Nitrox Stik

Set Up and Use Instructions

www.EnviroDive.com

The Nitrox People

www.EnviroDive.com

The Nitrox People

Hello,

Thank you for your business.

As our customer, we feel that it is important that you be treated with prompt, quality service.

We also believe that our relationship with you does not end with this sale. Please consider us to be your personal resource in the Nitrox and gas-blending field.

If you have any questions, or require product support, please don't hesitate to call us at 250-254-5076 or info@envirodive.com

Bart Bjorkman
EnviroDive Services
The Nitrox People

WARNING

Although oxygen itself will not burn, it will enhance combustion. By its very nature, increasing the oxygen content will increase the intensity of a fire. It is understood that the factors contributing to combustion in a pressurized system include oxygen, heat, pressure, gas flow, system design and the presence of hydrocarbons. All of these factors are present to some degree in a high-pressure compressor. However, In concentrations below 40% oxygen, the North American diving industry has deemed that nitrox can be treated the same as air with no special oxygen service requirements. The diving industry also recognizes that preparing and handling pressurized oxygen and oxygen/air mixtures is a skilled operation*, not to be undertaken without proper training*.

As EnviroDive Technologies Ltd., has no control over the training or the actual blending of nitrox or compressor maintenance and operation, we will not be responsible for any injury, death or damage as a result of blending nitrox or the use of high-pressure compressors, pressure systems, or oxygen.

Set-up Instructions

NOTE: Please read ALL instructions PRIOR to starting the set-up of the unit

WARNING:

ONLY individuals certified as Nitrox Gas Blenders are qualified to operate this unit.

- Unpack the Nitrox Stik and components. Unwrap the protective plastic from the components. Depending on the size of the Nitrox Stik it may come in two sections. If in two sections, **gently** screw on the top (filter) to the Nitrox Stik body being careful not to cross thread the metal filter on the PVC (plastic) body threads. **DO NOT OVERTIGHTEN** - Finger tight is fine.
- In the small plastic ziplock bag there is a chrome ¼ inch threaded barb fitting. This barb threads into the very top of the Nitrox Stik. One end of the ¼ inch clear tubing can be gently pressed onto the barb.
- The Nitrox Stik should be mounted in a rigid manner, in either a horizontal or vertical orientation***, as near to the compressor as is reasonably possible so as not to restrict the compressor intake air flow.*** The "Stik" itself has been sized/engineered to provide maximum mixing characteristics, with minimum/negligible gas flow restriction, but extensive distances can restrict the compressor's intake, possibly causing compressor damage.
- The location of the "Stik" must also provide a good supply of fresh inlet air to the compressor.
- The Nitrox Stik actually becomes the compressor air intake. Most diving operations simply attach the Nitrox Stik to the end of the existing air inlet using a piece of tubing (A piece of tubing has been supplied as a sample of the size required). Or the Nitrox Stik may be plumbed in using PVC piping, but a short section of tubing (or other flexible piping) is required because the tubing is also used to isolate the oxygen sensor from the compressor's vibration. This isolation is essential for the continued longevity of the sensor.
- Once the Nitrox Stik body has been mounted in a suitable location, gently press fit the yellow PVC "Tee" to onto the outlet tube extending bellow the Nitrox Stik. Do not press this part onto the Stik with too much force, as it will have to come off during periodic inspections and cleaning. * **Never glue this part on.*** Please note that the "Tee", which has the oxygen sensor port in it, can be mounted anywhere between the Nitrox Stik and the compressor.

Important: Press fit plastic parts – DO NOT GLUE – DO NOT FORCE

- **Ensure that there are no leaks** anywhere between the blending unit and the compressor first stage. Any leaks in this section will cause a lower O2% reading when the Nitrox is tested after blending.

Important: Re-familiarize yourself with the "handling oxygen" rules from your gas blender training. Remember to keep away all hydrocarbons such as grease and oil as well as to open all valves slowly.

www.EnviroDive.com
The Nitrox People

- Place the oxygen supply cylinder in a nearby convenient location where it can be **secured** in a vertical orientation. Before attaching the regulator to the O2 cylinder, briefly "crack" the valve of the O2 source to blow out any impurities that may be lodged in the orifice of the tank valve.

Important: When opening the oxygen valve - Make sure that the valve opening is facing away from yourself and others.

- Attach the oxygen regulator to the oxygen cylinder. When doing so use the proper size wrench so as not to round the corners on the nut. It is important to tighten this nut so that no O2 escapes, but **do not over tighten.**
- Ensure the oxygen **regulator** pressure adjustment knob is turned off (counter clockwise), so there is no pressure on the diaphragm (a no-flow condition).
- Ensure the micro metering valve is fully closed, then ***slowly*** and completely open the O2 **tank** valve and then the O2 **regulator** valve. (Note that the O2 regulator valve opens opposite that of a normal valve).
- **Ensure that there are no oxygen leaks:** If any leaks are detected, turn off the O2 tank valve, and open the micro metering valve to drain the system of O2. The most common place to find a leak is where the regulator attaches to the O2 cylinder. To remedy a leak at the attachment, release all pressure and snug up the nut, then slowly pressurize and re-test for leaks. If you find leaks anywhere within the actual "regulator" portion of the regulator assembly, send the regulator assembly back to EnviroDive for warranty repair or replacement.
- When you are not using the system, turn off the oxygen at the cylinder valve and back the regulator valve off until there is no pressure on the diaphragm.
- Using a suitable length of the supplied low pressure 1/4 inch oxygen tube, connect the oxygen regulator output to the inlet fitting on the top end of the Stik blender unit.
- With everything connected, your Nitrox Stik system should look like the picture at the beginning of these instructions. If you have any questions, prior to, during or after the installation of your Nitrox Stik, please call EnviroDive at 250-254-5076

The "NITROX STIK"
Continuous Gas Blending System

Note: The *Nitrox Stik* Continuous Gas Blending System is intended for use on high pressure diving compressors suitable for compressing grade "E" breathing air. These compressors may be of the oil-free type, or of conventional lubrication design, (synthetic oil is recommended). There is no requirement for hyper filtration or oxygen service. Although the *Nitrox Stik* is capable of homogenous blending far in excess of 40% O2, this practice is not recommended nor endorsed. Nor is the use of this continuous blending system with pressures above 3300 psi. As a designed process component, the *Nitrox Stik* is sized for the intended compressor system. Variations in the process (i.e. varying the compressor speed) will have an effect on the operation and should be avoided.

HP OXYGEN SOURCE
These are typically K or T cylinders, with a working pressure of up to 2400 psi. Medical, breathing or aviation grade oxygen required. (User supplied)

HP REGULATOR
This is a conventional high-pressure oxygen regulator with a maximum outlet pressure of 120 psi. It is attached to the cylinder valve by a CGA 540 fitting.

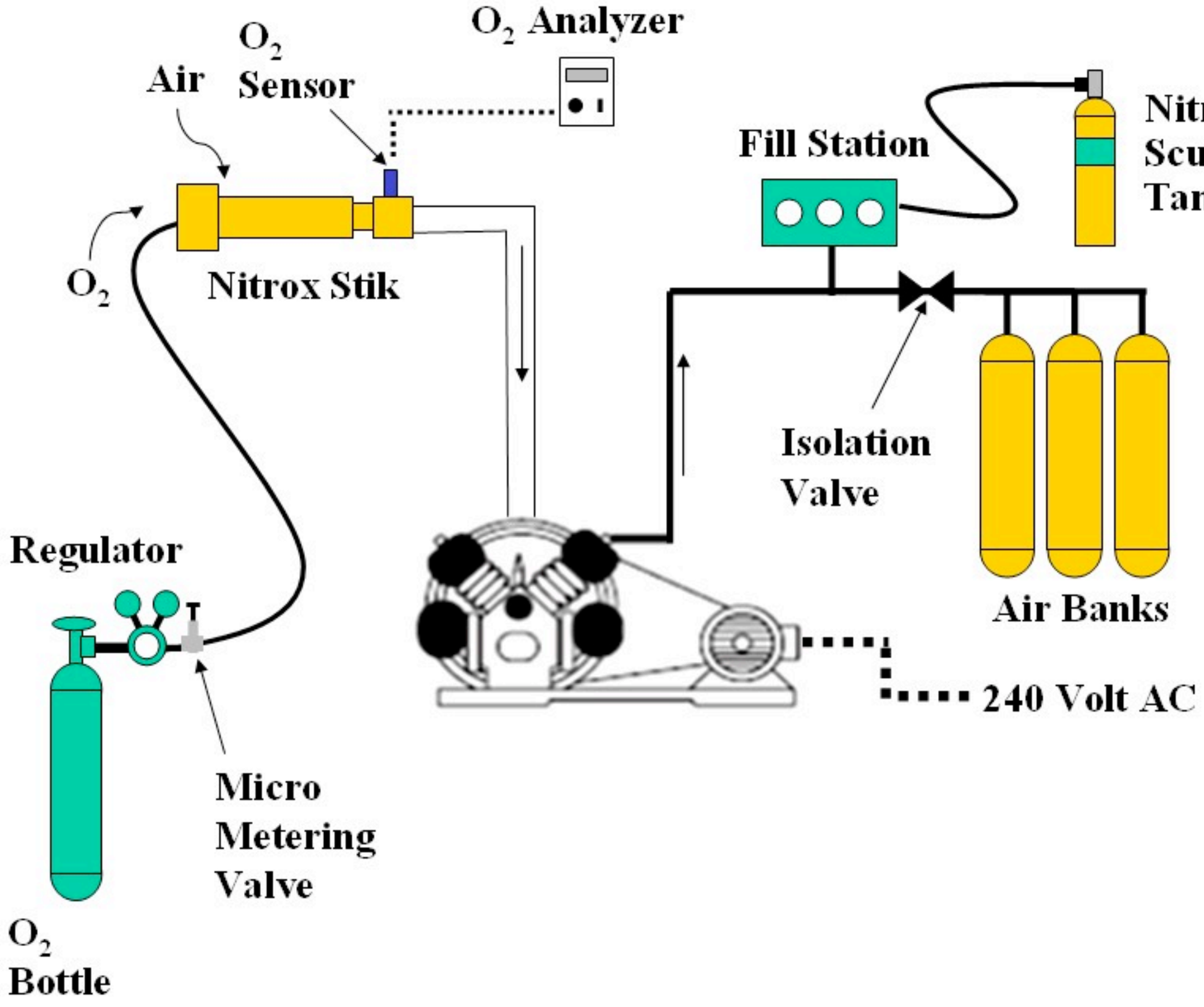
LOCKOUT SYSTEM
This is a locking metering valve. The intent here is to allow the use of the regulator's pressure adjustment control to determine the O2 percentage of the system, while limiting the maximum oxygen concentration to 40% (or less) with the compressor at load. (see micro-metering valve setup for limiting oxygen)

OXYGEN CONNECTION TUBING
This is conventional low- pressure (150 psi WP) one quarter inch food grade clear tubing.

NITROX STIK BLENDING UNIT
This comprises the concentric filter/pre-blender diffuser, the patented mixing stage, and the oxygen analyzer sensor receptacle. Th e Nitrox Stik is to be mounted securely near the compressor, coupled to the compressor intake with a short length of flexible hose-which acts as a vibration isolator which protects the O2 sensor. The filter/air inlet surface must have a good clearance all around (1 foot minimum). This must be in a well-ventilated area, both for supply of fresh inlet air, and to allow adequate dispersal of oxygen should the compressor be stopped or shut down before the oxygen flow to the blender is stopped. The Nitrox Stik can be mounted in any direction- even upside down or overhead on the ceiling.

OXYGEN ANALYZER
A remote sensor oxygen analyzer is required. We recommend the Maxtec SCUBA AE (our price is $335 – shop and compare) although any quality analyzer with a remote sensor will work. (user supplied).

FLOW RESTRICTOR
Although not required while measuring the oxygen concentrations in the Nitrox Stik a flow restrictor is used when measuring the Oxygen content of the SCUBA cylinders to insure an accurate measurement. The flow restrictor accurately limits the gas flow to two liters per minute, which protects the analyzer sensor from damage (from over pressurization) as well as insures that everyone is taking the same measurement. The flow restrictor attaches between the low-pressure inflator hose on a scuba regulator and the sensor of the oxygen analyzer. With the flow to the sensor controlled, all readings from the analyzer will be consistent. (User supplied)


O2 Analyzer
O2
Sensor
Air
O2
Nitrox Stik
Fill Station
Nitrox
Scuba
Tank
Isolation
Valve
Air Banks
240 Volt AC
Regulator
Micro
Metering
Valve
O2
Bottle


Oxygen Inlet
NITROX
Air Intake
NITROX STIK
Oxygen Analyzer
Oxygen Regulator Valve
Oxygen Sensor Port
Micro Metering Valve
Oxygen Cylinder
Out to Compressor

Limiting Oxygen Content to 40% (or less)

When the Nitrox Stik system is installed, and the connections are tight, the next step is to limit the oxygen concentration through the unit to 40% oxygen or less. This is done as follows:

- Identify the three valves: 1- Oxygen cylinder valve, 2- Oxygen regulator valve, 3- Micro-metering valve. (See labeled picture)
- Ensure that the micro-metering valve is **FULLY CLOSED** (finger tight).
- Start the compressor and allow it to pump up to a head of 2500 to 3000 psi - keep this pressure constant by slightly bleeding air at a filler whip.
- Insert the oxygen sensor into the provided receptacle on the Nitrox Stik body.
- Turn on the analyzer and calibrate it. Set it to read 20.9% with the compressor running.
- **Slowly**, and completely, open the oxygen **cylinder** valve.
- **Slowly**, and completely, turn on (clockwise) the oxygen **regulator's** adjustment knob.

Status: the Micro Metering valve is fully closed, the O2 cylinder valve is fully open, and the oxygen regulator is fully open. There is no flow going to the Nitrox Stik because the micro metering valve is closed, (finger tight)

Important: With the micro-metering valve <u>fully closed,</u> if the oxygen analyzer reading indicates <u>an increase in oxygen,</u> immediately shut down the oxygen at the oxygen cylinder.

- Watching the oxygen analyzer (at this point it should still be reading 20.9%), **<u>SLOWLY!</u>** Open the **micro metering** valve and continue to increase the flow until a steady 40% O2 reading is indicated on the analyzer. (Allow for the time lag for the oxygen analyzer to adjust its reading) **DO NOT EXCEED 40%**.

- Confirm the units operation by adjusting the *oxygen **regulator*** to give varying percentages of oxygen. (When the oxygen regulator adjustment knob is adjusted counter clockwise (closed) it will be noted that the oxygen concentration will rapidly decrease.)

<u>WARNING:</u> The oxygen analyzer must be in place, in use, and monitored continuously when pumping nitrox through the Nitrox Stik.

www.EnviroDive.com
The Nitrox People

NOTE: This maximum O2 output level must be checked each time a new O2 cylinder is installed. O2 output through this unit is NOT to exceed 40% when the oxygen regulator is opened fully and the O2 cylinder valve is opened completely.

- The unit may now be used to develop EANx mixtures up to 40%.

It is important not to exceed the 40%, as higher concentrations of oxygen, under pressure, may be hazardous to equipment and personnel.

If there are any questions or confusion regarding these instructions, please call us immediately, **prior to installing the unit** and we will clarify.

Installation is also available.

www.EnviroDive.com
The Nitrox People

How To Blend Up To 40% Nitrox With The *Nitrox Stik*

(Please install as per "Set-up Instructions")

1. Ensure the O2 regulator valve is fully closed.

2. Start the compressor and crack open a fill whip (slightly).

3. Turn on the O2 analyzer and calibrate it to 20.9.

4. **SLOWLY** open the O2 cylinder valve.

5. Slowly open the O2 regulator valve while watching the O2 analyzer for the desired O2 percentage. (NOTE: allow time for the O2 analyzer to register the initial O2 concentration.).

6. Fine-tune the O2 percentage by minutely adjusting the O2 regulator valve to get the desired O2 content as indicated on the oxygen analyzer.

7. Allow for lag time. (Lag time is the amount of time required to purge the system (i.e.: towers, filters, tubing, etc.,) of the previous concentration of gas. This amount of time should be ascertained when initially setting up the continuous blending system by analyzing the outlet gas until it is the same as the inlet gas, and recording the time it takes for both readings to be the same.)

8. Attach fill whip to scuba cylinder, or bank cylinder.

9. Fill to desired pressure.

10. Turn off the oxygen cylinder valve and back off the oxygen regulator valve (counter clockwise).

11. Turn off the compressor.

12. Analyze the contents of the cylinder.

13. Record the results in the Blending LogBook.

General Care and Maintenance of the *Nitrox Stik*

The Nitrox Stik must be inspected on a regular basis. The inspection is looking at the general level of cleanliness, specifically in and around the concentric diffuser. (The thing that looks like a filter).

If you notice dust on the filter (concentric diffuser) gently spin off the top of the Nitrox Stik. Be very careful when taking off or re-installing the filter as the plastic threads on the Stik body are easily damaged by the metal threads of the filter. If you need to remove the PVC cover from the filter before washing you may have to put the filter/PVC cover assembly in a freezer for 20 minutes to shrink the nylon post that the top slides on.

The white nylon centerpiece, which has the O2 inlet port in the end, is simply press fitted into the diffuser. Gently twist it out if required.

After removal, rinse the diffuser in hot soapy water, rinse well and ***thoroughly*** blow-dry with compressed air. If you find the diffuser is rusty or damaged in any way, call EnviroDive for an inexpensive replacement.

If required, the kinetic mixer portion of the Nitrox stik (the main body tube) can also be washed with hot soapy water, rinsed well, and gently blown dry with compressed air. Just remember to remove the O2 sensor and the outlet hose, and to dry the unit ***thoroughly***.

Once reassembled, check to ensure that there are no leaks between the Nitrox Stik and the compressor first stage inlet. This can be tested by pumping a predetermined mix into a scuba cylinder then testing the mix to see that it has the same percentage of O2 that you pumped in. For example, if your analyzer reading is 32% at the Nitrox Stik but when you analyze the contents of the tank you find a 28% mix, then you have air getting in somewhere between where the hose hooks up to the Nitrox Stik and the actual inlet orifice machined in the compressor block.) Often we find that air is getting in around the inlet particulate filter housing on the compressor. This is usually easy to find and remedy.

When you are not using the system, the oxygen should be turned off ***at the cylinder*** and the oxygen regulator adjustment valve should be backed off (counter clockwise) until there is no pressure on the diaphragm.

History of the "Nitrox Stik"

Continuous Gas Blender

Dr. Morgan Wells, the former Director of the National Oceanographic and Atmospheric Administration (NOAA), developed a process for mixing oxygen enriched air which he called a continuous blending system. His patented invention originated as a coil of pool hose attached to the intake of an oil free compressor. Into the opening of this hose he injected pure oxygen. The idea was that the oxygen and air, being drawn into the compressor, would mix in the coils before being compressed. The mixture was then measured on the downstream side of the compressor for oxygen content. With a little trial and error he was able to gauge the oxygen input to get the desired fraction of oxygen in the final mix.

Wells recognized that the compressor had to be oil free because the oxygen/air mixture was not always homogenous. It was possible that streams of pure/unmixed oxygen could enter the compressor, and when combined with the elevated temperature and the pressure in the final stages of compression, the condensed hydrocarbons in an oil-lubricated compressor could potentially be a combustion risk.

If more coils were added to increase the turbulence, resulting in a more complete mix, the additional restriction (Delta P) to the compressor intake could cause damage to the compressor. This limited Well's system to an oil free compressor. But even with these limitations Dr. Wells' invention was the only practical alternative to partial pressure blending for many years. That is, until the early to mid nineties.

Ross Cowell, a Canadian maritime engineer, technical diver, and a fan of Dr. Well's, came up with a simple but effective method of blending nitrox without restricting the flow to the intake of the compressor. Utilizing a mixer that blends gases at least ten times more thoroughly than the mixing coils on the NOAA continuous mixer, he was able to produce a completely homogenous mix of nitrox, in less than 2 milliseconds. He called his invention the "LlewocSIS". That's "Cowell" spelled backwards, with the acronym for "Scientific Injection System".

The market, however, had other ideas. As children often acquire nicknames more appropriate than their given names, so it happened with the LlewocSIS. Because of its appearance, people just simply called it the "Nitrox Stick". To add a little flair we called it the "Nitrox Stik". Again the market had different ideas and usually refers to it as the "Stik".

A "Stik" is sized according to the compressor it is to be used on/with, and the sizing takes into consideration two main design requirements: Reynolds numbers and Delta P's.

A Reynolds number is an engineering term that is used to describe how thoroughly mixed something is. A Reynolds number of 2000 or higher denotes something that is thoroughly (or homogeneously) mixed.

The "Stik" has Reynolds numbers ranging from 5,000 to 60,000, depending on the size of "Stik", and the flow of air being drawn through it.

The Delta P for the "Stik" ranges from .00 to .33 of one PSI, and refers to the additional resistance that the "Stik" adds to the intake of the compressor. In other words, the workload of the compressor is not noticeably increased when a "Stik" is added.

After eighteen months of field testing, an independent engineering study was commissioned and patent applications followed. The unit now holds both US Patent and Canadian patents.

With the "Stik" being dependable, consistent, and accurate, diving operations find that they can get into producing Nitrox at a fraction of the cost of any other system.

At the November 2000 “Nitrox Symposium” held at Duke University and sponsored by Divers Alert Network (DAN), one of the most notable items, unanimously agreed upon, was that **up to 40% oxygen content can be used in diving equipment*, without modification*.****

As most shops follow this forty percent guideline, they restrict the maximum fraction of oxygen to 40%, and use oil-lubricated compressors.

For those facilities that choose to operate using the 21% guidelines, the use of an oxygen serviced, oil free compressor would be indicated. Interestingly, almost one hundred percent of the Nitrox Stik blenders are attached to oil lubricated compressors.

Mixing accurate Nitrox with the “Stik” is simply a matter of turning on the compressor, calibrating/setting the oxygen analyzer to 21% as it analyzes the intake air, and then adding oxygen until the desired mix is indicated on the analyzer. It is so simple to use that the phrase "Dial-a Mix" has been used to describe its operation. What goes into the compressor intake is what comes out. Simple.

The Gas Blending Technician is always aware of the O2 concentrations entering the compressor because the oxygen analyzer measures the oxygen content before the gas mix is introduced into a compressor’s intake.

The "Stik" itself is capable of mixing very high fractions of oxygen, therefore a locking micro metering valve is placed inline to limit the oxygen content to 40%.

A medical oxygen regulator, specifically designed and manufactured for oxygen use, is used to control the flow of oxygen through the unit. The oxygen regulator is the only part of the system that is exposed to high-pressure oxygen concentrations above 40%, and as such, is oxygen serviced.

The rest of the system uses much safer low pressure oxygen until it is mixed with air to become Nitrox, eliminating the need for oxygen servicing the rest of the system, and making this a very user friendly way of blending nitrox.

When Dr. Morgan Wells looked over the Nitrox Stik, which is the evolution of something he started many years ago, he said, "It makes an old diver happy to see a simple philosophy in use".

One of the biggest problems facing the diving industry today is the expense of setting up a safe, effective, and accurate Nitrox fill station in diving operations.

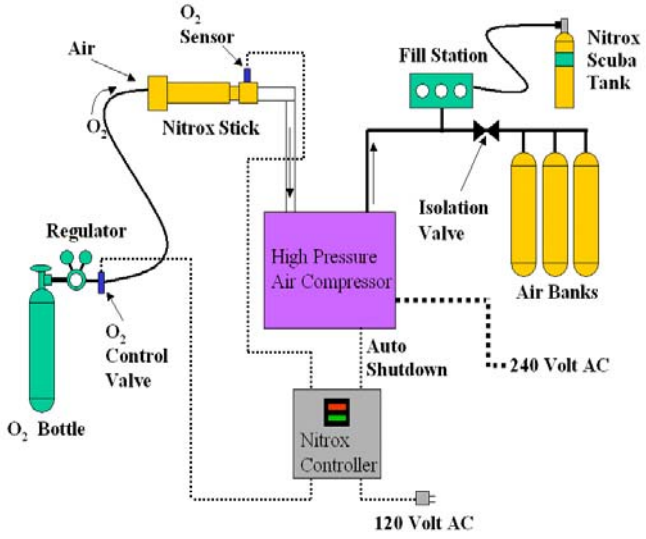
The Nitrox Stik solves these problems.

For more information, please contact EnviroDive Technologies Ltd, 250-254-5076, online at info@envirodive.com, or visit our website at www.envirodive.com

**Copies of the proceedings of the Nitrox Symposium are available from DAN*

NITROX CONTROLLER

The Nitrox Controller automatically manages the addition of oxygen to your Nitrox Stik, accurately maintaining the desired oxygen concentration while blending Enriched Air Nitrox (EANx) for SCUBA, resulting in more accurate Nitrox mixes with less effort, reducing the burden and tedium on the operator.



When placed into "Run" mode, Nitrox Controller quickly ramps up addition of oxygen, and maintains blend within .05% of selected setting.

Easy to Calibrate.

Auto shutdown feature closes oxygen control valve when compressor turns off.

Buzzer alerts operator if oxygen concentration is not within 2% of set point value.

Nitrox Controller automatically shuts oxygen control valve in event of a high oxygen condition (40%) or system malfunction.

Nitrox Controller wire lengths are long enough to allow mounting Controller visibly in the shop while Nitrox Stik, compressor and oxygen cylinders are in a separate location.

Visit www.RubberDuckieDesigns.com for one of your own!