



X SCUBA

SERVICE AND REPAIR MANUAL

SPIRIT REGULATOR PN RG100



Revised - 02/11

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SECTION 1

Introduction

This manual provides factory prescribed procedures for the correct service and repair of the Spirit™ regulator, including the first and second stage. 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 repair seminar that has been directly sponsored by XS Scuba.

If you do not completely understand all of the procedures outlined in this manual, contact **XS Scuba** 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 the Spirit™ 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 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 Spirit User's Guide.)

When performing service, whether it is a routine overhaul or a repair of a specific problem, it is important to understand how the regulator is designed and how it operates. If you have any questions, please consult your XS Scuba representative.

EAN/ Nitrox Service

Newly manufactured XS Scuba regulators are assembled and packaged to be compatible with oxygen enriched air (EAN/ Nitrox), not to exceed 40% oxygen content. If the regulator is going to be used for this application, however, it must be dedicated and clearly labeled as such, in order to prevent any crossover use with standard compressed air. **Refer to the instructions provided in the XS Scuba Authorized Service Document, titled - Regulator Parts Cleaning Procedures.**



CAUTION: It is important to avoid using, testing, or otherwise pressurizing a dedicated EAN regulator with standard compressed air, which contains hydrocarbon contaminants.

Facility Requirements

As an Authorized XS Scuba Dealer, your customers expect you to provide top-notch overhaul service, both before and after the sale. Next to airfills and gas blending, it is the single most important commodity your store can provide.

The service department is therefore the most important part of your store. It should be clean and well lighted, and stocked with a complete inventory of parts and all the specialty tools you will need to get the job done right. As a minimum requirement, your service facility should be equipped with the following items:



Ultrasonic Cleaner

- ❑ **Ultrasonic Cleaner** – Select the right size model that can keep up with the volume of equipment that your store services. A built in timer and heater will help control the cleaning time and temperature of the solution, since most solutions work best when heated.

- ❑ **Bench Mounted Vise** – A vise is sometimes needed to hold the regulator secure – especially when removing the first stage yoke retainer. Special care must be taken, however, to avoid damage that can result from improper use of this tool. Be sure to follow the instructions provided in this manual.

NOTE: XS Scuba especially endorses and recommends the **Jaws Gripmaster Bench Vise**, available from Peter Built Co. It is designed specifically for the professional dive store service bench, and will prevent damage that can easily be caused by a conventional vise.

- ❑ **Magnification Lamp** – Strong lighting and magnification are essential requirements for performing a thorough parts inspection - especially when locating the source of a small leak.

- ❑ **Quality Wrenches & Sockets** – When working with brass parts, it is especially critical to use the correct size wrench and to ensure that it fits properly over the part. The use of an adjustable wrench is very likely to cause damage to your customer's equipment, and should be strictly avoided at all times.

- ❑ **Calibrated Inch-Pound and Foot-Pound Torque Wrenches** – It is important to follow the manufacturer's torque values whenever they are specified, in order to avoid overtightening or undertightening a part. This is especially important for smaller parts and fittings, when overtightening can easily damage the part. Torque wrenches that can be set for both inch-pound and foot-pound measurements tend to be less accurate than wrenches that are designed to measure torque within a specific range.



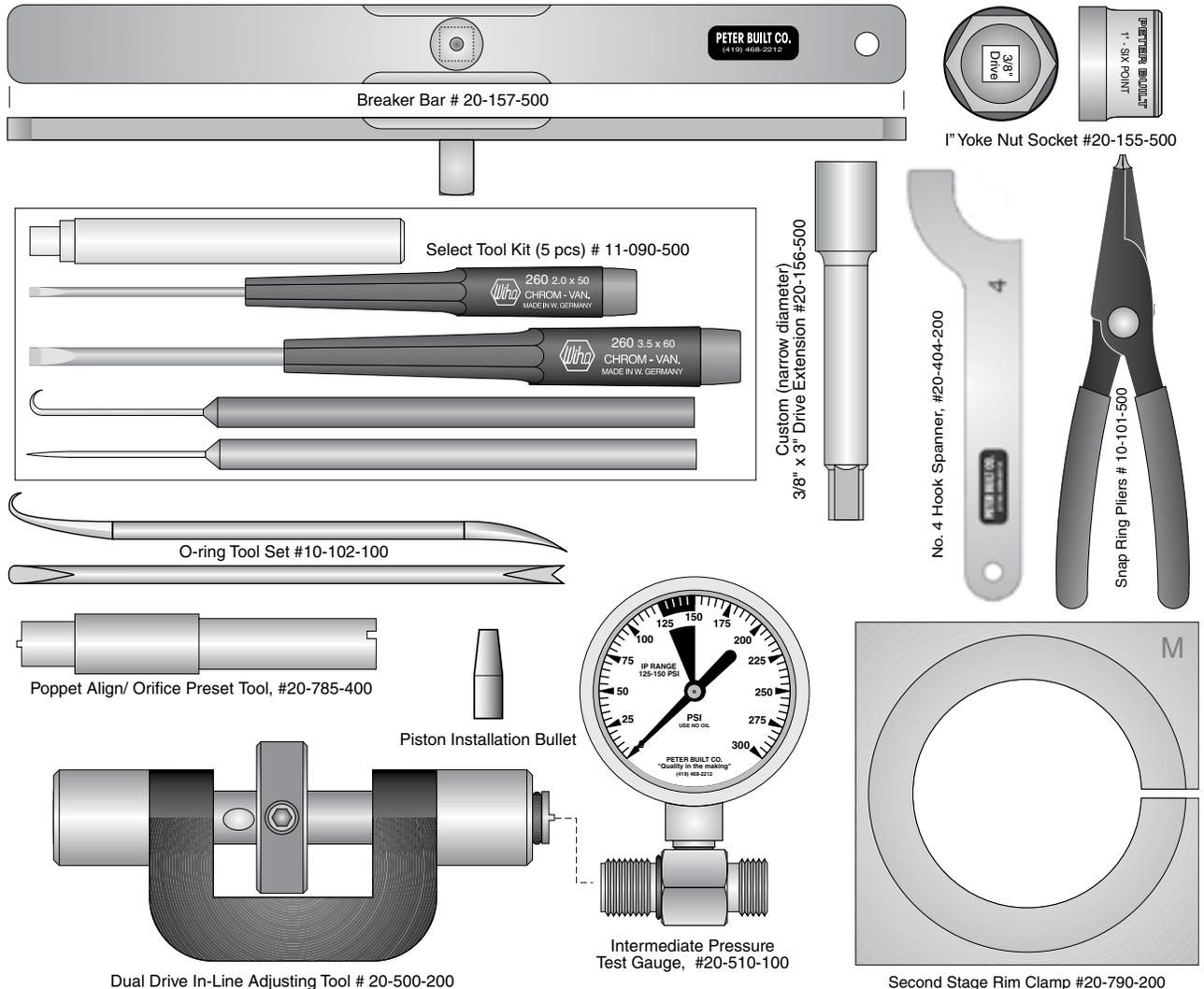
"Jaws" Gripmaster Vise



Specialty Tools

For the finest tools, fixtures, and supplies that are designed and manufactured specifically for servicing SCUBA equipment, we recommend one source for all your service facility's needs.

Peter Built Co., in Galion, Ohio, is dedicated to serving the diving industry, and offers a wide selection of the most innovative specialty tools found anywhere to help you get the job done efficiently - and done right.



Illustrations courtesy of Peter Wolfinger.

Required Tools/ Lubricant

- | | |
|-------------------------------|----------------|
| No. 4 Hook Spanner Wrench | PN #20-404-200 |
| Dual Drive Adjusting Tool | PN #20-500-200 |
| Tech Driver IPG | PN #20-165-111 |
| O-ring Tool Set | PN#10-125-400 |
| 1/4" Slotted Screwdriver | PN #11-465-500 |
| 1/4" Nut Driver | PN #11-168-500 |
| Small (.02) Blade Screwdriver | PN #11-133-500 |
| Cristo Lube | PN #MS150 |
| Hakko Side Cuts, 5" | PN #16-020-500 |
| Snap Ring Pliers | |
| 11/16" Open End Wrench | |
| 3/4" Open End Wrench | |



Galion, OH 44833
 Phone: 419-468-2212
 www.scubatools.com

SECTION 2

Preliminary Inspection

External Inspection

1. Closely examine the conical filter to check for any signs that contaminants have entered the system, including sea water, rust, or aluminum oxide.



NOTE: A green discoloration of the filter indicates that moisture has entered the regulator, and internal corrosion has possibly occurred. Other types of discoloration may indicate that the regulator has been used with a corroded cylinder. Advise the customer of this, and the possible need to obtain service for the cylinder.

2. Slide back the hose protectors, if present, to visually inspect the condition of the hoses, especially at their fittings.
3. Closely examine the finish of the first stage to check for any chips, scratches, or other damage that exposes the brass beneath the finish.



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

4. 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, especially at the fittings of hoses.
3. Note the source of any leakage found and refer to the *Troubleshooting Guide* to determine its possible cause.
4. Close the cylinder valve and depress the second stage purge button to depressurize the regulator before per-

forming the next procedure.

Intermediate Pressure Test



NOTE: It is not necessary to perform this test unless a problem has been reported that requires diagnostic troubleshooting and repair. When performing routine overhaul service, proceed directly to the following section, *Disassembly*.

1. Connect a calibrated intermediate pressure test gauge to the regulator, either with a quick-disconnect inflator hose or with the female fitting of a second stage LP hose, depending on the connection of the test gauge.



CAUTION: To provide a safety relief valve in the event that intermediate pressure exceeds 155-170 psi, ensure that a fully assembled and properly adjusted second stage is connected to the first stage before pressurizing. Failure to relieve intermediate pressure that exceeds 400 psi may result in damage or rupture of the test gauge or LP hose, and could cause serious personal injury.

2. Slowly open the supply valve to pressurize the first stage. Closely monitor the IP test gauge to determine whether the intermediate pressure rises above 145 psi.
3. Note the intermediate pressure indicated by the test gauge, and purge the second stage several times to determine whether 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 first stage is 140 (± 5) psi, with an inlet pressure between 2,500 - 3,000 psi.

5. Close the supply valve and depress the second stage purge button to depressurize the system before attempting to perform any disassembly.

▼ **After completing the Preliminary Inspection, proceed to Section 3 – Disassembly**

**SECTION
3**

Disassembly Procedures

General Guidelines

- ▼ *Prior to performing any disassembly, check to ensure that the service facility is well equipped with all the tools and parts needed to perform a complete service from start to finish. DO NOT attempt to perform the service unless all of the required tools and parts are available.*
- ▼ *All o-rings are classified as being either dynamic or static. **Dynamic** o-rings are those which sustain friction and movement, as they are either mounted directly onto a moving part, or create a seal against a moving part. **Static** o-rings simply create a seal between two non-moving parts, and are therefore less subject to wear than dynamic o-rings. After passing close inspection, static O-rings may sometimes be reused, although this is not necessarily recommended. Dynamic O-rings must be automatically discarded and replaced with every service, regardless of age or appearance.*
- ▼ *Refer to the schematic and parts list while performing these procedures. Each part is identified by its reference number shown on the drawing the first time it is referred to in the procedure.*
- ▼ *Do not attempt to reuse parts that are designated to be automatically discarded and replaced with the parts provided in the overhaul parts kit. These parts should be shown to the customer, however, to ensure their confidence and satisfaction that complete overhaul service has been performed.*
- ▼ *Inspect all reusable parts as directed, either during or immediately following the disassembly procedures. When in doubt, compare the part with one that is new to best determine its condition.*

First Stage Disassembly



CAUTION: Whenever possible, use only plastic or brass O-ring tools for removing O-rings in order to prevent damage to the sealing surface. Steel instruments, such as dental picks, can easily damage the sealing surface of a softer brass part, causing irreparable leakage and requiring the part to be replaced with new.

1. Before disassembling the first stage, remove the low pressure second stage hose with a 6" open end wrench, the high pressure hose with a 5" open end wrench, and the low pressure inflator hose with a 2" (or other size required) open end wrench. Remove all remaining port plugs(13&15) with a 1/8" (4mm) hex key.
2. Remove and inspect the O-rings(12&14) on these items to determine their condition, and discard them if any signs of decay are found.
3. Loosen the yoke screw(2) as needed to remove the dust cap(4) from the yoke(3).



NOTE: It will be necessary to use a bench mounted vise to hold the first stage secure throughout the next procedure. This ensures the best protection against slippage and accidental damage to soft metal parts. If an ordinary bench vise will be used, the first stage must be mounted outside the vise with the use of a vise mounting tool fastened into the high pressure port. **To ensure the best available protection against damage, XS Scuba specifically recommends the Gripmaster Vise, available from Peter Built Co.**

4. Secure the first stage inside the Gripmaster Vise, so that the piston cap(23) faces straight up and the yoke screw faces down. Fit the #4 Hook Spanner (Peter Built PN 20-404-200) onto the piston cap to mate the pin inside one of the bore holes (see Fig. 1). While holding the tool securely engaged, turn the piston cap counter-clockwise to loosen no more than 4 turn (90 degrees) so that it can later be removed by hand. Do not loosen it further than 4 turn at this time.
5. Loosen the vise, and resecure the first stage in the opposite position, so that the yoke or DIN adapter faces straight up.



Fig. 1 – Loosening the Piston Cap



Fig. 2 – Loosening the Yoke Retainer



Fig. 3 – Removal of Filter Retaining Ring



Fig. 4 – Removal of DIN Retainer

6. Disassembly of the Yoke Connector

- a. Loosen the yoke screw several turns counter-clockwise. Place a 1" Yoke Retainer Socket (Peter Built PN 20-156-500) inside the yoke and over the hex features of the yoke retainer(8). Pass a Breaker Bar (PN 20-157-500) through the yoke, and tighten the yoke screw lightly snug over the dimpled feature (see Fig. 2). Then, grasp the breaker bar with both hands on opposite ends and turn the socket counter-clockwise with steady force to loosen the yoke retainer. Do not use impact.



CAUTION: The socket and breaker bar combination provide the best insurance against damage while removing the yoke retainer, using the procedure described above. **DO NOT**, under any circumstances, use an adjustable wrench or an open end wrench that does not fit completely over the flats on both sides. Doing so may result in permanent damage to the yoke retainer, requiring its replacement.

- b. Turn the yoke screw counter-clockwise to remove, and set aside the breaker bar and socket.
- c. Unscrew the yoke retainer counter-clockwise to remove from the body, along with the yoke.
- d. Remove the main seal O-ring(9) from the yoke retainer. Discard the O-ring and do not reuse, regardless of its condition.
- e. While holding the yoke retainer secure, apply a pair of Snap Ring Pliers to remove the retaining ring(5) from the yoke retainer (see Fig. 3). Tap out the filter(6), and remove the O-ring(7) with a brass O-ring tool. Discard the filter and O-ring, and do not reuse these parts regardless of their condition.

7. Disassembly of the DIN Connector

- a. Apply a 4" hex key to the filter retainer(3b), and turn it counter-clockwise to loosen and remove (see Fig. 4). Remove and discard both O-rings(3a&3c).
- b. Lift the handwheel(3f) off the filter housing(3g), and closely inspect the condition of the threads to ensure it is free of any burrs or other damage that could prevent proper threading.
- c. Apply a m" open-end or box wrench to the filter housing, and loosen it counter-clockwise with steady force to remove from the first stage body. Remove and discard the filter(3d) and both O-rings(3e).

8. Remove the saddle(10) and check for any signs of damage. Set it aside to be reused if none are found.
9. Remove the first stage from the vise. While holding the first stage body secure with one hand, unscrew the piston cap (pre-loosened in Step 4) counter-clockwise with the other. Lift the piston cap with the piston(21) straight up and off the first stage body and spring(17). Remove the collar(22) and discard or set it aside to be reused, depending on its condition.
10. Pull the piston straight out of the piston cap, being careful to avoid rocking or twisting it in order to prevent metal against metal contact. Remove and discard both dynamic O-rings(19&20).
11. To remove the high pressure seat(18) from the end of the piston shaft, carefully insert a slim rod through the head and shaft of the piston. Firmly press the rod against the underside of the seat to press it out of the piston shaft (see Fig. 5). Discard the seat, and do not attempt to re-use.
12. Remove the high pressure valve spring and spring isolators(16) from the body. Inspect the spring isolators for any signs of damage or distortion, and discard if any is found. Closely inspect the spring with a magnifier to check for any signs of damage or corrosion that has permeated the wall of the metal. Set the spring aside to be reused if it is determined to be in satisfactory condition with no signs of permanent corrosion or damage.

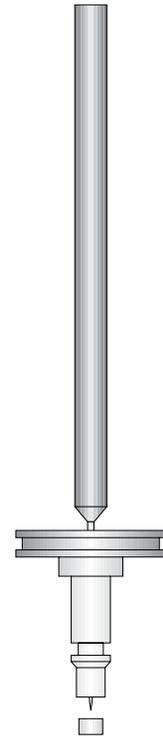


Fig. 5 – Removal of HP Seat



CAUTION: If damage is found, or if the intermediate pressure was measured lower than 135PSI during preliminary inspection, replace the spring. **DO NOT** attempt to raise the intermediate pressure by adding spring isolators to compensate for a damaged spring.

13. Under strong lighting, closely inspect the inner bore and all sealing surfaces of the first stage body with a magnifier, including the intermediate and high pressure ports, and especially, the machined orifice cone (see Fig. 6). Check to ensure there are no scratches or other damage that could contribute to leakage. If damage is found that is determined to cause irreparable leakage, it will be necessary to discard the first stage body and replace it with new. Do not attempt to polish the sealing surface of the orifice cone.

▼ **After completing the disassembly of the first stage, proceed to the following procedure - Second Stage Disassembly.**



Fig. 6 – HP Cone Inspection

Second Stage Disassembly



CAUTION: Whenever possible, use only plastic or brass O-ring tools for removing O-rings in order to prevent damage to the sealing surface. Steel instruments, such as dental picks, can easily damage the sealing surface of a softer brass part, causing irreparable leakage and requiring the part to be replaced with new.

1. Slide back the hose cover to expose the connection of the LP hose.
2. While holding the inlet fitting(20) secure with an n" open-end wrench, apply a 17mm open-end wrench to the fitting of the LP hose. Turn the hose fitting counter-clockwise to loosen and remove.
3. Using a plastic or brass O-ring tool, carefully remove the O-ring(25) from the post inside the hose fitting.



CAUTION: When performing the above step, be very careful to avoid scratching the O-ring sealing surface. Doing so may cause a permanent leak that will require the replacement of the LP hose.

4. Using an n" open end wrench, turn the inlet fitting counter-clockwise to loosen from the second stage housing(12), and unscrew it completely by hand to remove.
5. Snip the plastic tie-strap(21) that holds the mouthpiece(23), and gently pull the mouthpiece off the second stage housing. Inspect the mouthpiece to ensure that it is supple and free of any tears or corrosion. If any damage is found that could result in discomfort or leakage, discard the mouthpiece and do not reuse.
6. While holding the second stage secure with one hand, firmly grasp the retaining ring(17) with the other, and turn the ring counter-clockwise to loosen and remove it, along with the diaphragm cover(16).



NOTE: If the retaining ring is difficult to loosen, XS Scuba recommends using the Rim Clamp (P/N 20-790-200), available from Peter Built Co. Complete instructions are provided with the tool.

7. Separate the diaphragm cover from the retaining ring, and closely inspect the cover to ensure that it is perfectly round and free of damage. If any damage is found, discard the cover and replace with new.
8. Lift out the diaphragm(14) and thrust washer(15) from the



Fig. 7 – Removal of Retaining Clip



Fig. 8 – Removal of Valve Assembly



Fig. 9 – Removal of LP Spring

- second stage housing. Inspect the diaphragm to ensure that it is supple and free of any pinholes, tears, corrosion, or other damage. If any damage is found, discard it and replace with new.
9. Using a small flat blade screwdriver, rotate the metal retaining clip(13) over the groove of the housing plug(1) inside the second stage housing until the notch in the center faces up. Place the tip of a 2mm flat blade screwdriver inside this notch, and gently lift the clip off the groove. (See Fig. 7.)
 10. Apply a c" hex key to turn the housing plug counter-clockwise until loosened, and remove it from the housing. Carefully remove the O-ring(2) with a plastic tool, and discard. Closely examine the condition of the housing plug, especially around the threads and O-ring seating groove. Discard if any damage is found that may cause leakage, or set it aside to be reused.
 11. While holding the lever(18) lightly depressed, press the inlet end to slide the entire valve assembly out of the other end of the second stage housing (see Fig. 8). Remove and discard the inlet fitting O-ring(19).
 12. Turn the air barrel over to allow the balance shuttle cap(3) and LP spring(4) to drop out (see Fig. 9). Inspect the spring closely with a magnifier to check for any signs of corrosion. Discard it if corrosion is found, and do not reuse.
 13. Gently remove the lever from the air barrel by lifting out one leg first, and then the other. Be careful to avoid bending or stretching either leg.
 14. Turn the air barrel over to allow the poppet(6) to drop out. Using fingernails or a plastic tool, carefully remove the LP seat(7) and small O-ring(5). Discard both soft parts, and do not reuse. Closely inspect the poppet around all seating surfaces, and compare it with new to ensure no damage is visible. If damage is found, discard the poppet and replace with new.
 15. Remove the white lever pad(9) from the air barrel. Discard, and do not reuse.
 16. While holding the air barrel secure, apply a medium blade screwdriver to the slotted head of the adjustable orifice(10), and turn it counter-clockwise to disengage its threads.



NOTE: The orifice is O-ring sealed, and it will remain inside the air barrel after it has been unthreaded. The following step must be performed to remove the orifice without damaging its polished sealing surface.

17. When the orifice has been unthreaded from the air barrel, carefully insert a small wooden or plastic dowel through the opposite end of the valve body, directly over the sealing edge of the orifice. Gently press out the orifice. (See Fig. 10.)
18. To avoid using a sharp tool that can damage the orifice, squeeze the O-ring(11) between thumb and forefinger to remove it from the orifice head. Discard the O-ring and do not reuse.
19. Closely examine the orifice with the use of a magnifier, checking for any scratches or other damage to the sealing edge and the groove that holds the O-ring (see Fig. 11). If any damage or wear is found, discard the orifice and do not attempt to reuse. If it is in reusable condition, set it aside on a soft surface to keep it isolated from other metal parts.
20. Remove the exhaust deflector(24) from the second stage housing to expose the exhaust valve(22) for inspection.



NOTE: To facilitate the removal of the exhaust deflector, first place it in hot (120°-150°F) water for 2-3 minutes and allow it to soften.

21. Closely inspect the exhaust deflector to check for any signs of damage that may have been caused by abuse or improper disassembly. If found, discard it and replace with new,
22. Closely inspect the condition of the exhaust valve to ensure that it is evenly seated against the second stage housing on all sides, and free of any tears, holes, or other signs of decay. Peel back the lip on all sides to ensure it is supple and returns to its original position. If any wear or damage is detected, or if the material feels stiff or decayed, pull the exhaust valve straight out of the housing and discard it.



NOTE: It is not necessary to remove the exhaust valve diaphragm unless it shows signs of wear or decay upon inspection. Once the diaphragm is removed, however, it will be permanently stretched and then must be replaced with new.

- ▼ **After completing the disassembly of the first and second stages, refer to the instructions provided in the XS Scuba Authorized Service Document, titled - Regulator Parts Cleaning Procedures.**



Fig. 10 – Removal of Adjustable Orifice



Fig. 11 – Orifice Inspection

4

section

Reassembly Procedures

General Guidelines

- ▼ Refer to the schematic parts list, that highlights automatic replacement parts which should be discarded and replaced with new during reassembly. These parts are provided in the Annual Service Kit.
- ▼ Before performing any reassembly, it is important to individually inspect all parts, both new and those that are being reused, to ensure that each part and component is perfectly clean and free of any dust, decay, or blemishes.
- ▼ If the regulator has been serviced for use with EAN/Nitrox, it is important to don powderless latex gloves before handling any parts, including O-rings, in order to avoid contaminating the parts with skin oil.
- ▼ Prior to dressing, inspect all O-rings with magnification to ensure they are supple, clean, and completely free of any scoring or decay that would impair proper sealing.
- ▼ XS Scuba recommends Christo-Lube® MCG-11 (PN MS150) to be used exclusively for the lubrication and dressing of O-rings and other internal parts. Christo-Lube® provides superior lubrication to that of silicone grease, especially in high pressure (DIN) systems greater than 3,000 psi, and extreme temperature conditions. It is also non-reactive to oxygen, and is approved for use with EAN/Nitrox.



CAUTION: Silicone grease is not compatible with oxygen enriched air, and must be strictly avoided when servicing a regulator that will be used with EAN/ Nitrox. The entire regulator will otherwise become contaminated, and rendered unsafe for use with any mixture of oxygen enriched air.

- ▼ Dress all O-rings with a visible film of Christo-Lube, but avoid applying excessive amounts, as this may attract particulate matter that can cause accelerated wear or damage to the O-ring.



CAUTION: The use of aerosol spray or petroleum based lubricants must be strictly avoided. The propellant gas or petroleum base may attack or weaken plastic or rubber parts.

- ▼ Use all replacement parts provided in the XS Scuba Authorized Dealer parts kit.

First Stage Reassembly

WARNING: DO NOT attempt to use any other manufacturer's part as a substitute for any XS Scuba part, 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. Generously lubricate and install the piston head O-ring(20) onto the head of the piston(21), and install the piston shaft O-ring(19) onto the piston shaft.
2. Install the high pressure seat(18) into the end of the piston shaft, and check to ensure it is seated flush with no visible protrusion (see Fig. 12).
3. Set the piston cap(23) on a flat surface with the open end facing up. Place the head of the piston inside the cap so that it rests perfectly level above the threads, and then gently press the piston straight down into place until it is fully seated.



Fig. 12 – HP Seat Installation

CAUTION: Be careful to prevent the piston from becoming cocked at an angle as the head travels past the threads of the piston cap. The O-ring could otherwise become unseated or damaged, and metal on metal contact could cause damage to the piston or the piston cap.

4. Fit the collar(22) over the open end of the piston cap, so that it seats flush against the shoulder.
5. Over the support post inside the intermediate pressure chamber of the first stage body, install the same color (thickness) and number of spring isolators(16) that were disassembled from the high pressure chamber.

CAUTION: Unless the spring has been replaced with new, it is very important to reinstall the same number and color combination of spring isolators as the original quantity that was removed during the disassembly procedure. No more than two spring isolators may be used between the spring and the body, and no more than one spring isolator may be used between the spring and the piston.

6. Apply a light film of lubricant to both ends of the high pressure spring(17), and place the spring down over the support post inside the high pressure cavity of the body.

Fig. 16 – Swivel Retainer w/ O-rings

7. Place the remaining spring isolator directly over the top of the spring.
8. Hold the body secure with the open intermediate pressure end facing straight up, and position the piston cap over the body so that the piston shaft is aligned through the center of the spring. Mate the piston cap onto the body and firmly press downward while turning it clockwise to engage the threads (see Fig. 13). Continue turning by hand until snug.
9. Fit the saddle(10) onto the high pressure (inlet) end of the first stage.
10. Secure the first stage inside the Gripmaster Vise with the high pressure end facing straight up.



Fig. 13 – Installing Piston Cap

11. Reassembly of the Yoke Connector

- a. Install the O-ring(7) into the yoke retainer(8), followed by the conical filter(6). Closely examine the retaining ring(5) to identify which side is flat and which side is slightly rounded. Using snap ring pliers, install the retaining ring into the groove above the filter, with the flat side facing out.
- b. Lubricate and install the main seal O-ring(9) into the groove in the bottom of the yoke retainer.
- c. Being careful to ensure that the O-rings remain properly seated, insert the threaded end of the yoke retainer through the bottom of the yoke(3), and mate the yoke retainer into the inlet port of the first stage body. Turn the retainer clockwise by hand until snug.
- d. Apply a torque wrench with the 1" Yoke Nut Socket (PN 20-155-500) and 3"x a" Socket Drive Extension (PN 20-156-500). Tighten the yoke retainer to a measurement of 24 foot-lbs (±1). (See Fig. 14.)
- e. Install the dust cap(4) onto the yoke, and mate the yoke screw(2) into the yoke. Turn the screw one to two revolutions clockwise to engage the threads.

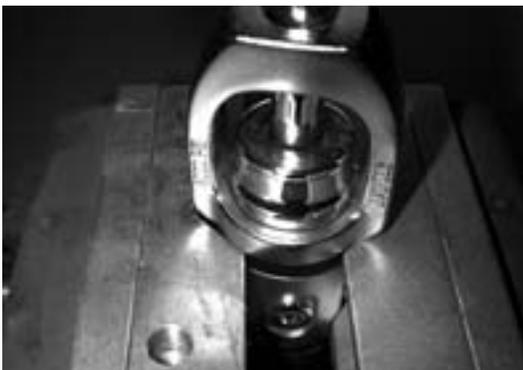


Fig. 14 – Torquing Yoke Retainer

12. Reassembly of the DIN Connector

- a. Install both O-rings(3e) and filter(3d) into the filter housing(3g).
- b. Mate the filter housing into the inlet port of the first stage body, and turn clockwise by hand until snug. Apply a torque wrench with a m" deep socket to tighten the filter housing to a torque measurement of 17 foot-lbs (±1). (See Fig. 15.)

- c. Fit the handwheel(3f) over the filter housing with the male threaded side facing up.
 - d. Install both O-rings(3c&3a) onto the filter retainer(3b). Mate the filter retainer into the filter housing, and turn clockwise by hand until snug. Apply a torque wrench with 4" hex key socket to tighten the filter retainer to a torque measurement of 130 inch-lbs (± 10).
13. Resecure the first stage inside the Gripmaster Vise, so that the piston cap faces straight up.
 14. Fit the #4 Hook Spanner (Peter Built PN 20-404-200) over the piston cap(23) to engage the pin with one of the bore holes, and hold the tool securely engaged. While holding the tool securely engaged, turn the piston cap clockwise only until it has reached the extent of its thread engagement, and do not tighten beyond snug.
 15. Loosen the vise to remove the first stage, and remove the vise mounting tool.
 16. Lubricate and install the O-rings(12&14) onto all hoses and port plugs. Install the LP hoses and port plugs(13&15) into their respective ports in the first stage. Apply a calibrated torque wrench with ④" (4mm) hex key socket (or appropriate size crow foot for hoses) to tighten the port plugs and hoses to a torque measurement of 38 inch-lbs (± 2).



Fig. 15 – Torquing DIN Housing

- ▼ *After completing the reassembly of the first stage, proceed to the following procedure - **Second Stage Reassembly.***

Second Stage Reassembly



WARNING: DO NOT attempt to use any other manufacturer's part as a substitute for any XS Scuba part, 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 exhaust valve(22) into the second stage housing(12) by gently pulling the stem through the hole in the center of the sealing area, until the barb has passed through and is securely seated inside.



NOTE: Prior to installing the exhaust deflector(24), place it in hot (120°-150°F) water for 2-3 minutes and allow it to soften.

2. Fit the exhaust deflector(24) over the top ridge of the second stage housing, so that the two corners are securely seated, and then stretch the lower portion down until it snaps securely into place.



CAUTION: Do not use a tool to install the exhaust deflector. Doing so may cause serious damage to the seating flange, requiring replacement of the housing.

3. Closely examine both sides of the white lever pad(9) to identify that the mounting tabs on both legs are rounded on one side and flat on the other. (See Fig. 21.) Hold the air barrel with the flat cut facing down, and place the clip over the tube with the rounded side facing toward the flange, so that one tab engages in the hole next to it. Then, gently press the opposite leg into place so the the other tab engages in the opposite hole. When done correctly, the lever pad should rest flush against the flange, with both tabs securely seated. (See Fig. 22.)



CAUTION: Do not stretch the legs of the lever pad, or attempt to install it if damage has occurred.

4. Insert the stem of the LP seat(7) into the large end of the poppet(6). DO NOT use adhesive.
5. Lubricate and install the small O-ring(5) over the groove on the opposite end of the poppet, being careful to avoid stretching it excessively. Closely examine the shape and features of the poppet. (See Fig. 23.)
6. While holding the air barrel with the flat cut facing straight up, guide the poppet into the tube, LP seat first, with the ears facing straight down. (See Fig. 24.)

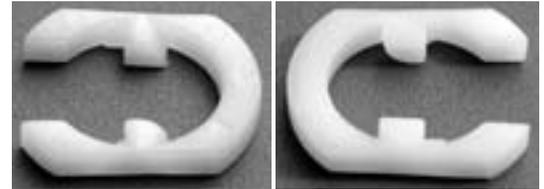


Fig. 21 – Lever pad Features



Fig. 22 – Air Barrel Orientation



Fig. 23 – Poppet Features



Fig. 24 – Correct Poppet Orientation



Fig. 25 – Poppet Correctly Installed



Fig. 26 – Lever Installation

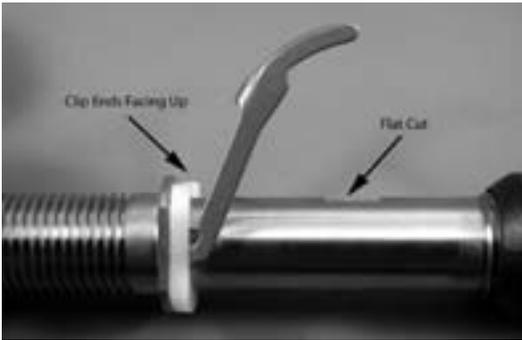


Fig. 27 – Correct Lever Orientation

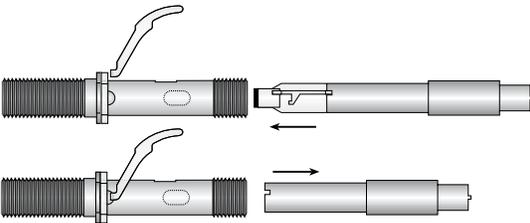


Fig. 28 – Poppet Alignment/ Preset Tool



Fig. 29 – Valve Assembly Completely Installed

7. Closely examine both holes where the lever pad is installed, to ensure that the ears of the poppet are properly aligned as shown (see Fig. 25). While holding the air barrel with the flat cut facing up, insert one leg of the lever(18) into one hole, so that it engages with the poppet (see Fig. 26). Being careful to avoid stretching or bending the lever, rotate it over the air barrel until the opposite leg engages with the opposite side. Check to ensure that the lever is properly seated on both sides, securely engaging the poppet ears. (See Fig. 27.)



NOTE: To better control the orientation of the poppet inside the air barrel while the lever is being installed, XS Scuba recommends using the Poppet Align/ Orifice Preset Tool (P/N 20-785-400), available from Peter Built Co. (See Fig. 28.)

8. While holding the second stage housing right side up with the front facing you, slide the valve assembly into the opening in the right side of the housing. Gently depress the lever, and then slide the valve assembly through the opening on the inlet side. Be careful to ensure that both lever arms fit squarely between the two flanges inside the housing, and then slide fully in place so that the lever pad is seated flush. (See Fig. 29.)
9. Apply a light coat of lubricant to both ends of the poppet spring(4), and place the spring inside the air barrel, over the small end of the poppet.
10. Insert the small end of the shuttle cap(3) into the end of the poppet spring.
11. Install the O-ring(2) onto the housing plug(1). Mate the housing plug directly over the shuttle cap, and screw the plug clockwise by hand to engage the threads of the air barrel. Apply a c" hex key to tighten only until snug. **DO NOT OVERTIGHTEN.**
12. Install the retaining clip(13) over the groove of the housing plug inside the housing, so that it snaps securely into place. (See Fig. 30.)
13. Install the O-ring(19) over the threaded inlet of the air barrel, being careful to avoid stretching it or rolling over the threads. Use a smooth instrument to ensure that it is seated at the base of the threads, against the wall of the housing.
14. Mate the inlet fitting(20) over the threads of the air barrel, and turn it clockwise by hand until finger snug. Apply a n" open end wrench to tighten it further by exactly 8 turn.



CAUTION: Be careful to avoid overtightening the inlet fitting, which can crack the wall of the second stage housing, requiring its replacement.

15. Install the O-ring(11) onto the head of the adjustable orifice(10) and carefully insert the orifice into the inlet of the air barrel with the polished cone facing in. Using a small wooden or plastic down, press the orifice in so that it rests against the threads inside the air barrel. (See Fig. 31.)
16. Apply a medium blade screwdriver to the slotted head of the orifice inside the air barrel, and turn it clockwise while closely watching the lever. When the lever starts to drop, stop – do not turn the orifice any further. This will indicate that the orifice has made contact against the LP seat. (See Fig. 32.)



NOTE: To pre-set the orifice at exactly the correct depth inside the air barrel, XS Scuba recommends using the Poppet Align/ Orifice Preset Tool (P/N 20-785-400), available from Peter Built Co. Complete instructions are provided with the tool. (See Fig. 33.)

17. Lay the diaphragm(14) inside the housing, directly over the lever with its raised surface facing up, and then the thrust washer(15).
18. Fit the front cover(16) inside the housing so that it seats directly over the diaphragm. Turn it as needed to align the logo horizontally level (See Fig. 34.)
19. Mate the retaining ring(17) over the front cover and into the housing, and turn it clockwise to engage the threads. While holding the front cover secure with one hand, tighten the retaining ring until snug with the other. Be careful to avoid over-tightening.
20. Install the mouthpiece(23) onto the housing, correctly oriented with the top facing up. Fasten a tie-strap(21) over the mouthpiece with the locking tab facing toward the inlet coupling, and cinch it snug. Trim the excess material close to the locking tab.

▼ **After completing the reassembly of the second stage, proceed to Section 5 – Final Testing.**



Fig. 30 – Installing Retaining Clip



Fig. 31 – Installing Orifice



Fig. 32 – Preliminary Adjustment of Orifice

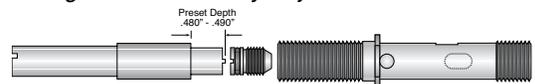


Fig. 33 – Using the Orifice Pre-Set Tool



Fig. 34 – Proper Logo Alignment

SECTION 5

Final Testing Procedures



CAUTION: If the regulator will be used with EAN/Nitrox, it is important to pressurize and flow test the regulator using only hydrocarbon-free gas. The regulator will otherwise become contaminated with hydrocarbons if normal compressed air is used. Industrial grade compressed Nitrogen is strongly recommended as a lower cost alternative to EAN/Nitrox for the purposes of flow testing.

First Stage Intermediate Pressure Test

1. Connect a calibrated intermediate pressure test gauge to the regulator, either with a quick-disconnect inflator hose or with the female fitting of a second stage LP hose, depending on the connection of the test gauge.



CAUTION: To provide a safety relief valve in the event that intermediate pressure exceeds 155-170 psi, ensure that a fully assembled and properly adjusted second stage is connected to the first stage before pressurizing. Failure to relieve intermediate pressure that exceeds 400 psi may result in damage or rupture of the test gauge or LP hose, and could cause serious personal injury.

2. Initially connect the first stage to a supply of 300 psi filtered test gas, and slowly open the supply valve to pressurize the first stage. Closely monitor the IP test gauge to determine whether the intermediate pressure rises above 145 psi.



CAUTION: If the intermediate pressure continues to rise above 200 psi, immediately shut the test gas supply valve. Refer directly to the Troubleshooting guide, and remedy as needed before proceeding any further.

3. When the intermediate pressure has been determined to be 145 psi or less, close the supply valve and purge the second stage to depressurize the system. Connect the

first stage to a supply of 2,500 - 3,000 psi test gas.



NOTE: Correct intermediate pressure for the first stage is between 135-145 psi, with a supply pressure of 2,500 - 3000 psi.

4. Open the supply valve again while monitoring the IP test gauge to ensure that the intermediate pressure does not rise above 145 psi. If the intermediate pressure rises above 145 psi, immediately close the supply valve and purge the system. Refer to the Troubleshooting Guide., and remedy as needed before proceeding.
5. Repeatedly purge the second-stage approximately 15-20 times to cycle the regulator. Then, check the test gauge to determine whether the intermediate pressure locks up consistently after each cycle and remains stable at 140 (± 5) psi, with no signs of creeping or fluctuation. If the intermediate pressure is not within the specified range, or if it fails to lock up with no creep, refer to the Troubleshooting Guide to determine the cause of the problem. Repeat this procedure after it is corrected.

Second Stage Adjustment and Flow Test

1. Connect the IP Test Gauge onto the inlet fitting of the Inline Adjusting Tool, and mate the opposite fitting of the tool onto the inlet fitting of the second stage. Pull back the knurled knob to retract the slotted drive, and tighten the tool clockwise onto the inlet fitting only until finger snug. (See Fig. 35.)
2. Mate the female fitting of the LP hose onto the male fitting of the IP Test Gauge, and tighten the swivel nut clockwise until finger snug.
3. Install the LP hose into an intermediate pressure port of the first stage regulator after it has been verified to be properly serviced, with a stable intermediate pressure of 140 (± 5) psi . Apply a torque wrench with 17mm crow-foot to tighten to 38 (± 2) inch-lbs.
4. Ensure that all the first stage ports are sealed, and connect the first stage with a filtered gas supply of 2,500-3,000 psi. Slowly open the valve to pressurize the regulator. Listen to verify that a leak can be heard from the second stage valve, and proceed to step 6.
 - a. If airflow cannot be heard, it will be necessary to initiate a slight leak between the orifice and poppet. Press the knurled knob inward to engage the slotted drive of the Inline Adjustment Tool with the head of



Fig. 35 – Inline Adjustment Tool w/ IP Gauge

the orifice inside the inlet fitting. Then, turn the orifice slightly counter-clockwise while lightly depressing the purge cover to prevent wear on the seat. Do not adjust any further than is needed to establish a slight leak.

5. Hold the drive of the Inline Adjustment Tool engaged with the orifice. While lightly depressing the purge cover, turn the orifice slightly clockwise a very small fraction of a turn. Pause after each adjustment to listen, and be careful to avoid over-adjusting beyond the point that the leak has stopped. When the leak has stopped, purge the second stage again to ensure that it does not return. Observe the IP Test Gauge while purging to verify that it indicates a stable intermediate pressure after each cycle, with no creep or fluctuation.



CAUTION: Over-adjustment of the orifice can cause excessive spring load in the second stage valve, and may impair the regulator's performance.

6. When the second stage is properly adjusted with no leaks or lever slack, depressurize and purge the system to disconnect the LP hose.
7. Reconnect the LP hose to the inlet coupling, and apply a torque wrench with 17mm crow-foot to tighten the fitting to a torque measurement of 55 inch-lbs (± 5).

Subjective Breathing Test

1. While the regulator is connected to a cylinder containing 2,500 – 3,000 psi and pressurized, turn the second stage adjustment knob completely out counterclockwise, and verify that a slight leak of airflow is present.
 2. Slowly turn the adjustment knob clockwise to verify that the airflow stops between 2 -1 turn.
 3. Turn the adjustment knob completely in clockwise to maximum opening effort, and depress the purge to ensure that an adequate volume of air flows through the mouthpiece, sufficient to clear the second stage.
 4. Turn the adjustment knob out counter-clockwise until a leak can be heard, and then back just until the leak stops. Breathe from the second stage.
- ▼ *A properly serviced and adjusted regulator should deliver air upon deep inhalation without excessive inhalation effort, freeflow, or vibration. When exhaling, there should be no resistance or sticking of the exhalation valve. If any of these problems occur, refer to the Troubleshooting*

Guide on pages 26-27.

Flowbench Testing (optional)

The Subjective Breathing Test, combined with the Intermediate Pressure Test, will sufficiently verify the regulator's performance in most circumstances. As an additional test, a Magnahelic flowbench can be used to verify the second stage opening effort, which should not exceed 1.5 column inches H₂O.

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. Disassemble the regulator at the source of the leak to check sealing surfaces, assembly sequence and component positioning in order to correct the problem(s).



NOTE: The location of extremely small leaks can best be detected by applying a soap solution to the leak area. 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) test gas. Refer to the Troubleshooting Guide.

- ▼ *When the second stage has been adjusted and tested according to the prescribed procedures, close the cylinder valve completely, and purge the second stage 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. Disinfect the mouthpiece, and dry the regulator completely with a clean towel. This completes the overhaul service procedures for the Spirit regulator.*

Troubleshooting Guide

First Stage

SYMPTOM	POSSIBLE CAUSE	TREATMENT
Excessive inhalation resistance from both second stages	<ol style="list-style-type: none"> 1. Cylinder valve partially opened. 2. Cylinder valve requires service. 3. Filter is clogged. 4. Low intermediate pressure. 	<ol style="list-style-type: none"> 1. Fully open valve, turn back 1/4 turn. Check fill pressure. 2. Connect to a different cylinder. 3. Replace filter with new. 4. See below.
Low intermediate pressure	<ol style="list-style-type: none"> 1. Piston cap is loose. 2. Main valve spring is damaged. 3. Incorrect number of spring washers 	<ol style="list-style-type: none"> 1. Tighten piston cap. 2. Replace spring and spring washers. 3. (With new spring only:) Install up to a total of three washers.
High intermediate pressure	<ol style="list-style-type: none"> 1. HP seat damaged or worn. 2. Piston O-rings damaged or worn. 3. Piston is damaged. 4. First stage body damaged internally. 5. Incorrect number of spring washers 	<ol style="list-style-type: none"> 1. Replace HP seat. 2. Replace O-rings. 3. Replace orifice. 4. Replace body. 5. Remove washers.
Leakage from beneath yoke	<ol style="list-style-type: none"> 1. Yoke retainer O-ring damaged or worn. 	<ol style="list-style-type: none"> 1. Replace O-ring.



CAUTION: All repairs must be performed with a complete overhaul service, unless the problem is detected immediately after a complete overhaul service has already been performed. Do not attempt to perform partial service if the regulator shows any signs of use. For additional troubleshooting assistance, contact your XS Scuba distributor.

Troubleshooting Guide

Second Stage

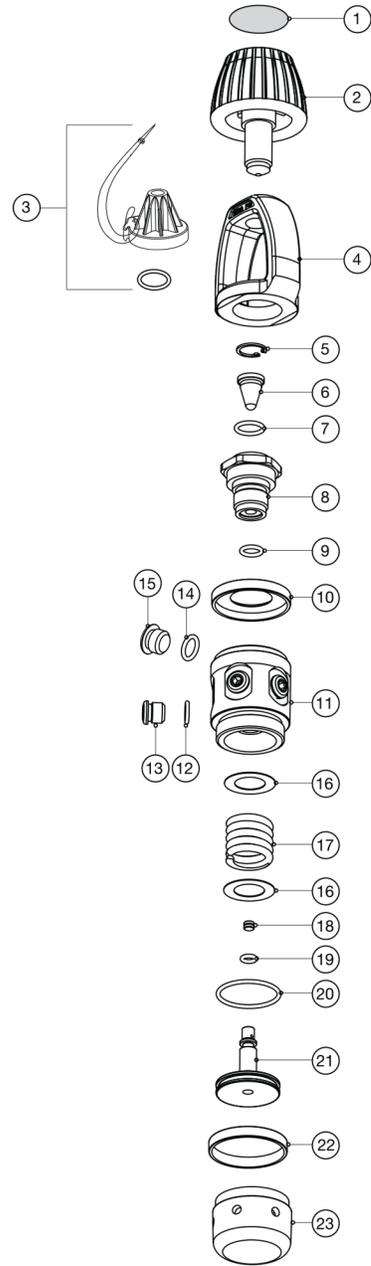
SYMPTOM	POSSIBLE CAUSE	TREATMENT
Freeflow or leakage (Adjustment knob turned in)	<ol style="list-style-type: none"> 1. Excessive intermediate pressure. 2. Damaged or worn LP seat. 3. Damaged orifice sealing surface. 4. Damaged orifice O-ring. 5. Orifice incorrectly adjusted. 6. Poppet spring damaged. 7. Lever pad is damaged or incorrectly installed. 	<ol style="list-style-type: none"> 1. Refer to first stage troubleshooting 2. Replace with new. 3. Replace with new. 4. Replace with new. 5. Reset to preliminary setting and readjust. 6. Replace with new. 7. Replace with new.
Excessive Inhalation Resistance or Hesitation (Adjustment knob turned out)	<ol style="list-style-type: none"> 1. Insufficient intermediate pressure. 2. Orifice incorrectly adjusted. 3. Lever is damaged. 	<ol style="list-style-type: none"> 1. Refer to first stage troubleshooting 2. Reset to preliminary setting and readjust. 3. Replace with new.
Insufficient airflow when purge button is depressed	<ol style="list-style-type: none"> 1. Lever is slack, or orifice incorrectly adjusted. 2. Lever is bent. 	<ol style="list-style-type: none"> 1. Reset to preliminary settings and readjust. 2. Replace with new.
Water entering second stage	<ol style="list-style-type: none"> 1. Exhaust valve worn or damaged. 2. Mouthpiece worn or damaged. 3. Adjustment knob or O-ring damaged, reassemble as required. 	<ol style="list-style-type: none"> 1. Replace with new. 2. Replace with new. 3. Disassemble and inspect, replace or incorrectly installed, or worn.



300 BAR DIN ADAPTER

DESCRIPTION		
RK7	DIN ADAPTER SERVICE KIT	
RP100	COMPLETE DIN ADAPTER	
24.	RP200-36	O-RING
25.	RP100-25	FILTER RETAINER
26.	RP200-17	O-RING
27.	RP200-38	FILTER
28.	RP200-29	O-RING
29.	RP100-29	HANDWHEEL
30.	RP100-30	DIN RETAINER
31.	RP200-29	O-RING

Part numbers in bold italics are standard replacement parts

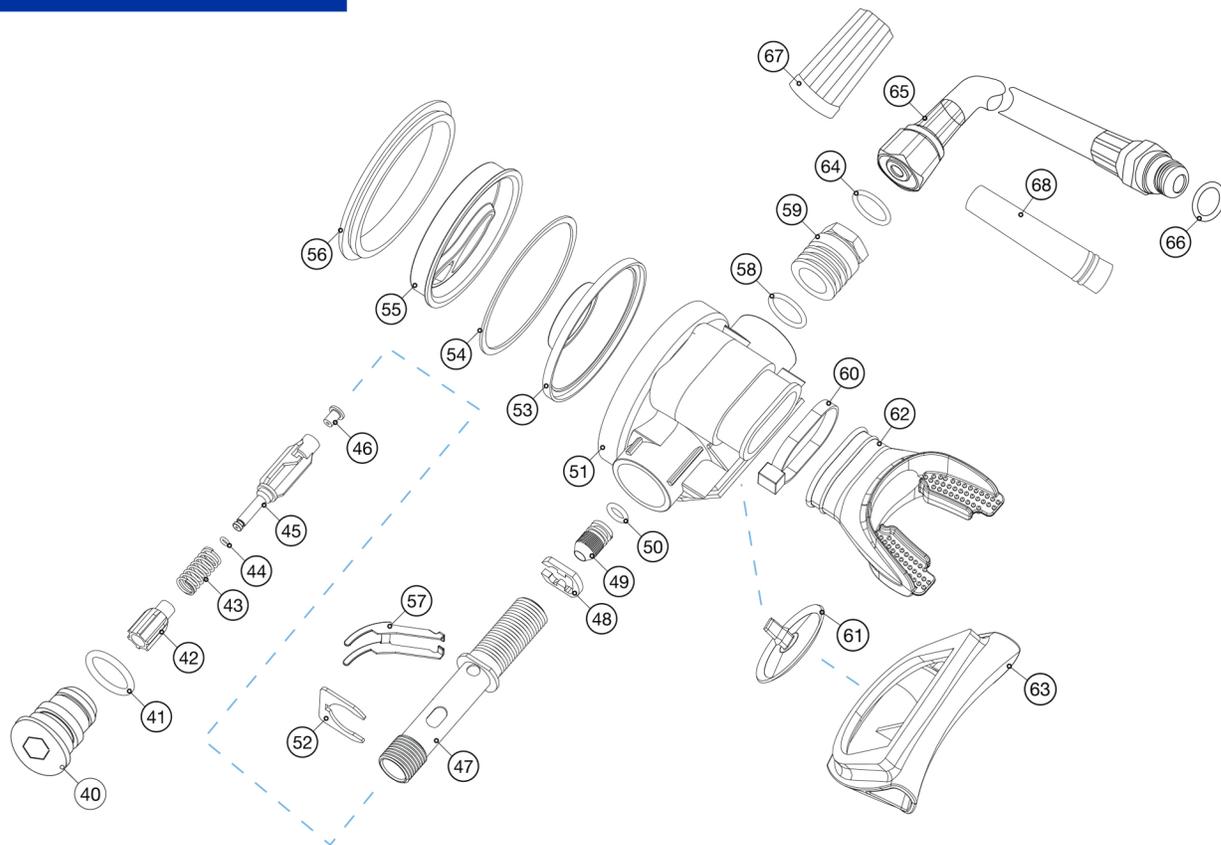


#	Part #	Description	#	Part #	Description
	RK3	SERVICE KIT - SPIRIT 1ST STAGE - YOKE	13.	RP200-32	LP PORT PLUG
1.	RP200-01	YOKE SCREW DECAL	14.	RP200-17	O-RING
2.	RP200-02	YOKE SCREW	15.	RP200-16	HP PORT PLUG
3.	RP200-03	DUST CAP w/STRING & O-RING	16.	RP100-16	SPRING WASHER
4.	RP100-04	YOKE	17.	RP100-17	HP SPRING
5.	RP200-05	RETAINING CLIP	18.	RP100-18	HP SEAT
6.	RP200-06	FILTER	19.	RP100-19	O-RING
7.	RP200-07	O-RING	20.	RP200-39	O-RING
8.	RP100-08	YOKE RETAINER	21.	RP100-21	PISTON
9.	RP200-29	O-RING	22.	RP100-22	COLLAR
10.	RP100-10	SADDLE	23.	RP100-23	PISTON CAP
11.	RP100-11	MAIN BODY			
12.	RP200-29	O-RING			

Part numbers in bold italics are standard replacement parts



SPIRIT
Second Stage



#	Part #	Description
	RK2	SERVICE KIT - SPIRIT 2ND STAGE
40.	RP250-28	PLUG
41.	RP250-02	O-RING
42.	RP250-03	BALANCE SHUTTLE CAP
43.	RP250-04	LP SPRING
44.	RP250-05	O-RING
45.	RP250-06	POPPET
46.	RP250-07	LP SEAT
47.	RP250-08	AIR BARREL - BRASS
47.	RP250-08S	AIR BARREL - TITANIUM
48.	RP250-09	LEVER PAD
49.	RP250-10	ADJUSTABLE ORIFICE
50.	RP200-19	O-RING
51.	RP250-12	HOUSING BODY
52.	RP250-13	RETAINING CLIP
53.	RP250-14	DIAPHRAGM

#	Part #	Description
54.	RP250-15	THRUST WASHER
55.	RP250-29	FRONT COVER
56.	RP250-30	RETAINING RING - PLASTIC
57.	RP250-18	LEVER
57.	RP250-18T	LEVER - TITANIUM
58.	RP200-12	O-RING
59.	RP250-20	INLET FITTING
60.	RP250-11	"NO BUMP" TIE STRAP
61.	RP250-22	EXHAUST VALVE
62.	RP250-23	MOUTHPIECE
63.	RP250-24	EXHAUST TEE
64.	RP200-19	O-RING
65.	LP30	LP HOSE - 30"
66.	RP200-29	O-RING
67.	RP250-25	HOSE PROTECTOR
68.	RP250-26	HOSE COVER

Part numbers in bold italics are standard replacement parts