

TECHNICAL MANUAL FOR SCUBAPRO REGULATORS



IMPORTANT NOTICE

THIS BOOKLET IS NOT A DIVING INSTRUCTIONAL MANUAL, NOR DOES IT ELIMINATE THE NECESSITY FOR OBTAINING PROFESSIONAL INSTRUCTION IN THE OPERATION OF A SCUBAPRO REGULATOR. THE DIVER IS THEREFORE ADVISED TO OBTAIN SUCH INSTRUCTION PRIOR TO WATERBORNE OPERATION OF ANY REGULATOR OR EQUIPMENT DISCUSSED HEREIN.

INTRODUCTION

It is the purpose of SCUBAPRO to give you, the diver, the most advanced equipment available in the world today.

After extensive research, engineering and testing, we have developed the line of regulators and accessories discussed in this Technical Manual. They are rugged and designed to be foolproof in operation.

Every step is taken to provide the diver with equipment whose functional reliability and operational safety are the highest in the diving industry.

Construction materials are of the highest quality possible. Stainless steel and nickel chrome plated brass are used exclusively for the major regulator components. Durable O-ring seals are incorporated at every air connection. Extremely flexible and long-lived silicone rubber is used for pressure sensing diaphragms. The mouthpieces are specially compounded rubbers for durability and diver comfort.

SCUBAPRO utilizes 100 per cent inspection of components before and during assembly. Every completed regulator is carefully inspected and functionally tested before being packaged for shipment. Extensive engineering development and quality control procedures have been established at the SCUBAPRO factory to maintain the best product quality.

Our continuing success in producing superlative products is not ours alone. We have had much cooperation and many helpful contributions from professional and sport divers alike.

SCUBAPRO sincerely hopes you will help by using the information in this Technical Manual. It is designed to provide you with the opportunity for more productive and pleasurable use of your regulator throughout your diving career.

By operating and maintaining your regulator correctly, you will become part of the SCUBAPRO team of excellence.

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DESCRIPTION

GENERAL:

SCUBA regulators supply breathing air to a diver at a pressure which balances the hydrostatic pressure of the water surrounding his lungs, when he demands it.

There are several different basic configurations of regulators in use in the sport diving community. The most popular is called a single-hose, two-stage, open-circuit, demand regulator. This is the type that SCUBAPRO manufactures. It is popular because it is more adaptable, more maneuverable, easier breathing, less cumbersome, more durable, more easily maintained, and generally less expensive than its predecessor; the double-hose regulator. It is described below.

Single-hose refers to the low pressure hose connecting the 1st and 2nd stages. Double-hose regulators had corrugated large diameter hoses from each side of the diver's mouthpiece to the regulator mounted on the tank.

Two-stage refers to the number of pressure reductions occurring between the supply tank pressure and the final breathing pressure at the diver's mouth. A typical diving tank contains air at 2250 pounds per square inch as read on a gauge (psig) when fully charged. A diver can not breathe such a high pressure so it must be reduced to ambient pressure for breathing. Ambient pressure is that of the water or air surrounding the diver's regulator mouthpiece, and is equivalent to about 29.4 psi when the diver is submerged 33 feet in ocean water at sea level. The SCUBAPRO regulator uses a 1st stage connected to the SCUBA tank valve to reduce its air pressure to about 140 psi above ambient for the low pressure hose. That 140 psi is reduced to ambient pressure by the 2nd stage held in the diver's mouth.

Open-circuit refers to the total discharge of breathing air through the exhaust valve to the environment after it is used. A closed-circuit system directs the used air through a purifying system to be re-breathed. A semi-closed-circuit exhausts some air and recycles the rest.

Demand refers to the operation of the 1st and 2nd stage valves which occurs only when the diver demands air by inhaling through the mouthpiece. When the diver inhales, the regulator operates to deliver the air demanded. Continuous-flow, a descriptive term, describes the opposite breathing system where air continuously flows, as in a diving helmet.

Table I lists the sport diving regulators produced by SCUBAPRO.

1ST STAGES:

SCUBAPRO produces 1st stage assemblies of the "piston" type as opposed to the "diaphragm" type.

A piston 1st stage has only two moving parts, the piston, which is sized to provide the proper pressure reduction required and a spring.

SCUBAPRO 1st stages are manufactured in three different configurations: (1) balanced, (2) balanced with audio reserve, and (3) unbalanced. Each is described below.

SCUBAPRO REGULATORS

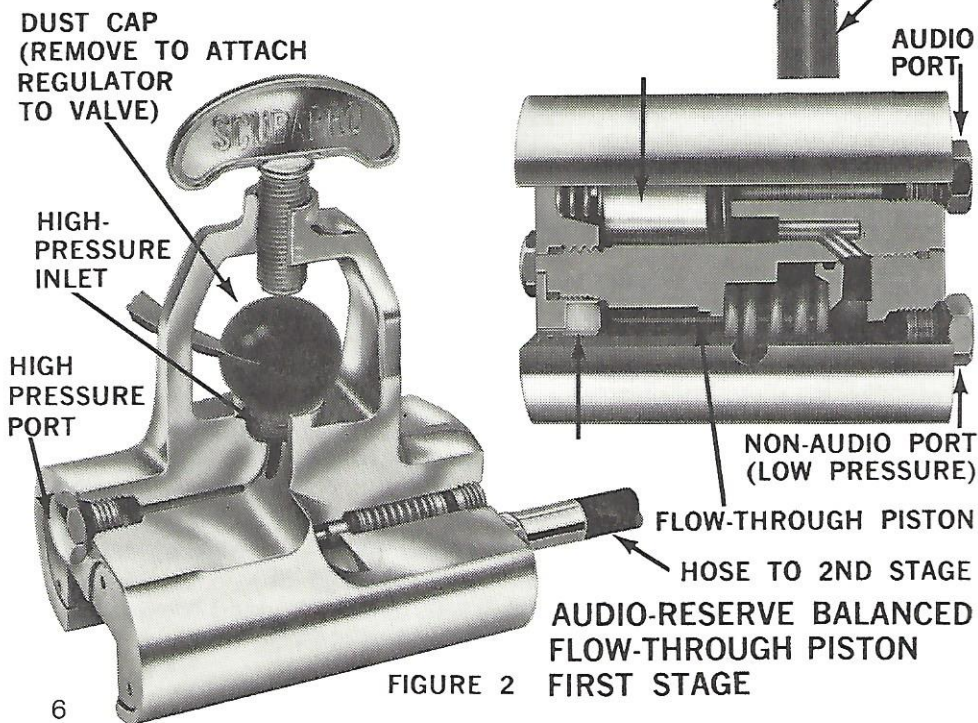
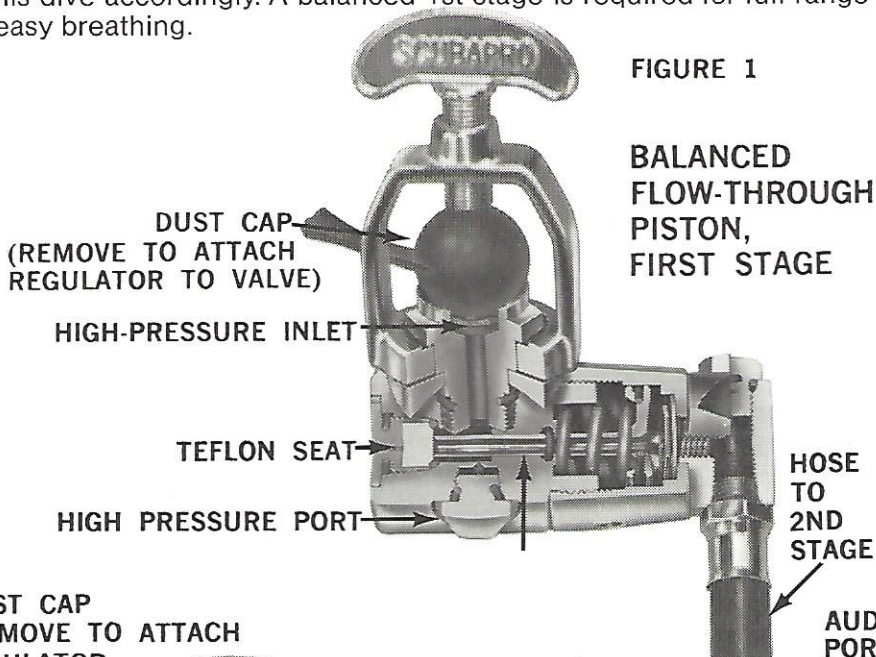
SYSTEMS —			
Name and Features	Regulator Numbers System	1st Stage	2nd Stage
Pilot-Audio balanced, audio reserve, Pilot 2nd Stage, lifetime warranty	12-127-000	10-107-001	11-128-001
Pilot balanced, swivel connections, Pilot 2nd Stage, lifetime warranty	12-125-000	10-105-001	11-128-001
Mark VII balanced, audio reserve, adjustable 2nd Stage, lifetime warranty	12-107-000	10-107-001	11-105-001
Mark V balanced, swivel connections, adjustable 2nd Stage, lifetime warranty	12-105-000	10-105-001	11-105-001
Mark III unbalanced, standard 2nd Stage, 2 year limited warranty	12-103-000	10-103-001	11-103-001
SECOND STAGES		2 YEAR LIMITED WARRANTY	
Pilot* balanced, inhalation resistance dive switch, extra-large exhaust, right or left-handed, standard hose			11-128-000
Adjustable* inhalation resistance adjustment knob, large exhaust, right-handed, 32" extra-long hose, orange mouthpiece & exhaust tee			11-109-000
Standard inhalation resistance set, large exhaust, right-handed, 32" extra-long hose, orange mouthpiece & exhaust tee			11-108-000

*A lifetime warranty and warranty card will be issued on all SCUBAPRO first stage and second stage regulator combinations when purchased together as a regulator system, except the SCUBAPRO Mark III Regulator, Part Number 12-103-000. A lifetime warranty and warranty card will also be issued on any SCUBAPRO second stage regulator added to a SCUBAPRO regulator system on which the consumer holds a lifetime warranty card, except the SCUBAPRO Standard Second Stage Regulator, Part Number 11-108-000.

TABLE I

The **SCUBAPRO balanced 1st stage** (Figure 1) utilizes a "flow-through" piston to nearly eliminate the effect of tank supply pressure on the breathing characteristics of the regulator. One end of the piston seats against a high pressure orifice which controls the flow of compressed air from the tank. The other end of the piston balances the intermediate air pressure in the low pressure hose, against a constant spring force and against ambient pressure. On demand (i.e. when the diver starts inhaling), the intermediate air pressure is slightly reduced. This reduction of intermediate air pressure unbalances the piston allowing the spring to move the piston away from the high pressure orifice. Compressed air is automatically metered into the 2nd stage assembly until balance is restored. The larger the demand, the farther open the piston moves, thereby allowing a larger flow of air.

The air passage in the flow-through piston is large to provide adequate air flow capacity for diving to the depth limits of sport diving. Since the regulator does not become harder to breathe through as the supply pressure reduces, the diver should monitor his air supply with a Dive Timer (Cat. 28-139-000) or a Submersible Tank Pressure Gauge (Cat. 28-132-000) to know its status to judge the duration of his dive accordingly. A balanced 1st stage is required for full-range easy breathing.



The **SCUBAPRO balanced 1st stage with audio reserve** (Figure 2) is operationally the same as the balanced 1st stage except that it includes an extra air chamber which pneumatically signals the diver when his tank pressure is low. The piston in that chamber vibrates to generate an audio signal (sounds like a honk) during each inhalation when the diver's air supply pressure is less than about 350 psi above ambient pressure. Thus, the deeper the diver is, the sooner his audio reserve will sound. In addition, the diver breathing greater amounts of air will be warned by the low air signal earlier than a diver breathing small amounts. The audio signal can easily be heard 60 feet away underwater for notification of all divers in the area. The vibrating piston also generates rapid pressure pulses in the 2nd stage, thereby producing a distinct tactile signal at the diver's mouth to remove any doubt as to whose tank pressure is low. The low air diver will feel it in his mouth.

The **SCUBAPRO unbalanced 1st stage** (Figure 3) is of the conventional piston design. The tank air passes through the high pressure orifice directly into the intermediate pressure hose. A feedback passage through the piston stem provides sensing pressure to the control side of the piston. This design is inherently reliable and requires very little maintenance. It does become slightly harder to inhale through as tank pressure decreases. In spite of this subtle warning, it is recommended that a Dive Timer or Submersible Tank Pressure Gauge be attached to the stage for monitoring the tank air supply submerged.

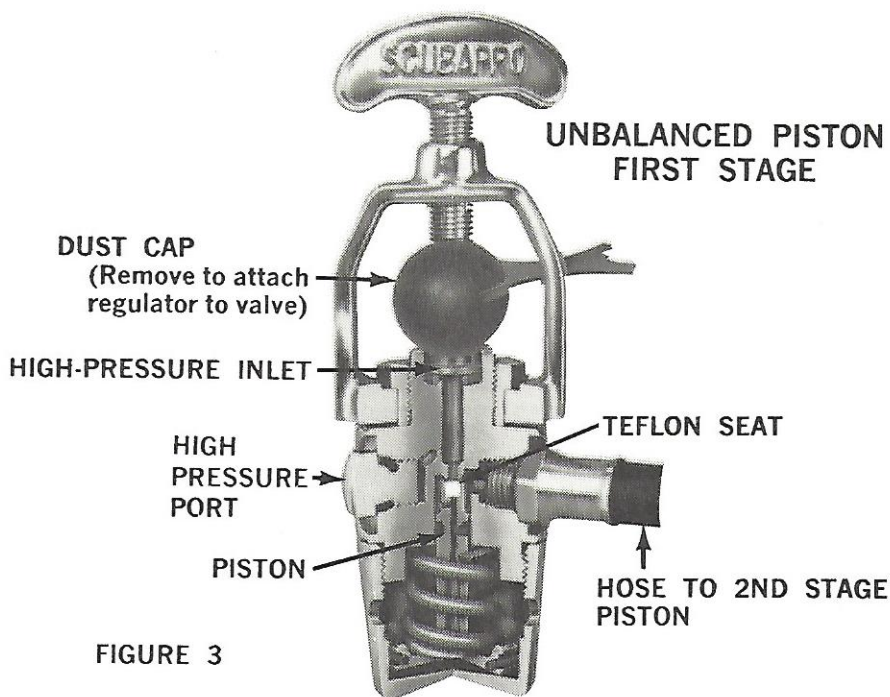


FIGURE 3

The SCUBAPRO 1st stages all have at least one plugged **high** pressure port for attachment of a Dive Timer or Submersible Tank Pressure Gauge. The port feeds through a No. 80 drill orifice that allows air pressure to be admitted to the gauge, but restricts the flow of air in case of a ruptured hose or broken gauge. In case of rupture, about 40 minutes are required for a 71.2 cubic foot tank to drain from 2000 psi to 100 psi through the port.

The SCUBAPRO 1st stages have at least one removable low pressure plug for attachment of an additional 2nd stage (octopus), Quick Release Inflator (Cat. 21-562-000), a pneumatic tool, or a Deluxe Utility Adapter (Cat. 121-000) or Utility Adapter (Cat. 10-119-000). The utility adapters provide three low pressure ports in place of one for use with the above accessory equipments.

2ND STAGES:

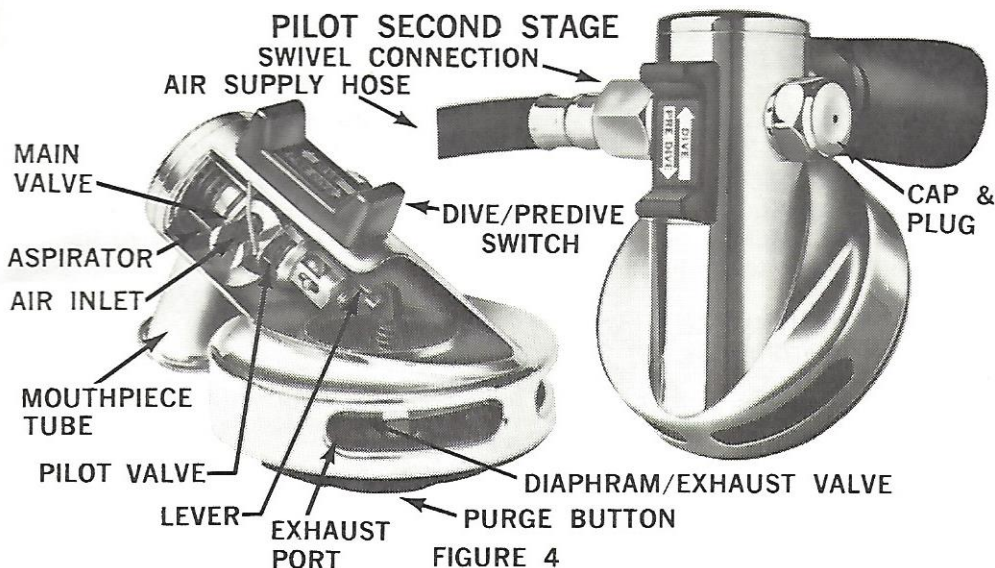
SCUBAPRO produces 2nd stage assemblies of the "downstream" type as opposed to the "upstream" or "tilt-valve" type. This means the demand valve seats with spring pressure against the intermediate pressure in the low pressure hose. The intermediate pressure therefore actually assists the opening of the demand valve thereby reducing its initial opening resistance. The downstream demand valve also is a safety valve to relieve any excessive overpressure which may exist in the low pressure hose in the rare event that the 1st stage leaks high pressure air into the hose.

SCUBAPRO 2nd stages are manufactured in three different configurations: (1) Pilot, (2) Adjustable, and (3) Standard. The operation of each varies slightly as described below.

The Pilot 2nd stage (Figure 4) represents an innovation in 2nd stage design which utilizes the intermediate air pressure instead of the diver, as the power source for opening the air supply demand valve. This is accomplished with a very small pilot valve which ports intermediate air to open the air supply valve on demand.

The air supply valve is balanced; unaffected by intermediate pressure variations due to the 1st stage or hose. The air supply valve remains closed as long as there is no pressure in a control chamber behind the valve. Inhalation suction by the Diver causes the regulator diaphragm to be drawn inward. The resulting linkage movement opens the pilot valve. Flow through the pilot valve pressurizes the control chamber. The resultant force opens the air supply valve. The structural arrangement between the pilot and air supply valves provides a feedback which forces the air supply valve to move in exact response to the pilot valve.

An aspirator port, directed toward the mouthpiece tube inside the regulator, generates a slight vacuum within the regulator case when air is flowing. As a result, the effort required to maintain air flow during inhalation is reduced. The aspirator is factory-set for normal sport diving conditions. Commercial or advanced divers working at depths in excess of 120 feet may desire to have the aspirator reset to provide positive-pressure breathing. This adjustment should be made only by trained technicians at an authorized SCUBAPRO Dealer.



A slide switch on the front of the regulator case is provided to decrease the response of the regulator when the regulator is not in the diver's mouth or when buddy breathing. Operation and use of this switch is described in detail in the OPERATION section.

The Pilot diaphragm doubles in function as an exhaust valve. This design provides an exhaust valve which is significantly larger than those of conventional regulators. The size increase is advantageous because less effort is needed to open the valve during exhalation.

The Pilot case has a low and narrow profile to avoid interfering with gloved hands when the diver equalizes pressure by squeezing his nose. The diaphragm is located next to the diver's chin where it will not snag on underwater objects or be activated by water currents or surge. The case can rest comfortably on the diver's chin, thereby distributing its weight between the teeth and chin.

The low pressure hose is connected in a right-handed configuration normally. It may be connected in a left-handed or double hose configuration to meet the diver's needs. Double hoses may be connected to the same 1st stage or to two separate 1st stage regulators for additional air capacity for deep diving or just for added safety.

The Adjustable 2nd stage (Figure 5) enables the diver to precisely set the inhalation resistance of his regulator while underwater. The adjustment knob increases inhalation resistance when it is screwed inward. Normally, this adjustment knob should be set to provide the diver with the least amount of resistance. During special circumstances, the regulator can be adjusted for "hard" breathing. For example, if the diver is working in head-down position, the regulator can be adjusted to prevent over-inflation of his lungs. Also, the regulator can be adjusted to prevent free-flow during rough water conditions, such as are encountered in the surf during beach entrances and exits.

The Adjustable 2nd stage features a flow-through demand valve of exceptional flow capacity and a large exhaust valve which provides extremely low exhalation resistance.

A Spacer (Cat. 11-109-119) is attached to the Safety Lanyard on all SCUBAPRO 2nd stages (except the Pilot, on which it is not needed). Its purpose is to move the demand valve seat away from its orifice so the seat does not take a set during storage. The Spacer should NOT be inserted during any rinsing of the regulator because that would allow water to pass into the low pressure hose.

ADJUSTABLE SECOND STAGE

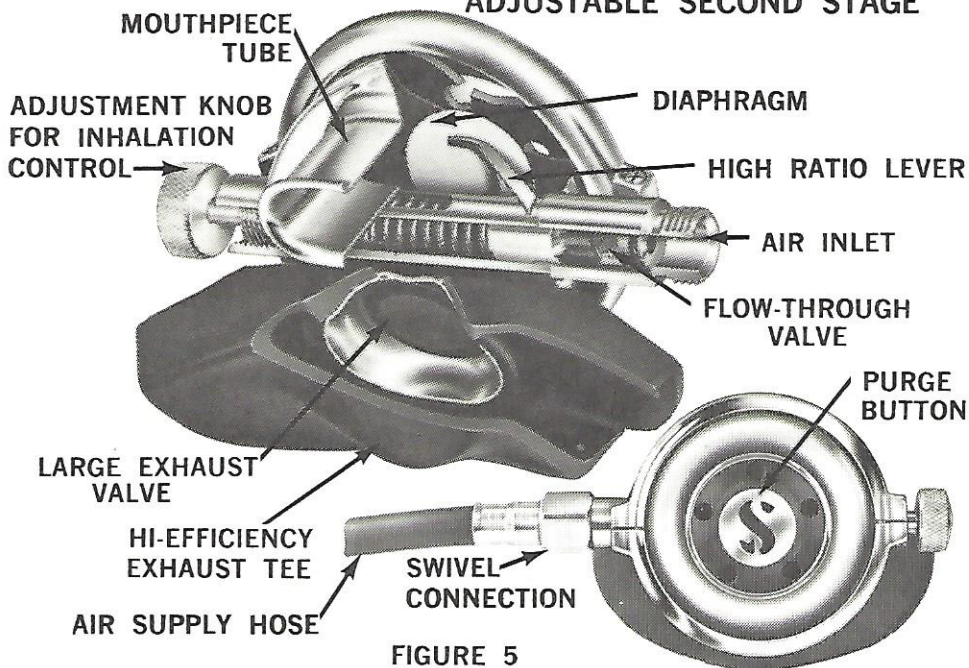


FIGURE 5

The Standard 2nd stage (Figure 6) incorporates a balanced venturi flow assist to reduce inhalation resistance at high flow rates. The venturi assist causes a pressure drop at the demand valve which augments the suction effort produced by the diver when inhaling. As a result, once the demand valve is open, inhalation effort will remain constant, even at abnormally high flow rates or extreme depths.

The inhalation resistance of the Standard 2nd stage assemblies is normally adjusted to approximately 2 inches of water. (One inch of water is equivalent to 0.037 psi.) This inhalation resistance compensates for the difference in elevation between the diver's second stage assembly and the center of his lungs when swimming horizontally. The diver will find it slightly harder to inhale when he is standing vertically or is on his back in the water. Conversely, the diver will find it somewhat easier to inhale when he is working in a head-down position.

The SCUBAPRO 2nd stages all are equipped with a contoured mouthpiece which a diver should find extremely comfortable even

STANDARD SECOND STAGE

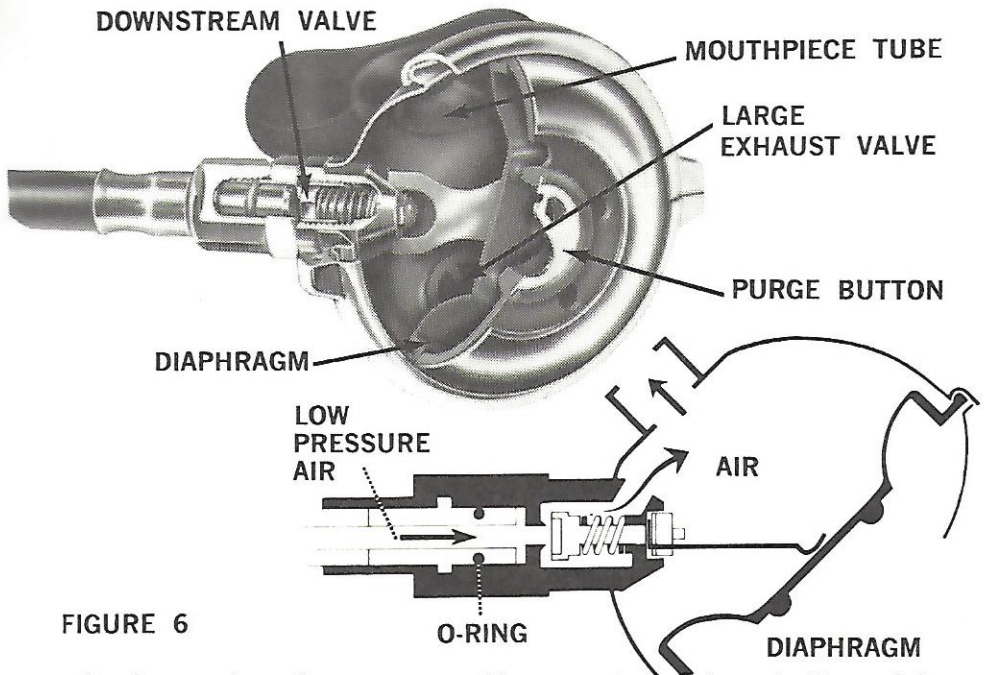


FIGURE 6

after hours of continuous usage. They are also equipped with a safety lanyard to attach the 2nd stage to the shoulder strap of the tank harness. The function of this cord and clip is to keep the 2nd stage within easy reach if it is purposely or accidentally dropped from the mouth. The clip can be quickly disconnected by a slight tug on the 2nd stage.

The exhaust valve on all 2nd stages is located at the lowest point on the assembly when the diver is looking slightly above horizontal. In this position, the 2nd stage can be completely purged of water by a simple exhalation or by depressing the purge button.

The intermediate pressure hose is made of the finest material to give it maximum strength and flexibility. The hose is rated for a minimum burst pressure of 2000 psi, a proof pressure of 500 psi, and a working pressure of 200 psi to carry the intermediate pressure of 140 psi safely.

Performance Characteristics:

The typical SCUBA regulator is a pneumatic system in which compressed air flows through a series of passages, valves, and chambers. Flow resistance is a dynamic characteristic of these pneumatic systems. The higher the flow rate, the greater the flow resistance.

The diver must exert muscular effort to overcome flow resistance during inhalation and exhalation. Excessive breathing resistance has been found to be detrimental to both the psychological and physiological well-being of the diver. For example, the diver can have the impression that he must "fight" for each breath, and he may become

PILOT SECOND STAGE PERFORMANCE CHARACTERISTICS

INHALATION RESISTANCE
(Inches of Water)

EXHALATION FLOW RATE
(Cubic Feet Per Minute)

SEA LEVEL
33 FEET
100 FEET
200 FEET

EXHALATION RESISTANCE
(Inches of Water)

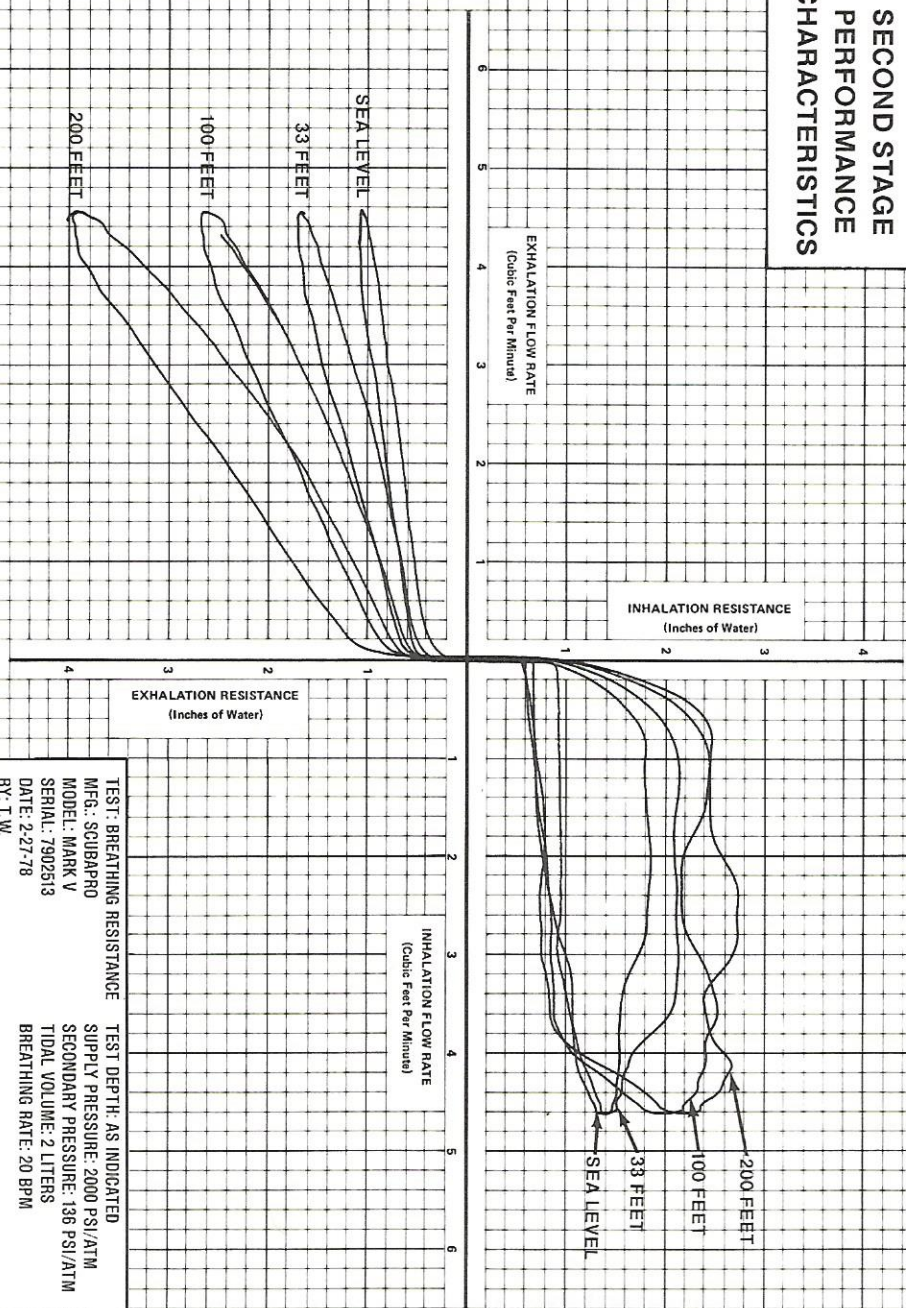
INHALATION FLOW RATE
(Cubic Feet Per Minute)

TEST: BREATHING RESISTANCE
MFG.: SCUBAPRO
MODEL: 125
SERIAL: 6800195
DATE: 1976
BY: SCUBAPRO R & D

TEST DEPTH: AS INDICATED
SUPPLY PRESSURE: 300 PSI/ATM
SECONDARY PRESSURE: 140 PSI/ATM
TIDAL VOLUME: 2 LITERS
BREATHING RATE: 20 BPM

FIGURE 7

MARK V SECOND STAGE PERFORMANCE CHARACTERISTICS



TEST: BREATHING RESISTANCE
MFG: SCUBAPRO
MODEL: MARK V
SERIAL: 7902513
DATE: 2-27-78
BY: T.W.

TEST DEPTH: AS INDICATED
SUPPLY PRESSURE: 2000 PSI/ATM
SECONDARY PRESSURE: 136 PSI/ATM
TIDAL VOLUME: 2 LITERS
BREATHING RATE: 20 BPM

physically fatigued, due to excessive effort in breathing. However, a certain amount of breathing resistance is necessary for regulator stability, otherwise the regulator would tend to free-flow excessively. Accordingly, minimization of inhalation and exhalation resistance even at maximum flow demands, while maintaining regulator stability is a major design feature of SCUBAPRO regulators.

SCUBAPRO ensures the adequacy of its designs, attainment of design objectives, and the quality of its regulators by evaluating their performances through extensive testing. Each production regulator is set and checked for proper inhalation and exhalation resistance before it is packaged for shipment.

Figures 7 and 8 show the actual results of precision testing of flow rate versus inhalation and exhalation resistance.

Figure 7 is a pressure/flow diagram for a Pilot regulator system (Cat. 12-125-000). The right-hand side of the diagram was generated during inhalation. The left-hand side was generated during exhalation. The flow rate at a simulated ocean depth of 33 feet with the switch in PRE-DIVE reaches a peak of 4.4 cfm (cubic feet per minute) $\frac{1}{2}$ way through the inhalation (or exhalation) cycle. Inhalation resistance rises rapidly to about 1 inch of water soon after inhalation begins. Then it climbs slowly to about 2 inches of water at maximum flow rate. Exhalation resistance increases nearly linearly with flow rate, reaching a maximum of about 1.2 inches of water at 4.4 cfm. The tidal volume of 2 liters with a breathing rate of 20 breaths per minute represents a moderately working or swimming diver.

Figure 8 is a typical pressure/flow diagram for the Mark V regulator system.

Accessories For SCUBAPRO Regulators:

A SCUBAPRO regulator is the focal point of a SCUBA diver's equipment. As such, it is augmented by many accessory items in assembling an integral diving system.

SCUBAPRO has long recognized the importance of making their regulators capable of meeting the demands of systems ranging from those used solely in shallow pool training to those supporting professional divers deep in the ocean. With that goal, SCUBAPRO has developed a complete line of accessory equipment for the SCUBAPRO regulator, regardless of model. These accessories are listed below, and in the current SCUBAPRO Professional Diving Equipment Catalog.

1ST STAGE ACCESSORIES:

High Pressure Protector (Cat. No. 10-101-111) *

For protecting against contamination during storage.

Deluxe Utility Adapter (Cat. No. 10-121-000)

For extra low pressure ports.

Utility Adapter (Cat. No. 10-119-000)

For extra low pressure ports.

Dive Timer (Cat. No. 28-139-000)

For monitoring air supply and breathing time.

Submersible Tank Pressure Gauge (Cat. No. 28-132-000)

For monitoring air supply.

Quick Release Inflator (Cat. No. 21-562-000)

For inflating the stabilizer jacket, BCs, etc.

Sleeve (Cat. No. 11-001-000)

For protecting hoses from bending damage.

Travel Kits (Cat. No. 40-758-000)

For replacement of O-rings & seats in 1st stages.

Octopus Regulators (Cat. No. 11-108-000, 11-109-000 and 11-128-000)

2ND STAGE ACCESSORIES:

Contour Mouthpiece, Black (Cat. No. 01-040-001) ## (#)

For mouthpiece comfort.

Contour Mouthpiece, Gum Rubber (Cat. No. 01-040-002)

For tender mouths.

Mouthpiece, Standard, Black (Cat. No. 01-040-003)

For alternate mouthpiece comfort.

Contour Mouthpiece, Orange (Cat. No. 01-040-004) ***

For comfort and visual identification.

Exhaust Tee, Orange (Cat. No. 01-043-103) ****

For visual identification.

Exhaust Tee, Orange (Cat. No. 01-043-104) **

Spacer (Cat. No. 11-109-119) ## ***

For preventive maintenance.

Safety Lanyard (Cat. No. 11-109-005) *

For location convenience.

Extra-long Low Pressure Hose (Cat. No. 01-032-034) ***

For octopus 2nd stages, or, personal preference.

Travel Kit (Cat. No. 40-758-000)

For replacement of O-rings.

REGULATOR SYSTEM ACCESSORIES:

Warranty Card (when registered with SCUBAPRO) *

For warranty service identification.

Technical Manual (Cat. No. 45-101-187) *

For knowledge.

Regulator Carrying Bag (Cat. No. 53-719-000)

For carrying and storage convenience.

Silicone Spray (Cat. No. 41-493-000)

For preservation of rubber components.

Silicone Grease (Cat. No. 41-494-000)

For lubricating O-rings.

* = Furnished with all new SCUBAPRO regulators.

** = Furnished with Model 11-108-000

*** = Furnished with Models 11-108-000 and 11-109-000

**** = Furnished with Model 11-109-000

(#) = Furnished with Models 11-128-000, 12-125-000 and 12-127-000

= Furnished with Models 12-103-000, 12-105-000 and 12-107-000

INSTALLATION

SCUBAPRO regulators are designed to be compatible with SCUBA hardware generally available in the sport diving community. The 1st stages mate with standard tank valves. The 2nd stages mate with most 1st stages.

Installing (mounting) a SCUBAPRO regulator system on a tank is discussed in the OPERATION section. Installing a 2nd stage on a 1st stage is covered below. Many divers are mounting an extra 2nd stage on their regulator systems for their buddy's use in the event the buddy needs air. The "octopus" 2nd stage eliminates the need for classic buddy-breathing in which two divers share the same mouthpiece. The divers breathing from an octopus rig are indeed sharing the air supply, but they are doing so without the sometimes fatal fumbling involved in buddy-breathing. An extra 2nd stage is considered mandatory for cave diving and should be for other dives in which direct access to the surface is limited, such as in wrecks, in kelp, and under the ice.

Any SCUBAPRO 2nd stage can be used as an octopus. The SCUBAPRO Models 11-108-000 and 11-109-000 are specifically configured for octopus use. They are equipped with a bright orange mouthpiece and exhaust tee for high visibility even at great depths and an extra long low pressure hose.

The Pilot 2nd stage can be connected to a 1st stage with the hose either in the right-hand or left-hand port of the Pilot. The unused port must be plugged and capped. This feature allows the Pilot to be used as a right-handed working 2nd stage or a left-handed octopus. It can also be used by commercial or advanced divers requiring extra flow performance at depth by connecting low pressure supply hoses to both ports at once, one over each of the divers shoulders. Maximum flow performance and safety can be achieved by attaching the Pilot to two independent 1st stages, each mounted on a separate tank.

Installing 2nd Stage On 1st Stage:

Connecting a 2nd stage to a 1st stage is done simply by:

1. Opening a low pressure (LP) port on the 1st stage by removing an existing 2nd stage hose or removing a port plug. **NOTE: It is recommended that when installing an octopus regulator or utility adapter on a Mark VII (Cat. No. 10-107-000) 1st stage, the non-audio low pressure port be used. This is for added safety in the very rare event that the audio portion of Mark VII 1st stage fails. It is also recommended that additional low pressure hoses or accessories such as; utility adapters, air moisturizers or air heaters not be attached to the audio port, since these items may cause the audio alarm to not function properly.**
2. Threading the 2nd stage low pressure hose fitting into the port. **CAUTION:** Since no significant force is needed to thread the hose fitting in, use of tools for threading could damage the connection.
3. Screwing the hose fitting all the way in by hand to seat the sealing O-ring. The connection should now be leak-tight. If it is not, check the O-ring for damage.
4. Lock the fitting in place by tightening it slightly with a small wrench. This tightening will not seal leaks allowed by a faulty O-ring. Excessive tightening could damage the connection.

Installing 1st Stage In Cold Water System:

Installing a SCUBAPRO balanced 1st stage in a diving system for use in extremely cold water requires special preparation. The flow-through piston design was developed to produce maximum flow. That high flow rate and its expansion of gas through the piston produces a

refrigeration effect that will produce ice on the outside of the piston shaft. The ice will build up and can eventually hold the piston open causing free-flow of the regulator.

Icing of the 1st stage can be prevented by filling the piston spring cavity with silicone grease, silicone oil or mineral oil and sealing the openings with a rubber sleeve. There is sufficient movement of the rubber sleeve at the opening to take care of the spring movement. Be sure there is no air trapped in the cavity.

Silicone or teflon sprayed into the cavity will not work as effectively but will decrease build-up of ice.

General:

OPERATION

The SCUBAPRO regulator systems are operated as most sport diving demand regulators. Since this booklet is not a diving instruction manual, the diver is advised to obtain professional instructions in the operation of the regulator prior to its waterborne use.

Mounting The Regulator On A SCUBA Tank Valve:

The tank valve should be positioned with the air outlet pointing towards the tank harness. This will put the 1st stage between the diver's head and tank for protection besides effectively making the low pressure hose longer and less binding than if the tank were reversed.

The 1st stage is then attached to the tank valve by means of the yoke and yoke screw in such a manner as to allow the low pressure hose to go up and over the right shoulder of the diver. The yoke screw should be applied only hand tight. Excessive tightening is unnecessary and can damage the screw threads on the yoke or yoke screw.

The Mark VII 1st stage interferes with some of the reserve levers of the reserve tank valves such that they can not be pulled to the "down" position without hitting it. If this is the case, put the reserve lever in the "down" position when mounting the regulator. Though the tank reserve warning is lost, the audio reserve of the Mark VII will operate to warn the diver of low air pressure.

The old style SCUBAPRO DC/AR valve reserve lever is one that will not clear the Mark VII 1st stage. This reserve lever can be reversed and the pull rod bent accordingly to allow the reserve lever to be pulled to the down position with the Mark VII mounted. This provides the valve reserve in addition to the audio reserve. This modification can be made by any SCUBAPRO Dealer. If this modification is not made, the reserve lever must be in the "down" position before mounting the regulator. SCUBAPRO's new style DC/AR valve reserve lever will now clear the Mark VII 1st stage. It is available as a spare part from your SCUBAPRO Dealer.

Pre-Dive Operational System Check:

Prior to each dive, the SCUBAPRO regulator system should be checked for proper operation as follows:

1. Mount the 1st stage on a SCUBA tank.
2. Check all hose connections on the 1st and 2nd stages to be sure they are at least hand-tight.
3. Remove the Spacer from the 2nd stage.
4. Ensure the Dive Timer or Submersible Tank Pressure Gauge indicates zero pressure.

5. Open the tank valve to pressurize the regulator system. Check dive timer or submersible tank pressure gauge to ensure that it indicates the proper pressure. NOTE: The Pilot 2nd stage is so extremely sensitive that it can turn on or free flow if jarred or struck sharply when out of the diver's mouth. Also, a slight fluttering sometimes occurs when used out of the water, but it disappears immediately upon submerging. Free flow of the Pilot is prevented by having the DIVE/PRE-DIVE switch in the PRE-DIVE position. Free flow of other 2nd stages out of water is prevented by placing a finger over the mouthpiece opening.
6. Listen for leaks.
 - a. If the tank valve O-ring leaks, depressurize the system, remove the regulator, replace the O-ring, and start again at Step 1 above.
 - b. If the regulator system leaks at any connection, depressurize the system, and start again from Step 2 above.
 - c. If the 1st or 2nd stage leaks excessively, wash them out thoroughly with fresh water to remove any foreign matter which may be causing the leaks. If the leaks persist, return the regulator to a SCUBAPRO Dealer for repair.
7. Confirm that the regulator system breathes properly by first exhaling through the mouthpiece to blow any foreign matter out of the chamber, then inhaling. DO NOT PURGE the regulator to test its breathing operation. Purging does not ensure operation of the exhaust valve.
8. Check the audio reserve of the Mark VII by turning the air off, then breathing or purging the contained pressure to zero. As the pressure drops below about 350 psi, the audio signal (honk) should sound.

The audio reserve mechanism can also be checked by slowly cracking the tank valve while breathing on the regulator or intermittently depressing the purge button. When the supply pressure within the regulator exceeds about 400 psi, the audio signal will stop.
9. Repressurize the regulator system and leave it pressurized for the dive.

Wearing The Regulator:

The low pressure hose to the 2nd stage should be routed over the diver's right shoulder for right-handed regulators, or over the left shoulder for left-handed regulators. Octopus 2nd stages can be routed parallel to the active 2nd stage, left dangling behind, or secured alongside in whatever manner the diver wishes.

The Safety Lanyard provided with SCUBAPRO active and octopus 2nd stages can be used to attach them to the tank harness shoulder strap to keep them within easy reach.

Entering The Water:

The SCUBAPRO regulators are finely tuned for easy breathing. Entering the water usually causes dynamic disturbances which often deflect the 2nd stage diaphragms enough to cause air to free flow from the regulators. To prevent this loss of air, observe the following:

1. The Pilot 2nd stage DIVE/PRE-DIVE switch should be in the PRE-DIVE position.

2. The Adjustable 2nd stage inhalation resistance knob should be turned in most of the way for harder breathing.
3. All 2nd stages should be oriented with their mouthpieces pointing down, which represents the hardest breathing position. If the mouthpiece is pointed up, a properly tuned 2nd stage will free flow underwater, but it will not when pointed down.

Submerged Breathing:

Underwater, the diver should breathe continuously through the regulator. The recommended breathing pattern consists of a rather rapid, but comfortable, inhalation followed directly by a slower continuous, but still comfortable, exhalation followed in turn immediately by another inhalation. Safety requires that at all times, the diver be either inhaling or exhaling, but never holding his breath.

The SCUBAPRO regulators permit the diver to establish and maintain the above breathing pattern with little effort. They deliver precisely the amount of air demanded by the diver. The Pilot 2nd stage, being designed to be particularly sensitive, may emit tiny bubbles periodically from the mouthpiece when submerged. This is an indication of the precision tuning done at the factory for maximum sensitivity. The amount of air escaping in these tiny bubbles is insignificant. It takes 12 hours to approximate one breath at a rate of 1 bubble per second. The Pilot 2nd stage may also pop slightly when the diver breathes on his back.

The inhalation resistance of the Pilot and Adjustable 2nd stages may be adjusted as described below to match diving conditions. Generally the inhalation resistance is set for minimum. But, sometimes a diver may be descending head first such that the easy-breathing regulator is delivering excess air because of its position. Or, the diver may be in a current which is depressing the purge button slightly to cause constant bubbling. Or, the diver may be positioned with his regulator low, as when looking under ledges upside-down. Or, the diver may be buddy breathing when excessive bubbles would add to the confusion of the process. These conditions require adjustment to less than easy breathing.

1. Pilot 2nd stage adjustment:

The DIVE/PRE-DIVE switch in DIVE position gives the easiest breathing (inhalation resistance). This allows the regulator to respond quickly and smoothly to the slightest inhalation effort. The PRE-DIVE position increases the inhalation effort for special conditions and prevents free flow. The PRE-DIVE position does not conserve air because the increased breathing effort requires extra use of respiratory muscles which, in turn, demands greater oxygen consumption and contributes to respiratory fatigue.

2. Adjustable 2nd stage adjustment:

The adjustment knob, when turned out as far as possible, gives the easiest breathing (inhalation resistance). The 2nd stage may even free flow slightly on easiest breathing. When turned full in (do not jam it full in) it gives the hardest breathing. Just as the PRE-DIVE position does not conserve air, neither does the knob being full in conserve air.

Exhaling through the mouthpiece directs the breathing exhaust gases to the environment through the exhaust valve and tee. The exhaust valve shuts instantly when exhaling stops. It is a light flexible disc that can be held open by objects as a small piece of grass or kelp. Because of this, care should be exercised to prevent foreign objects from entering the breathing chamber to foul the exhaust valve. The exhaust valve also tends to leak slightly on inhalation when the diver is standing on his head underwater.

Clearing:

The SCUBAPRO 2nd stages can be cleared underwater by (1) exhaling, (2) purging, (3) swishing, and (4) free flow.

The extensive travel of the purge buttons on all the 2nd stages allows a great deal of air to be delivered to the diver when it is used. Such an amount of air may startle a diver, or possibly even shoot some water into his throat, therefore the following caution should be observed during purging. **CAUTION: When purging a 2nd stage, especially the Pilot, hold it securely in place and restrict the flow of air into the throat and lungs.**

Purging the Pilot is best done by pushing the purge button with the thumb with the other fingers resting on the front of the regulator. Purging the other 2nd stages can be done with any finger.

Free flow of the Pilot underwater can be stopped by either switching to the PRE-DIVE position and/or by turning the regulator to the position shown in Figure 9.

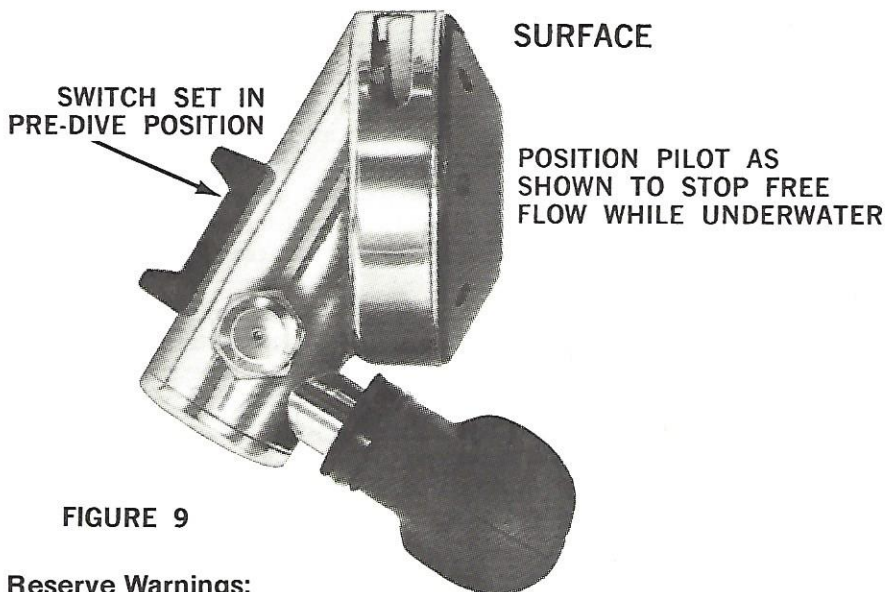


FIGURE 9

Reserve Warnings:

The reserve of a tank valve used in conjunction with a Mark VII may, under certain conditions, take effect before or at the same time as the audio reserve of the regulator. After the reserve lever has been pulled, the audio of the regulator will take effect at its designed pressure level.

With the Mark VII reserve, and with any other, it is strongly advised that the regulator have a Dive Timer or a Submersible Tank Pressure Gauge. These accessories continuously inform the diver as to the status of his breathing supply, and enable him to better judge the duration of his dive accordingly.

Completing The Dive:

Divers who crawl ashore or come through surf or dirty water at the end of the dive, should consider keeping their 2nd stages in their mouths during exit for two reasons:

- (1) The 2nd stage will not get filled with sand, dirt, or other contamination.
- (2) It is easier to breathe from a regulator than a snorkel in confusing conditions such as the surf.

The regulator should not be released until the diver is standing up, clear of the water.

After completing a dive perform the post-dive maintenance immediately.

General:

MAINTENANCE

A SCUBAPRO regulator is a precision life support system. The diver's safety and enjoyment depend on its proper operation. Every precaution has been taken by SCUBAPRO to provide the diver with the best that today's technology can produce. For his own safety, it is up to the diver to maintain this critical life support system. SCUBAPRO regulators have been designed so that only a minimum of preventive maintenance is required to keep the regulator in top condition. With proper care, the regulator will last the diver a lifetime.

Post-Dive Maintenance:

1. After completion of the diving day, RINSE the regulator thoroughly in clean fresh water WHILE THE REGULATOR IS PRESSURIZED. Run the water through the water ports of the 1st stage to remove foreign matter and prevent contamination build up around the piston spring and O-rings. Run water into the mouthpiece of the 2nd stage and out the exhaust tee to remove foreign matter from the breathing chamber.

If the regulator is not pressurized during rinsing:

- a. Ensure the High Pressure Protector is securely in place over the high pressure filter.
 - b. Do not depress the purge button or otherwise deflect the diaphragm. If either happens, contaminants may enter and foul the valves and low pressure hose.
2. SHAKE DRY, wipe the exterior, then insert the Spacer in the Adjustable or Standard 2nd stage to move the demand seat away from its orifice so it does not take a set during storage.

SPECIAL PREVENTIVE MAINTENANCE. SCUBAPRO regulators must have special preventive maintenance when used in chlorinated water (swimming pools) because of the detrimental effects that the acids and chlorine may have on various materials used. After each use in a swimming pool, SCUBAPRO regulators must be thoroughly rinsed in fresh water and allowed to dry completely before storing.

Storage:

Store the regulator in a cool, dry, and clean place with the hoses not kinked and the Spacer (Cat. No. 11-109-119) inserted in the purge opening on the Adjustable or Standard 2nd stage. Adequate storage is provided by a protection container such as the SCUBAPRO Instrument and Regulator Bag (Cat. No. 53-719-000).

Dealer Maintenance:

Wear on regulator parts is proportionate to the amount of use, type of use, personal treatment, storage, and the amount of preventive maintenance. It is recommended that your SCUBAPRO regulator be serviced once every year by a SCUBAPRO Dealer. Typical servicing includes lubrication of all O-rings, general cleaning, part replacements when needed, and a performance evaluation. This yearly service will ensure longer life because of the complete maintenance the Dealer can perform. Regulator Service Records are included in this booklet for your use.

Owner Maintenance:

Other than the Post-Dive Maintenance, it is recommended that owners leave internal maintenance of regulators in the hands of authorized regulator servicepersons because of the special techniques and tools required for internal maintenance.

SCUBAPRO has Travel Kit (Cat. No. 40-758-000) for replacement O-rings and seats for flow through 1st stages for those professional divers trained in maintaining their regulators. It also has Silicone Spray (Cat. No. 41-493-000) and Silicone Grease (Cat. No. 41-494-000) especially formulated for lubricating O-rings. The silicone grease is used by removing the O-ring from its groove, working the silicone into the surface of the rubber with fingers, then WIPING EXCESS SILICONE OFF. The pores of the rubber will retain the proper amount of silicone for lubrication. The O-ring can then be replaced in its groove.

The O-rings are the only parts of a regulator which require lubrication. **Under no circumstances should the regulator be oiled. The oil not only damages rubber parts, but can when combined with compressed air form carbon monoxide. Carbon monoxide, when inhaled, renders the blood incapable of carrying oxygen to the tissues. OIL IS A DEADLY POISON when used in a SCUBA regulator.**

REPAIR

It is recommended that all repairs to your regulator be accomplished by the trained technicians at the SCUBAPRO factory or at a SCUBAPRO Dealers.

REGULATOR SERVICE RECORDS

The following forms will become the history of your regulator. Be sure a form is filled out completely when having your regulator serviced.

Dealer: _____

Address: _____

Condition: _____ Clean: _____ Lubricate: _____

Parts Replaced: _____ Serial No. _____

Model: _____ Limited Warranty: yes no

Remarks: _____

_____ Serviced By: _____ Date _____

Dealer: _____

Address: _____

Condition: _____ Clean: _____ Lubricate: _____

Parts Replaced: _____ Serial No. _____

Model: _____ Limited Warranty: yes no

Remarks: _____

_____ Serviced By: _____ Date _____

Dealer: _____

Address: _____

Condition: _____ Clean: _____ Lubricate: _____

Parts Replaced: _____ Serial No. _____

Model: _____ Limited Warranty: yes no

Remarks: _____

_____ Serviced By: _____ Date _____

EQUIPMENT LOG AND TRIP CHECK-LIST

The following table can be used both as a permanent record of your equipment in case it is lost or stolen, and, in preparation for and return from a dive trip.

EQUIPMENT	PURCHASE RECORD				TRIP DATES		
	Brand	Model	Date	Cost	Store	Serial Nr	
Gear Bag							
Mask							
Spectramar Beris							
Snorkel							
Fins							
Exposure Suit — hood							
jacket							
pants							
boots							
gloves							
Neoprene cement							
Cold Guard							
Sun Guard							
Underwater Flashlight							
Flotation Device							
Q.D. Inflator							
Extra CO ₂ Cartridge							
Whistle							
Silicone Spray							
Weight Device							
Weights							
Instruments							
Console							
Depth Gauge							
Compass							
Thermometer							

LIMITED ONE-OWNER LIFETIME WARRANTY

SCUBAPRO warrants that as long as you own your regulator it will be free from defects in materials and workmanship under normal use and with reasonable maintenance, which must, as a minimum, include yearly servicing. A lifetime warranty and warranty card will be issued on all SCUBAPRO first stage and second stage regulator combinations when purchased together as a regulator system, except the SCUBAPRO Mark III Regulator, Part Number 12-103-000. A lifetime warranty and warranty card will also be issued on any SCUBAPRO second stage regulator added to a SCUBAPRO regulator system on which the consumer holds a lifetime warranty card, except the SCUBAPRO Standard Second Stage Regulator, Part Number 11-108-000. This warranty extends to the basic metal components of the regulator, however, does not cover filters, plastic components, and hard or soft rubber components which are covered by SCUBAPRO's limited (one-year) warranty. This warranty extends only to the original consumer.

SCUBAPRO will, at its option, repair or replace without charge, any components of the regulator which it finds defective.

To obtain warranty service you must either bring your SCUBAPRO regulator together with proof of purchase to any authorized SCUBAPRO dealer or send it to SCUBAPRO, 3105 E. Harcourt, Compton, California 90221 or to any other SCUBAPRO factory in the United States, Europe or Asia. If you send the regulator to a SCUBAPRO factory, you pay the shipping charges to the factory. Parts and service must be obtained through SCUBAPRO or an authorized SCUBAPRO dealer.

This warranty does not cover and SCUBAPRO shall not be liable for incidental or consequential damages. Some states do not allow exclusions of incidental or consequential damages, so the above exclusions may not apply to you.

This warranty does not cover anything resulting from misuse, abuse, neglect, alteration, failure to observe maintenance procedures, attempted disassembly, unauthorized repair or service, or failure to service the regulator annually. This warranty does not cover any representation or warranty made by dealers beyond the provisions of this warranty. This warranty does not cover costs incurred for normal repair, inspection and preventive maintenance.

You must establish proof of purchase and proof of yearly service to obtain warranty service. You may establish proof of purchase by completing the Warranty Registration Card and mailing it to SCUBAPRO. In return you will receive a card which will enable you to obtain service at any authorized SCUBAPRO dealer.

This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state.

LIMITED (TWO-YEAR) WARRANTY

SCUBAPRO warrants that for a period of two years from your date of purchase, your SCUBAPRO regulator will be free from defects in materials and workmanship under normal use and with reasonable maintenance, which must, as a minimum, include yearly servicing. This warranty extends to the basic metal components of the regulator, however, does not cover filters, plastic components, and hard or soft rubber components which are covered by SCUBAPRO's limited (one-year) warranty. This warranty extends only to the original consumer.

SCUBAPRO will, at its option, repair or replace without charge, any components of the SCUBAPRO regulator which it finds defective.

To obtain warranty service you must either bring your SCUBAPRO regulator together with proof of purchase to any authorized SCUBAPRO dealer or send it to SCUBAPRO, 3105 E. Harcourt, Compton, California 90221 or to any other SCUBAPRO factory in the United States, Europe or Asia. If you send the regulator to a SCUBAPRO factory, you pay the shipping charges to the factory. Parts and service must be obtained through SCUBAPRO or an authorized SCUBAPRO dealer.

All implied warranties of merchantability and fitness for intended use are limited in duration to the duration of this written warranty. This warranty does not cover and SCUBAPRO shall not be liable for incidental or consequential damages.

Some states do not allow limitations on how long an implied warranty lasts or limitations or exclusions of incidental or consequential damages, so the above limitations or exclusions may not apply to you.

This warranty does not cover anything resulting from misuse, abuse, neglect, alteration, failure to observe maintenance procedures, attempted disassembly, unauthorized repair or service, or failure to service the regulator annually. This warranty does not cover any representation or warranty made by dealers beyond the provisions of this warranty. This warranty does not cover costs incurred for normal repair, inspection and preventive maintenance.

You must establish proof of purchase and proof of yearly service to obtain warranty service. You may establish proof of purchase by completing the Warranty Registration Card and mailing it to SCUBAPRO. In return you will receive a card which will enable you to obtain service at any authorized SCUBAPRO dealer.

This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state.

LIMITED (ONE-YEAR) WARRANTY

SCUBAPRO warrants that for a period of one year from your date of purchase, your SCUBAPRO regulator will be free from defects in materials and workmanship under normal use and with reasonable maintenance. This warranty extends only to the original consumer.

SCUBAPRO will, at its option, repair or replace without charge, any components of the SCUBAPRO regulator which it finds defective.

To obtain warranty service on SCUBAPRO regulators you must either bring your SCUBAPRO regulator together with proof of purchase to any authorized SCUBAPRO dealer or send it to SCUBAPRO, 3105 E. Harcourt, Compton, California 90221 or to any other SCUBAPRO factory in the United States, Europe or Asia. If you send the regulator to a SCUBAPRO factory, you pay the shipping charges to the factory. Parts and service must be obtained through SCUBAPRO or an authorized SCUBAPRO dealer.

All implied warranties of merchantability and fitness for intended use are limited in duration to the duration of this written warranty. This warranty does not cover and SCUBAPRO shall not be liable for incidental or consequential damages.

Some states do not allow limitations on how long an implied warranty lasts or limitations or exclusions of incidental or consequential damages, so the above limitations or exclusions may not apply to you.

This warranty does not cover anything resulting from misuse, abuse, neglect, alteration, failure to observe maintenance procedures, attempted disassembly, unauthorized repair or service, use in chlorine water without special preventive maintenance, puncture of diaphragms or damage caused by rust or other contaminants from air source. This warranty does not cover any representation or warranty made by dealers beyond the provisions of this warranty. This warranty does not cover costs incurred for normal repair, inspection and preventive maintenance.

You must establish proof of purchase to obtain warranty service.

This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state.



Your SCUBAPRO Regulator is Guaranteed as long as you own it.
Serial Number Model

89 19 023 Date Issued.

This card is a symbol of matchless precision — a degree of craftsmanship achieved in regulators only by SCUBAPRO. It is your passport into the envied group of truly serious divers, a group that will, because of their desire to own the finest in diving equipment, enjoy a lifetime of trouble-free diving pleasure.

SCUBAPRO®

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