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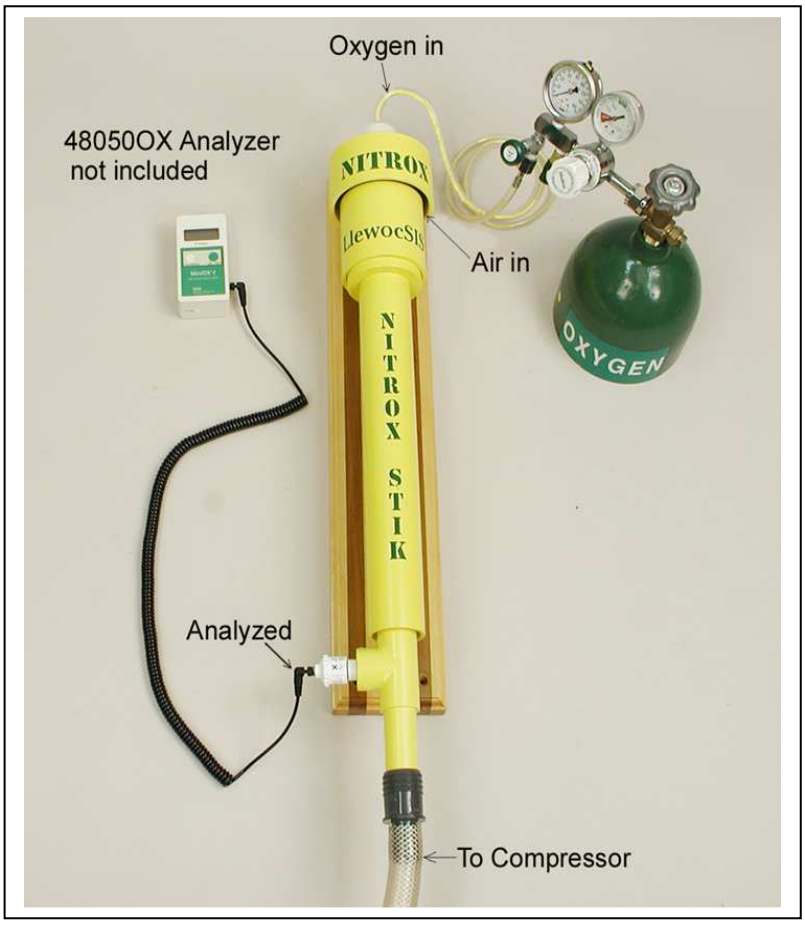
GMC #45450ox - 45451ox

# ALL ABOUT THE "STIK!"

With increasing interest in mixed gas diving, especially with Nitrox, fast and reliable production methods are of great interest. One popular technique utilizes the dive shop compressor in conjunction with a special gas mixing apparatus that can generate Nitrox as fast as the unit can pump. This patented device is commonly called the STIK and employs a gas blending principle that won a national engineering award in Canada some years ago. The inventor, maritime engineer Ross Cowell, called his innovation the LlewocSIS, which stands for "Cowell spelled backwards Scientific Injection System." His patented equipment is marketed worldwide by EnviroDive Services of Canada.

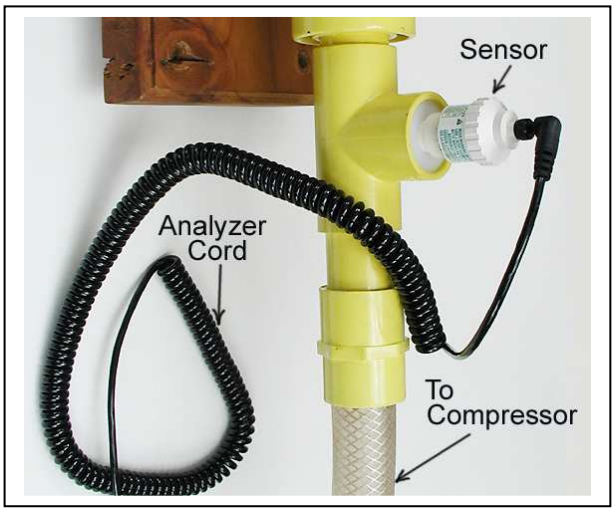
Two decades ago, most technical divers and oxygen experts were fearful of using a conventional oil-lubricated compressor in any gas blending operation. This fear was soundly based because early mixing apparatus did not always thoroughly blend the component gases and the compressor might suffer injections of dangerously high concentrations of oxygen. Early mixing devices originated by NOAA (National Oceanic and Atmospheric Administration) scientists utilized a series of "turbulence coils" to homogenize the gases. The suction pressure required to draw the gases through these mixing coils was so high that it caused overheating of the compressor's intake valves. If fewer coils were used to reduce stress on the compressor, the gases were NOT thoroughly blended, allowing high levels of oxygen to enter the machine.



While no one really knows exactly what level and under what exact conditions oxygen becomes problematic in a conventional compressor, it is estimated to be in the range of 50 – 55%. For that reason, the STIK and other Nitrox-producing paraphernalia have been limited to producing gas mixtures with a maximum oxygen level of 40% whenever an oil-lubricated machine is employed as the gas transfer pump. This limit has proved immanently safe and successful after years of field use.

The STIK has solved the mixing problems just discussed. Cowell's unique system produces highly homogenized blends almost instantly. The degree of "molecular blending" in a gas mixture is measured by its Reynolds Number, which expresses the dispersal of molecules within the mix. A thoroughly homogenized gas mixture should have a Reynolds Number of least 2,000. Blends delivered by the STIK have Reynolds Numbers of 5,000 or more and do so in a mere two milliseconds!

It is also important to remember that NO actual gas blending is taking place within the compressor itself, it is merely acting as a gas transfer device. Therefore, for reasons already discussed, it is essential that the mixing apparatus produce highly homogenized blends with very accurate oxygen levels before they enter the compressor.




The physical operation of the STIK is really quite simple. The unit is mounted in an upright (or horizontal) position adjacent to the compressor and the outlet port of the STIK is connected to the inlet port of the compressor by the means of a plastic hose. As the compressor operates, each intake-suction stroke of the machine draws air through the top dome of the STIK, through an internal filter, and into the mixing chamber. Oxygen, supplied from a rental tank, is reduced in pressure to about 100 psi and then passes through a metering valve, which trickles it at very low pressure into the top dome of the STIK. The incoming air and oxygen are drawn through the mixing chamber where the special blending vanes almost instantly homogenize the gas to the high degree previously described. The completed mixture is analyzed as it leaves the bottom of the STIK and is drawn into the compressor where it is pressurized and transferred to some appropriate storage vessel such as large DOT cylinders or directly into dive tanks.

As already discussed, the oxygen level in mixtures delivered to oil-lubricated "scuba air" compressors must be restricted to 40% maximum. How does the STIK do this? Quite simply! After installation, the STIK is calibrated by starting the compressor and allowing the compressed air to be vented to the atmosphere through an open filler hose. At this point, the oxygen system remains turned off, but the attached oxygen analyzer has been turned on and calibrated to atmospheric conditions (20.9% $0_2$). Next, the Oxygen Control Regulator is set to its maximum flow position by turning in the control knob to wide open (fully clockwise). An Intermediate Output Pressure of about 100 psi will be produced. Finally, the special Metering Valve is opened very slowly, allowing oxygen to first enter the STIK, noting the increasing $0_2$ level on the oxygen analyzer. The valve is progressively opened is until exactly 40% Nitrox is being produced.

At this point, the knob on the Metering Valve is removed and replaced with a special "Lock Sleeve," which prevents any tampering with the setting. Thus, with the Oxygen Control Regulator "wide open" and the Metering Valve locked, the maximum output of the STIK is fixed at 40% Nitrox. Mixtures with lesser amounts of $O_2$ can be obtained by simply "backing off" the control knob of the regulator. This special regulator also has an internal relief valve to vent off excess pressure should the unit's high pressure seat ever fail.

The STIK works satisfactorily with nearly all compressors with an output of 3 to 30 cubic feet per minute (CFM). There are two sizes: GMC #45450 is for compressors outputting 10 to 30 CFM. Model #45451 is for units of 10 CFM or less and is smaller in size. This "breakpoint" (10 CFM) is not magic and some slight overlap is permitted, and one should usually opt for the larger size if there is some question.
This choice allows for updating to a larger compressor at some future time if ever desired, whereas the smaller unit usually permits little upward movement in compressor size. Matching the STIK size (model) to compressor CFM rating is important to ensure proper gas homogenization.

There seems to be some misconceptions regarding compressor lubricants when using the STIK. Today, most dive shop compressors employ various high grade synthetic oils, time-proven to enhance mechanical operation and yield extremely high quality dive air. However, several new synthetic lubricants are claiming to be superior for Nitrox production, largely based on laboratory tests and chemical features. At this time, we simply do not have sufficient field data to substantiate these claims and probably won't for many years. Therefore, one should not feel compelled to switch oils as long as you are presently using a recognized synthetic lube.

Examining another factor, one must acknowledge that when pumping 40% Nitrox, the machine's lubricant is being subjected to twice as much oxygen as it would when compressing plain air. This likely has a heightened degrading effect on the oil itself, but to what degree is still poorly understood. The solution?? Simply change your oil more frequently! Most synthetics are commonly used for up to one year between changes. With Nitrox production, we suggest that oil changes be increased to 3-4 times per year, depending on actual usage.

Each STIK comes with a handsome wooden mounting plate that is easy to affix to any wall or bulkhead. The STIK should be mounted vertically or horizontally within approximately 10 feet of the compressor. As already explained, this is because that the compressor must exert a slightly increased suction pressure to draw the oxygen / air mixture through the STIK's blending chamber. This increased work load can be exacerbated by very long intake hoses, so a reasonably short tube is desirable. Significantly increased suction pressures can be detrimental to the compressor's intake valves and other parts, so one does not want to magnify this condition.

Owners sometime ask: "I still intend to pump regular Grade E scuba air. Can I simply leave the oxygen system turned off and just draw plain air through the STIK?" While that can be done, it is usually NOT recommended for several reasons: (1) Small as it is, you will be placing continuous extra stress as already described on the compressor's intake valves, and

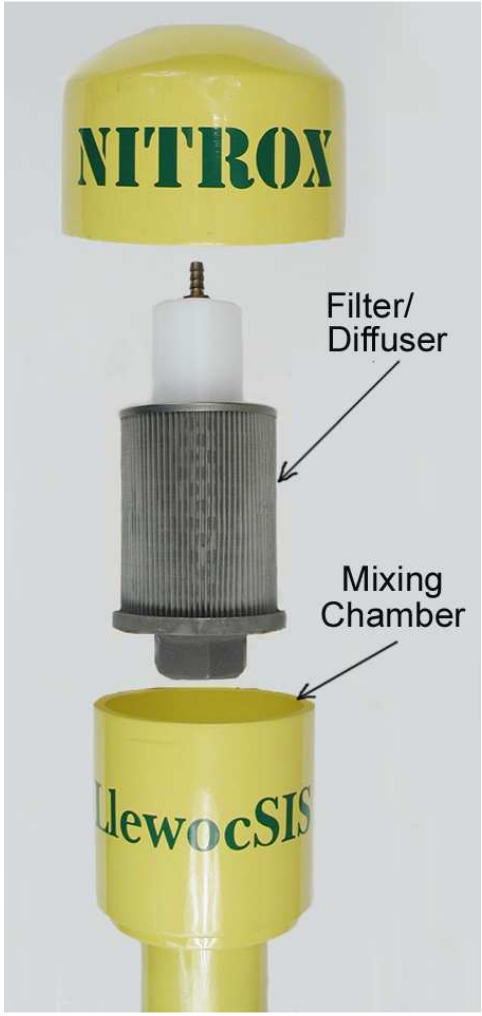
(2) you will be slowly contaminating the STIK's inlet air filter and mixing chamber by this additional air flow. Thus, internal cleaning of the STIK may have to be done more frequently.


This matter air intake connections is usually solved by either of two methods: (1) Where air intake hose attaches to the compressor, some exchange system is designed by the owner so that the regular air inlet hose and the "STIK hose" can be exchanged as needed. Simple draw clamps or large quick couplers work well. (2) A more elegant system features the use of a special plastic ball valve, sometimes known as a "side loading" ball valve. This device has two open positions, but NO "off" position, so that one can select plain air or Nitrox. It is mandatory that the valve has NO "off" position because should the compressor be started with a closed airway, swift and severe damage to the machine is very likely. Surprisingly, most of these ball valves have parts that are oxygen-compatible at these low inlet pressures.

Also, any valve used must never have an internal diameter smaller than that of the compressor's inlet because this would add an additional work load on the intake valves. Likewise, we do not want to use any hose or fitting smaller than the transfer hose size used on the STIK. Thus the minimal size is about 1.5 inches in diameter (ID). Properly installed, a side-load ball valve allows one to select air or Nitrox with the flip of a handle. Such valves are readily available from farm stores, pool supply companies, or Global Mfg. Corp. Incidentally, the STIK can also be plumbed with rigid PVC pipe, but a short piece of hose should be used to make the jump from the pipe to the compressor. This flexible connection is essential to create a "vibration dampener" between the compressor and the oxygen sensor, which can be damaged by continuous vibrations.

We should mention the matter of new compressor warranties. If your machine is new and still under warranty, you should check with your vendor to determine whether Nitrox processing will affect your specific coverage. Presently, many suppliers do NOT warrant their compressors for use with gases other than air. This is strictly a business decision and is not based on any meaningful statistics or field data. How do we know this? Most compressor companies buy a basic compressor block from some major manufacturer like Bauer or Coltry to which they add their own motor and filter system. Currently some companies that DO warrant their machines for Nitrox production use the very same machine as a company that does NOT. From this, we would deduce that warranty coverage is largely "company policy," and has little to do with the suitability of the machine itself or any potential dangers associated with mixed gases. Since compressor warranties are very time-limited, this problem usually only affects brand new purchases. As the popularity of Nitrox increases throughout the diving / firefighting / public safety communities, this entire problem is slowly dissipating.

Lastly, how much maintenance is required for the STIK? The requirements are quite modest. While one should always maintain reasonable cleanliness around any oxygen system, the fact is that we are dealing with such low pressure oxygen in the STIK itself that cleanliness demands are relatively benign when compared to partial pressure mixing systems. The apparatus should be inspected regularly for general contamination, especially around the intake dome. The mixer does contain a metallic internal air filter element (actually a filter-diffuser) that can be unscrewed and extracted after removing the STIK's top dome (see photo). This canister should be washed in soapy water as needed, rinsed thoroughly, and then air-dried or blown dry with clean air. If required, the entire kinetic mixing tube of the STIK can be washed with soapy water, rinsed, and dried as just described. As you can see, this routine service is relatively modest, straight forward, and largely cost-free.




So exactly what do you get when you purchase a STIK and what else must you provide to complete and install the system? Your purchase includes the STIK unit mounted on an attractive back-board which can be easily attached to any wall or bulkhead. Included is the Oxygen Control Regulator with its special Metering Valve and a length of plastic tube to connect it with input fitting atop the STIK. Of course, a good instructional manual is included.

You must provide an oxygen analyzer suitable for use with the STIK, which means one that has its sensor on the end of an extendable cord. The sensor plugs into a port in the base of the STIK where it measures the oxygen percentage of Nitrox being drawn to the compressor. Two brands of analyzers that have had a long, successful use with the STIK are the MINI-OX by Mine Safety Appliances and the MAXTEC by Maxtec Inc. These companies market simple, LCD direct reading models as well as deluxe units with alarm systems (both visual & audio) that activate if the oxygen percentage should drift from preset levels.

You must also provide the tube and hardware to connect the STIK to your compressor. A clear, heavy-duty plastic tube suitable for light vacuum duty is recommended, with a diameter (ID) no smaller than 1.5 inches. The type with a thick wall and an imbedded, reinforcing fiber braid works very well and is readily available from farm or pool suppliers and irrigation and water control companies. Beyond these items, you must supply whatever hardware might be required to connect the tube to your compressor and air inlet system.

The standard STIK unit is strictly a manually operated and supervised unit, that is, it must be monitored by qualified technicians familiar with its proper function. If the oxygen controls should drift, as indicated by the oxygen analyzer reading, the supervisor must reset that control or shut the system down…there is NO automatic shut-down control built into the

standard unit. However, in actual field use with hundreds of standard units, this oxygen control system has proved remarkably stable and significant problems have been almost negligible. The few accidents that have occurred have all been gross operator error…such as going home overnight, forgetting the system is still operating! In actual use, this required supervision is not significantly greater than that demanded when decompressing air.

In recent years, the Rubber Duckie Company (Hawaii) has produced some automation controls for the STIK that range from a simple oxygen shutoff system to complete production automation control of both the oxygen input and compressor operation. These devices work well, but can add significant additional cost to the system depending upon the complexity of the particular device. Full automation sometimes more than doubles the cost. All devices can be retrofitted at a later date if and when demand for Nitrox or simple prudence suggests their addition