

TR-350 / TR-390 REGULATOR

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SECTION I

GENERAL INFORMATION

1.0 IMPORTANT INFORMATION

This manual is designed for use by authorized 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 USA Incorporated and is not meant for general distribution. Accordingly, Tabata USA makes no representations or warranties of any kind concerning the techniques or procedures contained within this manual. It is assumed the authorized service personell 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 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 personell when absolutely necessary.

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SECTION II

DESCRIPTION AND OPERATION

2.0 NOMENCLATURE AND DESCRIPTION OF OPERATION

The following discussion will introduce the proper nomenclature to be used through this 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 parenthesis.

The regulator reduces high pressure air from the scuba cylinder (supply pressure) to ambient pressure suitable for 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 135 to 150 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. The first and second stages of the regulator are connected by a low pressure (LP) hose. 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 2250 to 3200 psi.

2.1 BALANCED PISTON FIRST STAGE

Refer to figure 2-1 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 air flow continues through the regulator body passages to the HP seat chamber where it flows across the annular gap between the HP seat and the end of the HP piston stem. Here the air expands resulting in a reduction of pressure. Air flow 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 emerges from 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 air flow 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.

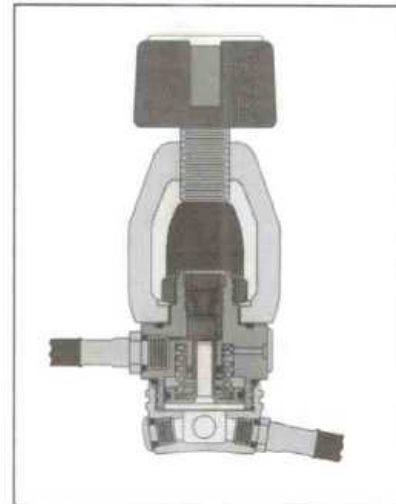


FIG 2-1

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 pressure range of 128 to 145 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 TR-390 Regulator functions to deliver the intermediate pressure at 135 to 150 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 150 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.

2.2 ADJUSTABLE SECOND STAGE

Refer to figure 2-2 for the following discussion. The second stage of the TR-390 is a "demand" type regulator which acts to convert the intermediate air pressure into a near ambient inhalation pressure. During the inhalation cycle the air pressure within the second stage case drops below the ambient water pressure acting on the outside surface of the diaphragm. This "differential pressure" causes this flexible diaphragm to move inward to counteract the dropping (negative) inhalation pressure. As the diaphragm flexes inward it depresses the demand lever which in turn pivots and lifts the poppet assembly off the seat of the adjustable orifice inside the coupler. This allows air at intermediate pressure to flow into the case of the second stage at a rate directly related to the differential pressure created across the diaphragm. The resulting reduction in intermediate air pressure in the first stage now causes the HP spring to lift the HP piston off the HP seat allowing supply (pressure) air to flow from the cylinder.

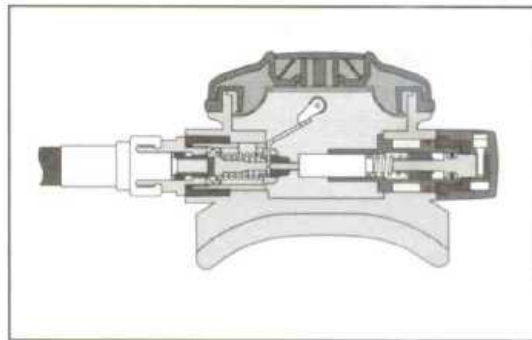


FIG 2-2

As inhalation decreases, the diaphragm returns to a normal state causing the demand spring to seal the poppet assembly against the seat. The demand lever and poppet move to a closed position stopping air flow. The first stage now senses an intermediate pressure returning to a normal state allowing the HP piston to overcome the force from the HP spring and seal off air flow from the supply (cylinder). During exhalation, increasing (positive) pressure in the second stage case causes the exhaust valve to open discharging exhaled air into the sea. This operation is repeated during every breathing cycle.

The second stage valve mechanism is termed a "downstream demand valve". If the intermediate pressure were to increase beyond the sealing capability of the demand spring, the valve automatically opens and functions as a pressure relief valve. This protects both the first stage regulator and the second stage hose assembly from over pressurization while allowing air to flow to the diver for safety.

The TR-390 and SS-350 second stages utilize two variants of the downstream demand valve. The TR-390 is an adjustable second stage demand valve. The SS-350 is a non-adjustable second stage demand valve. The TR-390 has two springs which generate sealing force sufficient to prevent airflow past the adjustable orifice and the poppet seat. The first spring is the demand spring acting directly on the poppet seat. The second spring is the secondary spring and acts to help push the poppet against the seat. The secondary spring compressed height is controlled by the diver turning the demand knob. As the demand knob is turned clockwise (when viewed head-on) it compresses the secondary spring allowing it to increase the total sealing force between the poppet and seat. As this sealing force increases, so does the effort required by the diver to generate a greater differential pressure across the diaphragm leading to valve actuation and air flow.

2.3 NON-ADJUSTABLE SECOND STAGE

Refer to figure 2-3 for the following discussion. The SS-350 works exactly like the TR-390 valve except for the fact that the valve has only one spring. The demand spring in the SS-350 can generate enough sealing force to prevent air flow from the poppet seat and orifice. It does not need the assistance provided by the absent secondary spring. The SS-350 demand spring is "stronger" than the TR-390 demand spring. It is important to remember this to avoid interchanging them during stocking or overhaul. These springs are not interchangeable. Refer to Section 6.0 for further discussion.

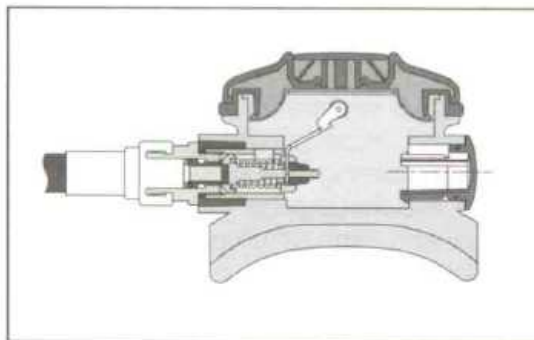


FIG 2-3

CAUTION

Use caution not to confuse or use the wrong demand spring when assembling all second stages, as each primary second stage spring exerts a different sealing force. Please refer to the appropriate schematic for correct part numbers.

SECTION III

GENERAL (USER) RECOMMENDED MAINTENANCE

3.0 GENERAL CARE GUIDELINES

TUSA recommends to all Authorized 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 insure the following goals:

Personalized 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.
2. 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 its matrix.
3. Prior to rinsing the regulator insure the dust cap is snug and covering the conical filter area of the yoke. If using the TR-390 IMPREX AD2 Adjustable second stage, dial the adjustment knob fully clockwise in to prevent water from entering into the hose and first stage.
4. Using either of the following rinse methods is necessary. A stream of fresh water, from a hose or faucet, 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 is 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.

5. 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:

WARNING

DO NOT expose the regulator to extreme heat or direct sunlight when not in use. Temperatures exceeding 180 °F for extended periods of time may cause permanent damage to some internal valve components leading to lack of performance or failure. If you suspect your regulator has been exposed to excessive heat, please have it examined by your authorized TUSA Service Center.

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 regular 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 & CYCLE LIFE

TUSA recommends that the Service Technician utilize the following guidelines to determine service intervals & extent of service required for the customer's 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:

$$\text{CYCLES} = \text{DIVE DAYS/YEAR} \times \text{DIVE HOURS/DAY} \times 20 \text{ BREATHS/MIN} \times 60 \text{ MIN/HOUR}$$

If you assume 25 dive days per year and 3 diving hours per diving day:

$$\begin{aligned} \text{CYCLES} &= 25 \text{ DAYS/YEAR} \times 3 \text{ HOURS/DAY} \times 20 \text{ BREATHS/MIN} \times 60 \text{ MIN/HOUR} \\ \text{BREATHING CYCLES} &= 90,000 \text{ per year} \end{aligned}$$

If you were to calculate this for rental equipment, assume 240 rental days per year and 4 dive hours per day:

$$\begin{aligned} \text{CYCLES} &= 240 \text{ DAYS/YEAR} \times 4 \text{ HOURS/DAY} \times 20 \text{ BREATHS/MIN} \times 60 \text{ MIN/HOUR} \\ \text{BREATHING CYCLES} &= 1,152,000 \text{ per year} \end{aligned}$$

Yes, that is correct:

ONE MILLION ONE HUNDRED FIFTY TWO THOUSAND BREATHING CYCLES!

Now for your own information, calculate what you would expect for an average customer on one 2 week dive boat vacation making 3 to 5 dives per day less than 60 feet deep.

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 exposure of equipment, extent of user maintenance, experience and application from the user and future planned use of the equipment. To summarize:

EXPOSURE OF EQUIPMENT

Diving cold water (40 °F or lower) requires the regulator to be "Environmentalized" or protected from potential freezing and requires more frequent servicing. (See Section 12.3)

Diving in low visibility or contaminated water requires more frequent servicing and overhaul to keep residue from building up inside valve components. (See Section 12.4)

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 12.2)

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.

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 maximize reliability.

FUTURE APPLICATION

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

SECTION IV

INSPECTION TECHNIQUES AND TROUBLESHOOTING

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 knob etc... It is most important to look for cracks or damage near the inlet coupler of the second stage case. Mishandling may lead to severe stress imparted into the LP hose resulting in cracks. Please refer to Section 6.0, Figure 6-8 for further discussion.

O-RINGS

O-rings are common off-the-shelf well engineered reliable sealing devices. A few words about handling them is 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 the warranty. Further details are available from the factory distributor. Do not attempt to clean or lubricate o-rings outside of the recommendations found in Section 11.0

SEALING SURFACES

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. Some components such as the first stage piston in both the TR-350 & TR-390 regulator 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 with 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.

HOSES AND RUBBER COMPONENTS

The examination, care and handling of all rubber components is well documented throughout 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 TUSA IMPREX 2 or IMPREX AD2 regulator we recommend you become familiar with the operation and design by reading Sections 2.0 and 5.0 through 8.0. 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 breath harder?" Discussions may lead to understanding your customer and his complaints better.
2. 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.
3. 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 TR-350/TR-390 BALANCED PISTON FIRST STAGE

SYMPTOM	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 (7) 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 (21) damaged.		1. Replace o-ring, check seal worn or damaged.
2. HP piston (20) sealing edge damaged or HP seat (10) bad.		2. Replace HP piston & HP seat.
3. Washer (19) installed incorrectly or wrong size.		3. Replace washer.
4. HP piston stem o-ring (17) worn or leaking.		4. Replace o-ring, check seal.
5. Filter housing (9) loose.		5. Tighten filter housing.
6. Leak between intermediate chamber, LP hose, and second stage.		6. Find leak in-water test.
7. Cap (24) loose.		7. Tighten cap.
INTERMEDIATE PRESSURE EXCESSIVELY HIGH		
1. HP Piston (20) sealing edge damaged or HP seat (10) bad.		1. Replace HP seat & check HP piston sealing edge.
2. Washer (19) installed incorrectly or wrong size.		2. Replace washer.
3. HP piston o-rings (17) & (21) are worn or leaking.		3. Replace o-rings, check seal.
AIR LEAKS DETECTED FROM IN-WATER TEST		
1. HP piston o-rings (17) & (21) are worn or leaking.		1. Replace o-rings, check seal.
2. Cap o-ring (11) is worn.		2. Follow special procedure Section 5.1 & 5.4 only

3. LP port plug o-rings (23) are worn or leaking.

3. Replace o-rings, check seal.

4.3 TROUBLESHOOTING SECOND STAGE

The following guide applies to both adjustable and non-adjustable second stage. Note the position of the adjustment knob as you utilize the following recommendations.

SYMPTOM	POSSIBLE CAUSE	RECOMMENDATIONS
LOW FLOW OR HIGH INHALATION EFFORTS (ADJUSTMENT KNOB OUT)		
1. Cylinder valve not open or clogged.		1. Open valve completely or overhaul needed.
2. Insufficient intermediate pressure from first stage.		2. Check first stage IP. Also check supply pressure.
3. Demand lever bent.		3. Replace demand lever.
4. Adjustable orifice too far in. Check seal edge condition.		4. Adjust per Section 8.1
5. Too much demand lever slack.		5. Adjust per Section 8.1
6. Locknut overtighten onto poppet shaft		6. Adjust per Section 8.1
7. Locknut too loose.		7. Adjust per Section 8.1
8. Piston (28) contaminated, and clean all parts.		8. Disassembly adjustment tube

ADJUSTMENT KNOB DIFFICULT TO TURN OR NO ACTION

1. Piston (28) or follower (30) is contaminated.	1. Disassembly Adjustment tube and clean all parts.
2. Follower is stripped onto stem (31).	2. Replace follower.
3. Poppet and demand lever action are sticky or damaged.	3. Disassemble valve and clean.
4. Secondary spring (29) corroded	4. Replace secondary spring.
5. Stem (31) threads are corroded.	5. Disassemble and clean.
6. Debris trapped between knob and packing nut (34).	6. Disassemble and clean.
7. Thrust washer (33) absent, contaminated, or worn.	7. Clean or replace with new thrust washer.

PURGE FUNCTION IS ABSENT OR LOW FLOW OR RATTLE HEARD INSIDE

1. Cylinder valve not open or clogged.	1. Open valve completely or overhaul needed.
2. Insufficient intermediate pressure first stage.	2. Check first stage IP. Also check supply pressure.
3. Demand lever bent	3. Replace demand lever.
4. Adjustable orifice turned too far in.	4. Adjust per Section 8.1 Check seal edge condition.
5. Too much demand lever slack.	5. Adjust per Section 8.1
6. Locknut overtighten onto poppet shaft.	6. Adjust per Section 8.1
7. Locknut too loose.	7. Adjust per Section 8.1

FREEFLOW OR LEAKAGE PRESENT (ADJUSTMENT KNOB TURNED IN)

- | | |
|---|---|
| 1. Purge button stuck open. | 1. Clean purge button. |
| 2. Excessive intermediate pressure first stage. | 2. Check first stage IP. |
| 3. Demand lever bent | 3. Replace demand lever. |
| 4. Adjustable orifice turned too far out. | 4. Adjust per Section 8.1
Check seal edge condition. |
| 5. Damaged poppet seat (8) or sealing edge of orifice (11). | 5. Replace poppet seat or adjustable orifice. |
| 6. Locknut overtighten onto poppet shaft. | 6. Adjust per Section 8.1 |
| 7. Washer (16) bent. | 7. Replace washer. |
| 8. Inlet coupler (10) loose. | 8. Tighten per Section 6.2 |
| 9. Demand spring (6) weak. | 9. Replace demand spring. |

WATER ENTERING SECOND STAGE

- | | |
|---|-------------------------------------|
| 1. Exhaust valve (5) distorted worn, or bad. | 1. Repair or replace exhaust valve. |
| 2. Diaphragm (24) not seated or torn. | 2. Reseat or replace diaphragm. |
| 3. Tear in mouthpiece (1). | 3. Replace mouthpiece. |
| 4. Cracked or damaged case (27). | 4. Replace case. |
| 5. Stem o-ring (32) worn or absent. | 5. Replace o-ring. |
| 6. Adjustment tube o-ring (26) cut or absent. | 6. Replace o-ring. |

SECTION V

DISASSEMBLY /ASSEMBLY BALANCED PISTON FIRST STAGE

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 which need replacement in case the customer requests to view the parts. For part replacement, as part of the annual service, please return these parts to your TUSA factory distributor.

Remember to record your findings as you proceed to allow both a complete record of 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 exploded view for this regulator found at the end of this section.

5.0 DISASSEMBLY PROCEDURE TR350/TR-390 BALANCED PISTON FIRST STAGE

1. Before disassembling the first stage, remove all attached hoses and port plugs. 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 1/2" open end wrench, and high pressure gauge hose(s) use a 5/8" open end wrench.
2. Prepare to remove the endcap (24) by inserting one 3/16" Allen wrench into one of L.P. plugs (22) on the end cap and one 3/16" Allen Wrench into one of the H.P. plugs (15) on the body (13) as shown in figure 5-1.
3. Holding the regulator firmly in place as shown in figure 5.1 twist the endcap (24) in a counterclockwise direction until cap (24) is loosened enough to complete removal by hand.

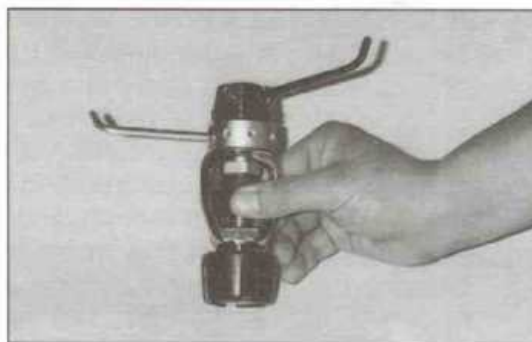


FIG 5-1

NOTE

Make certain the allen wrenches are firmly seated into both plugs (15) & (22) before attempting to rotate the cap (24) in a counterclockwise direction.

4. Remove all L.P. Plugs (22) from cap (24) and all H.P. Plugs (15) from body (13) with the same 3/16" Allen wrench.
5. Remove and inspect the O-Rings now visible on all these items for any sign of decay (see Section 4.0 INSPECTION TECHNIQUES for guidance). RECORD REPLACEMENT if found.
6. Remove the HP piston (20) from the body (13) by carefully grasping the piston between thumb and forefinger, pulling straight up with a slow, steady force.

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 edge is found.

7. Remove the washer (19) from the base of the piston head and inspect this area for signs of rust. Also inspect the piston stem for unusual scratches, dings, dents or wear along its sealing surface. Closely inspect the sealing edge of the piston stem for cracking, 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. See Section 4.0 for important guidelines.
8. Remove the HP spring (18) and inspect it for any unusual cracks, rust or bent coils. **RECORD FOR REPLACEMENT** and **DO NOT** attempt to reuse if any of these conditions are found. See Section 4.0 for important guidelines.

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 HP spring regularly to maintain top performance in the regulator function.

9. Remove the piston head o-ring (21) and **RECORD FOR REPLACEMENT**. If the piston will be reused, take steps at this time to protect the piston stem sealing edge from damage during handling.
10. Remove the piston stem o-ring (17) from the body (13).

NOTE

Removal or replacement of the piston stem o-ring (17) 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 (17) seals against both the stem of the HP piston (20) 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. 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. Refer to figure 5-4.



FIG 5-4

11. Remove the yoke knob (2) and the dust cap (3) from the yoke (5).
12. Inspect the yoke (5) very thoroughly for cracks, wearing, or distortion. If none are present and the yoke shows no signs of deterioration, it need not be removed to service the first stage. However, to remove the yoke (5) from the main body, we recommend using a 1" socket wrench or slotted flat bar tool as shown in figure 5-5. Place the first stage in a smooth-jawed vise, with yoke facing up. Install the

socket or flat bar tool onto the yoke retainer nut. Using firm, steady force, rotate the tool in a counterclockwise direction until the yoke retainer nut and yoke are removed

NOTE

Use care and caution to avoid damage to the hex surface of the yoke nut. DO NOT overtighten the vise onto the soft brass parts of the first stage.



FIG 5-5

13. After removing the yoke retainer nut from the body (13), remove and inspect the yoke for any signs of distortion or cracking. RECORD FOR REPLACEMENT if found.
14. To remove the conical filter (7), first remove the filter housing assembly with 3/8" allen wrench use a sharp pick to remove the filter retainer (6) from the housing (9). The conical filter and the filter o-ring (8) 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.
15. To remove the HP seat (10) tap the body (13) lightly against a soft surface with the yoke section in the down position. If H.P seat (10) does not dislodge and fall out by itself push it out from opposite end with a 3/16" Allen wrench. Examine and record your findings on the condition of the HP seat looking for deep indentations, contamination, severe discoloration or debris. RECORD FOR REPLACEMENT and DO NOT attempt to reuse if any of these conditions are found. Section 4.0 for important guidelines.

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 found on the threads or yoke retainer nut (4) and main body (13). It is important to do this prior to cleaning.

This concludes the disassembly of the TR350/TR-390 balanced piston first stage. Please refer to the Section 11.0 for proper guidance on cleaning.

5.1 REPAIR AND REPLACEMENT SCHEDULE TR-350/TR-390 BALANCED PISTON FIRST STAGE

The following repair and replacement schedule is recommended for the TR-350/TR-390 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 1 year.

The mandatory replacement of the HP spring is required after a maximum life of 750,000 (seven hundred fifty thousand cycles) based on excessive exposure to corrosion of high performance use. Refer to figure 5-6 for a view of all soft seals and hardware.



FIG 5-6

5.2 ASSEMBLY TR-350/TR-390 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 11. Double check to make sure all o-rings are of the proper size and are being handled and installed per this procedure.

1. Lubricate and install the HP piston stem o-ring (17) into the main body (13) using a plastic 3/16" dowel and a blunt o-ring pick. Use the pick from the piston end of the body and the plastic dowel from the HP seat side. Manipulate the o-ring into the internal groove of the main body. Refer to figure 5-7.



FIG 5-7

NOTE

Replacement of the piston stem o-ring (17) 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 piston entrance to locate the internal o-ring groove. The piston stem o-ring seals against both the stem of the piston (20) and the internal o-ring groove within the main body. Extreme care must be taken not to damage the brass sealing surface of the o-ring groove when removing or installing this o-ring.

2. Lubricate and install the piston head o-ring (21) onto the head of the HP piston (20).

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 11.0) to both sides of the washer (19). Install over the piston stem onto the head of the piston.
4. Apply a very light film of lubricant to both ends of the HP spring (18) and place into the spring cavity of the main body (13).