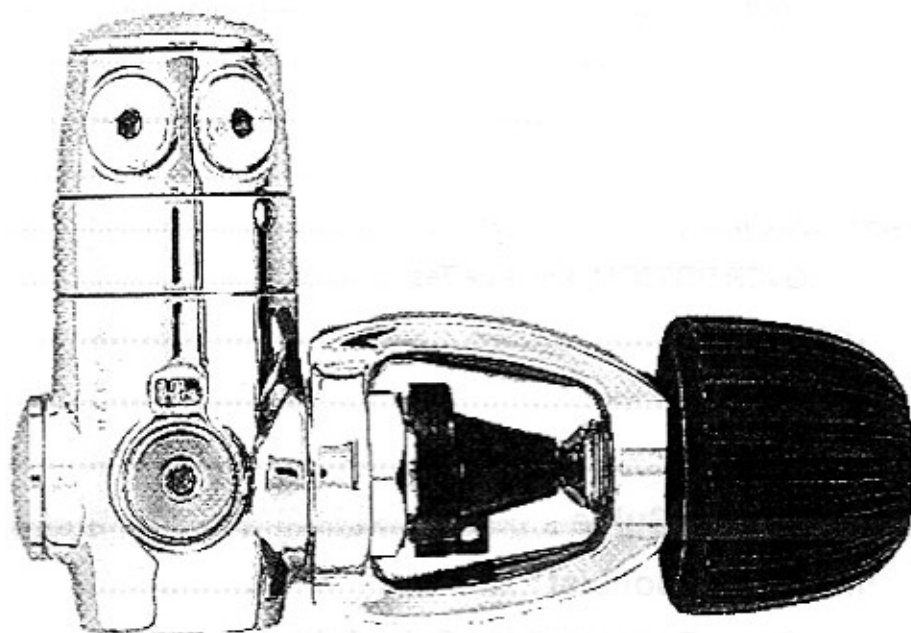


Pioneer & Nordic First-Stage Regulator



**Authorized
Aqua-Lung™ Dealer**

SERVICE & REPAIR MANUAL

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Service & Repair Manual - Pioneer First stage


Introduction


This manual provides factory prescribed procedures for the correct service and repair of the Pioneer balanced piston 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 a U.S. Divers®/ Aqua-Lung® Service & Repair Seminar.


If you do not completely understand all of the procedures outlined in this manual, contact U.S. Divers Co., Inc. 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

Because a diving regulator is considered to be a life-supporting product, it is extremely critical that it receives service according to the procedures outlined in this manual on a regularly scheduled basis; at least once a year with normal or infrequent use.

 **NOTE:** A regulator 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 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 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.
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 an efficient repair facility.
3. Before beginning any disassembly, it is important to first perform the Initial Inspection procedure, and refer to the Troubleshooting Table to determine the possible cause of any symptoms which may be present.
4. As each regulator is disassembled, reusable components should be segregated and not allowed to intermix with non-reusable parts or parts from other regulators. Delicate parts, including pistons and crowns which contain critical sealing surfaces, must be protected and isolated from other parts to prevent damage during the cleaning procedure.
5. Use only genuine factory parts purchased directly from U.S. Divers (or an authorized distributor outside of the U.S.) when servicing any U.S. Divers/ Aqua-Lung product. Substitution with another manufacturer's parts constitutes an after-market modification of the product, and renders all warranties 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. Do not overtighten parts beyond their torque specification when reassembling. Most parts are made of either marine brass or plastic, and can be permanently damaged by undue stress.


Initial Inspection Procedure

EXTERNAL INSPECTION

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

 **NOTE:** An orange, rust colored residue usually indicates that the regulator has been used with a corroded steel cylinder, while a gray or white discoloration of the filter may indicate use with a corroded aluminum cylinder. Advise the customer of this, and the possible need to obtain service for their cylinder. A green discoloration positively indicates that moisture has entered the regulator, and internal corrosion is therefore likely to be found.

2. Visually inspect the secondary diaphragm and the secondary diaphragm retainer, to check for any signs of damage to the diaphragm or leakage of silicone fluid.
3. Remove the hose protectors, if present, to visually inspect the condition of the hoses along their length, as well as at their fittings.
4. Closely examine the chrome finish of the first stage to check for any flaking, chipping, or other damage to the chrome.

 **CAUTION:** Do not clean any parts which show damage to their chrome finish inside an ultrasonic cleaner.


5. Closely examine all parts of the first stage for any other signs of external corrosion.


IMMERSION / LEAK TEST

1. Check to ensure that the regulator is fully assembled and connected to a second stage, and that there are no open ports or hoses. Connect the first stage to a cylinder that is filled with 3,000 psi, and open the cylinder valve to pressurize the regulator.
2. If leakage cannot be heard, or if the source of leakage detected audibly is not obvious, immerse the first stage in fresh water to check further for any signs of air leakage from the following areas:
 - a. LP swivel, between the swivel cap(31) and piston cap(29).
 - b. Beneath the yoke(3), from the inlet fitting(10).
 - c. End plug(24) of main body(17).
3. Immerse all hoses in fresh water to check for any signs of leakage from along their length or at fittings on both ends.
4. Note 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.


INTERMEDIATE (OVER-BOTTOM) PRESSURE TEST

1. Depress the second stage purge button to determine once again 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, U.S. Divers strongly recommends that a fully assembled and properly adjusted second stage 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 counter-clockwise to ensure that it is open before pressurizing. Failure to relieve intermediate pressure in excess of 400 psi may result in damage or rupture of the test gauge or 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 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 Pioneer first stage is 138 (± 5) psi, with an inlet pressure between 2,500 - 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.

Disassembly Procedures

NOTE: Before performing any disassembly, refer to Table 4, 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: Use only a plastic or brass O-ring removal tool (P/N 9440-22) when removing O-rings to prevent damage to the sealing surface. 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 steel instrument.

NOTE: The Quad Spanner Wrench (P/N 1077-50) is a multi-function specialty tool designed specifically for the disassembly of the Pioneer and Aquarius first stage regulators. As its name implies, it is actually four spanner wrenches in one. Refer to Fig. A to identify each individual spanner as it is referenced throughout the Disassembly and Reassembly procedures.

1. Before disassembling the first stage, remove the low pressure second stage hoses with a $\frac{1}{16}$ " open end wrench, the high pressure hose(s) with a $\frac{5}{8}$ " open end wrench, and the low pressure inflator hose with either a $\frac{1}{16}$ " or $\frac{1}{2}$ " open end wrench. Remove all remaining port plugs(28&33) with a 4mm ($\frac{5}{32}$ ") hex key.
2. Remove and discard the O-rings on these items.
3. Turn the yoke screw(2) counter-clockwise to loosen and remove from the yoke(3). Set the yoke screw aside.
4. Untie the dust cap(5) from the yoke. Remove and discard the dust cap O-ring(6).
5. Install a vise mounting tool (P/N 1003-95) or a discharged CO₂ cartridge (P/N 7039-09) connected to a HP port adapter (P/N 1020-85) into one of the HP ports of the first stage body.

CAUTION: DO NOT use a CO₂ cartridge which has not been discharged. Doing so may cause the cartridge to rupture, resulting in serious personal injury.

6. Secure the vise mounting tool inside a bench vise so that the first stage is positioned outside the vice with the yoke facing straight up.
7. Apply a 26mm open-end wrench over the inlet fitting(10) (see Fig. 1). Using firm, steady force, turn the inlet fitting counter-clockwise to loosen and remove. Lift the inlet fitting and yoke off the first stage body, and set the yoke aside.

NOTE: It is important that the wrench is securely seated over the entire hex portion of the inlet fitting to prevent any damage to the part. Do not use impact to loosen.

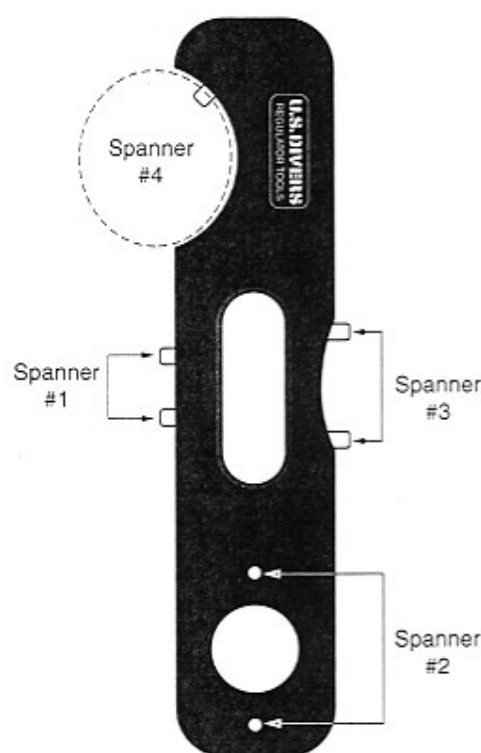


Fig. A - Quad Spanner Wrench

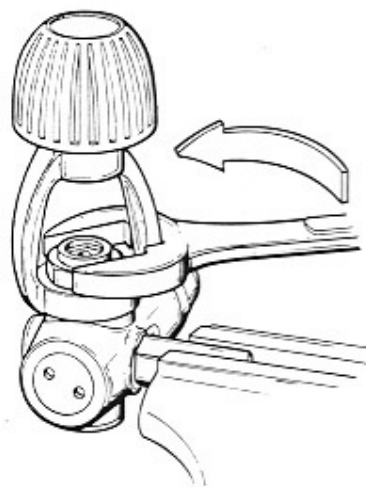


Fig. 1 - Inlet Fitting Removal

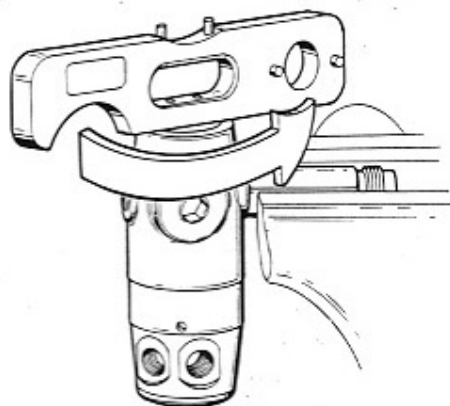


Fig. 2 - HP End Plug Removal

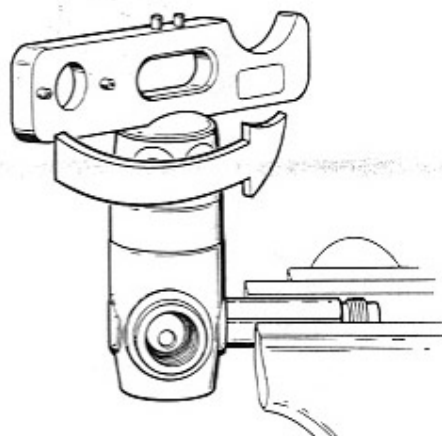


Fig. 3 - Swivel Retainer Removal

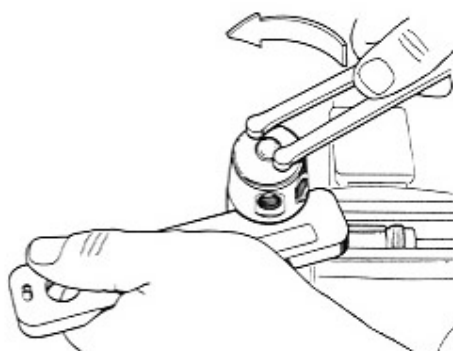


Fig. 4 - Alternate Removal Procedure

8. Remove and discard the inlet fitting O-ring(11).
9. While holding the inlet fitting secure, use a flat bladed jeweler's (2.0mm) screwdriver to carefully press one side of the filter retainer(7) inward and lift up to remove, using caution to avoid damaging the inlet fitting. Insert the screwdriver through the small opening of the inlet fitting to press out the conical filter(8), and discard the filter and retainer.
10. Remove the recessed filter O-ring(9) inside the inlet fitting and discard. Set the inlet fitting aside.
11. Remove the yoke washer(4), and inspect to determine whether it is intact and in reusable condition. Discard if found to be torn, wrinkled, or otherwise damaged.
12. Loosen the vise and reposition the first stage to stand vertical, with the high pressure end plug(24) facing straight up, and refasten the vise securely onto the vise mounting tool.
13. Apply the No. 1 Spanner of the Quad Spanner Wrench (P/N 1077-50) to the end plug, and hold it securely seated while turning the end plug counterclockwise to loosen it completely from the body(17) (see Fig. 2).
14. Lift the end plug out of the body, and remove the high pressure seat(22) and O-ring(23). Discard these items, and set the end plug aside.
15. Loosen the vise to remove the first stage, and turn the body over to allow the secondary spring(21) and thrust bearing(20) to drop out onto the bench. Set the thrust bearing aside, and inspect the secondary spring closely with a magnifier to check for any signs of pitting, rusting, or other corrosion that has permeated the surface of the metal. If corrosion is found, discard and do not attempt to reuse.
16. Position the first stage vertically with the LP port swivel facing straight up, and refasten the vise securely onto the vise mounting tool.
17. Apply the No. 3 Spanner of the Quad Spanner Wrench to the swivel retainer(34), and hold it securely seated while turning the retainer counter-clockwise to loosen and remove (see Fig. 3). Set the swivel retainer aside.



NOTE: If the piston cap(29) begins to turn with the swivel retainer, it will be necessary to hold the piston cap secure with the No. 4 Spanner while turning the swivel retainer with a separate Quad Spanner or Adjustable Face Spanner (P/N 1073-94). (See Fig. 4.)

18. While holding the first stage body secure with one hand to prevent it from turning in the vise, firmly grasp the swivel cap(31) and lift it straight off the stem of the piston cap.
19. With the use of a brass or plastic O-ring tool, carefully remove all residue of thread adhesive from the male threads of the piston cap stem and the female threads of the swivel retainer.

- NOTE:** It is imperative to remove any residue of thread adhesive with the use of a brass or plastic O-ring tool prior to cleaning parts in the acid bath. The residue will otherwise remain inside the threads, and may interfere with proper threading during reassembly.

20. Apply the No. 2 Spanner of the Quad Spanner Wrench over the piston cap stem, and mate it securely onto the flat surface of the piston cap (see Fig. 5). While holding the tool and first stage level and securely seated with one hand, turn the piston cap counter-clockwise to loosen no more than one full turn from the body.

- NOTE:** Avoid loosening beyond 1 full turn, in order to prevent leakage of silicone fluid from between the body and the piston cap.

- CAUTION:** Be certain to hold the spanner wrench securely seated in the recessed holes of the piston cap while turning. Damage to the chrome finish will result if the wrench is allowed to slip.

21. Apply a 8mm hex key to the secondary diaphragm retainer(26) and turn counter-clockwise to loosen.
22. While holding a container below the first stage to receive the silicone fluid, loosen the diaphragm retainer further to remove, and extract the secondary diaphragm(24) with a brass O-ring tool (see Fig. 6). Discard the diaphragm and do not reuse.
23. Continue holding the container below the first stage to allow the silicone fluid to drain from the ambient chamber, and turn the piston cap counter-clockwise to completely loosen from the body, using the No. 2 or No. 4 Spanner if necessary. Slowly lift the piston cap off the body and piston, being careful to prevent spillage of fluid. Set the piston cap aside.
24. Lift the piston assembly straight up and out of the body and set aside while the silicone fluid drains through the secondary diaphragm chamber into the container. When the silicone fluid has drained completely, dispose of it and do not attempt to reuse.
25. Lift the main valve spring(16) out of the body and examine closely with a magnifier to check for any signs of pitting, rusting, or other corrosion which permeates the surface of the metal. (This would indicate that sea water has entered the ambient chamber.) If permanent corrosion is found, discard and do not attempt to reuse.

- CAUTION:** If the intermediate pressure was measured less than 130 psi during the initial inspection, indicating that the main valve spring has possibly weakened, replace with new and do not attempt to reuse.

26. Remove the two swivel O-rings(30) from the stem of the piston cap and discard. Set the piston cap aside.

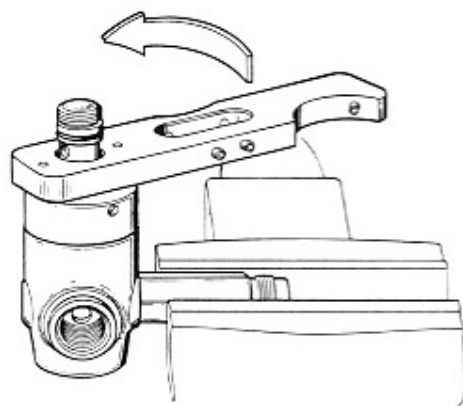


Fig. 5 - Piston Cap Removal

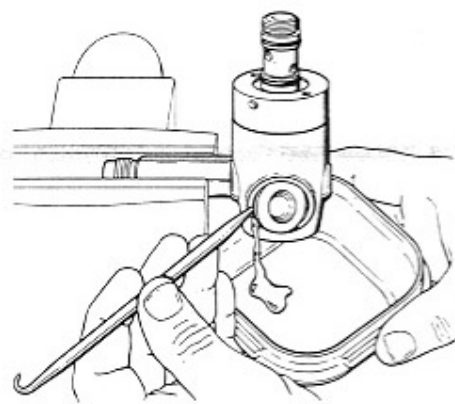


Fig. 6 - Secondary Diaphragm Removal

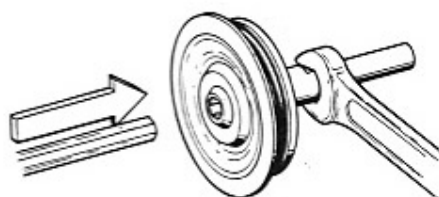


Fig. 7 - Piston Diaphragm Removal

26. Loosen the vise to remove the first stage body. Remove the vise mounting tool from the body and set it aside.
27. Remove the O-ring(19) and backup ring(18) from inside the high pressure chamber of the body with the use of a brass or plastic O-ring removal tool. Discard both items and set the body aside.
28. Apply a 6mm open end wrench to the flat portion of the piston shaft beneath the piston head to hold the piston secure and elevated. Apply a 4mm hex key to the diaphragm retainer(12), and turn counter-clockwise to loosen and remove the diaphragm retainer and diaphragm(13) from the piston head (see Fig. 7).



CAUTION: Do not place the end of the piston shaft directly on the repair bench. Ensure that it remains elevated to avoid damaging its delicate seating surface.

29. Remove the diaphragm from the diaphragm retainer, and discard. Set the retainer aside.
30. Remove and discard the piston head O-ring(14).
31. With the use of a brass or plastic O-ring tool, carefully remove all residue of thread adhesive from the female threads of the piston and the male threads of the diaphragm retainer.



NOTE: It is imperative to remove any residue of thread adhesive with the use of a brass or plastic O-ring tool prior to cleaning parts in the acid bath. The residue will otherwise remain inside the threads, and may interfere with proper threading during reassembly.

32. Closely examine the seating edge of the piston shaft with the use of a magnifier, checking for any signs of damage or wear, such as cracks, nicks, or scoring. If found, replace with new and do not attempt to reuse.

This concludes the disassembly of the Pioneer first stage. Refer directly Procedure A and Table A, titled Cleaning & Lubrication, before proceeding to the Reassembly Procedures.

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 silicone grease, check to ensure that it is clean, supple, and free of any blemish.

WARNING: Use only genuine U.S. Divers parts, subassemblies, and components whenever assembling U.S. Divers products. DO NOT attempt to substitute a U.S. Divers 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 two swivel O-rings(30) onto their respective grooved sealing surfaces on the swivel stem of the piston cap(29), and set the piston cap aside.
2. Install the piston diaphragm(13) over the threaded stem of the diaphragm retainer(12) and into the groove at the base of the stem.
3. Apply only one small drop of medium strength (serviceable) thread adhesive to the center threads of the diaphragm retainer (see Fig. 8). Immediately mate the diaphragm retainer into the head of the piston(15) and turn clockwise by hand until snug.
4. While holding the piston secure and elevated with a 6mm open end wrench applied to the flat portion of the piston shaft, apply a torque wrench with 4mm hex key to tighten the diaphragm retainer clockwise into the piston head to a torque measurement of 50 (± 2) inch-pounds (see Fig. 9).

CAUTION: DO NOT place the end of the piston shaft directly on the repair bench. Ensure that it remains elevated to avoid any damage to its delicate seating surface.

5. Install the piston head O-ring(14) onto the head of the piston, and set the piston assembly aside on a padded surface to prevent damage to its delicate seating edge.
6. Install the main spring(16) into the ambient chamber of the body, and ensure that it remains seated evenly over the mating stem in the center.
7. Gently mate the shaft of the piston through the center of the spring and the body, being careful to avoid scoring the brass surface inside the body. Continue pressing inward until the head of the piston rests flush against the main valve spring.
8. Carefully place the piston cap over the diaphragm and head of the piston, and press straight down to seat the cap upon the threads of the body. Grasp the body with one hand and turn the cap clockwise with the other to engage the threads. Continue tightening by hand until snug.



Fig. 8 - Thread Adhesive Application

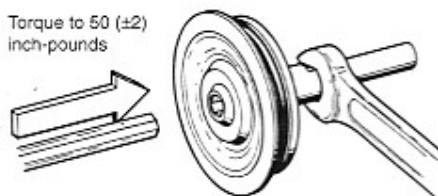


Fig. 9 - Piston Diaphragm Installation



Fig. 10 - O-Ring & Backup Ring Setup

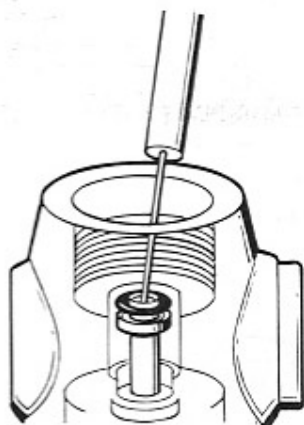


Fig. 11 - O-ring & Backup Ring Installation

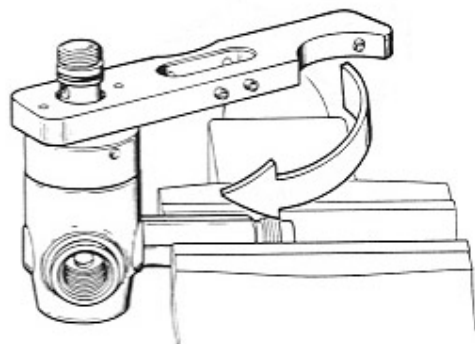


Fig. 12 - Tightening Piston Cap

9. Closely examine both sides of the backup ring(18) to determine which side is slightly concave. Place the O-ring(19) down over the rod portion of the Seat Extraction/ Installation Tool (P/N 1094-36), followed by the backup ring with the concave side facing against the O-ring (see Fig. 10).
10. Carefully insert the rod portion of the Seat Installation Tool through the open high pressure chamber and into the open end of the piston shaft. Gently tamp the backup ring and O-ring down over the piston shaft, and remove the tool (see Fig. 11).
11. Use the Seat Installation Tool to install the thrust bearing(20) down and over the piston shaft in the same manner, with the flat side facing down and against the O-ring.
12. Gently place the secondary spring(21) inside the high pressure chamber, down over the thrust bearing and piston shaft. Tamp the spring down to ensure that the O-ring, backup ring, and thrust bearing are completely seated.
13. Stretch the end plug O-ring(23) over the flat side of the end plug(24) to install it into its grooved seating surface. (Do not roll it down over the threads.)
14. Place the high pressure seat(22) inside the end plug and mate the end plug into the high pressure chamber of the body, being careful to prevent the seat from dropping out. Turn the end plug clockwise by hand to engage the threads, and apply the No. 1 Spanner to tighten the end plug until snug, or until the outer surface of the end plug is flush with the outer surface of the body.
15. Install a vise mounting tool (P/N 1003-95) or a discharged CO₂ cartridge (P/N 7039-09) connected to a HP port adapter (P/N 1020-85) into one of the HP ports of the first stage.



CAUTION: DO NOT use a CO₂ cartridge which has not been discharged. Doing so may cause the cartridge to rupture, resulting in serious personal injury.

16. Secure the vise mounting tool inside a bench vise so that the first stage is standing vertical outside the vice with the swivel stem of the piston cap facing straight up.
17. Apply the No. 2 Spanner of the Quad Spanner Wrench over the piston cap stem, and mate it securely onto the flat surface of the piston cap (see Fig. 12). While holding the tool and first stage level and securely seated with one hand, turn the piston cap clockwise to tighten until it is snug and seated flush against the body.



CAUTION: Be certain to hold the Spanner Wrench securely seated in the recessed holes of the piston cap while turning. Damage to the chrome finish will result if the wrench is allowed to slip.

18. Place the large end of the swivel cap(31) over the stem of the piston cap, and press it down until it audibly snaps into place.

19. Apply only one small drop of medium strength (serviceable) thread adhesive to the center threads of the swivel retainer(34), and immediately mate the retainer onto the piston cap stem (see Fig. 13). Turn the retainer clockwise by hand to engage the threads.
20. Apply the No. 3 Spanner to tighten the swivel retainer further until completely snug (see Fig. 14).

NOTE: A very small gap between the swivel and the swivel retainer will remain visible after the swivel retainer has been completely tightened.

CAUTION: DO NOT attempt to overtighten beyond the limits of thread engagement. Doing so will cause damage to the tool, the parts, or both.

21. Install the O-ring(9) into the recessed groove inside the inlet fitting(10).
22. Install a new filter(8) into the yoke retainer with the conical portion facing downward, and press it firmly into place to ensure that it seats inside the recessed O-ring. Install a new filter retainer(7) to secure the filter.
23. Install the O-ring(11) over the stem of the inlet fitting and into the groove at the base of the threads, and set the inlet fitting aside.
24. Loosen the vise and reposition the first stage to lay horizontal, with the inlet opening of the body facing straight up, and refasten the vise securely onto the vise mounting tool.
25. Lay the yoke washer(4) down over the inlet opening of the main body. Insert the threaded stem of the inlet fitting through the yoke(3). While holding the inlet fitting and yoke together, mate the inlet fitting into the body and turn it clockwise to engage the threads.
26. Tighten the inlet fitting further clockwise by hand until snug, and apply a torque wrench with 26mm crow-foot to tighten to a pre-set measurement of 20 (± 2) foot-lbs (see Fig. 15).
27. Loosen the vise to remove the first stage. Remove the vise mounting tool from the body and set it aside.
28. Hold the first stage standing horizontal, so that the high pressure end is facing up. Using a syringe, if available, or squeeze bottle, slowly inject or pour approximately 11.5 cc's silicone fluid (P/N 1088-65) into the secondary diaphragm orifice until the ambient chamber is completely filled. Slowly rotate the first stage and tap it lightly to dislodge any loose bubbles. Top off as needed, until the secondary diaphragm cavity of the body is at least half full of fluid (see Fig. 16).

WARNING: Failure to fill the ambient chamber completely full with silicone fluid before sealing will result in substandard performance of the regulator, and may possibly cause an "air starvation" situation at deeper depths.

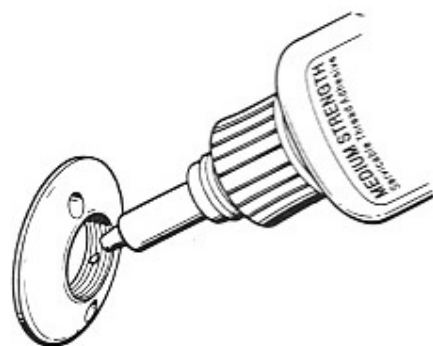


Fig. 13 - Thread Adhesive Application

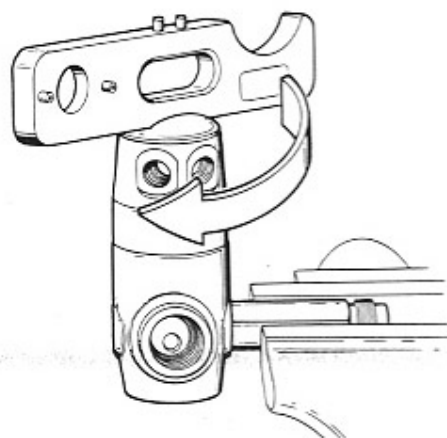


Fig. 14 - Swivel Retainer Installation

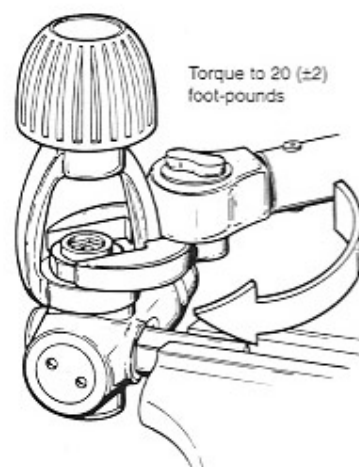


Fig. 15 - Torquing Inlet Fitting

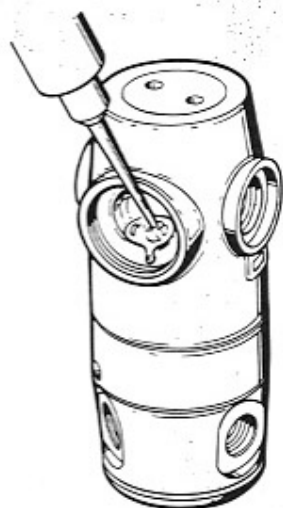


Fig. 16 - Filling Ambient Chamber w/ Silicone



Fig. 17 - Secondary Diaphragm Installation


29. While holding the first stage with the secondary diaphragm orifice facing up to prevent any spillage of silicone fluid, install the secondary diaphragm(24), with the dimple facing into the round cavity of the body (see Fig. 17). Carefully tamp the diaphragm into place to ensure that it is evenly seated in the recessed groove below the base of the threads.
30. Install the secondary diaphragm retainer(26) into the body, and apply a 8mm hex key to tighten it clockwise until completely snug. With a clean towel, wipe the first stage thoroughly clean of any excess silicone fluid that may have been displaced.
31. Install the O-ring(6) into the dust cap(5). Wrap the nylon cord that is tied to the dust cap around one leg of the yoke, and pass the cap through the loop to form a loose knot.
32. Lightly lubricate the threads of the yoke screw(2) with silicone grease. Turn the yoke screw clockwise to install it into the yoke.
33. Lubricate and install all O-rings(27&32) onto all hoses and port plugs. Install all LP hoses and port plugs(33) into their respective ports of the swivel cap, and the HP hose(s) and port plug(28) into the HP ports of the main body. Apply a torque wrench with hex key or crow-foot to tighten these to a torque measurement of 40 (± 2) inch-pounds.


! WARNING: Be certain not to install any low pressure hoses into the high pressure ports via an adapter. Doing so will cause the hose to rupture when pressurized, and may result in severe personal injury.

This concludes the reassembly of the Pioneer first stage with standard yoke connector. Refer directly to the following section, titled Final Testing.


Final 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 IP hose, depending on the connector of the test gauge.


 **NOTE:** Whenever possible, U.S. Divers strongly recommends that a fully assembled and properly adjusted second stage 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 counter-clockwise to ensure that it is open before pressurizing. Failure to relieve intermediate pressure in excess of 400 psi may result in damage or rupture of the test gauge or IP hose.

2. Connect the first stage to a cylinder that is filled with 300 psi and 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 143 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. Refer directly to Table 1 - Troubleshooting, and remedy as needed before proceeding any further.

3. When the intermediate pressure has been determined to be 143 psi or less, turn the cylinder valve completely shut and open the bleed valve of the test gauge or purge the second stage to depressurize the system. Loosen the yoke screw and remove the first stage from the cylinder. Connect the first stage to a cylinder that is filled with 2,500 - 3,000 psi.

 **NOTE:** Correct intermediate pressure for the Pioneer first stage is 138 (± 5) psi, with an inlet pressure between 2,500 - 3,000 psi.

4. Open the cylinder valve while monitoring the IP test gauge once again to ensure that the intermediate pressure does not rise above 143 psi. If the intermediate pressure rises above 143 psi, immediately reopen the bleed valve of the test gauge and shut the valve of the supply cylinder. Refer directly to Table 1 - Troubleshooting, and remedy as needed before proceeding.
5. 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 138 (± 5) psi, with no signs of creeping or fluctuation.

6. After determining that the intermediate pressure holds stable at 138 (± 5) psi, refer to the Final Adjustment & Testing procedures outlined to perform the final tuning of the second stage while connected to the newly serviced first stage.
7. External Leak Test - After first stage reassembly and final adjustment of the second stage has been completed, submerge the entire regulator in a test tank of clean water while pressurized with 2,500-3000 psi. Observe any bubbles arising from the submerged regulator over a one 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).



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 (25 psi) air. Disassemble and remedy the problem, referring to Table 1 - Troubleshooting.

8. Subjective Breathing Test - 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 1 - Troubleshooting. Also, depress the purge button fully to ensure that an adequate volume of air needed to clear the second stage flows through the mouthpiece.
9. When the second stage has been adjusted and tested according to the prescribed procedures, turn the supply cylinder valve completely shut, and purge the second stage or open the test gauge bleed valve to depressurize the system. Loosen the yoke screw to remove the first stage from the cylinder, and seal the dust cap over the inlet fitting. If necessary, dry the regulator completely with a clean towel.

This concludes annual service procedures for the Pioneer First stage regulator.

Table 1
Troubleshooting Guide
Pioneer First stage

SYMPTOM	POSSIBLE CAUSE	TREATMENT
Restricted airflow/ high inhalation resistance through entire system.	<ol style="list-style-type: none"> 1. Cylinder valve not completely opened. 2. Cylinder valve requires service. 3. Conical filter(8) is contaminated. 4. Ambient chamber not completely filled with silicone fluid. 5. Insufficient intermediate pressure. 	<ol style="list-style-type: none"> 1. Open valve, check fill pressure. 2. Connect to a different cylinder. 3. Replace filter w/ new. 4. Refill ambient chamber with silicone fluid to fullest level. 5. See below.
Insufficient intermediate (over-bottom) pressure.	<ol style="list-style-type: none"> 1. HP end plug(24) is loose. 2. Main spring(16) is weakened. 	<ol style="list-style-type: none"> 1. Tighten end plug until snug. 2. Replace main spring.
External leakage of silicone fluid.	<ol style="list-style-type: none"> 1. Piston cap(29) loose. 2. Diaphragm retainer(26) loose. 3. Secondary diaphragm(25) damaged. 	<ol style="list-style-type: none"> 1. Replace fluid. 2. Replace diaphragm & fluid. 3. Replace diaphragm & fluid.
High intermediate pressure (leakage or freeflow through second stage).	<ol style="list-style-type: none"> 1. HP seat(22) damaged or worn. 2. Sealing surface of piston(15) damaged. 3. Dynamic O-rings(14 or 19) damaged or worn. 4. Body(17) damaged internally. 	<ol style="list-style-type: none"> 1. Replace HP seat. 2. Replace piston. 3. Replace O-rings. 4. Replace body.
Leakage of air beneath yoke.	<ol style="list-style-type: none"> 1. Inlet O-ring(11) damaged or worn. 	<ol style="list-style-type: none"> 1. Replace O-ring.
Leakage of air between piston cap and swivel cap.	<ol style="list-style-type: none"> 1. Swivel O-rings(30) damaged or worn. 	<ol style="list-style-type: none"> 1. Replace O-rings.
Leakage of air from HP end plug.	<ol style="list-style-type: none"> 1. End plug O-ring(23) damaged or worn. 	<ol style="list-style-type: none"> 1. Replace O-ring.

NOTE: This is a partial list of possible problems and recommended treatments. For more information, 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.

Table 2
Recommended Tool List
Pioneer First stage

PART NO.	DESCRIPTION	APPLICATION
7803-00	Aqua-Lung Service Manual	All Aqua-Lung regulators
1116-00	I.P. test gauge	Intermediate pressure testing
N/A	0-120 inch-lbs torque wrench	Small fittings
N/A	10-50 foot-lbs torque wrench	Large fittings
9440-22	O-ring tools	O-ring removal & installation
N/A	Bench vise	First stage disassembly/reassembly
1003-95	Vise mounting tool	First stage disassembly/reassembly
7039-09 w/ 1020-85	Empty CO ₂ cartridge w/ adapter	(Can be used instead of vise mounting tool)
N/A	Magnifier w/ illumination	Sealing surface inspection
N/A	Ultrasonic cleaner	Brass & stainless steel parts cleaning
N/A	4mm or 5/32" hex key	Piston diaphragm removal & installation
N/A	3/16" open-end wrench/ crow-foot	Low pressure hose removal & installation
N/A	5/8" open-end wrench/ crow-foot	High pressure hose removal & installation
N/A	2.0mm (jeweler's) screwdriver	Filter retainer removal
N/A	26mm open-end wrench/ crow-foot	Inlet fitting removal
1077-50	Quad Spanner Wrench	First stage disassembly & reassembly
1073-94	Adjustable Face Spanner	Swivel retainer removal (alternative method)
N/A	8mm hex key	Secondary diaphragm removal & installation
N/A	6mm open-end wrench	Piston diaphragm removal & installation
1094-36	Seat extraction/installation tool	Piston shaft O-ring & backup ring installation
N/A	Syringe or squeeze bottle	Silicone fluid installation

Table 3
Standard Parts Replacement Schedule
Pioneer First stage

PART NUMBER	DESCRIPTION	KEY NUMBER	QTY
8201-20	O-ring	6	1
1068-29	Conical Filter	8	1
8200-14	O-ring	9 & 30	2
8244-06	O-ring	11	1
1077-08	Piston Diaphragm	13	1
1067-37	O-ring	14	1
1077-58	Backup Ring	18	1
1068-21	O-ring	19	1
1068-26	HP Seat	22	1
8200-18	O-ring	23	1
1077-52	Secondary Diaphragm	25	1
9570-04	O-ring	27	2
8200-11	O-ring	32	4
1088-65	Silicone Fluid	n/s	11-12 cc

Table 4
Torque Specifications
Pioneer First stage

PART NUMBER	DESCRIPTION / KEY NUMBER	TORQUE
1077-07	Piston Diaphragm Retainer / 12	50 (±2) inch-lbs
1063-39	Inlet Fitting / 10	20 (±2) foot-lbs
1063-03	Port Plug / 28 or HP Hose	40 (±2) inch-lbs
1043-04	Port Plug / 33 or LP Hose	40 (±2) inch-lbs

Table 5
Test Bench Specifications
Pioneer First Stage


TEST	CONDITION	ACCEPTABLE RANGE
Leak test	Inlet 2,500-3,000 psi	None
Intermediate pressure	Inlet 2,500-3,000 psi	138 (± 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 +2.0 inch H ₂ O
Flow effort	Intermediate pressure 135 (± 5) psi at 10 SCFM	+6 inches H ₂ O (maximum)
Purge flow	Intermediate pressure 135 (± 5) psi	5.0 SCFM flow rate (minimum)


Procedure A


Cleaning & Lubrication

(All Aqua-Lung Regulators)

1. **Acid Bath** - U.S. Divers strongly recommends ChromeSafe™ regulator cleaner (P/N 0201-09) 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. **Neutralizing Bath** (optional) - Mix ¼ cup sodium bicarbonate to one quart water. Remove parts from the acid bath and place directly into this solution for 30-60 seconds.
3. **Fresh Water Rinse** - If tap water is extremely "hard," distilled water may be used to prevent any mineral residue. Remove parts from the neutralizing bath and place directly into this rinse. Agitate lightly, and allow to soak for at least 15 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 Dow Corning® 111 (or equivalent) pure silicone grease only. 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.

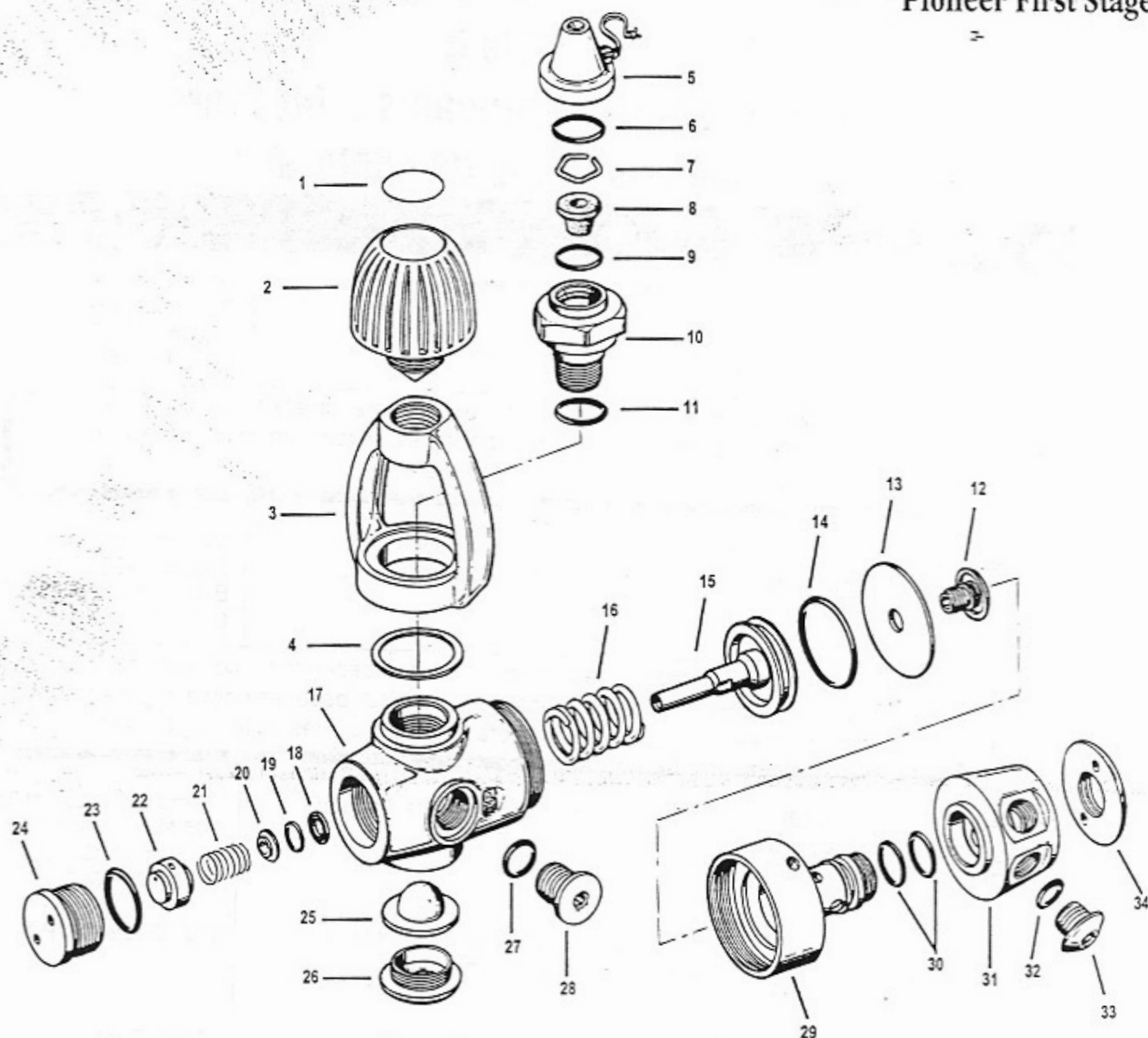
Table A

Recommended Lubricants & Cleaners

(All Aqua-Lung Regulators)

Dow Corning® 111 (pure silicone grease)	All O-rings; threaded metal parts	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 reuseable stainless steel and brass parts.	U.S. Divers Co. P/N 0201-09
Oakite #31	Acid bath for reuseable stainless steel and brass parts.	Oakite Products, Inc. 50 Valley Road Berkeley Heights, NJ 07922
White distilled vinegar (100 gr.)	Acid bath for reuseable 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 216-951-7100

Pioneer First Stage



Key #	Part #	Description
—	1077-62	First Stage, Pioneer
1	1003-88	Decal
2	1075-06	Yoke Screw
3	1073-11	Yoke
4	1077-59	Yoke Washer
5	1010-12	Dust Cap
6	8201-20	O-ring
7	1067-24	Filter Retainer
8	8630-51	Circlip (Alternate Filter Retainer)
9	1068-29	Conical Filter
10	1063-39	Inlet Fitting
11	8244-06	O-ring
12	1077-07	Diaphragm Retainer
13	1077-08	Diaphragm
14	1067-37	O-ring
15	1077-03	Piston
16	1067-71	Main Spring
17	1077-04	Body
18	1077-58	Backup Ring

Key #	Part #	Description
19	1068-21	O-ring
20	1068-25	Thrust Bearing
21	1067-23	Spring
22	1068-26	HP Seat
23	8200-18	O-ring
24	1068-28	End Plug
25	1077-52	Secondary Diaphragm
26	1077-53	Diaphragm Retainer
27	9570-04	O-ring
28	1063-03	HP Port Plug
29	1068-16	Piston Cap
30	8200-14	O-ring
31	1068-19	Swivel Cap
32	8200-11	O-ring
33	1043-04	LP Port Plug
34	1068-33	Swivel Retainer
n/s	1088-65	Silicone Oil

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