PLATINA

R-100 FIRST STAGE TECHNICAL MANUAL

SECTION I

1.0 IMPORTANT INFORMATION

This manual is designed for use by authorised service technicians who have completed a training course in TUSA Regulator repair. This manual is intended for use only in connection with the TUSA Regulator Repair course as prescribed by Tabata Co., Ltd and is not meant for general distribution. Accordingly, Tabata Co., Ltd makes no representations or warranties or any kind concerning the techniques or procedures contained within this manual. It is assumed the authorised service personal repairing and servicing regulators have average mechanical ability, a good understanding of the operation of SCUBA regulators and adequate diving experience.

This manual is not intended for use by divers in overhauling or attempted repair of regulators in the field. Such practice by untrained persons is strongly discouraged and should be attempted only by trained personnel when absolutely necessary.

1.1 LUBRICANTS AND SEALANTS

This regulator is approved for a food grade (pure) type of silicone grease or perfluoropolyether grease (CHRISTO-LUBE MCG 111, DC111) lubricant only.

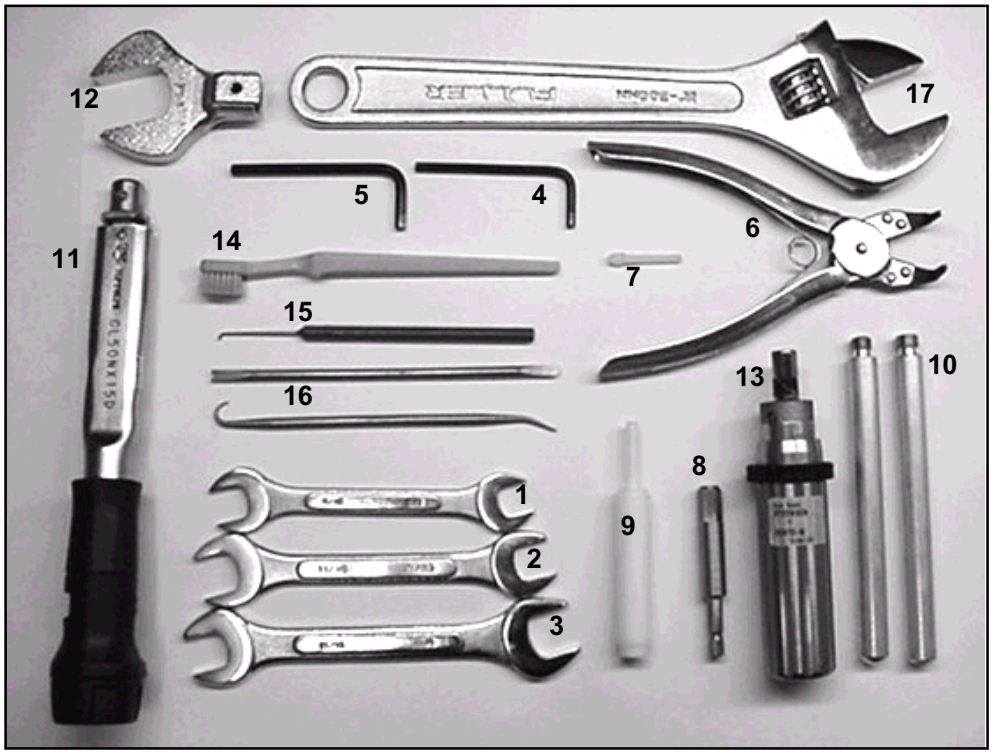
When using a thread locking compound we recommend Loctite No. 242, 243 or 4013 medical. Sources for these compounds may be obtained from your TUSA factory service centre.
See Figure 1.a

FIG 1.a

1.2 TOOLS REQUIRED

The following tools are recommended for servicing the R-100 regulators. Some tools listed are available from local sources. Special tools can be purchased upon request from the TUSA Technical Service Department using the indicated catalogue number.

ITEM	CATALOGUE NO.	DESCRIPTION
1		Open end wrench, 1/2”-9/16”
2		Open end wrench, 11/16”-19/32”
3		Open end wrench, 5/8”-3/4”
4	MT-6W1	Allen Key, 3/16”
5	MT-6W2	Allen Key, 5/32”
6	MT4-10	Snap ring pliers
7	MT1-1	R-100 Piston bullet
8	MT1-2	Filter Retaining Bit
9	MT1-3	R-100 Piston stem o-ring guide
10	MT1-4	Tightening Bars (2/set)
11	MT-TW50N	Torque wrench TW50N
12	MT-SH25.4	Spanner head 25.4mm
13	MT-26NTD	Torque driver RTD260CN
14		Toothbrush, nylon bristle
15		O-rings pick, nylon or soft brass
16	BRASSPICK	Brass pick set (2 picks)
17		12”-300mm adjustable wrench



SECTION II

2.0 TERMINOLOGY AND DESCRIPTION OF OPERATION

The following discussion will introduce the proper terminology to be used through the manual. To help establish efficient communications when reporting problems to the factory or discussions with the customer we recommend that you utilize these terms. Terms will be introduced in full text followed by the acronym or abbreviation in brackets.

The regulator reduces high-pressure air from the scuba cylinder (supply pressure) to ambient pressure suitable breathing, through the operation of first and second stage regulators. The first stage regulator reduces incoming high pressure (HP) air, to an intermediate pressure (IP) of approximately 130 to 145 pounds per square inch (psi). The second stage regulator is a diaphragm operated downstream demand valve and functions to reduce air from intermediate pressure to ambient pressure permitting normal breathing at depth. A low-pressure (LP) hose connects the first and second stages of the regulator. A yoke on the first stage body secures the regulator to the cylinder valve, while an o-ring surrounding the outlet orifice on the cylinder valve ensures an airtight connection to the first stage. During servicing and overhaul, the term supply pressure is used to denote an air supply of high pressure between 2750 to 3000 psi.

2.1 BALANCED PISTON FIRST STAGE

Refer to **Figure 2-a** and **2-b** for the following discussion. High-pressure air entering the yoke retainer inlet port of the first stage regulator passes through a sintered filter which helps prevent the entry of any foreign particles. This airflow continues through the regulator body passages to the HP seat chamber where it flows across the annular gap between the HP seat and the need of the HP piston stem. Here the air expands resulting in a reduction of pressure. Airflow continues past the HP seat, as long as the piston remains in an OPEN position, and passes through the internal section of the HP piston stem. The term “flow through piston” describes this operation. Air merges form the HP piston stem and enters the intermediate pressure chamber inside the upper portion of the cap and swivel. The LP hoses are attached to the swivel and guide airflow to the second stage regulator or buoyancy compensator inflator device.

The forces which tend to maintain the HP piston in the OPEN position are (1) the force of the HP spring and (2) the force produced by ambient water pressure acting on the back surface of the HP piston head. The force, which tends to move the piston to the CLOSED position is the pneumatic force produced by the intermediate pressure acting on the front of the piston head. The regulator is designed so that the piston remains in the open position until the intermediate pressure approaches approximately 135 psi. When this intermediate pressure is achieved the force becomes great enough to overcome the force of the HP spring and the ambient water pressure allowing the piston to move into the CLOSED position sealing against the HP seat.

The piston will remain in the CLOSED position until the intermediate pressure in the LP hose is lowered by the actuation of the demand lever in the second stage regulator during inhalation. This lowering reduces the pneumatic force acting against the front of the HP piston head which permits the combined force of the HP spring and the ambient water pressure to move the HP piston to the OPEN position allowing high pressure air to flow into the swivel chamber again.

The first stage piston is pneumatically “balanced” meaning that the high pressure air surrounding it exerts no opening or closing force against the piston itself. The advantage of a “balanced” piston is that the first stage regulator maintains a stable intermediate pressures range of 128 to 150 psi over ambient pressure, despite a continually decreasing supply pressure from the SCUBA cylinder. This stabilization of intermediate air pressure in the first stage assures optimal second stage performance as the air supply in the SCUBA cylinder is depleted.

The balanced piston first stage of the R-100 Regulator functions to deliver the intermediate pressure at 135 to 145 psi above the depth related ambient pressure. This depth compensation is achieved by allowing ambient water to enter the main body and flood the HP spring area and act upon the back side of the HP piston. As the diver descends the ambient water pressure becomes the reference point from which the HP piston controls the intermediate pressure from 135 to 145 psi above ambient pressure. The balanced piston first stage maintains a constant differential between surrounding ambient water pressure and intermediate air pressure. This helps to assure that the effort to actuate the second stage will remain relatively constant with changing depth.

CLOSED POSITION

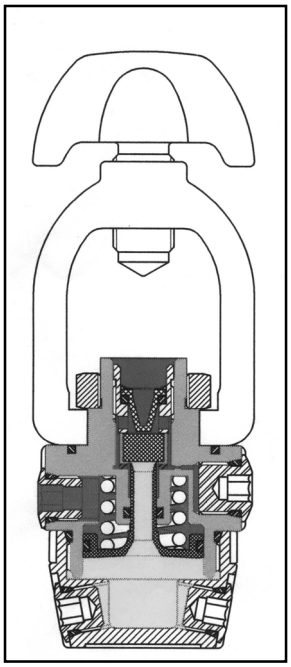


FIG. 2-a

OPEN POSITION

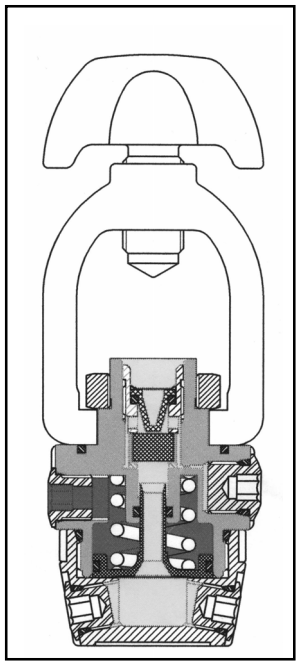


FIG. 2-b

SECTION III

3.0 GENERAL CARE GUIDELINES

Tusa recommends to all Authorised Dealers that they take individual time with each customer to explain and demonstrate the following simple steps for care and maintenance of the regulator. This will help to ensure the following goals:

Personalised contact with the customer insuring satisfaction.
Help to insure long life of the new purchase through maintenance.
Communication of findings during tuning or overhaul service.
Help prevent problems described if this step is not taken.

1. After exiting the water and with the cylinder valve still on, purge air through the second stage to help blow out remaining water.

1. Close cylinder valve and purge remaining pressure from the regulator. Loosen the yoke knob and remove the first stage from the valve. Crack the valve slightly to direct a stream of air onto the dust cap to dry it off. Immediately place the dry dust cap over the conical filter and tighten the yoke knob to prevent moisture from entering the first stage. The conical filter is a nickel-plated sintered brass component whose metallic matrix structure creates a large filtration area allowing for efficient air filtration with low-pressure drop. This large area makes the filter susceptible to corrosion by trapping tiny droplets of water within it's matrix.

1. Prior to rinsing the regulator insure the dust cap is snug and covering the conical filter area of the yoke. If using the S-30 Platina adjustable second stage, dial the adjustable knob fully clockwise in to prevent water from entering into the hose and first stage.

1. Using either of the following rinse methods if necessary. A stream of fresh water, from a hose or tap, directed around and especially into the holes in the first stage will flush salt water from the piston and spring area preventing corrosion and minimal deposits. Direct fresh water into the mouthpiece of the second stage to flush the internal components, diaphragm and exhaust valve area. The build up of mineral (salt) deposits will lead to premature wear on the o-rings of the first stage piston and lead to a rough breathing second stage valve mechanism.

OR

Immerse the regulator (make sure dust cap in place) into a bath of fresh water and agitate to insure good flushing. If extended storage is anticipated, immersion for 12 hours or more is preferred. After immersion, utilize the rinse step above to flush all regulator components thoroughly.

NOTE

Do not depress the purge button of the second stage while rinsing or soaking. This will help prevent water from entering the valve mechanism or intermediate pressure hose causing corrosion or deposits

1. Before storing the regulator, hang it with the second stage down to insure drainage and ample time to completely dry all components. If a cylinder is available, the user may wish to install the regulator and purge air through the system to insure no water remains within the valve mechanism prior to storage.

EMPHASIZE THE FOLLOWING TO YOUR CUSTOMERS:

DO NOT expose the regulator to extreme heat or direct sunlight when not in use. Temperatures exceeding 80oC (180oF) for extend periods of time may cause permanent damage to some internal valve components leading to a lack of performance or failure. If you suspect your regulator has been exposed to excessive heat, please have it examined by your authorised TUSA service centre.

DO NOT leave the regulator pressurized or attached to a SCUBA cylinder for an extended period of time when not in use.

DO NOT lift the SCUBA cylinder by using the regulator hoses or first stage as a handle. Always secure the cylinder to prevent it from tipping over and damaging the regulator while it is attached.

3.1 DETERMINING SERVICE INTERVALS AND CYCLE LIFE

TUSA recommends that the Service Technician utilize the following guidelines to determine service intervals and extent of service required for the customers' regulator. Most components in a regulator have very high expected usable life based on the number of breathing cycles and exposure of the equipment.

The following calculation is meant to educate the Service Technician on how many cycles (breathing) a regulator may see from average use.

CYCLES = **No. of** DIVE DAYS per YEAR X **No. of** DIVE HOURS per DAY
X **20** BREATHS per MINUTE X **60** MIN per HOUR

For example: If you dived 25 days last year for 3 hours per day:

CYCLES =
25 DAYS/YEAR X **3** HOURS/DAY X **20** BREATHS/MIN X **60** MIN/HOUR

CYCLES = **25** X **3** X **20** X **60**

BREATHING CYCLES = 90,000 PER YEAR

3.2 DETERMINING SERVICE APPLICATION

As you can see it is important to determine your customers dive habits to determine the best possible recommendation for service. Other factors to consider include the exposure of the equipment, extent of user maintenance, experience and application from the user and future planned use of the equipment. To summarise:

(A) EXPOSURE OF EQUIPMENT

Diving cold water 4.5oC (40oF or lower) requires the regulator to be "Environmentalised" or protected from potential freezing and requires more frequent servicing (See section 7.3).

Diving in low visibility or contaminated water requires more frequent servicing and overhaul to keep residue from building up inside the valve components. (See section 7.4)

Diving in tropic salt-water environments tends to subject the regulator to constant moisture exposure and will lead to accelerated corrosion of regulator valve components.

Diving with Enhanced Air (Safe Air) mixtures requires the regulator to be specially cleaned and lubricated. (See section 7.2)

(B) USER MAINTENANCE

Obviously a regulator that has been maintained extensively by the user will require far less overhauls to replace worn or corroded components. Poor user maintenance indicates that more attention (overhauls and tuning) of the regulator is required to prevent failures.

(C) EXPERIENCE AND APPLICATION

Deep diving or overhead environment diving requires a regulator to be in top condition at all times. The experienced user would require more frequent overhauls and replacement of key o-rings and first stage spring to maximise reliability.

(D) FUTURE APPLICATION

A user planning an extended dive vacation, training or use for applications discussed above would benefit from an overhaul prior to the planned extended use to insure maximum performance and reliability.

SECTION IV

4.0 INSPECTION TECHNIQUES

We encourage the service technician to develop good habits and practice in inspection techniques during service and overhaul. Observing the exterior condition of a regulator can offer clues on what may be found during overhaul. Finding sand or salt deposits on the exterior crevices between mating parts may indicate a regulator that is not properly maintained by the customer. One may almost certainly discover more sand or salt deposits inside the second stage case. In severe instances, a major overhaul and adjustment would probably take less time to accomplish than to attempt a light cleanup leading to marginal performance adjustment. Severe dings in the chrome plated brass body of the first stage or plastic case of the second stage may indicate gross negligence in handling the regulator. Further examination must proceed especially looking for small cracks or damage in the second stage body, LP hoses, yoke knobs etc. It is most important to look for cracks or damage near the external nut of the demand housing in the second stage case. Mishandling may lead to severe stress imparted into the LP hose resulting in cracks. Please refer to disassembly of the stages for further discussion.

(A) O-RINGS

O-rings are common off-the-shelf well-engineered reliable sealing devices. A few words about handling them are required. O-rings can be ordered in different sizes, rubber compounds and hardness (durometer). It is important not to substitute o-rings from other sources in replacing TUSA regulator seals. Use only factory supplied o-rings. As part of the TUSA annual servicing policy it is recommended that all o-rings be replaced to maintain warranty. Further details are available from the factory distributor. Do not attempt to clean or lubricate o-rings outside of the recommendations in Section 5.1.

(B) SEALING SURFACES

All metal parts use in TUSA regulators are made of either a corrosion resistant stainless steel or chrome plated brass. Handle all metal components with care to avoid scratches, dings or dents. Some components such as the first stage piston in the R-100 have a very smooth and polished surface on the stem. This is the sealing surface for the HP o-ring. A very unnoticeable scratch or ding on this surface may allow a high-pressure leak across the o-ring. The piston cannot be repaired and thus becomes an expensive replacement, which could have been avoided by proper handling. Pay particular attention to the assembly of all components and which surfaces are used for sealing against o-rings. Handle these surfaces with particular care to avoid scratches, dings or dents.

(C) HOSES AND RUBBER COMPONENTS

The examination, care and handling of all rubber components are well documented through out the TUSA Dealer Service Manual. Look for deterioration and cracking of rubber components resulting from age, misuse, or exposure to caustic cleaning compounds. Contact your factory representative should you have further questions.

4.1 TROUBLESHOOTING GUIDANCE

Prior to troubleshooting the R-100 regulator we recommend you become familiar with the operation and design by reading Sections 2.0 and 5.0 through to 6.0. You will find that a good basis and understanding of the regulator function will benefit your repair and servicing abilities.

Prior to beginning a service or troubleshooting session it is important to proceed as follows:

1. Talk to the customer. Attempt to understand the nature of the problem. If the customer describes for instance, “sporadic periods of high inhalation efforts”. Ask the obvious question: “Did you happen to be swimming upside down when the regulator seemed to breathe harder?” Discussions may lead to understanding your customer and their complaints better.

1. Attempt to duplicate the functional problem by doing an In-Water Test. A reported leak or bubble from the first stage may be traced to a specific o-ring much quicker with this method.

1. Record your findings as you examine and test the regulator prior to and during the entire service and overhaul procedure. Record the customers name, date of last service, intermediate pressure before and after service, supply pressure during testing, unusual conditions or debris present, components and seals replaced during this service, approximate breathing cycles between service periods and any other pertinent information.

4.2 TROUBLESHOOTING R-100 BALANCED PISTON FIRST STAGE

SYMPTON	POSSIBLE CAUSES	RECOMMENDATIONS
LOW FLOW OR HIGH INHALATION EFFORTS		
	1 Cylinder valve not open or clogged	1 Open valve completely or overhaul needed
	2 Sintered filter (5) clogged	2 Replace sintered filter
	3 HP spring (18) coil weak or fatigued	3 Replace HP spring
INTERMEDIATE PRESSURE LOW OR UNSTABLE		
	1 HP piston head o-ring (20) damaged	1 Replace o-ring, check seal worn or damaged
	2 HP piston (19) sealing edge or HP seat (8) damaged	2 Replace HP piston and HP seat
	3 Spring isolator (17) installed incorrectly or wrong size	3 Replace Spring isolator
	4 HP piston stem o-ring (12) worn or Damaged.	4 Replace o-ring and check seal
	5 Filter housing (7) loose	5 Tighten filter housing
	6 Leak between intermediate chamber, LP hose and second stage	6 Find leak in-water test and replace damaged o-ring.
	7 End cap (22) loose	7 Tighten cap
INTERMEDIATE PRESSURE EXCESSIVELY HIGH		
	1 HP Piston (19) sealing edge or HP seat (8) damaged.	1 Replace HP seat & check HP piston sealing edge
	2 Spring isolator (17) installed Incorrectly or wrong size.	2 Replace isolator.
	3 HP piston o-rings (12) & (20) Are worn or damaged.	3 Replace o-rings, check seal.
AIR LEAKS DETECTED FROM IN-WATER TEST		
	1 HP piston o-rings (12) & (20) Are worn or damaged.	1 Replace o-rings, check seal.
	2 End cap o-ring (16) is worn.	2 Follow special procedure Section 5.1 & 5.3 only.
	3 LP port plug o-rings (24) Are worn or damaged.	3 Replace o-rings, check seal.

SECTION V

NOTE

Prior to disassembly, record the results of the preliminary inspection, the in water test, and the first stage intermediate pressure. Remember to retain all o-rings, filters or other components that are to be replaced in case the customer requests to view the parts. For replacements, that were part of the Warranty scheme annual service, please return these parts to your TUSA factory distributor along with a copy of the service report.

Remember to record your findings as you proceed to allow both a complete record of the overhaul and future reference for servicing. The words “RECORD FOR REPLACEMENT” will indicate all components to be handled in this manner.

Read and understand the Troubleshooting Section 4.0 to gain a better idea of which internal parts may be worn, and to better advise your customer of the service that is required. Refer all item numbers (99) to the “schematic” view or exploded view for this regulator found at the end of Section 5.3.

5.0 DISASSEMBLY PROCEDURE R-100 BALANCED PISTON FIRST STAGE

1. Before disassembling the first stage, remove all attached hoses. Remember to use the proper wrench with each hose as required: low pressure second stage hoses use a 9/16” open end wrench, low pressure inflator hose use either a 9/16” or _” open end wrench, and the high pressure gauge hose users a 5/8” open end wrench. Refer to **Figure. 5-a**

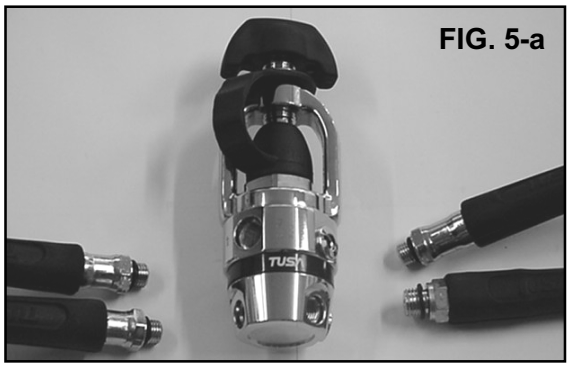


FIG. 5-a

1. Remove all LP plugs (23) from end cap (22), all HP Plugs (10) and all EP Plugs (15) from body (13) using correct Allen key. Remove o-rings (24) from LP plugs and o-rings (11) from HP plugs inspect o-rings for any sign of decay. RECORD REPLACEMENT IF REQUIRED. Refer to **Figure. 5-b**

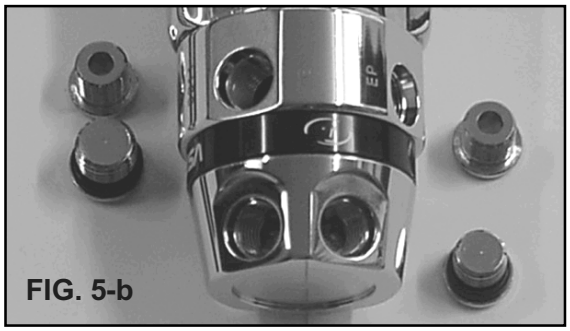


FIG. 5-b

3. Prepare to remove the End-cap (22) by inserting one LP tightening bar into one of LP port in the end cap and one HP tightening bar into one of the HP ports in the body (13) Refer to **Figure. 5-c**

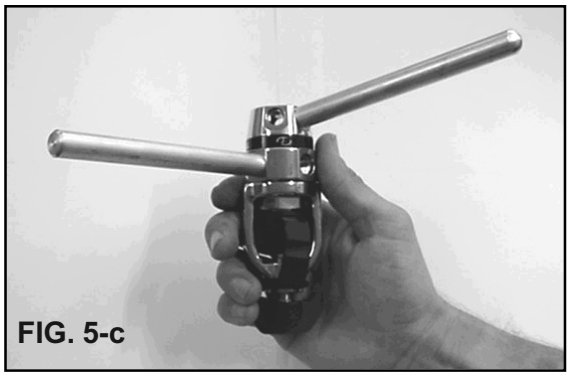


FIG. 5-c

NOTE
Make certain the Tightening Bars are firmly seated into both plugs (23) & (10) before attempting to rotate the end cap (22) in a counterclockwise direction.

4. Holding the regulator firmly in place, twist the end cap (22) in a counter clockwise direction until the end cap (22) is loosened enough to complete removal by hand. The end cap ring (21) should then be taken from the body by hand, inspected and cleaned. Refer to **Figure. 5-d**

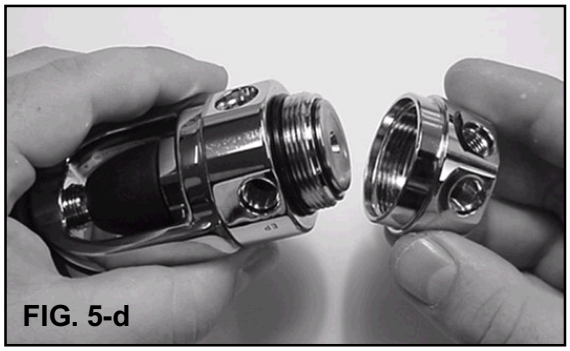


FIG. 5-d

5. Using an o-ring pick remove the body o-ring (16) RECORD FOR REPLACEMENT. DO NOT attempt to reuse this o-ring.

6. Remove the HP piston (19) from body (13) by carefully grasping the piston between thumb and forefinger, pulling straight up with a slow, steady force.
Refer to **Figure. 5-e**

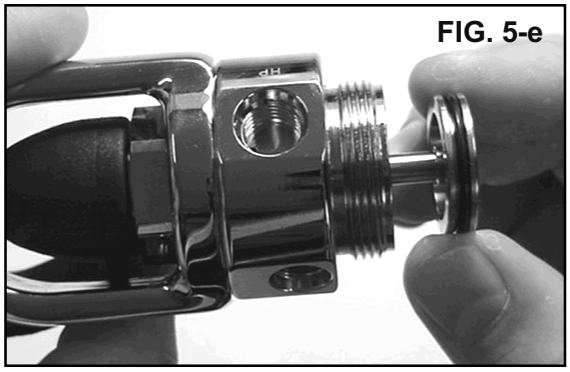


FIG. 5-e

WARNING
Failure to recognize or replace a faulty HP piston may lead to failure of the regulator to regulate the intermediate pressure. Use prudence and replace the piston if damage to the piston stem sealing (knife) edge is found.

7. Remove any spring isolators (17) (using a pneumatic air gun) from the base of the piston head and inspect this area for signs of corrosion **See Figure. 5-f**. Also inspect the piston stem for unusual scratches, dings, dents or wear along its sealing surface. Closely insect the sealing edge of the piston stem for dings or dents. Record your findings on the condition of the piston. RECORD FOR REPLACEMENT and DO NOT attempt to reuse if any of these conditions are found.

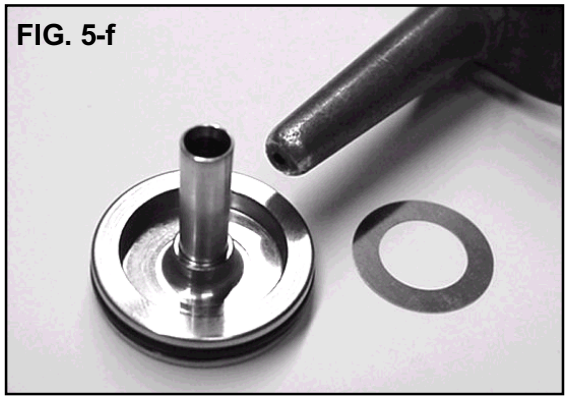


FIG. 5-f

8. Remove the HP spring (18) and inspect it for any unusual cracks, corrosion or bent coils. RECORD FOR REPLACEMENT and DO NOT attempt to re-use if any of these conditions are found. Refer to **Figure 5-g**

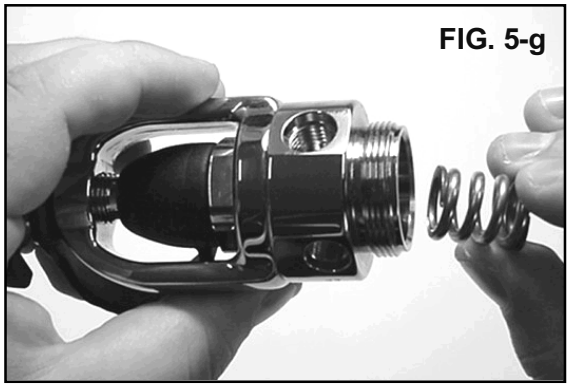


FIG. 5-g

WARNING

Failure to recognize or replace a faulty HP spring may lead to failure of the regulator to supply air. Use prudence and replace the spring regularly to maintain top performance in the regulator function.

9. Remove the piston head o-ring (20) and RECORD FOR REPLACEMENT. DO NOT attempt to reuse this o-ring **Figure 5-h**. If the piston is to be reused, take steps at this time to protect the piston stem and sealing edge from damage during handling and cleaning.

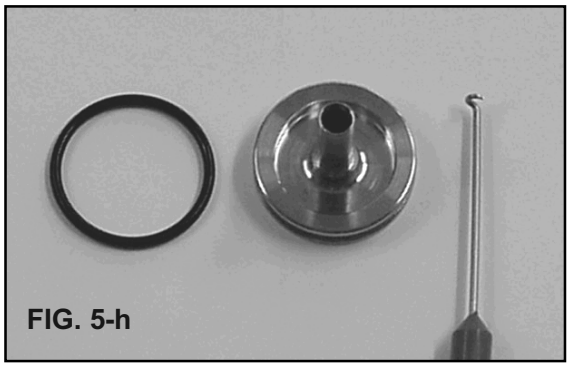


FIG. 5-h

10. Removal the piston stem o-ring (12) located within the internal o-ring groove of the main body (13), but must be attempted using only the proper tools and patience. View the main body through the piston entrance to locate the internal o-ring groove. The piston stem o-ring (12) seals against both the stem of the HP piston (19) and the brass internal o-ring groove within the main body. Refer to **Figure 5-i**.

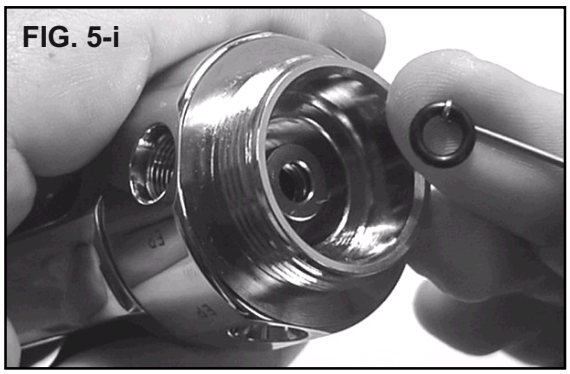


FIG. 5-i

NOTE

Extreme care must be taken not to damage the brass sealing surface of the groove when removing or installing this o-ring. Use only soft brass or plastic o-ring pick to attempt this operation. Examine the o-ring upon removal and RECORD REPLACEMENT. DO NOT attempt to reuse this o-ring.

11. Remove the Yoke knob (1) and the dust cap (3) from the yoke (2). Inspect very thoroughly for cracks, wearing, or distortion. Also check the internal thread located on the yoke. RECORD REPLACEMENT IF REQUIRED. Refer to **Figure 5-j.**

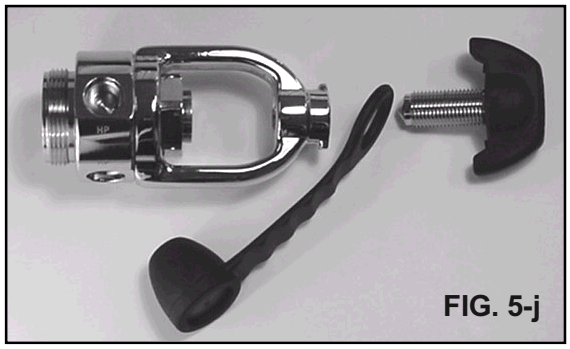


FIG. 5-j

12. Remove and inspect the yoke for any signs of distortion or cracking. If none are present and the yoke shows no signs of deterioration, it need not be removed to service the first stage.

12. To remove the yoke (2) from the main body (13), we recommend using a slotted flat bar tool or a 12” adjustable wrench. Place the first stage in a smooth-jawed vise, with yoke facing up. Install the wrench or flat bar tool onto the yoke retainer (14). Using firm, steady force, rotate the tool in a counterclockwise direction until the yoke retainer nut and yoke are removed. See **Figure 5-k**

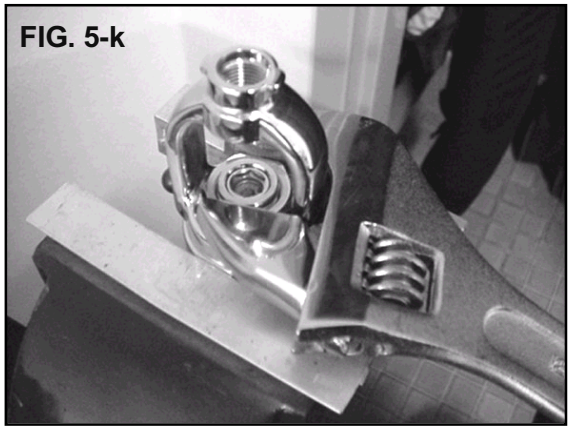


FIG. 5-k

NOTE
Use care and caution to avoid damage to the surface of the body (13). DO NOT over-tighten the vise onto the soft brass of the first stage.

14. To remove the conical filter (5), first remove the filter retainer assembly with 3/8" Allen key. Use snap ring pliers to remove the filter retaining ring (4) from the housing (7). The conical filter and the filter o-ring (6) should drop in your hand. Examine and record the condition of the conical filter looking for large particles of rust, debris, corrosion, or dark deposits from excessive contamination. RECORD FOR REPLACEMENT and DO NOT attempt to reuse. Refer to **Figure 5-l**

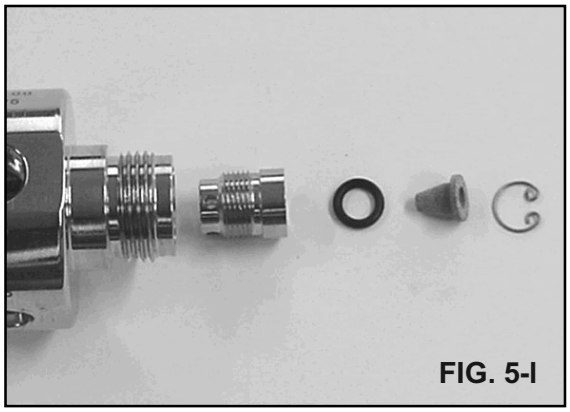


FIG. 5-l

15. To remove the HP seat (8) and HP seat retainer (9) turn the body (13) upside down. See **Figure 5-m**. If the HP seat assembly does not dislodge and fall out by itself, push it out from opposite end using a short burst air from an LP air gun. Examine and record your findings on the condition of the HP seat looking for deep indentations, contamination, severe discolouration or debris. RECORD FOR REPLACEMENT and DO NOT attempt to reuse the HP seat if any of these conditions are found. See Section 4.0 for important guidelines.

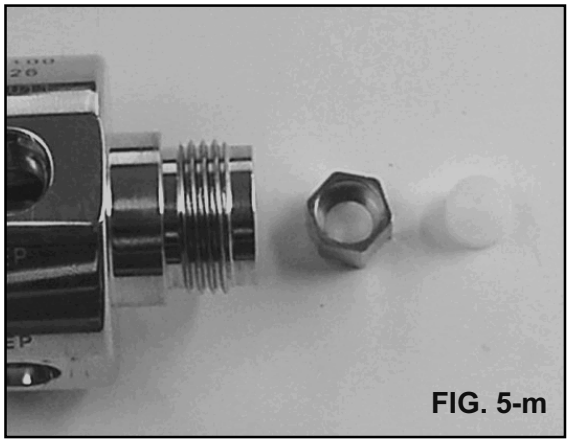


FIG. 5-m

NOTE
DO NOT attempt to remove the HP seat from the body by inserting any sharp instrument. Doing so will cause damage.

16. Use a nylon bristle brush or toothbrush to remove any Loctite. Residue will be found on the threads or yoke retainer nut (14) and main body (13). It is important to do this prior to cleaning.

This concludes the disassembly of the R-100 balanced piston first stage.

5.1 GENERAL CLEANING METHODS

Authorised TUSA Service and Repair technicians shall heed all warnings on the service and cleaning of all plastic parts in order to prevent failures. The design and performance of regulators has advanced significantly within the past 10 years. Advances in materials Science has led to the use of engineered plastic polymers and thermoplastic resin alloys replacing traditional metal components.

All metal parts used in TUSA regulators are made of either a corrosion resistant stainless steel or chrome plated brass. Handle all metal components with care to avoid scratches, dings or dents.

We recommend using a mild yet effective cleaning solution for removing salt deposits, grease and dirt from all metal components. We recommend using a cleaning solution similar to Oakite #31 or VFC-23 and a small ultrasonic cleaner for most parts plastic & metal. You may substitute a mild dish soap or diluted household grade of white distilled vinegar.

Other exterior cleaning can be accomplished using isopropyl (alcohol) where required. Use only clean lint-free wipes and cotton applicators for all cleaning requirements.

WARNING

DO NOT use any acids or hydrocarbon based cleaning solutions on any plastic or metallic components of the regulator. Some spray-on products may contain hydrocarbon-based propellants that may chemically attack or otherwise degrade some of the materials used in the manufacture of the regulator.

DO NOT use any ARMOR-ALL or vinyl restoration type liquids in an attempt to improve the appearance of the regulator.

DO NOT use silicone-based liquids, grease or sprays on the exterior surfaces of the regulator in an attempt to restore appearance.

DO NOT use any RTV silicone or silicone sealant type products to attempt repair on any regulator components.

DO NOT attempt to clean any parts by poking sharp objects into holes. Failure to heed these warnings may lead to damage or failure of regulator components.

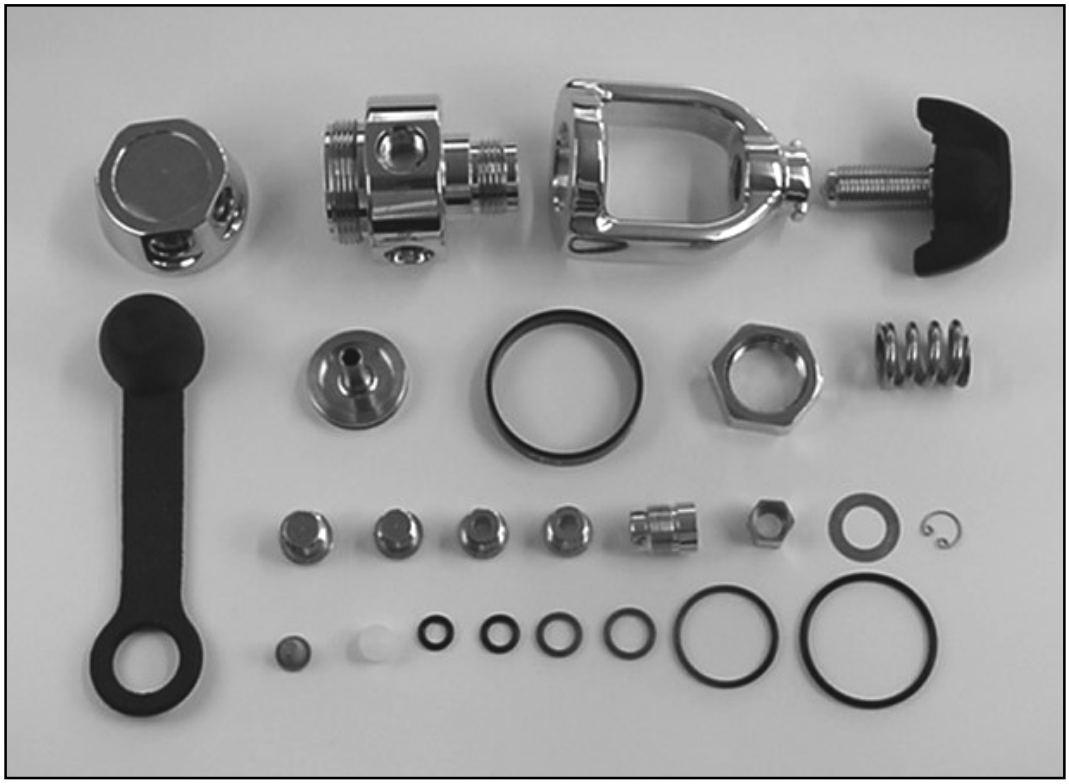
5.2 REPAIR AND REPLACEMENT SCHEDULE

The following repair and replacement schedule is recommended for the R-100 Balanced Piston First Stage. Tusa recommends full replacement of all soft seals (o-rings & seats) according to service use and cycle life of the regulator as discussed in Section 3.0. Annual service requires replacement of all soft seals at a minimum of I year and 6 months for regulators in rental, dive school or commercial applications.

ANNUAL OVERHAUL REPAIR KIT RS110/130 FIRST STAGE

Product Code	Description	Remarks	Qty
R100-020	FILTER		1
010	O-RING	BS010	1
R100-040	HP SEAT		1
012	O-RING	BS012	1
009	O-RING	BS009	1
S30	O-RING	30x2	1
020	O-RING	BS020	1
011	O-RING	BS011	2

The mandatory replacement of the HP spring (18) is required after a maximum life of 750,000 (seven hundred and fifty thousand) cycles based on excessive exposure to corrosion of high performance use. Refer below for a view of all soft seals and hardware.



5.3 ASSEMBLY R-100 BALANCED PISTON FIRST STAGE

NOTE

Prior to assembly, ensure that all parts have been inspected (both new and those that are being reused) and are of top quality. Ensure that all o-rings are clean, supple and lubricated as described in Section 5.1. Double check to make sure all o-rings are of the proper size and installed per this procedure.

1. Install the HP piston stem o-ring (12) into the main body (13) using the R100 piston stem o-ring guide tool and a blunt o-ring pick. Use the pick from the piston end of the body and the guide tool from the HP seat side. Manipulate the o-ring into the internal groove of the main body. Lubricate this o-ring with Christolube before installing. Refer to **Figure 5-n**


FIG. 5-n

NOTE

Replacement of the piston stem o-ring (12) located within the internal o-ring groove of the main body (13) must be attempted using only the proper tools and patience. View the main body through the piston entrance to locate the internal o-ring groove. The piston stem o-ring (12) seals against both the stem of the HP piston (19) and the brass internal o-ring groove within the main body. Extreme care must be taken not to damage the brass sealing surface of the groove when removing or installing this o-ring.

2. Lubricate and install the piston head o-ring (20) onto the head of the piston (19).

WARNING

Failure to recognize or replace a faulty HP piston may lead to failure of the regulator to regulate the intermediate pressure. Use prudence and replace the piston if damage to the piston stem sealing (knife) edge is found.

3. Apply a light film of lubricant (see section 1.1) to both sides of the spring isolator (17). Install over the piston stem onto the head of the piston. See **Figure 5-o**. Then apply a light film of lubricant to both sides of another (if required) spring isolator (17), install into the spring cavity of the main body. Use a blunt object to position the spring isolator down flat.

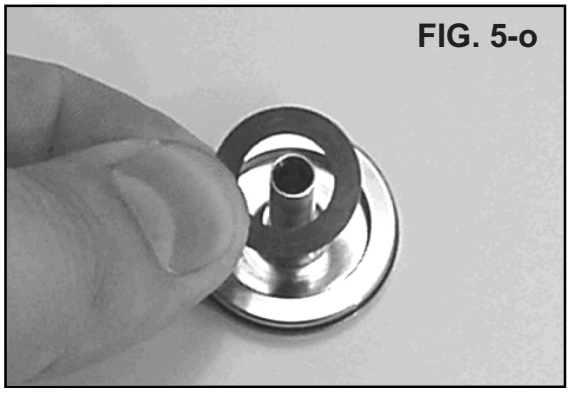


FIG. 5-o

4. Apply a light film of lubricant to both ends of the HP spring (18) and place into the spring cavity of the main body (13) and against the second spring isolator. Refer to **Figure 5-p**

5. Then place a genuine TUSA R100 piston bullet through the piston, from the orifice end. The bullet should be exposed out the end of the piston.

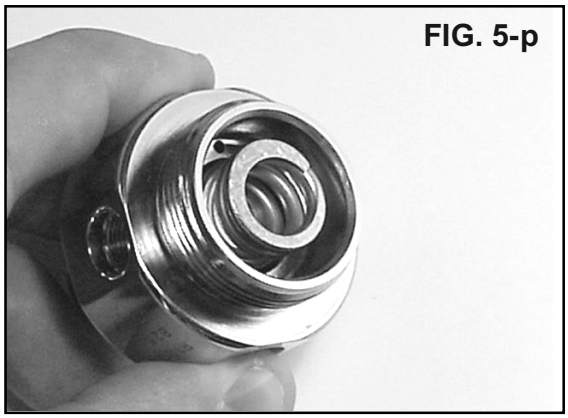


FIG. 5-p

WARNING

Failure to recognize or replace a faulty HP spring may lead to failure of the regulator to supply air. Use prudence and replace the spring regularly to maintain top performance in the regulator function.

6. Before lowering the HP piston (bullet first) into the main body (13) lubricate the stem 2mm below the knife edge, this will lubricate the stem o-ring. Then insert until the bullet and stem have passed through the piston stem o-ring (12). Refer to **Figure 5-q**

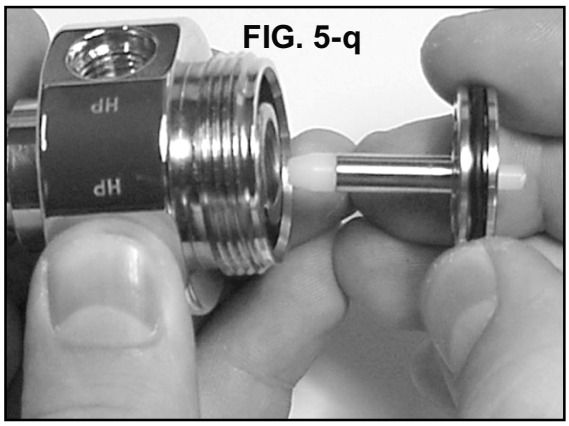


FIG. 5-q

CAUTION

Failure to use this bullet may result in cutting the piston stem o-ring (12) or damaging the sealing (knife) edge of the piston stem while performing the following step.

7. Grasp the piston and body together, preventing the piston from sliding back out, and turn over to press out the installation bullet with your thumb. See **Figure 5-r**

8. Lubricate and install the main body o-ring (16) on to the body (13).

9. Place the end cap ring (21) onto the end cap (22).

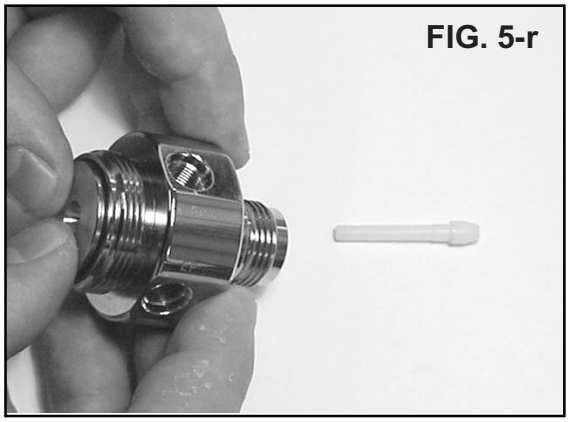


FIG. 5-r

NOTE
If tuning is required after assembly of the R-100 regulator it is recommended not to use Loctite until the intermediate pressure has been adjusted.

10. Holding the body with your hand apply one drop of Locktite 4013 to the threads of body (13) before installing the end cap (22). Quickly mate the end cap (22) to the main body seating the threads properly. Grasp the body with one hand and turn the cap with the other in a clockwise direction until snug.
See **Figure 5-s**

FIG. 5-s

11. To secure the End-cap (22) insert one LP tightening bar into LP port of the end cap and one HP tightening bar into a HP port. The end cap only needs a firm hand tight force, do not over-tighten in a vise. Refer to **Figure. 5-t**

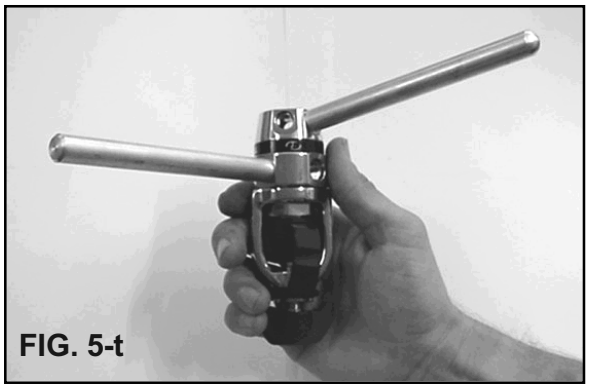


FIG. 5-t

NOTE
Make certain the Tightening Bars are firmly seated into both plugs (23) & (10) before attempting to rotate the end cap (22) in a counterclockwise direction.

12. Examine the condition of the HP seat looking for scratches, cuts, dings or dents near the diameter of the piston stem. DO NOT attempt to use the seat if any of these conditions are found. See Section 3.0 for important guidelines. Install the new HP seat (8) into the HP seat retainer (9), then into the body (13) ensuring that it bottoms out. See **Figure 5-u**.

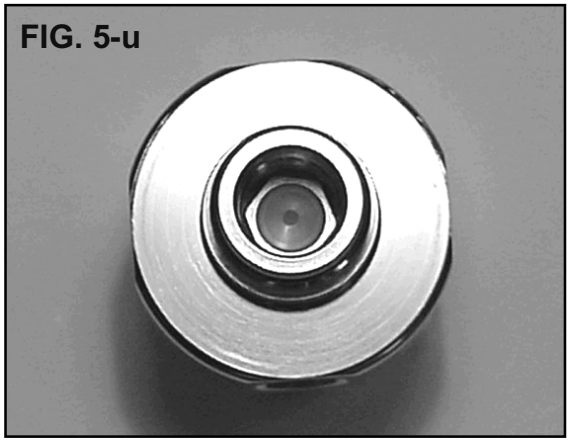


FIG. 5-u

13. Pre assemble the filter assembly as follows:
    1. Place o-ring (6) into housing (7). Do not lubricate this o-ring.
    2. Insert filter (5) into housing (7) on top of o-ring (6).
    3. Place filter retaining ring (4) into housing (7)rounded side down, using snap ring pliers. Make sure the retaining ring clicks into housing groove properly before continuing.

14. Place the main body (13) of the regulator into the jaws of a padded vise. Install the filter assembly into main body with a 3/8" Allen key. Then hand-tighten in a clockwise direction until snug. For torque settings refer to Section 6.1

NOTE
DO NOT over-tighten the vise onto the soft brass parts of the first stage main body.

15. Lightly lubricate the under side of the yoke (2) Place the yoke over the threaded portion of the main body (13).

16. Holding the yoke retainer between thumb and forefinger, apply one drop of Loctite to the middle threads of the yoke retainer nut. Quickly, mate the yoke retainer nut to the main body seating the threads properly. Immediately hand tighten. Using a slotted flat bar tool or a TUSA special wrench tool as shown in **Figure 5-v**, begin a firm, steady, clockwise force tightening the yoke retainer nut. Refer to section 6.1 for proper torque specifications.

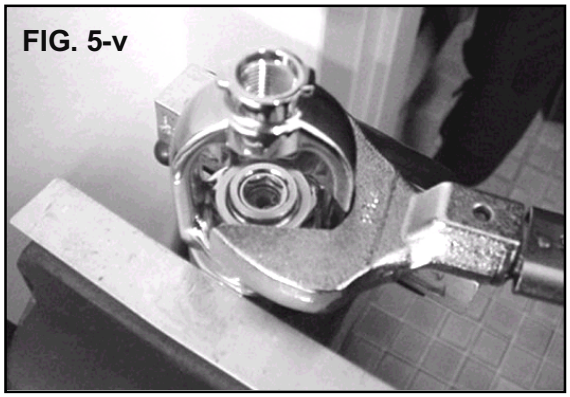


FIG. 5-v

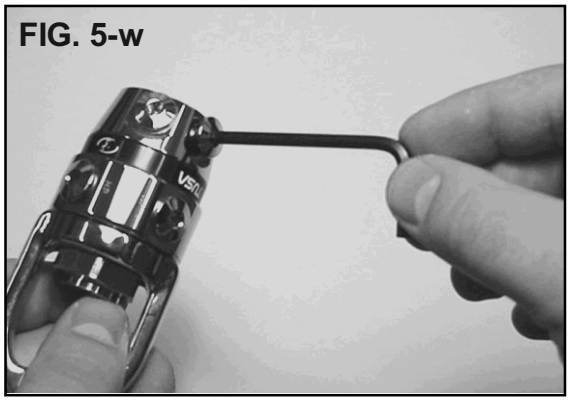


FIG. 5-w

17. Lubricate and install all o-rings (24) & (11) onto all hoses and port plugs. Install the LP hoses and port plugs (23) into cap and the HP hose and port plug (10) into the main body, tightening until snug and fit EP plugs into body (15). See **Figure 5-w.**

18. Install the dust cap (3) onto the yoke knob (2) and install these onto the yoke (5).

This concludes the assembly of the Balanced Piston First Stage.

SECTION VI

6.0 R-100 BALANCED PISTON FIRST STAGE TUNING

Refer all item numbers (99) to the schematics view for this regulator found after Section 5.3

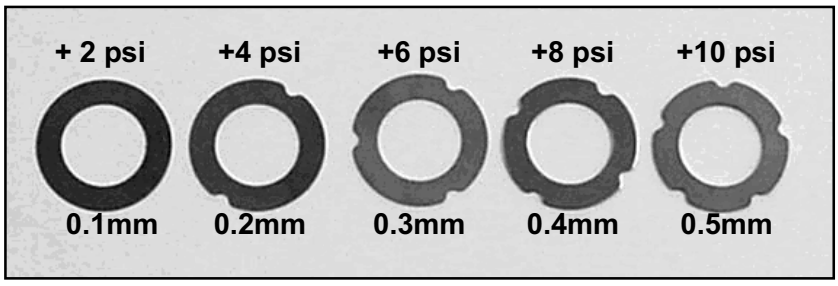
1. Prior to tuning the balanced piston first stage regulator, ensure that all cleaning, assembly and disassembly procedures have been followed closely. If the regulator is being tuned without previous disassembly, read Section 5.0 through 5.3 prior to tuning the regulator. Ensure that all in-water and visual test & inspection results have been documented. It is most important to heed all notes, cautions and warnings found in Section 5.0 while performing tuning and adjustment.

WARNING

Failure to recognize or replace a faulty HP spring or HP piston may lead to failure of the regulator supply air or regulate the intermediate pressure. Use prudence and replace the HP spring or HP piston, as required, to maintain top performance in the regulator function.

2. The intermediate pressure delivered by the balanced piston design does vary slightly according to the supply (tank) pressure. Properly adjusted, the intermediate pressure should be within the 135 to 145 psi range with a supply source of 2750-3000 psi. An example of normal variance due to supply pressure is illustrated as follows: An intermediate pressure of 145 psi at 3000 psi supply pressure will drop to 130 to 135 psi when the supply pressure correspondingly drops to 500-750 psi. Insure that the supply pressure is maintained through all tuning and testing procedures.

3. The intermediate pressure is controlled by the loaded height of the HP spring (18) in the sealed (no flow) condition. The intermediate pressure will rise as the loaded height of the HP spring is reduced. Replacing a thin spring isolator (17) with a thicker one will increase the intermediate pressure. See below.



REMEMBER THIS

Installation of a thicker spring isolator (17) will raise the intermediate pressure delivered by the balanced piston first stage.

4. To replace a spring isolator (17), remove the End-cap (22) and End-cap ring (22) by inserting one LP tightening bar into one of LP port in the end cap and one HP tightening bar into one of the HP ports in the body (13).

NOTE
Make certain the Tightening Bars are firmly seated into both plugs (23) & (10) before attempting to rotate the end cap (22) in a counterclockwise direction.

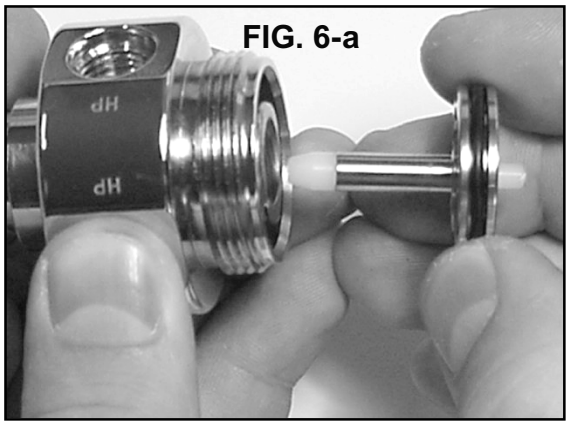
5. Remove piston being careful not damaged the knife edge or stem. Then remove HP spring (18) from main body.

6. Remove the yoke knob (1) and then remove the retainer ring (4). The filter assembly can then be removed using a 3/8" Allen key. Also remove the HP seat assembly, this should fall out into hand.

7. Replace spring isolators as required to adjust the intermediate pressure. Apply a light film of lubricant (see section 1.1) to both sides of the spring. Before installing the HP spring.

8. Install a genuine Tusa piston installation bullet into the HP piston stem. **Refer to Figure 6-a.** Carefully lower the HP piston (bullet first) into the main body until the bullet and stem have passed through the piston stem o-ring (12). Turn over to allow the installation bullet to fall out in your hand.

FIG. 6-a



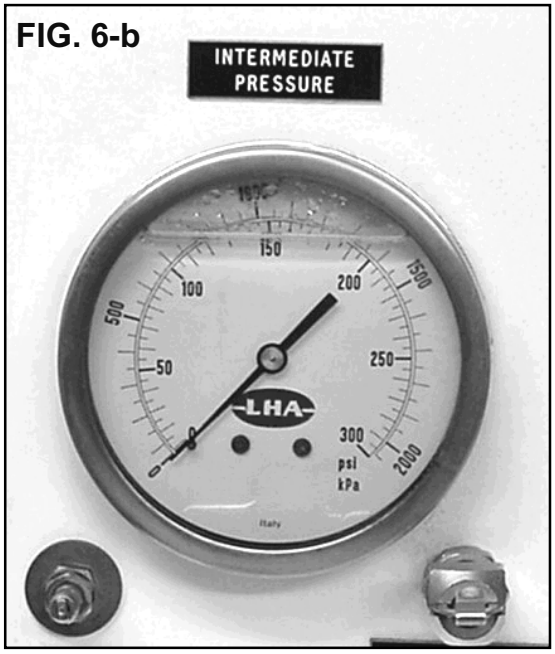
CAUTION
Failure to use this bullet may result in cutting the piston stem o-ring (12) or damaging the sealing (knife) edge if the piston stem during installation.

9. Reinstall the HP seat and filter assemblies, snap retainer ring into groove and replace yoke knob. Refer to section 6.1 for proper torque specifications.

NOTE
Use care and caution to avoid damage to the surface of the body (13). DO NOT over-tighten the vise onto the soft brass of the first stage.

10. Apply a 2750-3000 psi air supply to the first stage. Record the intermediate pressure after the second stage has been purged 30 to 60 times. If necessary, repeat steps 4 through 10 until intermediate pressure falls within a range of 135 to 145 psi. **Refer to Figure 6-b.**

FIG. 6-b



This concludes the tuning & adjustment of the TUSA PLATINA R-100 Balanced Piston First Stage. Please refer to the Section 4.2 for troubleshooting.

6.1 TORQUE SPECIFICATIONS FOR R-100 BALANCED PISTON FIRST STAGE

The following specifications are to be adopted upon assembly of the R-100 Balanced piston First Stage. Make certain you verify your torque wrench is calibrated.

Torque conversions:

Intermediate pressure	10 kg/cm2	=	142 PSI		
Ambient pressure	2 bar	=	29.4 PSI	=	10m
Tank pressure	3000 psi	=	20689 kPa	=	210 bar
Movement of force	10 kgf cm	=	1 Nm		
Movement of force	1 Nm	=	8.85 lb in	=	0.7375 lb ft

ITEM NO.	DESCRIPTION	TORQUE (Nm)	TOOL REQUIRED
7	FILTER RETAINER	2 Nm	RTD260CN – HEX BIT
14	YOKE RETAINER	20 Nm	CL50NX15D – WRENCH HEAD
22	END CAP	HAND+	TIGHTENING BARS
10	HP PLUG	HAND+	ALLEN KEY
23	LP PLUG	HAND+	ALLEN KEY

SECTION VII

7.0 PERFORMANCE SPECIFICATIONS

The performance specifications for the R-100 balanced piston first stage regulator is listed as follows and is subjected to change without notice:

Weight: First stage with out hose 1.35 lb. Or 612 gms

Working Pressure First Stage:
K valve - range 2750-3000 psi.

Intermediate Pressure:
135 to 145 psi over ambient pressure.
NB: Intermediate pressure should not fall below 130 psi with a supply pressure between 500-750 psi.

Breathing Resistance:
Refer to Second Stage Performance Specifications

7.1 MAXIMUM PERFORMANCE ADJUSTMENTS

To Maximize performance of the regulator, it is necessary to insure that the intermediate pressure has been properly adjusted. The intermediate pressure delivered by the balanced piston design does vary slightly according to the supply (tank) pressure. Properly adjusted, the intermediate pressure should be within the 135 to 145 psi range with a supply source between 2750 and 3000 psi. If a regulator will be used exclusively in the 2250 to 2500 psi range, the first stage can be adjusted to deliver 145 psi at 2250 psi. This insures that the regulator will perform within specifications at lower supply pressures.

7.2 ENHANCED AIR MIXTURES & APPROVED MODIFICATIONS

DO NOT use this equipment in OVERHEAD ENVIRONMENT or TECHNICAL DIVING (Enhanced Air Mixtures) without first obtaining proper training and certification. We encourage you to consult the proper training agencies to obtain instruction and certification on the use and modification of regulator equipment for such activities.

7.3 COLD WATER DIVING

DO NOT use this equipment when diving in water temperatures less than 40 degrees F (4.5 degrees C).

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7.4 CONTAMINATED WATER DIVING

Sophisticated diving gear designed for use in contaminated water provides constant positive pressure inside the regulator case and utilizes redundant exhaust valve passages. The R-100 is not designed to provide this requirement and therefor is not recommended for use in contaminated water diving.