The Voit 50 Fathom Regulator

In the realm of scuba diving regulators progress is generally made in evolutionary phases rather than revolutionary. Even the original Aqua Lung was a modification of an already existing demand valve. Approximately a decade after the initial Gagnan/Cousteau design, Gagnan set his sights on the development of a single stage regulator. Not only would such a development be less expensive to manufacture, but it would be mechanically simpler in function as well.

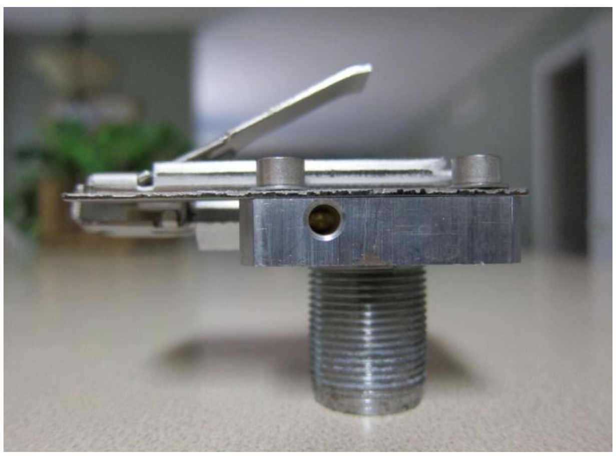
The original single stage regulator was known as the DX Over-Pressure. That particular system went through its own evolutionary path until culminating in the highly respected Mistral DW. Other manufacturers in their parallel quest to develop a single stage unit used the same basic "upstream" system. In the upstream design, the seat assembly moves against the force of the incoming air from the cylinder. As the cylinder pressure diminishes, less force is being applied to the back of the high pressure seat. This is the reason why the unbalanced, upstream single stage scuba regulator's inhalation effort decreases as the cylinder pressure lessens. While the unbalanced upstream system is highly regarded, it does have one significant negative attribute.

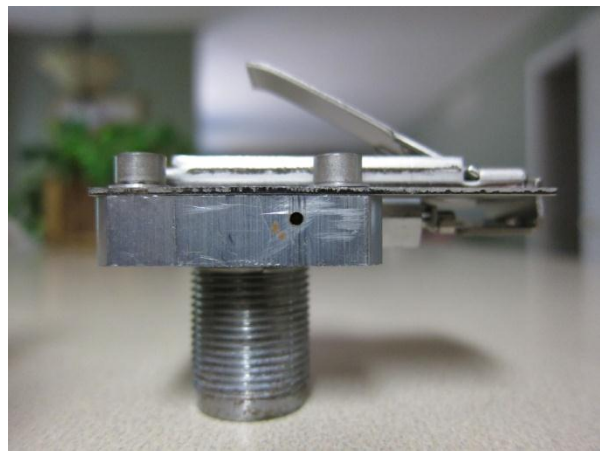
Due to the variations in cylinder pressure that act directly upon the high pressure seat, the inside diameter of the volcano orifice needs to be rather small as compared to those of a balanced variety. The smaller orifice consequently limits the flow of gas, particularly when doing deep dives on air. Cousteau's team did some extraordinary deep dives in the 1970s using Mistral regulators, but those were done utilizing blends of oxygen and helium. Due to the decreased density of heliox as compared to air, a regulator will have similar work-of-breathing effort at much greater depths. For example, a diver breathing heliox at 400fsw would closely compare to a diver breathing air at 150fsw.

A short time after having finished the Mistral DW model, Gagnan began developmental work on a single stage downstream mechanism. "While working on the 'Aqua-Matic' (1957), Gagnan had conceived of a pressure balancing system that could be used with single-stage, two hose regulators like the 'Mistral' to overcome some of the 'small orifice' problems that he had previously thought inherent in the single stage design." (Nuytten, Phil, 2004)

W.J. Voit Rubber Corporation established a business relationship with U.S. Divers in the mid-1950s. Voit sold various single and double hose regulators that were simply rebadged versions of existing U.S. Divers models. It is reported that, in turn, Voit produced various rubber goods for the U.S. Divers line. Whatever the relationship, an interesting turn occurred in 1959. "Oddly, when this design (single stage downstream system) was finally perfected it was never offered by U.S. Divers-but, instead, the patent was licensed to the Voit Rubber Company." (Nuytten, Phil, 2004) Thus, the birth of the Voit 50 Fathom regulator. Nuytten also reports that the "50 Fathom" name was chosen because the regulator underwent successful chamber tests to a depth of 300 feet (1 fathom=6 feet). The catalog nomenclature was VCR-2. The VCR representing, *V*oit *C*ompensated *R*egulator. The -2 being a bit confusing, as the VCR-1 40 Fathom Viking single hose regulator (mechanically the same as the U.S. Divers Professional Aqua-Matic) was brought to market after the 50 Fathom.

The 50 Fathom had a number of interesting features in addition to that of the downstream mechanism. It contained a venturi system based upon that which appeared on the DW Stream Air and Mistral DW. Rather than using a removable orifice, the valve body contained two holes directly 180 degrees apart. The smaller of the two openings pointed toward the inhalation horn, while the significantly larger orifice pointed toward the can's wall. The theory was that due to the smaller size of the "horn" orifice, the gas velocity would be significantly higher than that of the opposite opening. This would, in theory, contribute to a marked improvement in venturi action. The larger opening's escaping gas would then be used to dampen the movement of the diaphragm, much as the secondary outlets do on the Mistral DW model. Many owners, including the author, perceive the regulator to offer increased performance with the body rotated 180 degrees with the larger orifice aligned with the inhalation horn.



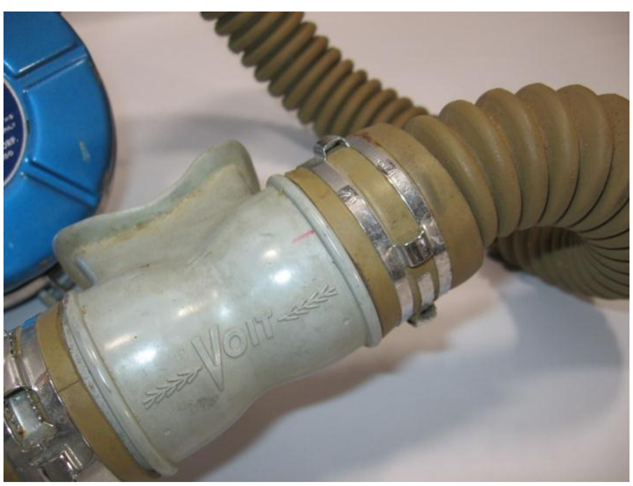


No scientific tests have been conducted to verify the validity of this modification. The body indexing pin obviously cannot be used in this configuration. Some owners drill an additional indexing hole, but the writer utilizes another method. Using snap ring pliers, the circlip (snap ring) is rotated so that its opening is oriented in the center of the horn. That way, the user can visually identify whether or not the valve body has rotated from its position. Unless the diver rotates the cans while on the cylinder valve, the tension of the yoke retainer nut should suffice to maintain the set position.

The regulator's brass top and bottom cans were painted with metal flake blue enamel paint rather than the customary plating process during the 1959 and 1960 production years. Some writers of the era reported that the cans were finished in an anodized fashion, but the researcher has never been able to substantiate such an example. Perhaps in its haste to bring the regulator to market, Voit's publicity department may have anticipated an anodized finish rather than the painted product. To prevent scratching the paint, Voit wisely installed a band clamp to secure the two cans together. Interestingly, the identification label was stamped from aluminum rather than the brass versions seen on the U.S. Divers regulators. The label also did not contain a serial number. In fact, the regulators were not serial numbered throughout the production period. The grey neoprene hoses had a type of vanilla flavoring added to the compound. This was intended to mask the odor and taste that many divers found offensive. Chromed Tinnerman hose clamps were employed on the painted examples as well. The plated Tinnermans did not appear to be very corrosion resistant, as regulators subjected to salt water soon displayed visible damage.

(Photograph From a Past eBay Auction Listing)

The hourglass shaped mouthpiece was stamped with the Voit logo. Earliest examples did not contain the “MADE NI USA” second line. The “NI” being such an attention getter, that the aftermarket supplier of reproduction mouthpieces, *thescubamuseum.com*, wisely chose to recreate the misspelling as well. Regulators produced during the 1961 time frame were finished in the 3 step chromed finish. The corrosion prone Tinnerman clamps were also replaced with Voit embossed nylon hose clamps.



(Photographs From Past eBay Auction Listings)

In 1961 Voit also introduced a variation known as the VCR-5 Blue 50 Fathom. This was identical mechanically to that of the plated model, but the cans were manufactured from ABS plastic. From having spoken to owners of these early VCR-5 regs, it would appear that most (if not all) of them had a label depicting a swimming diver. This particular model was not catalogued, but a full page advertisement was found in Skin Diver Magazine during 1961.

(Photographs From a Past eBay Auction Listing)

Internally, the valve body was created from satin finished brass. Many of the remaining parts were composed of stainless steel stampings. The stampings themselves appear to be well finished, and are quite robust. The diaphragm lever's height is adjusted by loosening the four lever plate screws, and then moving the lever plate in a horizontal fashion. As far as lever height adjustment goes, the writer has found that it is best to have the downward tip of the diaphragm lever on the same plane as that of the top of the can. That places the top of the lever above the plane. If you hold the assembled top can at eye level, you should be able to see the downward tip of the lever in its relative position. Another method is use a metal straight edge to determine the position. The adjustment process is done while the regulator is not pressurized.

When the regulator is properly adjusted, it should demonstrate a cracking effort between 0.8-1.2" while pressurized on a cylinder filled to 2,200-2,300psi. Setting the lever height in the suggested manner, and the installation of a silicone diaphragm, will almost always result in a regulator cracking effort that falls within that range. Due to the fact that the cylinder pressure is acting on the seat in a downstream fashion, the regulator will breathe easier at higher cylinder pressures. As the pressure diminishes, the cracking effort will correspondingly increase. Generally, a regulator that displays a cracking effort of 1.0" with a cylinder pressure of 2,200psi will gradually increase to around 1.75" at 750-1,000psi. It is common to encounter a reading of 2.0-2.2" at 500psi. Conversely, if you adjust the regulator properly, it will likely display an audible leak if used with a cylinder filled to more than 2,300psi.

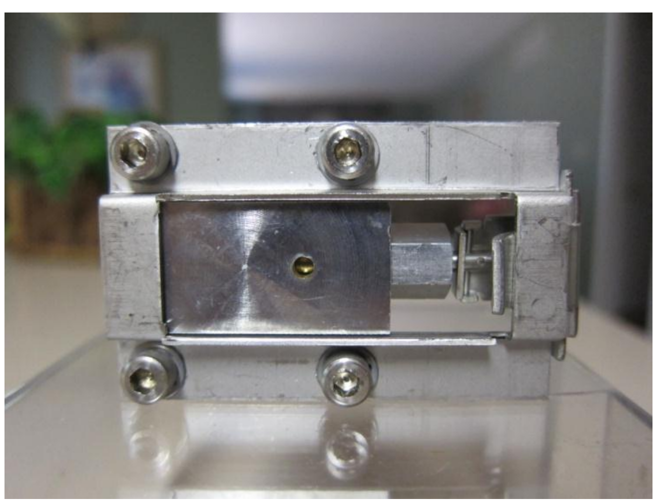
The initial production models could have their seat disc and retainer (HP poppet assembly) spring tension adjusted by screwing the accompanying guide inward or outward. The general method used for adjustment was to place the regulator's valve assembly on a 2,200psi cylinder and rotate the threaded guide to adjust the spring tension to a point where no audible leaks were heard. Then, the guide would be turned clockwise a slight bit more. A common practice was to adjust the guide from that of a 12:00 position to that of 2:00. This would also accommodate for the permanent groove that would be established in the translucent nylon face of the seat disc. This is the same general procedure that is used by many of today's regulator technicians when adjusting a modern single hose unit that does not contain a user adjustable cracking effort.

The initial production runs of the 50 Fathom could develop agonizing leaks after a significant amount of use. This was primarily caused by the seat disc and retainer being able to move slightly in reference to the established seating groove that was created between the integral hard seat (volcano orifice) and the soft seat (nylon seat). Engineers assigned the task of correcting the issue created a system that allowed existing units, along with new, to be fitted with additional parts. A removable stainless steel hard seat, two phenolic washers, and a ventilated sleeve were used. The two phenolic washers were used to create a leak proof seal between the hard seat and body. The sleeve was used to mechanically stabilize the distal end of the seat disc and retainer, and to serve as an anchor point for the guide. While the guide was formerly used to adjust the spring compression, it was now used to provide the necessary force on the sleeve, hard seat, and phenolic washers to establish a leak proof seal. Rather than the use of two phenolic washers, it is now recommended to use a nylon washer that serves as the seal. The nylon washer has the thickness of the two combined phenolic washers, and provides a more reliable seal. The original spring was maintained. Regulators fitted with the upgraded parts will generally display a cracking effort between 1.00-1.2" using 2,200-2,300 cylinder pressure. The diaphragm lever's height should be adjusted in the same manner as above.

Refacing the nylon soft seat on the seat disc and retainer unit is necessary to maintain a leak-free seal. A suggested method is to use a drill press to carefully polish the nylon surface. A slow speed must be maintained, and progress checked after but a few rotations. 600-800 wet/dry sandpaper is suggested as a polishing medium. Only polish the seat until the seating groove has been removed. Using the above procedure will maintain the original angle of the critical sealing edge.

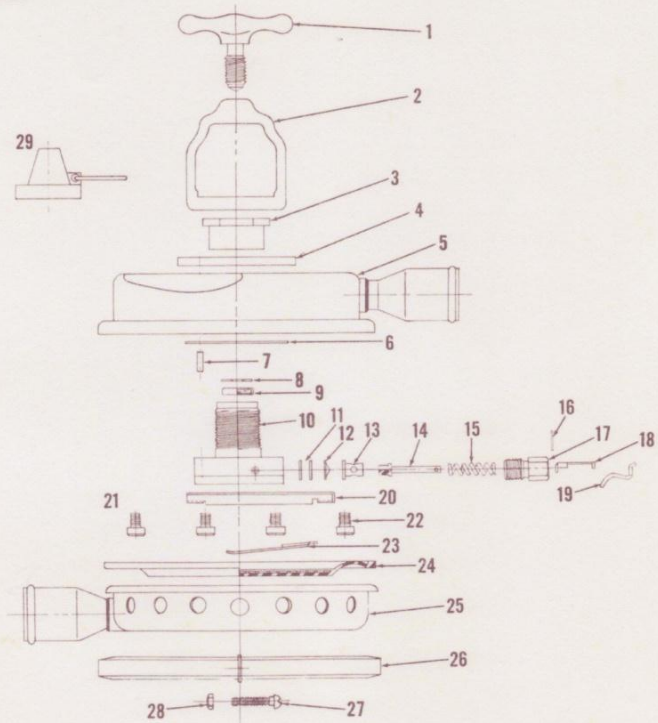
While assembling the mechanism, the author will generally put a small amount of lubricant on the seat disc and retainer's shaft where it moves through the guide. The amount of torque that should be applied to the guide (those containing the upgraded parts) is relatively low. Generally, a slight turn past finger tight is all that is required to produce a leak-proof seal. A torque rating of 25-35 inch pounds should suffice. It is also recommended to use new star (lock) washers under the four screws on the lever plate. A small amount of lubricant on the screw's threads is also warranted.

Tuning of the downstream valve can prove to be frustrating. Sometimes, even after careful assembly, you will encounter a persistent, agonizing leak. Prior to assembling the valve system in the top can, hand cycle the mechanism at least 300-500 times with your thumb. This takes a lot less time than what one would anticipate. The process creates a seating grooving in the soft seat that matches the unique sealing edge of the volcano orifice. If the regulator continues to leak, you will need to disassemble the unit. Following disassembly, replace the spring with one from *vintagedoublehose.com*, and reface the soft seat. The reasoning for doing so is that it would be very difficult to get the hard and soft seats in their exact prior orientation. Patience is the key to success in the tuning of the downstream system. On a positive note, once adjusted, the regulator will generally need little maintenance. This is particularly true with those fitted with the parts upgrade. The regulator does not contain a single O-ring, and as mentioned earlier, it is a robust design.



VOIT

VCR-2 REGULATOR



ITEM	STOCK NO.	DESCRIPTION	ITEM	STOCK NO.	DESCRIPTION
1	DS400	Yoke Screw	16	DS435	Pin
2	DS450	Yoke	17	DS436	Guide
3	DS430	Yoke Retainer Nut	18	DS437	Toggle
4	DS454	Body Washer	19	DS438	Lever
5	DS431	Box, Top	20	DS439	Lever Plate
6	DS457	Gasket	21	DS428	Lock Washers
7	DS455	Dowel Pin	22	DS440	Screw
8	DS402-6	Circlip	23	DS441	Diaphragm Lever
9	DS402-5	Sintered Screen	24	DS469	Diaphragm Assembly
10	DS432	Body	25	DS442	Box, Bottom
11	DS447	Gaskets (2)	26	DS443	Clamp Ring Assembly
12	DS448	Seat	27	DS444	Screw
13	DS449	Sleeve	28	DS445	Nut
14	DS433	Seat & Disc Assembly	29	DS446	Nylon Cap with Cord
15	DS434	Spring	Not Illus.	DS422	Exhaust Valve

The VCR-2 50 Fathom and the VCR-5 Blue 50 Fathom regulators had a relatively short production run as compared to many of their contemporaries. During the 3 year period, the VCR-2 sold quite well, as evidenced by the number of samples that appear on auction sites such as eBay. Many divers consider it to be one of the more visually appealing models, particularly so in its painted version. Worldwide sales paled to the U.S. Divers Mistral DW, but it secured its spot in diving history as being the industry's only single stage downstream double hose regulator.

Reference Cited

Nuytten, Phil, 2004, "Emile Gagnan and the Aqua-Lung, Part 1: 1948-1958"