



XL4 SECOND STAGE REGULATOR



MAINTENANCE MANUAL FOR AUTHORISED TECHNICIANS

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XL4 Second Stage Maintenance Manual
(AP5840 Issue 1)

INTRODUCTION

This manual provides factory prescribed procedures for the correct maintenance and repair of the Apeks XL4 second stage regulators. It is not intended to be used as an instructional manual for untrained personnel. The procedures outlined within this manual are to be performed only by personnel who have received factory authorised training through an Apeks Service & Repair Seminar. If you do not completely understand all of the procedures outlined in this manual, contact Apeks 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:



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



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



NOTES are used to emphasise important points, tips, and reminders.

SCHEDULED SERVICE

It is recommended that the Apeks XL4 2nd Stage regulator should be examined annually regardless of usage.

A full service should be performed every two years.

However, If you are at all unsure about the correct functioning of the Apeks XL4 2nd Stage then it must be officially inspected immediately.

All service and inspection details need to be documented to keep the *Limited Lifetime Warranty* in effect.

A Second Stage Official Inspection consists of:

1. Checking the lever height with setting tool.
2. Checking for opening effort that is within the acceptable range.
3. A pressurised immersion test of the entire unit to check for air leakage.
4. A visual inspection of the exhaust valve(s) to see that they are in good condition and that it is seating against a clean and undamaged surface.
5. Pulling back hose protectors and checking that the hoses are secure in the hose crimps.
6. A visual inspection of the mouthpiece looking for tears or holes and checking the general condition.

If a regulator fails steps 1,2 or 3 the entire regulator should be serviced. If a regulator fails step 4 it will be up to the technician's discretion whether or not a full service is required. Failure of step 5 or 6 requires replacement of the part.

HOSE INSPECTION & CLEANING PROCEDURE

Please refer to separate document labelled "Hose Inspection & Cleaning Procedure" for full details of the maintenance of hoses which can be found in the Technical section of the Apeks website.

AQUA LUNG



HOSE INSPECTION AND
CLEANING PROCEDURE

GENERAL GUIDELINES

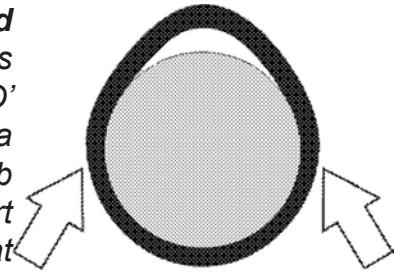
1. In order to correctly perform the procedures outlined in this manual, it is important to follow each step exactly in the order given. Read over the entire manual to become familiar with all procedures and to learn which specialty tools and replacement parts will be required before commencing disassembly. 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. During disassembly, reusable components should be segregated and not allowed to intermix with non reusable parts or parts from other units. Delicate parts, including inlet fittings and valve seats which contain critical sealing surfaces, must be protected and isolated from other parts to prevent damage during the cleaning procedure.
4. Use only genuine Apeks parts provided in the 2nd stage service kit (AP0219). DO NOT attempt to substitute an Apeks part with another manufacturer's, regardless of any similarity in shape or size.
5. 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.
6. When reassembling, it is important to follow every torque specification prescribed in this manual, using a calibrated torque wrench. Most parts are made of either marine brass or plastic, and can be permanently damaged by undue stress.

GENERAL CONVENTIONS

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


1. When instructed to *remove, unscrew, or loosen* a threaded part, turn the part anti-clockwise.
2. When instructed to *install, screw in, or tighten* a threaded part, turn the part clockwise.
3. When instructed to remove an 'O' Ring, use the pinch method (see figure below) if possible, or use a brass, aluminium or plastic 'O' Ring removal tool. Avoid using hardened steel picks, as they may damage 'O' Ring sealing surfaces. All 'O' Rings that are removed are discarded and replaced with brand new 'O' Rings.


Pinch Method
Press upwards on sides of 'O' Ring to create a protrusion. Grab 'O' Ring or insert 'O' Ring tool at protrusion.



4. The following acronyms are used throughout the manual: MP is Medium Pressure; HP is High Pressure; PN is Part Number.
5. Numbers in parentheses reference the key numbers on the exploded parts schematics. For example, in the statement, "...remove 'O' ring (11) from...", the number 11 is the key number to the Inlet Fitting 'O' Ring.

DISASSEMBLY PROCEDURES

 **NOTE:** Before performing any disassembly, refer to the exploded parts drawing, which references all mandatory replacement parts. These parts should be replaced with new, and must not be reused under any circumstances - regardless of the age of the regulator or how much use it has received since it was last serviced.

 **CAUTION:** Use only a plastic, brass or aluminium 'O' Ring removal tool (PN AT79) when removing 'O' Rings to prevent damage to the sealing surface. Even a small scratch across an 'O' Ring sealing surface could result in leakage. Once an 'O' Ring sealing surface has been damaged, the part must be replaced with new. DO NOT use a dental pick, or any other steel instrument.

Removal of hose

1. Using a 13/16" spanner hold the Inlet Shroud (18) whilst undoing the hose with an 11/16" spanner (AT39).



2. Remove O Rings (17) and (28) from the hose (30). Exercise caution not to scratch the O Ring groove in the hose swivel.



3. Pull back the two Hose Protectors (29) and inspect the hose crimps. If either crimp is damaged or the hose is pulling out of the crimp then the hose must be replaced.



NOTE: Before starting reassembly refer to Hose Inspection & Cleaning Procedure found on page 4.

Removal of Exhaust Tee

4. Place one finger into each side of the Exhaust Tee (7) and squeeze them together. Pull the Exhaust Tee away from the Case (13).



Removal of Mouthpiece

5. Unfasten the Mouthpiece Clip (12) and pull the Mouthpiece off the Case(13)



Removal of Front Cover & Diaphragm

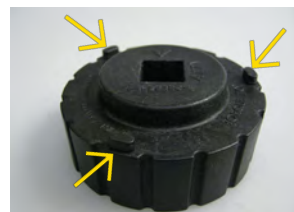
6. To remove the XL4 Clamp Ring (1) place your thumb on the top of the clamp ring as shown on the first image below. Grip the rest of the clamp ring and turn anti-clockwise. Separate the Purge Clamp Ring (1) from the Purge Button assembly and the Case (13).



NOTE: Failure to hold the Clamp Ring as outlined in section 6 may result in the cover being more difficult to remove due pressure being applied to the locking mechanism.



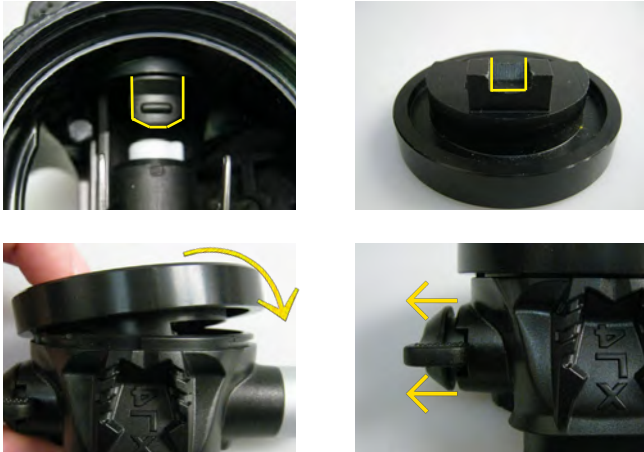
7. Locate the three kidney shaped pegs of the AT71 Locking Ring Tool into the slots of the Inner Locking Ring (4). Unscrew the Inner Locking Ring (4). Remove the Friction Ring (5) and the Diaphragm (6) from inside of the Case (13).



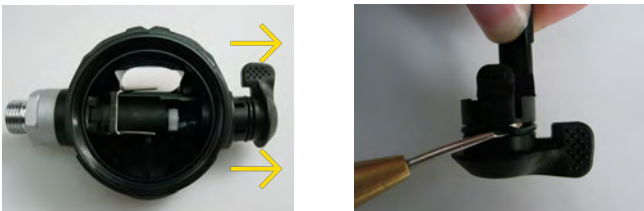
Removal of Venturi Lever & Spindle

CAUTION: Take care not to damage or distort the Lever (15) when removing the Venturi Lever (9). DO NOT depress the tab of the Venturi Lever too far, as this will result in permanent deformation.

8. To remove the Venturi Lever (9) from the Case (13), position the lever vertically so that the tab is visible as shown in the first image below. Locate the venturi lever removal tool (AT77) slot on the venturi lever, then press down on the opposite side to push out the venturi lever.



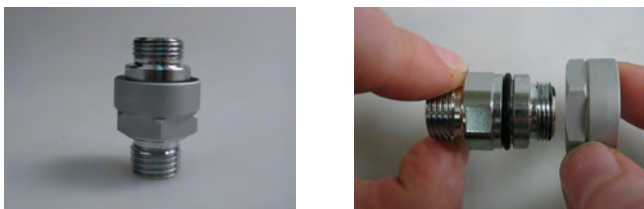
9. Totally slide out the Venturi Lever (9) from the body (13). Remove the 'O' ring (10) from the Venturi Lever (9) taking care not to scratch the 'O' ring Groove.



10. Using a 13/16" Spanner unscrew the Inlet Shroud (18).

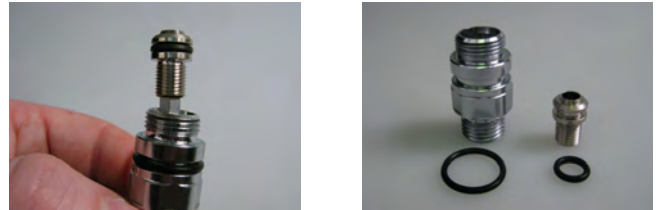


11. The Inlet Shroud assembly will remove as one. To separate grip the 3/8" regulator hose thread on the Inlet Shroud Fitting (20) and slide off the Inlet Shroud (18).



NOTE: There will be some slight resistance removing the two parts above due to the O Ring (19) underneath the Inlet Shroud (18).

12. Using a 5mm Hex Key (AT37) unscrew the Valve Seat (16) from the Inlet Shroud Fitting (20). Once satisfied that the thread has disengaged, the Valve Seat may need a little push as the O ring will be holding it in the bore of the Inlet Shroud Fitting. Remove O Rings (19) and (17).



NOTE: Hold the Inlet Shroud Fitting and unscrew the Valve Seat clockwise.

13. To remove the spindle assembly from the Case (13) use the opposite end of the cracking effort adjuster tool (AT76) to push it out.



14. Once the Lever assembly is free from the Case (13) push it backwards towards the Venturi Lever hole, then lift out as shown.



15. To remove the Lever (15) from the Spindle Body (14) screw the AT48 tool into the spindle to compress the spring. Carefully pull one of the legs out of the Valve Body and then ease the second leg out. Separate the Shuttle Valve assembly (22-27) as shown below, making sure that the 'O' ring (25) is removed from the Shuttle Valve (26).



NOTE: O-Ring (25) may remain in the shuttle valve (26) when disassembled, make sure it is removed before proceeding.



NOTE: There is no need to remove the Micro Adjuster Screw (21) from the Spindle Adjuster Sleeve (22).



16. Fold back the edges of the Exhaust Valve (8) and inspect underneath. The seating surface should be clean and free of damage. Inspect the Exhaust Valve. It should be supple and have well defined edges. If it looks good, there is no need to remove it and it may be reused. If there is any sign of deterioration, it should be replaced.

NOTE: If the Exhaust Valve (8) is to be removed, pinch the edge of the Valve and pull the tail through the hole in the Case (13).



This Ends Disassembly

Before starting reassembly, perform parts cleaning and lubrication according to the procedures outlined in 'Cleaning & Lubrication' on page 17.

INSPECTION PROCEDURES

NOTE: Before performing any reassembly procedures, some parts must be inspected. The following section details the parts and areas that must be checked.

The following parts should be checked for cracks, deep scratches, excessive wear and tear and distortion.

Sealing faces, grooves and bores should be checked for scratches.

Purge Button Assembly (2) and (3)

1. Inspect the back face of the Purge Button (2) and, ensure that the Rubber Purge Spring is firmly located around the entire perimeter of the Button.



Venturi Lever (9)

2. Check that the tab of the Venturi Lever (9) has not been over stressed and that it is level with the rest of the lever.



Spindle (14)

3. Check that the Spindle Body (14) is free from scratches, cracks and distortion. Look for excessive wear around the Lever holes. Check that the thread is in good condition.



NOTE: Before starting reassembly refer to Hose Inspection & Cleaning Procedure found on page 4.

REASSEMBLY PROCEDURES

Assembling of the Spindle Body

1. Carefully insert the Spindle Adjuster Sleeve (22) into the Spindle Body (14). Ensure that two legs of the Spindle Adjuster Sleeve correctly line up with the slots in the Body. Check the Spindle Adjuster Sleeve is firmly pressed into the end of the Body.



2. Press the Shuttle Valve (26) down firmly onto the Silicone Valve Seat (27), making sure it is fully engaged.



CAUTION: Ensure the work surface is clean and free from debris. DO NOT mark the face of the Silicone seating, this will cause the 2nd stage to leak when fully assembled.

3. Install a new lubricated 'O' ring (25) onto the Spring Carrier (23), followed by the Spring (24). Fit the Shuttle Valve (26) onto the Spring Carrier and Spring, carefully guiding the end of the Carrier into the bore of the Shuttle valve.



4. Insert the Spring Carrier end of the assembly into the Spindle Body (14). Screw in the AT48 tool to fully compress the Spring until it passes the triangular shaped hole in the Body.



CAUTION: Ensure that the Lever is not twisted and that legs are parallel. Lever should appear as that shown on the left, not as shown on the right. If necessary, gently squeeze legs together to straighten.



5. Insert the feet of the Lever (15) into the gap, this retains the Shuttle Valve inside the Body. Ensure the feet are engaged fully in the Shuttle Valve (26) and the Lever is parallel to the Spindle Body (14). Press down on the Lever (15) to disengage the Silicone Seat (27) and remove the tool AT48.



NOTE: Ensure that the Lever has a full range of movement and does not catch on the Valve Spindle Body. Ensure that the spring can be seen through the Valve Spindle Hole.



Fitting Spindle Assembly into Case

CAUTION: DO NOT use the lever to push the Spindle into the case as this will bend the lever.

6. Insert the Spindle Body assembly into the Case. Insert the Spindle Adjuster side first into the Venturi Lever hole then slide back so the Silicone Valve Seat end engages into the Body snug.




NOTE: The longer lug on the underside of the Spindle Body (14) should engage into the slot in the Body (13).



7. Using the opposite end of the Cracking Adjuster tool (AT76) lined up with the Spindle Adjuster Sleeve (22) push the Spindle Assembly firmly into the Case ensuring that there is no gap between the two parts. Ensure that the Lever has a full range of movement and does not catch on the Valve Spindle Body.



 **NOTE:** The square lug on the top side of the Spindle Body (14) should engage into the slot in the Body (13).

8. Install a new Lubricated 'O' ring (17) onto the Valve Seat (16) and O Ring (19) onto the Inlet Shrouded Fitting (20).



9. Carefully push the Valve Seat (16) into the larger diameter bore of the Inlet Shrouded Fitting (20) threaded end first. Using a 5mm Hex Key (AT37) turn the valve seat counter clockwise until it bottoms out.




10. Slide the Inlet Shroud (18) onto the Inlet Shroud Fitting (20) hex side first past the already installed O Ring.




11. Screw the Inlet Fitting assembly into the Spindle Body (14) and torque to 3 Nm (2.2ft.lb) using a 13/16" socket.



 **NOTE:** The 13/16" socket can be used on it's own to get a better grip when fitting the Inlet Fitting assembly.


12. While holding the Case (13) at eye level, use a 5mm Hex Key (AT37) to screw the Valve Seat (16) clockwise until the Lever (15) drops just below the rim of the Case. Check by gently flicking the lever, it should bounce and have free movement. The lever should return to its set position, if it sticks then the lever is not square, fitted incorrectly or it is bent.




 **CAUTION:** Ensure that the Lever (15) moves freely and sits vertically within the case (13).

13. Refit the Diaphragm (6) into the front of the Case (13). Using your finger carefully work the edges of the Diaphragm into place so it sits evenly in the Case. Insert the Friction Ring (5) into the case. Use the same technique to ensure it sits evenly onto the Diaphragm.



 **CAUTION:** Ensure that the Diaphragm (6) and Friction Ring (5) are seated correctly and are not creased.

14. Fit the Inner Locking Ring (4) ensuring the 3 small grooves are facing up. (see pic below). Using the AT71 Tool slowly screw the Inner Locking Ring into the Case. Hand tighten only.

 **NOTE:** Refer to section 7 on page 6 for Tool use instructions.



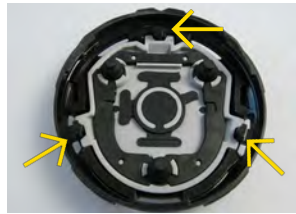
14 cont'd. Once the diaphragm is secure, gently grip the diaphragm pad between the thumb and forefinger, and gently pull from side to side to check the diaphragm is secure.



Before starting Final Assembly, perform Final Testing according to the procedures outlined in 'Final Testing' on page 12.

Final Assembly

1. Place the Purge Button (2) inside the Clamp Ring (1) ensuring the three locating tabs line up.



2. Fit the front cover assembly onto the case (13) roughly at the 11 o'clock position then turn clockwise until the cover locks firmly into position.



3. Install a new lubricated 'O' ring (10) onto the Venturi Lever (9). Align the Venturi Lever in a vertical position with the Case (13) and press the lever into place. Ensure that the Venturi Lever rotates freely and feels secure.



NOTE: The thumb grip section of the Venturi Lever needs to fit in the grooved section on the Case.



NOTE: To check that the Diaphragm has sealed correctly, place your thumb over the end of the Inlet Fitting with the hose removed (see paragraph 1 in disassembly to remove and paragraph 4 and 5 in final assembly to refit) . Suck and hold at the mouthpiece port, a vacuum should be held without any leakage.

4. If equipped with a Comfo-bite Mouthpiece, make sure the 'bridge' of the Mouthpiece (11) is facing upward. Stretch the Mouthpiece over the second-stage Mouthpiece outlet port.



At the base of the Mouthpiece is a groove for the Mouthpiece Clip (12). Wrap the Clip around the Mouthpiece so that the buckle points toward the Hose. Fasten the Clip, ensuring that the Mouthpiece (11) is securely held in place.



5. Locate the bottom of the Exhaust Tee (7) onto the Case (13). Place a thumb in each exhaust port and push the Tee towards the mouthpiece. Ensure that the Tee fits over the Case and is secure. Taking care not to damage or dislodge the Exhaust Valve (8).



NOTE: Ensure the Exhaust Tee is captured fully by the Case



6. Fit O Ring (28) onto the first stage end of the hose and O ring (17) into the Hose Swivel end of the hose.



7. Screw the Hose onto the second stage. Using a 11/16" crowsfoot, torque to 5Nm (3.7 ft/lb), holding the Inlet Shroud (18) with a 13/16" spanner.



This Ends Reassembly

FINAL TESTING

WARNING: Compressed air can be highly explosive and is dangerous if misused. Ensure the cylinder valve is opened slowly. Use eye and ear personal protective equipment when performing any tests involving compressed air.

Setting the Lever Height

1. Attach an Inline Adjustment Tool (AT72) to a regulator hose on a correctly set first stage. Refer to the appropriate first stage technical manual before attempting to perform any adjustments.



2. Screw the Inline Adjustment Tool onto the threaded end of the 2nd stage. Attach the first stage to a cylinder containing 207 Bar (3000 psi). Slowly open the cylinder valve and pressurise the regulator.



NOTE: If the 2nd stage is leaking turn the inline adjuster clockwise until the leaking stops.



3. Purge the 2nd stage gently 2 to 3 times to check there is air flow.



4. Place the "GAS FLOW" side of the testing puck section on the Setting Tool (AT75) over the plastic pad of the Diaphragm. There should be a flow of air, if not adjust the inline adjuster counter clockwise in 1/16 turns until there is a steady flow.



NOTE: Keep the puck in place whilst making adjustments

NOTE: "NO GAS" will be visible when performing gas flow setting.

CAUTION: The air flow should be continuous with no fluttering

CAUTION: Free flow test should be done every time the lever height has been adjusted.

5. Turn the puck section of the adjustment tool (AT75) to the opposite side "NO GAS FLOW" to check that the lever is set correct and there is no flow of air.



NOTE: "GAS FLOW" will be visible on the tool when checking no gas flow.

NOTE: If there is gas flow, keep the puck on "NO GAS FLOW" and turn the inline adjuster clockwise in 1/16 increments until the flow ceases. Turn the puck back to "GAS FLOW" to make sure there is still air flow.

NOTE: It is important to ensure that the rim of the tool is concentric with the rim of the inner locking ring throughout. Pressing on the plastic pad of the Diaphragm with the tool misaligned will not measure the purge button depth and therefore give incorrect results.

Second Stage Opening Effort Test

1. Insert the Micro Adjuster Tool (AT76) into the open side of the Case (13), making sure that the hexagonal bit engages into the Micro Adjuster Screw (21). Connect the first stage regulator to a calibrated test bench and pressurise the system to 207 bar (3000 psi). Slowly open the flowmeter control knob (start vacuum) while watching both the magnahelic gauge and the intermediate pressure gauge.



2. When the intermediate pressure begins to drop, indicating the second-stage valve is open, the magnahelic gauge should indicate an opening effort of +1.4 in.H₂O (3.5 mbar) to +1.6 in.H₂O (4 mbar). If the reading is outside of these specifications, adjust the Micro Adjuster Screw (21), turning anti-clockwise to lower the opening effort or clockwise to increase the opening effort. If this fails to give the correct reading refer to "Table 1 - Troubleshooting" for corrective actions.



3. With the second stage still attached to the Magnehelic mouthpiece, turn the supply off, the vacuum gauge should read above 100mm Hg (53.5" of water)



NOTE: If the Magnehelic being used isn't fitted with a vacuum gauge you will need to perform the test orally. Place your thumb over the inlet fitting and inhale normally through the mouthpiece. If you can draw air in or hear air flow refer to the trouble shooting guide on page 14.

Immersion Test

1. After disconnecting the regulator from the flow bench, connect it to a gas cylinder filled to approximately 200 bar. Open the cylinder valve to repressurise the regulator, and submerge the entire system in a test tank of clean water.



2. 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 the system to 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 air. Disassemble and remedy the problem, referring to "Table 1 - Troubleshooting."

Subjective Breathing Test

1. Depress the Purge Button (2) fully to ensure that an adequate volume of air needed to clear the second stage flows through the mouthpiece. Then, inhale slowly but deeply from the mouthpiece. 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".

2. With the Venturi Lever set to the + position tap the Purge Button quickly, this should cause the regulator to freeflow. Stop the freeflow after a couple of seconds by placing a hand over the mouthpiece.

Table 1 - Troubleshooting Guide

SYMPTOM	POSSIBLE CAUSE	TREATMENT
Leakage or freeflow from Flight Second Stage	1. Excessively high first-stage intermediate pressure.	1. Refer to first-stage Troubleshooting Guide.
	2. Silicone seating (27) damaged or worn.	2. Replace with Silicone Seating.
	3. Valve Seat (16) adjusted incorrectly, Lever (15) set too high.	3. Reset Seat preliminary settings, and repeat Adjustment Procedures.
	4. Lever (15) bent.	4. Replace Lever.
	5. Valve Seat (16) sealing surface damaged.	5. Replace Valve Seat.
	6. Spring (24) damaged.	6. Replace Spring.
	7. Shuttle Valve 'O' Ring (25) damaged.	7. Replace 'O' Ring.
	8. Shuttle Valve (26) bore damaged.	8. Replace Shuttle Valve.
	9. Venturi Lever 'O' Ring (10) damaged.	9. Replace 'O' Ring.
Low purge or excessive work of breathing (full cylinder)	1. Low first-stage intermediate pressure.	1. Refer to first-stage Troubleshooting Guide.
	2. Seat (16) adjusted incorrectly, Lever (15) set too low.	2. Reset Seat preliminary settings, and repeat Adjustment Procedures.
	3. Intermediate pressure hose clogged or obstructed.	3. Clean or replace Hose.
	4. Black rubber seating fitted	4. Replace with silicone seating and reset with AT75 setting tool marked with letter 'B'
	5. Lever (15) bent or catching on Valve Spindle (14).	5. Replace Lever.
Water entering Flight Second Stage	1. Mouthpiece (11) damaged or incorrectly fitted.	1. Replace or re-fit Mouthpiece as appropriate.
	2. Diaphragm (6) damaged.	2. Replace Diaphragm.
	3. Diaphragm (6) improperly seated in Case (13).	3. Remove Purge Button assembly and Inner Locking Ring (5), properly reassemble Diaphragm (check for distortion).
	4. Exhaust Valve (8) damaged.	4. Replace Exhaust Valve.
	5. Case (13) damaged. (Check exhaust valve seating surface.)	5. Disassemble and replace Case.
	6. Inlet Fitting 'O' Ring (19) damaged.	6. Replace 'O' Ring.
	7. Venturi Lever (9) or 'O' Ring (10) damaged.	7. Replace 'O' Ring.

Table 2 - Recommended Tool List

PART #	DESCRIPTION	APPLICATION	IMAGE
AT48	1ST AND 2ND STAGE TOOL	REMOVING / INSERTING LEVER	
AT71	INNER LOCKING RING TOOL	REMOVAL / INSERTING INNER LOCKING RING	
AT72	INLINE ADJUSTING TOOL	LEVER HEIGHT SETTING	
AT75	SETTING TOOL	LEVER HEIGHT SETTING	
AT76	ADJUSTMENT TOOL	MICRO ADJUSTER SETTING / REMOVAL AND FITTING SPINDLE	
AT77	VENTURI TOOL	REMOVING VENTURI LEVER	
AT79	O RING TOOL	O RING REMOVAL	
AT39	11/16" SPANNER	HOSE REMOVAL	
N/A	13/16" SPANNER	HOSE REMOVAL	
N/A	13/16" SOCKET	INLET FITTING	
N/A	TORQUE WRENCH	INLET FITTING	
AT37	5MM HEX KEY	VALVE SEAT	
N/A	CYLINDER	FINAL TESTING	

Table 3 - Recommended Lubricants, Cleaning & Disinfectant Solutions

LUBRICANTS	APPLICATIONS	SOURCE
Christo-Lube MCG111	All o rings. Oxygen Compatible	Aqua Lung # 820466 or 480025 or AP1495
PerFluroLube 20/1	All o rings. Oxygen Compatible	Aqua Lung # AP1493

⚠ CAUTION: Silicone rubber requires no lubrication or preservative treatment. DO NOT apply grease or spray to silicone rubber parts. Doing so may cause chemical breakdown, can change their molecular construction and cause premature deterioration of the material

GENERAL CLEANING SOLUTIONS		
Liquid dishwashing detergent (diluted with hot water) *Soapy water is defined as 'household' grade liquid dishwashing detergent diluted in warm water.	Degreaser for brass and stainless-steel parts; general cleaning solution for plastic and rubber parts	'Household grade'

⚠ CAUTION: Do not place plastic and rubber parts in acid solutions. Doing so may alter the physical properties of the component and cause degradation and premature breakdown.


White distilled vinegar (acetic acid, 50% warm water)	Acid bath for reusable stainless steel and brass parts	'Household grade'
OAKite #31 (diluted with warm water to a maximum of 25%)	Acid bath for reusable stainless steel and brass parts	Oakite Products, Inc.
NETALU (diluted with warm water to a maximum of 25%)	Acid bath for reusable stainless steel, brass and aluminium parts	Aqua Lung ref# 455001


⚠ CAUTION: Do not use hydrochloric acid, (muriatic acid, spirit of salt), for the cleaning of any parts. Even if strongly diluted, hydrochloric acid can harm the coating of metal parts and leaves a corrosive deposit that is harmful and damages plastic parts and O-ring seals.

Table 3 - Recommended Lubricants, Cleaning & Disinfectant Solutions Continued

Oxygen Cleaning Solutions	Use as Trained	
Promoclean TP1113 or TP108 (diluted with warm water to a maximum of 5%)	Nitrox/Oxygen Cleaning	Inventec Performance Chemicals SA 20, Rue de Bourgogne BP 211 69802 Saint-Priest Cedex
BIOX O2 Liquid	Nitrox/Oxygen Cleaning	The Granary, Yeo Lane, North Tawton, Devon, UK. EX20 2DD www.bioxint.com
Disinfectant solutions		
Liquid dishwashing detergent (diluted with warm water) *Soapy water is defined as 'household' grade liquid dishwashing detergent diluted in warm water	General low risk disinfecting	'Household grade'
Chemgene HLD4L breathing apparatus surface disinfectant solution. Follow the manufacturers dilution recommendations	All round non-corrosive disinfecting for all plastic and metallic parts. Shared training and rental equipment	http://www.medi-mark.co.uk
STERANIOS 2% Ready to use. (Toxic, follow manufacturer's instructions for use)	All round disinfecting for all plastic and metallic parts. Shared training and rental equipment	Aqua Lung Ref: 382062

 **CAUTION:** Disinfection of products for multi-use applications such as Training and rental equipment must be carefully considered. Do not use bleach based disinfectants or disinfectants known to be corrosive, such as Milton, as these can prematurely age or corrode the equipment being used.

 **WARNING:** Never use solvents to clean breathing equipment or components

 **NOTE:** Always follow the guidelines of use, cleaning procedures and safety data sheets published by the cleaning and disinfectant solution manufactures. Methods, temperatures, dilution ratios and times can vary. These cleaning solutions and disinfectants have been developed and are intended for use with compressed oxygen diving and life support systems and are accompanied with detailed information.


Always follow your local regulations and cleaning solution guide lines regarding disposal.

Cleaning & Lubrication Procedure

 **WARNING:** Always wear the appropriate Personal Protective Equipment such as medical gloves and safety glasses.

General Cleaning of Brass and Stainless-Steel Parts

1. Pre-clean by soaking in warm soapy water*. If required soak in NETALU diluted to 25%, or other diluted general cleaning solutions as recommended and shown in the Recommended Cleaning Solutions table. Use a nylon bristle toothbrush as required.
2. Thoroughly clean the parts in a hot ultrasonic bath filled with a mixture of soapy water*. If some deposits remain then fill the bath with diluted white vinegar (acetic acid), max 50%, and repeat.

 **CAUTION:** Do not place plastic, rubber, silicone or anodised aluminium parts in contact with Vinegar.

3. Remove parts from the ultrasonic cleaner, rinse and soak parts for ten minutes with fresh water, agitate lightly. If tap water is extremely 'hard' then rinse in distilled water to prevent any mineral residue. Dry with filtered low pressure (1.75 bar/25psi) air or leave to dry naturally. Check that their condition is now suitable for re-use.

General Cleaning of Plastic, Composite, Rubber and Anodised Aluminium Parts

Anodised aluminium parts are to be soaked and cleaned with warm soapy water*. Use only a soft nylon toothbrush to scrub away any deposits. Rinse in fresh water and dry with filtered low pressure (1.75 bar/25psi) air or leave to dry naturally. Check that their condition is now suitable for re-use. If required prior to cleaning with warm soapy water and rinsing, pre-soak in NETALU diluted to 25%.

Parts made from plastic or soft materials such as rubber, for example, box bottoms, cases, covers etc., are to be soaked and cleaned with warm soapy water*. Use only a soft nylon toothbrush to scrub away any deposits. Rinse in fresh water and dry with filtered low pressure (1.75 bar/25psi) air or leave to dry naturally. Check that their condition is now suitable for re-use.

If required the use of an ultrasonic bath can be used, but only with warm soapy water.

 **CAUTION:** Do not place plastic and rubber parts in acid solutions. Doing so may alter the physical properties of the component and cause degradation and premature breakdown.

*Soapy water is defined as 'household' grade liquid dishwashing detergent diluted in warm water.

General Cleaning of Hoses.


Hoses shall be cleaned and maintained. Refer to Aqua Lung document 'Hose inspection and Cleaning Procedure'

 **CAUTION:** Do not place complete hose length in contact with acid solutions. Doing so may alter the physical properties of the component and cause degradation and premature breakdown.

Cleaning parts for Nitrox and Oxygen use

 **WARNING:** Please check the regulations regarding Oxygen/Nitrox in your particular country, as this may differ from Aqua Lung's standard policy. Always follow the training received for Oxygen Cleaning.

 **WARNING:** Always use genuine authorised service kit components and lubricants which are recommended and oxygen/nitrox compatible. New service kit components are also required to follow these cleaning guidelines.

 **WARNING:** During testing and use of the regulator following oxygen cleaning it is essential that only Oxygen Compatible Air in accordance with EN12021:2014 (or later) is used. Standard compressed Breathing Air in accordance with EN12021 or often referred to as Grade E in the United States, does not meet this criterion and could contaminate the regulator.

Although regulator second stage components are not exposed to high pressure oxygen/nitrox, Aqua Lung and Apeks recommends that the same cleaning procedure is followed for the complete regulator. This prevents the cross contamination and guarantees the cleanliness of the entire regulator.

Hoses shall be cleaned for Oxygen use in accordance with the Aqua Lung document 'Hose inspection and Cleaning Procedure'

1. Complete the General Cleaning sections on all parts as listed previously.
2. Ultrasonic cleaning at 50°C [122°F] in Promoclean TP1113 or TP108 diluted at 5%, or other Oxygen Cleaning Solutions shown in the recommended cleaning solutions list, for at least 6 minutes. **
3. Rinse in warm demineralised water. Soak for 10 minutes.
4. Dry in open air in a controlled clean and dust free atmosphere. Place the parts on a white cloth, allow to dry and check after drying that the cloth shows no grease deposits and that the condition of the parts are appropriate for reuse with Nitrox/Oxygen.

**Note: Always follow the guidelines of use, cleaning procedures and safety data sheets published by the cleaning and disinfectant solution manufacturers. Methods, temperatures, dilution ratios and times can vary. These cleaning solutions and disinfectants have been developed and are intended for use with compressed oxygen diving and life support systems and are accompanied with detailed information.

Wiping

To wipe parts, use a white filter paper, a pure cotton cloth or any other material that is lint free and does not produce fluff.

Inspection

Visually check under a white light (daylight or artificial light).
The parts are to be completely free of any traces of:

1. Organic materials (oil, grease, paint, rust....)
2. Cleaning agents
3. Dust
4. Humidity

Lubrication and Dressing for General and Oxygen use

When handling and lubricating O-rings, wear powderless latex gloves. Keeping internal parts free from skin oils and other contaminants is always important especially when the regulator is being prepared for Nitrox and Oxygen use. All Seals shall be lubricated with an oxygen compatible grease as recommended and shown in the lubricants table, such as Christo-Lube MCG111. Dress the O-rings with a very light film of grease and remove any excess by running the O-ring between thumb and forefinger. Do not apply excessive amounts of grease, as this will attract particulate matter that may cause damage to the O-ring.

Disinfecting parts and products. (Multi Use Rental and Training Equipment)


 **CAUTION:** Disinfection of products for multi-use applications such as Training and rental equipment must be carefully considered. Do not use bleach based disinfectants or disinfectants known to be corrosive, such as Milton, as these can prematurely age or corrode the equipment being used. Only use the recommended disinfectant solutions. Further information on recommended diluted solutions, when to use and risks are explained in document DOC-0053-O-02 Cleaning and Disinfectant Protocol for high level training use of Underwater Breathing Apparatus.

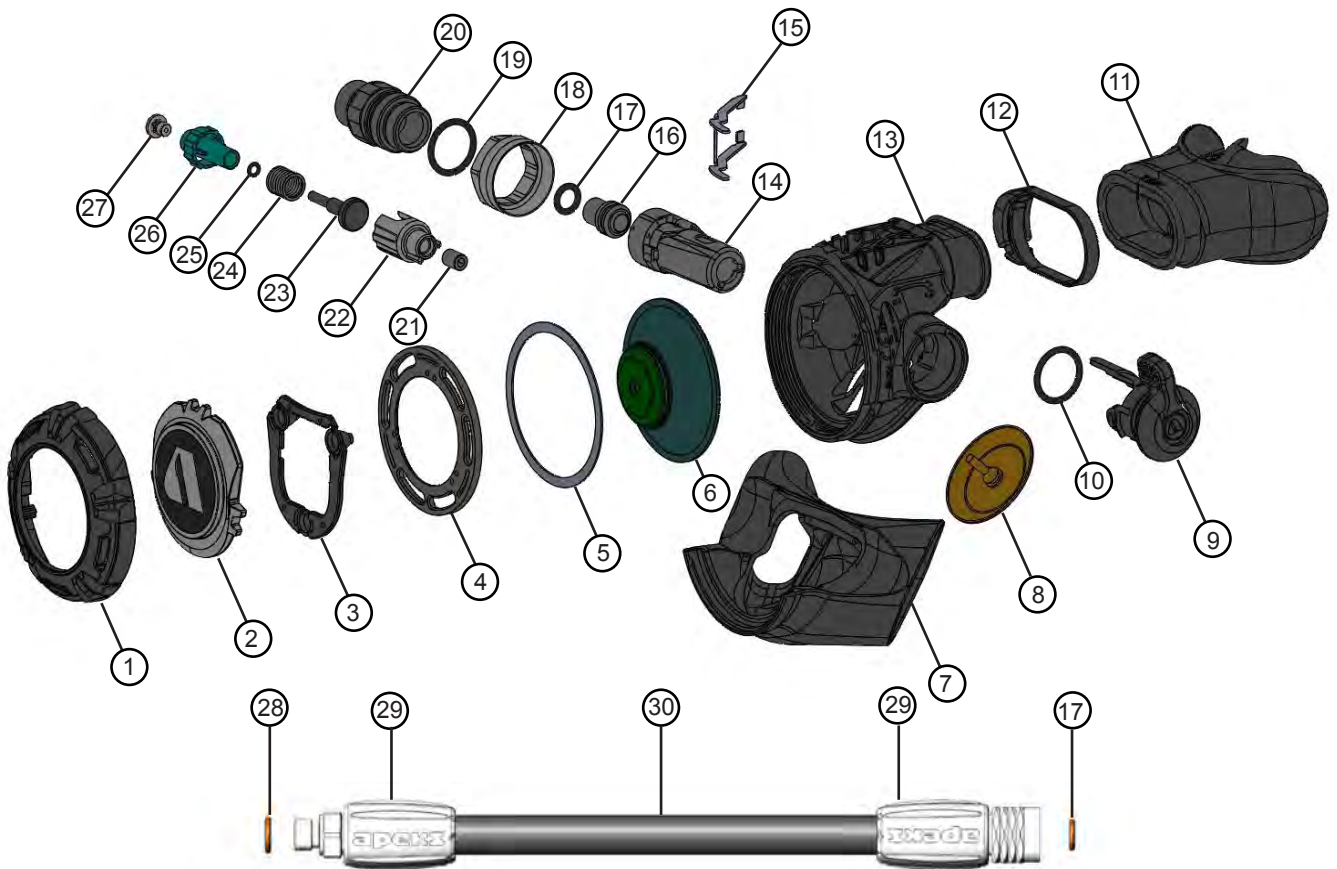
Table 4 - Torque Specifications

PART NUMBER	DESCRIPTION / KEY NUMBER	TORQUE
AP9006	Inlet Shroud (18)	3Nm / 2.2ft.lb

Table 5 - Test Bench Specifications

TEST	CONDITION	ACCEPTABLE RANGE
Opening Effort	High Pressure > 50 bar gauge Medium pressure 9.5±0.5 bar	+1.4 to +1.6 in. H ₂ O (3.5 to 4.0 mbar)
External Leak	High Pressure > 50 bar gauge Medium Pressure 9.5±0.5 bar	No Leaks allowed

XL4 2nd Stage Exploded Parts Diagram



All items in bold italics to be replaced when servicing. Service kit AP0254

1	AP9003	XL4 Clamp Ring	15	AP2035	Lever
2	AP9005	Purge Button	16	AP7563	Valve Seat
	AP9005G	Purge Button Green	17	AP1154	O Ring
	AP9005Y	Purge Button Yellow	18	AP9006	Inlet Shroud
3	AP7593	Purge Spring	19	AP1267	O Ring
4	AP7577	Inner Lock Ring	20	AP9002	Inlet Shrouded Fitting
5	AP7592	Friction Ring	21	AP7570	Micro Adjuster Screw
6	100181	Diaphragm	22	AP7582	Spindle Adjuster Sleeve
7	AP7578	Exhaust Tee	23	AP7584	Spring Carrier
8	AP6223	Exhaust Valve	24	AP2021	Spring
9	AP7579	Venturi Lever	25	AP5711	O Ring
10	AP1267	O Ring	26	AP5707	Shuttle Valve
11	AP5324	Mouthpiece	27	AP2034	Silicone Valve Seat
12	APF129154	Bracelet Clip	28	AP1409	O Ring
13	AP9004	XL4 Case	29	AP6814	Hose Protector
14	AP7581	Spindle Body	30	AP0198SHPS	Flexi Hose



**XL4 SECOND STAGE REGULATOR
MAINTENANCE MANUAL**

**FOR
AUTHORISED TECHNICIANS**

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