the low pressure second stage hoses with a 9/16" open-end wrench, and the low pressure inflator hose with a 9/16" or 1/2" open-end wrench. Remove the high pressure hose with a 5/8" open-end wrench, or the high pressure port plug with a 4mm hex key. Remove and discard the O-rings from the male fittings of each hose.
2. Install a vise mounting tool (P/N 1003-95) or a discharged $C0_2$ cartridge (P/N 7039-09) connected to a HP port adapter (P/N 1020-85) into the HP port of the first stage body(16).

WARNING: DO NOT use a $C0_2$ cartridge which has not been discharged. Doing so may cause the cartridge to rupture, possibly resulting in serious personal injury.

3. Secure the vise mounting tool inside a bench vise so that the first stage is positioned standing vertical outside the vice with either the yoke or DIN connector facing straight up.

NOTE: Before proceeding, determine whether the first stage is configured with a DIN or yoke connection, and refer to the appropriate disassembly procedure provided below.

4. **Disassembly of Yoke Connector**
   - A. Remove the yoke screw(1) and untie the dust cap(2) from the yoke(5). Remove and discard the dust cap O-ring(3).
   - B. Apply a 26mm open end wrench to the yoke retainer(4). Using firm, steady force, turn the yoke retainer counter-clockwise to loosen and remove from the inlet boss of the first stage body (see Fig. 1). Lift the yoke retainer and yoke straight off the inlet boss, and set the yoke aside.

CAUTION: It is important that the wrench is securely seated over the entire hex surface of the yoke retainer to prevent any damage to the part. Do not use impact to loosen.

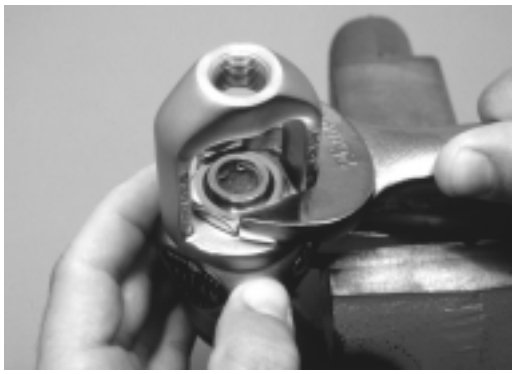


Fig. 1

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Fig. 2



Fig. 3



Fig. 4



Fig. 5

Disassembly of DIN Connector

A. Unscrew the thread protector cap(5a) and remove it from the first stage.

B. Apply a 6mm hex key to the hand wheel retainer(5c), and turn it counter-clockwise to loosen and remove (see Fig. 2). Remove and discard both O-rings(5b&5d).

C. Lift the handwheel(5e) off the DIN adapter(5f), and closely inspect the condition of the threads to ensure it is free of any burrs or other damage that could prevent proper threading. Replace the handwheel if damage is found, or set it aside to be reused.

D. Apply a 26mm open end wrench to the flat sides at the base of the DIN adapter, and turn it counter-clockwise to loosen and remove from the inlet boss of the first stage body (see Fig. 3). Remove and discard the O-ring(5g) from the inlet boss.

5. Loosen the vise to turn the first stage over, and re-secure it so that the first stage stands vertical outside the vice with the spring retainer(26 or 30) and adjustment screw(29) facing straight up.

NOTE: If a "DRY" Environmental Protection Kit has not been installed on the first stage, proceed directly to step 7. If an Environmental Protection Kit has been installed, disassemble according to steps 6a-6c, outlined below:

6a. Mate an environmental diaphragm retainer wrench (P/N 0812-47) into the slots on both sides of the external diaphragm retainer(34). While holding the tool securely in place, turn the diaphragm retainer counter-clockwise to loosen and remove (see Fig. 4).

6b. Remove the external diaphragm(33) from either the diaphragm retainer or the spring retainer(30). Discard the diaphragm, and do not attempt to reuse.

6c. Remove the environmental piston(31), and inspect it closely to check for any signs of stress or other damage. Discard the piston if it is found to be damaged, or set it aside if it is in reusable condition. Replace the decal(32) as needed.

7. Apply a 8mm hex key to the adjustment screw(29), and turn the screw counter-clockwise to loosen and remove from the spring retainer (see Fig. 5).

8. Lift out the washer(28) and spring(27). Examine the spring with the use of a magnifier, checking closely for any signs of pitting, rusting, or other corrosion which permeates the surface of the metal. Set the spring and washer aside if they are found to be in reusable condition, or replace with new as needed.

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CAUTION: If permanent corrosion is found, discard the spring and DO NOT attempt to reuse. A damaged or badly corroded spring may seriously impair first stage performance by failing to provide stable intermediate pressure.

9. Apply a 30mm open end wrench to the spring retainer(26), or use a 34mm open end wrench for the "DRY" version spring retainer(30), and turn the retainer counter-clockwise to loosen and remove from the first stage body.
10. Lift the spring pad(25) and thrust washer(24a) out of the first stage body. Discard the thrust washer and do not reuse.
11. Using a 4mm hex key, install spare LP port plugs(23) into three of the four LP ports, leaving one LP port open while the other ports are sealed.
12. Direct a short burst of low pressure (50 psi) air through the primary LP port to partially dislodge the diaphragm(24b) from the first stage body (see Fig. 6). Lift out the diaphragm and discard. Remove the port plugs that were installed in the previous step.

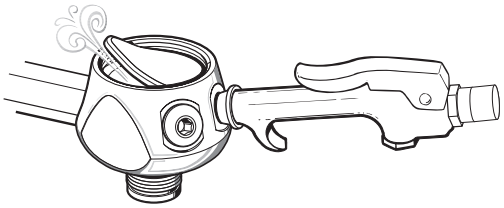


Fig. 6 – Removing diaphragm w/ LP air

CAUTION: DO NOT attempt to pry the diaphragm out of the first stage with a metal instrument. Doing so will permanently damage the seating shoulder in the first stage, requiring replacement of the body.

13. Loosen the vise to remove the first stage, and turn it over to allow the pin support(19) and pin(18) to drop out onto the bench. Remove the vise mounting tool from the HP port, and stand the first stage body on a padded surface so the inlet boss faces upward.
14. Apply a pair of circlip pliers (P/N 1111-00) to the circlip(6) which retains the inlet filter(8). Place a thumb over the circlip and filter to prevent the ejection of spring loaded parts beneath it, and squeeze the circlip until it has disengaged from the inlet boss (see Fig. 7). Slowly relax pressure on the filter to relieve the spring tension beneath it, and remove the circlip from the inlet boss. Lift out the washer(7), filter(8), and spring(9a), and then turn the first stage body over to drop out the spring block(10), spring(9b), and high pressure seat(13).
15. Discard the filter, washer, circlip, and high pressure seat, and do not attempt to reuse these items. Closely inspect both springs to check for any signs of corrosion that may have resulted from moisture entering the first stage. If corrosion is found on either spring, discard and do not reuse.
16. Carefully remove the O-ring(12) and backup ring(11) from inside the balancing chamber of the spring block, using a brass or plastic O-ring removal tool to prevent any damage to the internal sealing surface of the spring block.



Fig. 7

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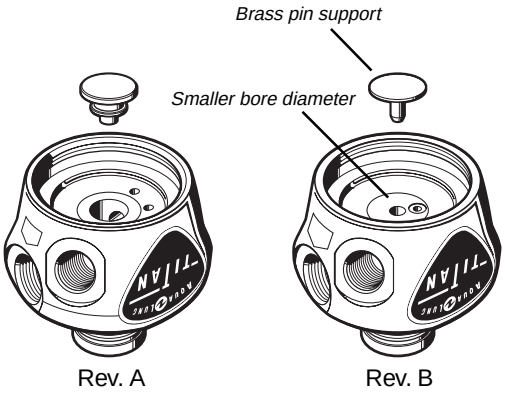


Fig. 8 – Revision Identification - Body & Pin Support

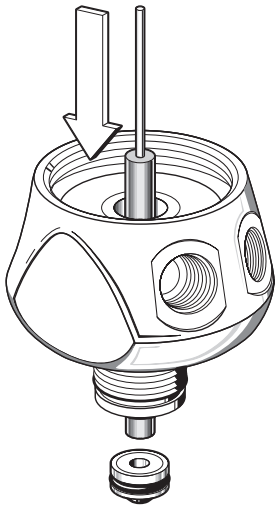


Fig. 9a – Removal of HP crown (Rev. A only)

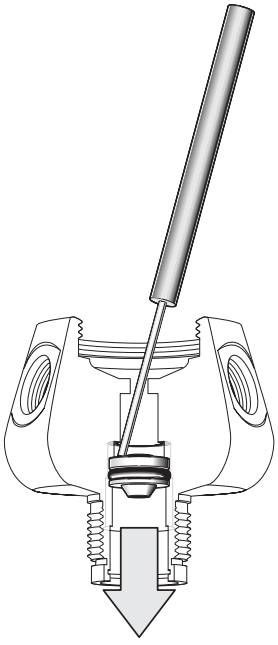


Fig. 9b – Removal of HP crown (Rev. B)

17. With the use of a magnifier, closely examine the sealing surface inside the balancing chamber of the spring block to check for any signs of permanent corrosion, scoring, or other damage. If found, discard the spring block and do not reuse.

⚠ **CAUTION**: The slightest scratch or scar across the sealing surface inside the spring block may cause leakage, and could prevent the regulator from achieving a stable lock-up of intermediate pressure.

18. Closely examine the first stage body and pin support to determine whether they are Revision A or Revision B parts. The revision B first stage (manufactured after July 1999) contains a body with a small internal bore, in addition to a brass pin support (P/N 1015-69) which has a straight stem (see Fig. 8). The revision A body has an internal bore that is slightly larger in diameter than the handle of the extraction tool, and the pin support is chrome plated with a tapered stem.

⚠ **NOTE:** This revision of the Titan first stage body and pin support does not require a mandatory upgrade or retrofit. It is important to correctly identify these parts, however, in order to avoid using a "Revision B" pin support with a "Revision A" body, and to follow the correct procedure for removing the HP crown. If replacement of the body with a "Revision B" part is required, it will be necessary to also replace the pin support with a Revision B part to match it.

19. Stand the body vertically on the inlet boss over a padded surface. If the body is a Revision A part, insert the handle of the extraction tool (P/N 1094-36) through the center bore (see Fig 9a). If it is Revision B, insert the pin of the extraction tool through the center bore at an angle to make contact with the flat underside of the crown(15). (See Fig. 9b.)
20. Firmly press downward until the crown exits the body. Lift the body up and off the crown, and closely inspect the sealing surface inside the bore to ensure that is perfectly smooth and free of any scratches or other blemishes. If the body shows these signs of damage or serious corrosion, it must be replaced with new and cannot be reused.
21. Remove and discard the crown O-ring(14). Using a magnifier, closely examine the crown seating surface to check for any signs of scratches, nicks, or other blemishes. If found, discard the crown and do not attempt to reuse.

This concludes the disassembly of the Titan First Stage. Refer directly to Procedure A and Table A, titled Cleaning & Lubrication, before proceeding to the Reassembly Procedures.

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Reassembly Procedures

NOTE: Before performing any reassembly, it is important to inspect all parts, both new and those that are being reused, to ensure that every part and component is perfectly clean and free of any dust, corrosion, or blemishes. Before dressing each O-ring with Christo-Lube®, check to ensure it is clean, supple, and free of any blemish.

WARNING: Use only genuine Aqua Lung parts, subassemblies, and components whenever assembling any Aqua Lung product. DO NOT attempt to substitute an Aqua Lung part with another manufacturer's, regardless of any similarity in shape, size, or appearance. Doing so may render the product unsafe, and could result in serious injury or death.

1. Install the O-ring(14) onto the crown(15), and place the crown inside the inlet boss of the first stage body with the orifice sealing surface facing up.
2. Insert the handle of the extractor tool (P/N 1094-36) into the inlet boss(16), and press the crown into place so that it fits snugly over the seating shoulder inside the body(see Fig. 10).
3. Turn the body over and stand it on a padded surface with the inlet boss facing down. Place the stem of the pin support(19) into the opening of the low pressure side of the body.

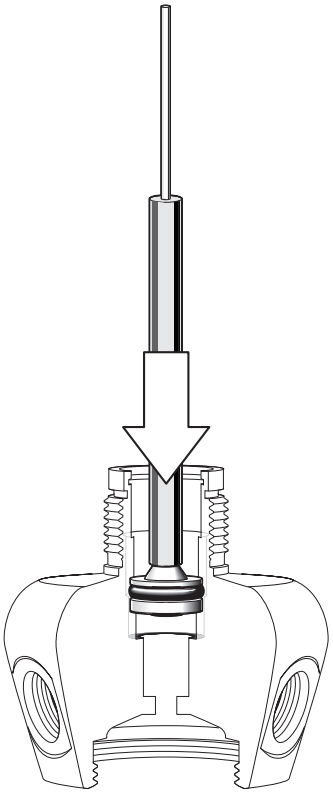


Fig. 10

CAUTION: If replacement of the pin support was necessary, it is important to use the correct revision part which matches the body. (Refer to step 18 of the Disassembly Procedures, and the Titan First Stage schematic on page 20.) Use of a "Revision B" pin support with a "Revision A" body may seriously impair the performance of the first stage.

4. Lay the diaphragm(24a) inside the body, and gently tamp it down below the threads until it is seated evenly on all sides.
5. Lay the thrust washer(24b) inside the body, and tamp it down below the threads until it is evenly seated over the diaphragm.
6. Lay the spring pad(25) in the center of the diaphragm with the mating tab facing up, and thread the spring retainer(26 or 30) clockwise into the body by hand until snug.
7. Install a vise mounting tool (P/N 1003-95), or a discharged $C0_2$ cartridge (P/N 7039-09) connected to a HP port adapter (P/N 1020-85), into the HP port of the first stage body.

WARNING: DO NOT use a $C0_2$ cartridge which has not been discharged. Doing so may cause the cartridge to rupture, resulting in serious personal injury.

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Fig. 11

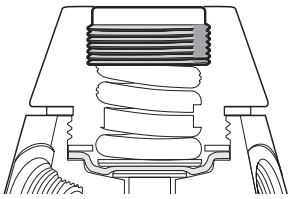


Fig. 12a

Fig. 12b

Fig. 13

8. Secure the vise mounting tool in a vise so the first stage stands vertical with the spring retainer facing up. Apply a torque wrench with 30mm crow-foot, or use a 34mm crow foot for the "D" environmental version spring retainer(30), and tighten the spring retainer to a torque measurement of 20 (±2) foot-lbs (see Fig. 11).
9. Check to ensure that the spring pad is positioned over the center of the diaphragm, and place the main spring(27) over the spring pad inside the spring retainer. Then lay the washer(28) on top of the spring.
10. Mate the adjustment screw(29) over the spring and washer, and turn it clockwise to engage the threads of the spring retainer. Apply a 8mm hex key to turn the adjustment screw to its appropriate preliminary setting, depending on whether it will assembled in the standard configuration, or with the "D" environmental protection kit.

a. Standard spring retainer(26) – Turn the adjustment screw clockwise until it is exactly flush with the top of the spring retainer (see Fig. 12a).

b. "D" Environmental Spring Retainer – Turn the adjustment screw clockwise until it is exactly flush with the internal shoulder, above the female threads (see Fig. 12b).

When the adjustment screw has been set at its preliminary adjustment, loosen the vise to remove the first stage.

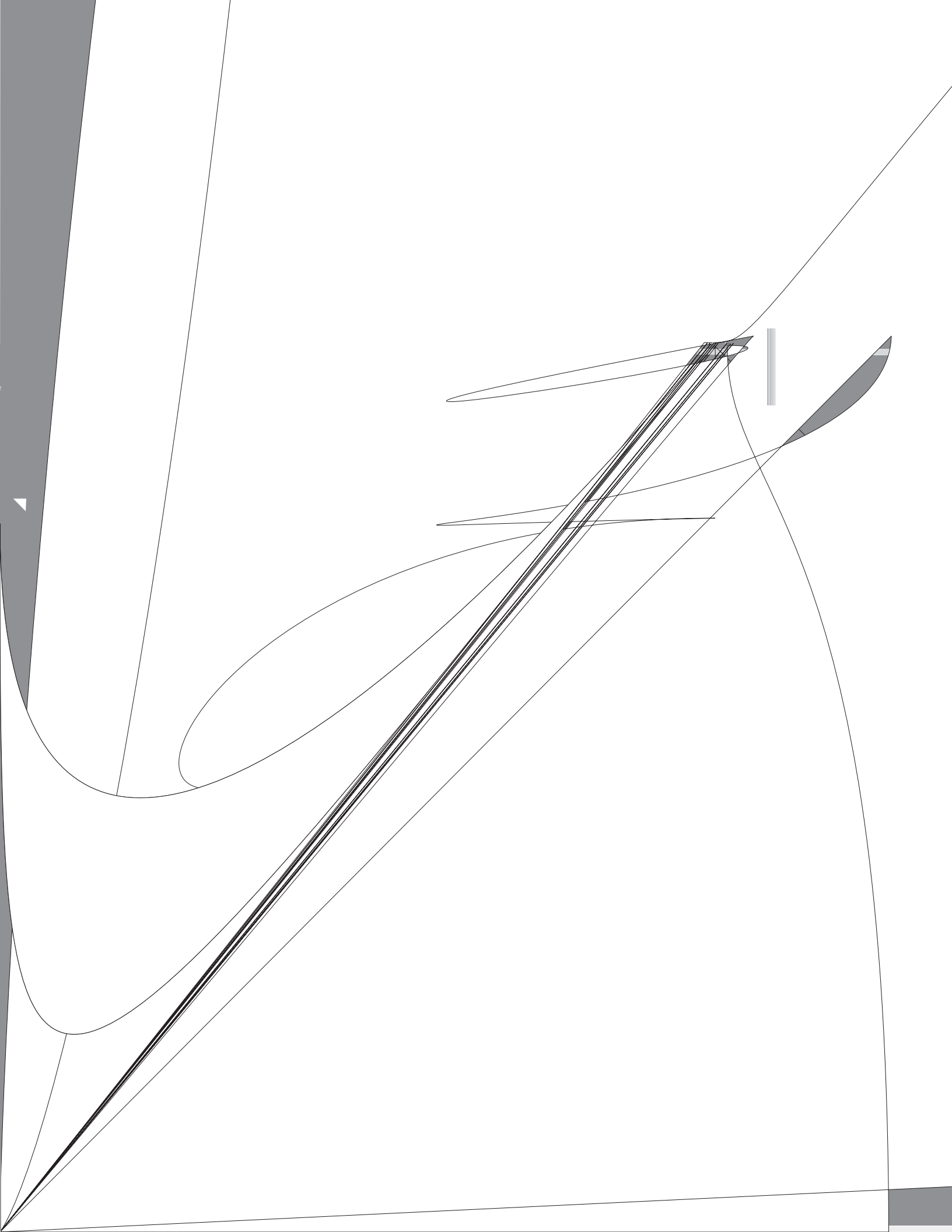
NOTE: Do not proceed further with the assembly of the "D" environmental protection kit at this time. Instructions for final assembly follow the section titled, Final Adjustment & Testing Procedures.

11. While holding the high pressure seat(13) by its stem, insert the pin(18) into the center opening. Hold the first stage above the pin with the inlet boss facing down, and carefully align the end of the pin with the opening of the crown inside. Gently guide the pin and seat into the inlet boss so that the pin passes through the crown and into the open side of the pin support, which can be sighted through any of the low pressure ports (see Fig. 13). When the pin is securely seated between the pin support and high pressure seat, turn the fist stage over and stand it on a padded surface with the inlet boss facing up.

CAUTION: Be careful to avoid damaging the polished sealing surface of the crown when installing the pin and high pressure seat. Excessive force or carelessness may otherwise scratch or nick the crown, and require it to be replaced.

NOTE: Refer to the Titan First Stage schematic and parts list on page 20 before installing the O-ring into the spring block in the following step. Titan first stages which are configured with the DRY environmental protection kit require a different O-ring that is designed for cold water use.

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D. Mate the yoke screw into the top of the yoke, and turn it clockwise to fasten the dust cap snugly in place over the inlet boss.

Reassembly of DIN Adapter

A. Install the O-ring(5g) onto the groove at the base of the first stage body inlet boss, just below the threads.

B. Mate the large female threads of the DIN adapter(5f) onto the inlet boss, and tighten it clockwise by hand until snug.

C. Secure the vise mounting tool in a vise so the first stage stands vertical with the DIN adapter facing up. Apply a torque wrench with 26mm crow-foot to tighten the DIN adapter to a torque measurement of 20 (±2) foot-lbs.

D. Mate the open side of the handwheel(5e) over the top of the DIN adapter, so the male threaded portion faces up.

E. Install both O-rings(5b&5d) onto the handwheel retainer(3), and mate the male threads of the retainer through the top of the handwheel and into the DIN adapter. Turn the retainer clockwise by hand until snug, and apply a torque wrench with a 6mm hex key to tighten the handwheel retainer to a torque measurement of 15 (±2) foot-pounds. Loosen the vise to remove the first stage, and remove the vise mounting tool.

F. Reattach the protector cap(5a) to the first stage, and install it over the threads of the handwheel.

17. Install all O-rings(20&22) onto all hoses and port plugs(21&23). Install all LP and HP hoses and port plugs into the body, and tighten the port plugs clockwise until snug. Apply a torque wrench with respective crow foot to tighten each hose to a torque measurement of 40 (±5) inch-pounds.

WARNING: Be certain not to install a low pressure hose into the high pressure port via an adapter. Doing so may cause the hose to rupture when pressurized, and could result in serious personal injury.

This concludes the reassembly of the Titan first stage regulator. Refer directly to the following section, titled Final Testing.

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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.

CAUTION: 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(29) is correctly set to its preliminary adjustment; flush with the top of the standard spring retainer(26), or flush with the shoulder inside the environmental spring retainer(30) (see Fig. 16).
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 completely shut.

CAUTION: 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 Table 1 - Troubleshooting, and remedy as needed before proceeding further.

4. When the intermediate pressure has stabilized below 120 psi, apply a 8mm hex key to turn the adjustment screw clockwise in small increments of adjustment. While turning the adjustment screw, 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.

CAUTION: Failure to cycle the regulator during adjustment can result in a false reading of the intermediate-pressure.

5. When the intermediate pressure has been determined to be stable at 120 psi or less, increase the inlet pressure to between 2,500 – 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 directly to Table 1 - Troubleshooting, and remedy as needed.

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6. Repeat the adjustment procedure in step 4 to adjust the Titan first stage intermediate pressure to exactly 135 psi. Repeatedly purge the second stage or open and shut the test gauge bleed valve at least 15 times to ensure that the intermediate pressure locks up consistently and remains stable at 135 (±5) psi, with no signs of creeping or fluctuation.
7. Final Assembly – "DRY" Environmental Kit
   a. While the regulator is still pressurized with 2,500 – 3,000 psi, insert the stem of the piston(31) into the hex opening of the adjustment screw.
   b. Lay the external diaphragm(33) inside the external diaphragm retainer(34), and tamp it down past the threads to ensure that it seats evenly against the sealing surface.
   c. Mate the external diaphragm retainer onto the spring retainer, and apply the retainer wrench (P/N 0812-47) to tighten it clockwise until completely snug.
   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 overhaul and adjustment procedures outlined in the Aqua Lung Service & Repair Manual provided for the second stage, 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 up to one minute to check for the formation of bubbles. If a steady stream of bubbles is present, the system must be disassembled at the source to check sealing surfaces, assembly sequence, and component positioning in order to correct the problem(s).



NOTE: Extremely small leaks may be better detected by applying a soap solution or Snoop™ to the leak area. 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 (30 psi) air. Disassemble and remedy the problem, referring to Table 1 – Troubleshooting.

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 abnormalities or problems occur, refer to Table 1 – Troubleshooting.

This concludes the annual service procedures for the Titan First Stage.

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Table 1
Troubleshooting Guide – Titan First Stage

SYMPTOM	POSSIBLE CAUSE	TREATMENT
Restricted airflow/ high inhalation resistance through entire system.	1. Cylinder valve not completely opened. 2. Cylinder valve requires service. 3. Sintered filter(8) is installed upside down or is contaminated. 4. Insufficient intermediate pressure.	1. Open valve, check fill pressure. 2. Connect to a different cylinder. 3. Reinstall or replace filter with new as needed. 5. See below.
High or unstable intermediate pressure	1. First-stage improperly adjusted. 2. HP seat(13) damaged or worn. 3. Spring block O-ring(12) damaged or worn. 4. Spring block(10) damaged. 5. Crown O-ring(14) damaged or worn. 6. Sealing surface of HP crown(15) damaged. 7. Springblock springs(9a& 9b) weakened or damaged.	1. Readjust adjustment screw(29). 2. Replace HP seat. 3. Replace spring block O-ring. 4. Replace spring block. 5. Replace crown O-ring. 6. Replace HP crown. 7. Replace springblock springs.
Low intermediate pressure	1. First-stage improperly adjusted. 2. Main spring(27) damaged. 3. Spring retainer(26 or 30) loose.	1. Readjust adjustment screw(29). 2. Replace main spring. 3. Tighten to 20±2 foot-lbs.
External air leakage (Immersion Test)	1. Spring retainer(26 or 30) loose. 2. Diaphragm(24a) worn or damaged. 3. Diaphragm seating surface inside first stage body(16) damaged.	1. Tighten to 20±2 foot-lbs. 2. Replace diaphragm. 3. Replace first stage body.

NOTE: This is a partial list of possible problems and recommended treatments. For more information, refer to the second-stage troubleshooting guide, or contact U.S. Divers Technical Services Department for assistance with problems not described here.

CAUTION: Recommended treatments which require disassembly of the regulator must be performed during a complete overhaul, according to the prescribed procedures for scheduled, annual service. Do not attempt to perform partial service.

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Table 2
Recommended Tool List

PART NO.	DESCRIPTION	APPLICATION
1116-10	I.P. test gauge	Intermediate pressure testing
9440-22	O-ring tools	O-ring removal & installation
N/A	Magnifier w/ illumination	Sealing surface and spring inspection
N/A	Ultrasonic cleaner	Brass & stainless steel parts cleaning
N/A	0-120 inch-lbs torque wrench	Small fittings
N/A	10-50 foot-lbs torque wrench	Large fittings
N/A	Bench vise	First stage disassembly/ reassembly
1003-95	Vise mounting tool	First stage disassembly/ reassembly
N/A	4mm or 5/32" hex key	Port plugs
N/A	6mm hex key	DIN handwheel retainer
N/A	8mm hex key	Adjustment screw
N/A	26mm open-end wrench/ crow-foot	Yoke retainer/ DIN adapter
N/A	30mm open-end wrench/ crow-foot	Spring retainer
N/A	34mm open-end wrench/ crow-foot	"DRY" spring retainer
N/A	9/16" open-end wrench/ crow-foot	Low pressure hose fitting
N/A	5/8" open-end wrench/ crow-foot	High pressure hose fitting
1110-00	Spring block assembly guide	Assembly of high pressure components
944019	1/2" wooden dowel	Assembly of high pressure components
1111-00	Snap ring pliers	Removal of filter circlip
1094-36	Extraction tool	Crown removal & installation
0812-47	"DRY" retainer wrench	"DRY" diaphragm retainer

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Table 3
Standard Parts Replacement Schedule – Titan First Stage

PART NUMBER	DESCRIPTION	KEY NUMBER	QTY
8200-94	O-ring	3	1
8630-51	Circlip	6	1
8450-95	Washer	7	1
1051-06	Filter	8	1
8280-05	Backup Ring	11	1
8240-06 (or) 8200-80	O-ring	12a (or) 12b	1
1059-40	High Pressure Seat	13	1
8200-38	O-ring	14	1
9570-04	O-ring	20	1
8200-11	O-ring	22	4
1034-25	Diaphragm w/ Washer	24	1
1063-37	Environmental Diaphragm	33	1

Table 4
Torque Specifications
Titan First stage

PART NUMBER	DESCRIPTION / KEY NUMBER	TORQUE
1031-62	Yoke Retainer/ (4)	20 (±2) ft-lbs
1060-56	DIN Handwheel Retainer/ (5c)	45 (±2) inch-lbs
1031-74	DIN Adapter/ (5f)	20 ±2 ft-lbs
1031-04	Spring Retainer/ (26)	20 ±2 ft-lbs
1063-17	"DRY" Spring Retainer/ (30)	20 ±2 ft-lbs
1063-03	Port Plug / (21) or HP Hose	20 (±2) inch-lbs
1043-04	Port Plug / (23) or LP Hose	20 (±2) inch-lbs

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Table 5
Test Bench Specifications
Titan First Stage

TEST	CONDITION	ACCEPTABLE RANGE
Leak test	Inlet 2,500-3,000 psi	None
Intermediate pressure	Inlet 2,500-3,000 psi	135 (±5) psi
Intermediate pressure creep	Inlet 2,500-3,000 psi	5 psi max between 5 to 15 seconds after cycling regulator (purge)
Opening effort	Inlet 2,500-3,000 psi, intermediate pressure 135 (±5) psi	+0.8 to +1.4 inch H_20
Flow effort	Intermediate pressure 135 (±5) psi at 10 SCFM	+6 inches H_20 (maximum)
Purge flow	Intermediate pressure 135 (±5) psi	5.0 SCFM flow rate (minimum)

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Procedure A
Cleaning & Lubrication
(All Aqua Lung Regulators)

1. Acid Bath - Aqua Lung strongly recommends ChromeSafe™ regulator cleaner (P/N 0201-05) for cleaning all reusable brass and stainless steel parts. ChromeSafe™ is a specially formulated cleaner that does not harm rubber or Teflon parts, yet effectively removes silicone grease, corrosion, and grime from metal parts, leaving only a brilliant shine. For best results, soak parts in an ultrasonic cleaner for 5 to 15 minutes, unless the chrome finish is chipped or flaking. Parts with damage to their chrome finish should be cleaned separately outside the ultrasonic cleaner to avoid agitation. Be certain to isolate more delicate parts, such as orifice cones, to prevent damage to sealing surfaces.

CAUTION: Harsh acids, such as muriatic acid, may cause damage to parts and must be strictly avoided. White vinegar, although less effective, is one suitable substitute for ChromeSafe™.

CAUTION: Ultrasonic cleaning times in excess of 15 minutes may damage the chrome finish of certain parts. Be certain to use a timer, and do not leave parts unattended while cleaning.

NOTE: Although ChromeSafe™ contains a degreasing agent, cleaning heavily greased parts in ChromeSafe™ will shorten the effective life of the solution, and require it to be replaced on a more frequent basis. Heavily greased parts may be degreased in a solution of warm water and mild dish detergent prior to being placed in the acid bath.

2. Fresh Water Rinse - If tap water is extremely "hard," distilled water may be used to prevent any mineral residue. Remove parts from the acid bath and place directly into this rinse. 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.

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 soap. Use only a soft nylon toothbrush to scrub away any deposits. Thoroughly blow dry, using low pressure filtered air.

HOSES

If buildup of corrosion is severe, it is permissible to soak only the hose fittings in ChromeSafe™ 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.

LUBRICATION AND DRESSING

All O-rings should be lubricated with either Christo-Lube® (preferred for high pressure systems) or Dow Corning® 111 food grade silicone grease . 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 silicone grease, as this will attract particulate matter that may cause damage to the O-ring.

Hoses and other black rubber parts may be dressed and preserved using a clean cloth impregnated with a pump silicone milk.

CAUTION: Aerosol spray silicone must be strictly avoided. Do not attempt to use as a substitute for silicone grease.

CAUTION: Do not apply any form of silicone lubricant to silicone rubber parts, as this will cause them to deteriorate prematurely.

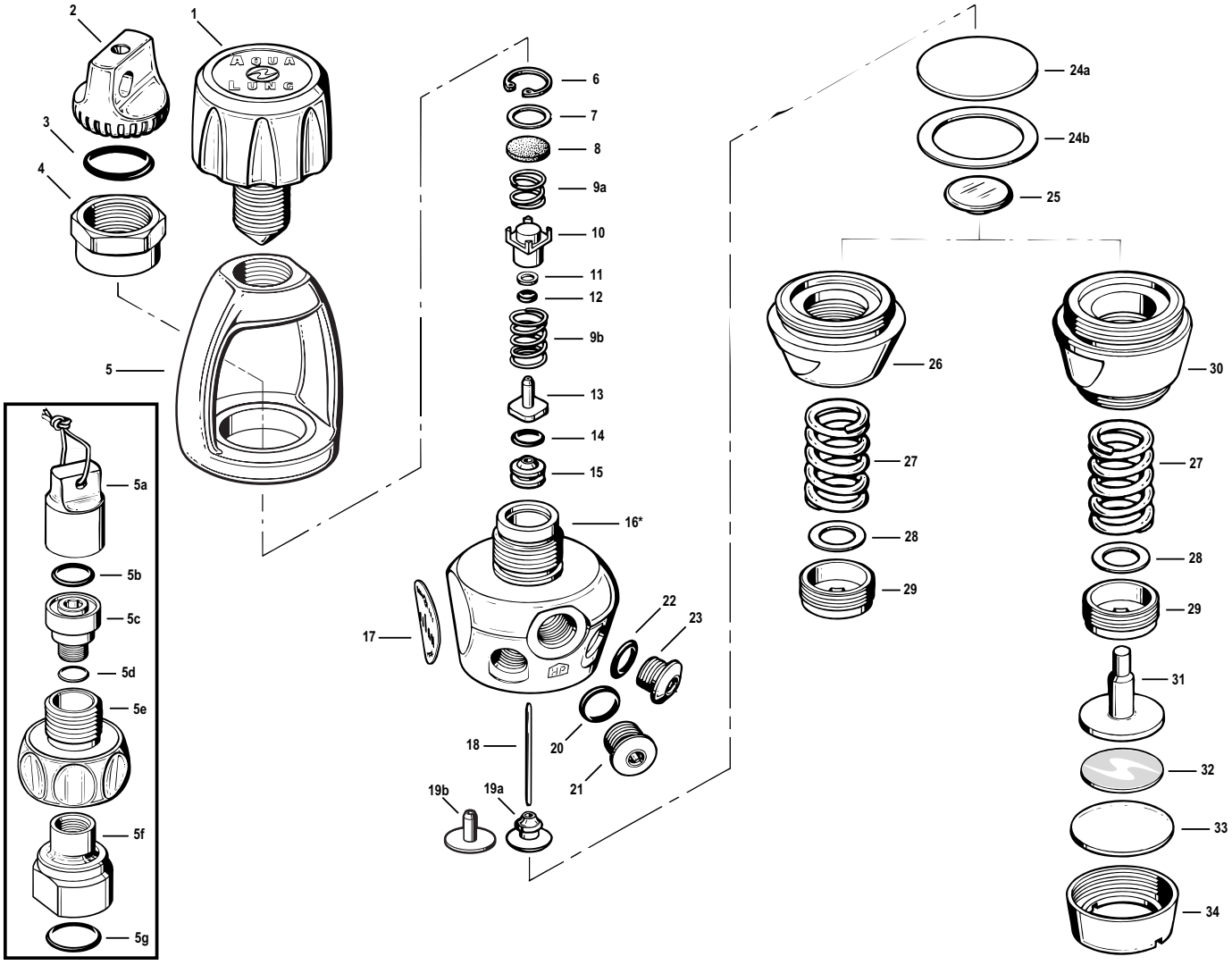
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Table A
Recommended Lubricants & Cleaners
(All Aqua Lung Regulators)

LUBRICANT / CLEANER	APPLICATION	SOURCE
Christo-Lube®	All O-rings seals; cylinder valve threads (preferred for high pressure DIN systems)	Lubrication Technologies 310 Morton Street Jackson, OH 45640 (614) 286-2644
Dow Corning® 111 (pure silicone grease)	All O-ring seals	Dow Corning Corp. P.O. Box 1767-T Midland, MI 48640 800-248-2481
CAUTION: Silicone rubber requires no lubrication or preservative treatment. DO NOT apply silicone grease or spray to silicone rubber parts. Doing so will cause a chemical breakdown and premature deterioration of the material.		
Silicone Pump™ (non-aerosol silicone milk spray)	General preservative/conditioner for hoses, instrument console boots, etc.	McNett Corp. P.O. Box 996 Bellingham, WA 98227 800-221-7325
CAUTION: Aerosol spray silicone should be avoided because (1) common aerosol propellants may attack plastic and rubber parts, and (2) because only a slight amount of silicone remains after the solvent evaporates, and provides no lasting benefit.		
Anti-Seize Lubricant #80208 (food grade - U.S.D.A. approved for conformance to MIL-A-907-E)	M.A.S. cylinder adapter - female threads Micra ADJ adjustment screw	Permatex Industrial Corp. 705 N. Mountain Rd. Newington, CT 06111 (860) 520-5000
ChromeSafe™ (ultrasonic cleaning solution)	Degreaser and acid bath for reusable stainless steel and brass parts.	Aqua Lung P/N 0201-05 (1 quart)
Oakite #31	Acid bath for reusable stainless steel and brass parts.	Oakite Products, Inc. 50 Valley Road Berkeley Heights, NJ 07922
White distilled vinegar (100 gr.)	Acid bath for reusable stainless steel and brass parts.	"Household" grade
CAUTION: DO NOT use muriatic acid for the cleaning of any parts. Muriatic acid, even when strongly diluted, can harm chrome plating, and may leave a residue that is harmful to O-ring seals and other parts.		
Liquid dishwashing detergent (diluted with warm water)	Degreaser for brass and stainless steel parts, general cleaning solution for plastic, rubber, and anodized aluminum parts.	"Household" grade
Snoop™	Leak testing	Nupro Company 400 E. 345th St. Willoughby, OH 44094 440-951-7100

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Titan First Stage



Key #	Part #	Description
	----- 9000-01	***Overhaul Parts Kit***
1	----- 1075-07	Yoke Screw
2	----- 1031-14	Dust Cap
3	***----- 8200-94***	***O-ring***
4	----- 1031-62	Yoke Retainer
5	----- 1068-43	Yoke
5a	---- 1074-42	Protector Cap, DIN Connector
5b	***---- 8200-94***	***O-ring***
5c	---- 1060-56	Handwheel Retainer
5d	***---- 8200-72***	***O-ring***
5e	---- 1031-76	Handwheel
5f	---- 1031-74	DIN Adapter, Titan
5g	***---- 8200-77***	***O-ring***
6	***----- 8630-51***	***Circlip***
7	***----- 8450-95***	***Washer***
8	***----- 1051-06***	***Filter***
9	----- 1015-09	Spring Kit (includes 9a & 9b)
10	---- 1053-24	Spring Block
11	***---- 8280-05***	***Backup Ring***
12a	***--- 8240-06***	***O-ring (Standard Titan, w/out DRY Kit)***
12b	***--- 8200-80***	***O-ring (Cold Water Titan, w/ DRY Kit)***
13	***---- 1059-40***	***HP Seat***
14	***---- 8200-38***	***O-ring***
15	---- 1060-27	Crown
16	---- 1031-01	Body (Revision B)

Key #	Part #	Description
17	---- 1031-82	Decal, Titan
18	---- 1020-02	Pin
19a	--- 1060-22	Pin Support (Revision A Configuration)
19b	--- 1015-69	Pin Support (Revision B Configuration)
20	---- 9570-04	O-ring (7/16" HP Port)
21	---- 1031-37	Port Plug, High Pressure
22	***---- 8200-11***	***O-ring (3/8" Port)***
23	---- 1031-33	Port Plug, Low Pressure
24	***---- 1034-25***	***Diaphragm w/ Thrust Washer***
25	---- 1017-29	Spring Pad
26	---- 1031-04	Spring Retainer
27	---- 1063-56	Spring
28	---- 8450-97	Washer
29	---- 1060-26	Adjustment Screw

Used with "Dry" Environmental Kit

	----- 1005-24	Dry Environmental Kit, Complete
30	---- 1063-17	Spring Retainer
31	---- 1063-19	Piston
32	---- 1063-38	Decal
33	***---- 1063-37***	***External Diaphragm***
34	---- 1063-18	Diaphragm Retainer

Part numbers in ***BOLD ITALICS*** indicate standard overhaul replacement part.

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TECHNICIAN'S NOTES

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2340 Cousteau Court
Vista, California 92083
Phone (760) 597-5000
Fax (760) 597-4900

www.aqualung.com