

The Truth About

Enriched Air Nitrox

by Dick Rutkowski

The various myths and misconceptions of oxygen and nitrox use in scuba diving unfortunately originate from many sources. Due to the nature of the errors that are being made, it appears that some people have apparently read some materials about one type of oxygen use and have applied that information to other types of use.

Nitrox is used in many types of diving including commercial, saturation, rebreathers, recompression therapy, deep diving on air or trimix, in-water decompression, and of course, recreational diving. However, since the introduction of nitrox into the recreational diving arena, some people have assumed that what they read about one use of nitrox applied to other uses. In other words, they wanted

to play in the game, but didn't come with the right ball.

Recreational divers using nitrox within all operational and physical limits of basic scuba certification dive profiles can only have an enhanced

physiological advantage, i.e., helping to prevent decompression sickness. Maximum no-decompression dive times can be increased without approaching central nervous system or pulmonary oxygen toxicity limits. Recreational divers, however, should not, under any circumstances, get involved with the mixing or blending aspects of nitrox. Neither

should recreational divers use more than a 40% mixture of nitrox. If recreational divers observe the

operational and physical limitations of recreational diving on air, and never use a breathing mixture greater than 40% oxygen, the same diving equipment can be used as if the mixture is air, and is not required to be oxygen cleaned.

In January 1992, the Diving Equipment Manufacturers Association (DEMA) hastily issued a warning to all dive shops that nitrox mixtures greater than 23% could not be used with standard diving equipment because it could cause the rubber, teflon, brass or chrome valves, and inflator hose parts to deteriorate faster. This statement is erroneous. Enriched air mixtures up to 40% have been used successfully for over 50 years by many organizations including commercial industry, the military, and NOAA, and for recompression therapy using standard non-oxygen cleaned equipment. The precedence for this follows:

- Code of Federal Regulations, Part 1910.430(i) (Commercial Diving Operations)
- OSHA Oxygen Specifications 1910.420 (i)

These standards contain requirements for the safe use of oxygen which apply to all components connected into the oxygen system. Equipment used with pure oxygen or

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with mixtures containing over 40% oxygen by volume must be properly designed for oxygen use. All components (except umbilical) used with mixtures over 40% oxygen by volume must be cleaned of flammable materials before use. Finally, oxygen systems carrying over 125 psig, and compressed air systems carrying over 500 psig must have slow opening shut-off valves in order to prevent the rapid buildup of pressure and temperature in the system. All of these requirements are meant to reduce the hazards of ignition and combustion present within oxygen systems. These recommended practices for oxygen cleaning of scuba equipment is also supported by both NOAA and the U.S. Navy indicated by their respective specifications below:

- NOAA Oxygen Specifications—Appendix "D" NOAA Nitrox I Diving and Decompression Tables. High pressure storage cylinders, SCUBA tanks, regulators, and all high pressure transfer equipment used with pure oxygen or with nitrox mixtures containing more than 40%, must be cleaned and maintained for oxygen use.
- United States Navy Oxygen Specifications—U.S. MIL-STD-777E (SH) Note K-6-4, Cat. K.6. Mixed Gas, 4500 PSI Service, 150 F Max. For systems with oxygen content greater than 40% by volume, oxygen system components shall be cleaned in accordance with the requirements of MIL-STD-1330.

Some diving manufacturers have insisted that diving equipment using oxygen mixtures over 22 percent must be oxygen cleaned. If these manufacturers would have performed some research, they would have discovered that this requirement is needless. All medical and welding cylinders, valves, and regulators are made from the same

brass and chrome materials as scuba equipment. Luxfer, one of the main cylinder manufacturers, stated openly that they have no problem with nitrox mixtures in their tanks.

As for the recreational diving community, as long as they never use more than 40% oxygen, they can use their equipment safely.

Divers who are using more than 40% oxygen in their tanks or regulators must have all components of the oxygen system cleaned for pure oxygen service. The 40% oxygen clean regulation study was conducted by the American Society for Testing and Materials in the 1960's for NASA at the White Sands Proving Grounds.

Additionally, certain diving equipment manufactures are trying to convince the Compressed Gas Association (CGA) that it is necessary to have special scuba regulators and tank valves for nitrox mixtures over 23%. This is erroneous as pointed out earlier. U.S. Navy rules regarding 23-25% oxygen containing equipment for recompression chambers is in no way related to breathing gases in high pressure cylinders. Rules for compressed gas cylinders are not related to rules for recompression chambers. Assumptions of this nature are inherently flawed. An FO2 less than 25% is for living in chambers, mechanical ignition, greater than 40% is for chemical ignition.

Because of DEMA's erroneous warning, a two day nitrox workshop was conducted with major experts representing gas physiology, medical, engineering, equipment, compressor, oxygen and oxygen

lubricant field representatives. The workshop was called "Evaluating Enriched Air (Nitrox) Diving Technology" and was held January 13th-14th, 1992 at the Hyatt Regency, Houston, Texas. The Minutes of the workshop are available from SDRG, P.O. Box 3229, Boulder, CO 80307 for \$12.00.

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When partial pressure filling, however, using 100% oxygen and then topping off with air, all cylinders, valves, O-rings, transfer hoses, and gauges must be oxygen cleaned. The cylinder must be labeled as a nitrox cylinder and only be filled at a proper nitrox facility. In this case, as long as the mixture is below 40% oxygen the regulator (first stage, second stages, inflator hose, high pressure hose, and pressure gauge) are not required to be oxygen cleaned. ☺

Dick Rutkowski retired as the Deputy NOAA Diving Coordinator with 35 years of service and is the past director of the NOAA Hyperbaric Facility, founder of Hyperbaric's International, Inc., IANTD (1985), and cofounder of ANDI (1989).