



HYPERBARICS INTERNATIONAL, INC.
INTERNATIONAL ASSOCIATION OF NITROX
AND TECHNICAL DIVERS, INC.
INTERNATIONAL BOARD OF UNDERSEA MEDICINE, INC.
UNDERSEA BREATHING SYSTEMS, INC.
UNDERSEA RESEARCH FOUNDATION, INC.

490 Caribbean Dr. • Located at Ocean Divers • Key Largo, FL 33037
Tel: 305-451-2551 • Fax: 305-451-5765 • 1-800-451-1113

To Whom it may concern

May 27, 1996

Dear Sir/Ms.,

Please review the attachment carefully. Lets use the existing reg's and mil spec's that were previously approved by responsible government and civilian agencies; pertaining to the oxygen index window or chemical ignition between 23% and 40% O₂, before we hastily make unnecessary standards or regulations.

DEMA's comments on this subject are in conjunction with their wishes to sell more Nitrox equipment. O₂ cleaning for O₂ service is not necessary for under 40% O₂, as professionals have been doing for over fifty years. (See attachments)

Nitrox (23 - 40% oxygen) is not air and it certainly isn't oxygen. Where questions of oxygen compatibility exist, the "ASTM Oxygen Index" is a valuable concept. Barry Werley and the ASTM/CGA Committee G-4 are also valuable resources.

Suggested references:

- 1. The Flammability of Carbon Steel as Determined by Pressurized Oxygen Index Measurements; by M. A. Benning and B. L. Wereley
- 2. Inflammability and Sensitivity of Materials in Oxygen Enriched Atmospheres; second volume; ASTM, STD 910, 1985; this reference addresses the general concept of "Oxygen Index"

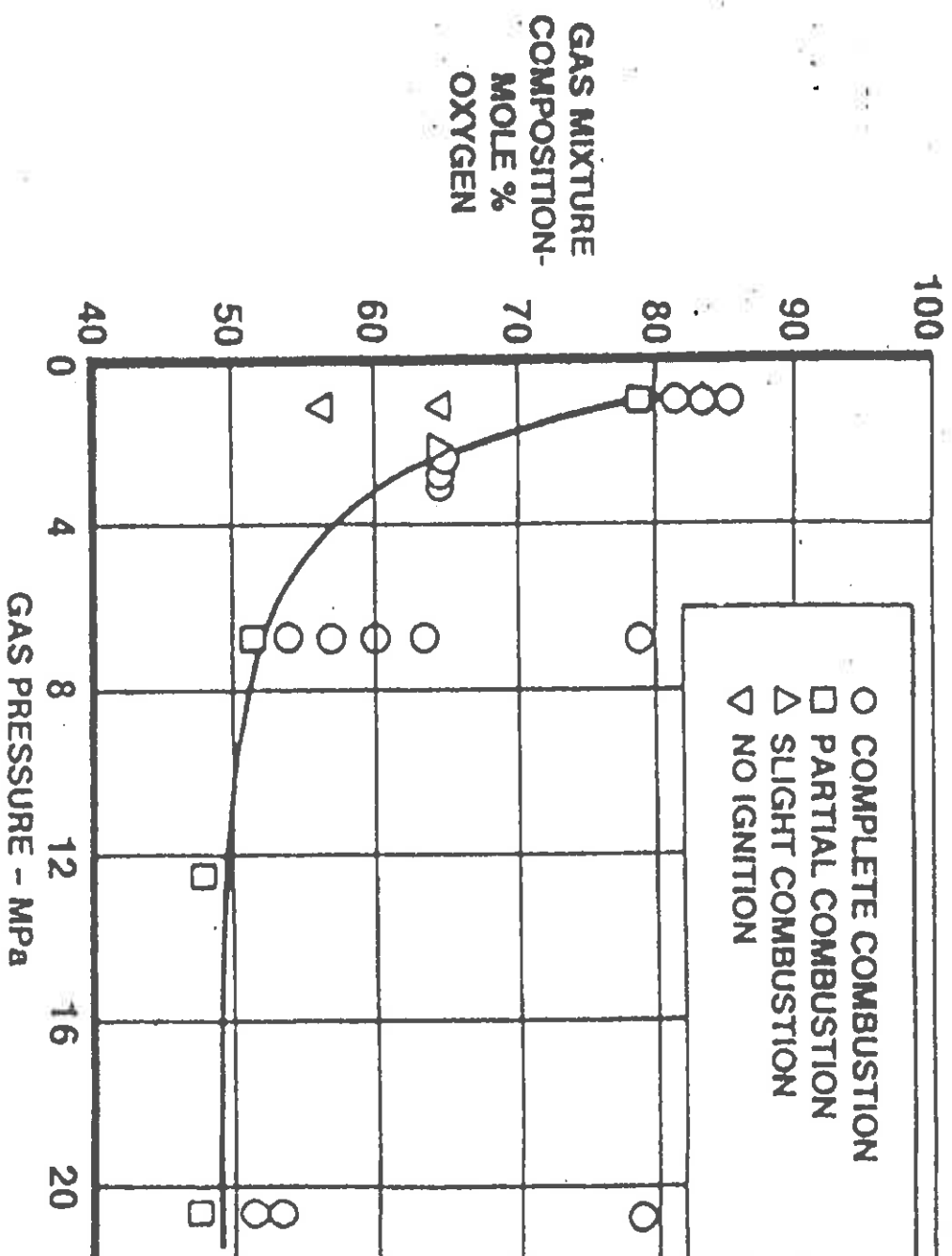
Where incomplete knowledge exists, I suggest that this type of study be conducted. If I can be of any further help, please feel free to call (305) 451-2551.

Sincerely,

Dick Rutkowski
President/Owner of all companies listed on letterhead
NOAA Deputy Diving Coordinator (retired)

*Please review attachments
for facts not myths.
WR*

FLAMMABILITY AND SENSITIVITY OF MATERIALS



NEWS RELEASE

Myths and Misconceptions of Oxygen Percentages for Oxygen Service

by Dick Rutkowski

The myths and misconceptions of oxygen percentages for oxygen service come from many sources. Many pseudo-experts read about one type of oxygen service and apply that information to other types of oxygen service. Nitrox is used for many types of diving including commercial, saturation, rebreathers, recompression therapy, deep diving on air or trimixes, and in-water decompression in conjunction with oxygen; and of course, recreational diving. What has happened since nitrox entered the recreational diving arena? "Experts" assumed that what they read for one use of nitrox applied to other uses. In other words, they all wanted to play in the ball game, but didn't come with the right ball.

Recreational divers using nitrox within all the operational and physical limits of the basic scuba certification agencies can only have an enhanced physiological advantage, helping to prevent decompression sickness. Available no-decompression limit time can be increased without approaching central nervous system or pulmonary oxygen toxicity limits.

Recreational divers should not get involved with the mixing or blending aspects of nitrox. Recreational divers should never use more than a 40% mixture of nitrox. If the recreational diver observes the operational and physical limitations of recreational diving air and never uses a breathing mixture above 40% oxygen, his diving equipment can be used as if the mixture is air and **is not required to be oxygen cleaned**. IANTD has nitrox mixing/blending workshops and certifications for responsible vendors (dive shops) including oxygen service, safety, handling and cleaning of nitrox systems.

In January 1992, the Diving Equipment Manufacturers Association (DEMA) hastily issued a warning to all dive shops that nitrox or oxygen 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 as successfully as air for over 50 years in the commercial industry, in the military, by NOAA, and for recompression chamber therapy using standard non-oxygen cleaned diving equipment. The precedence for this is quoted below.

CODE OF FEDERAL REGULATIONS, PART 1910.430(i) (COMMERCIAL DIVING OPERATIONS)

OSHA OXYGEN SPECIFICATIONS 1910.420 (I)

The 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 with mixtures containing over 40% oxygen by volume must be properly designed for oxygen service. All components (except umbilicals) used in such service (or with mixtures over 40% oxygen by volume) must be cleaned of flammable materials before use.

Finally, oxygen systems carrying over 125 pounds per square inch gauge (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 these requirements are meant to reduce the hazards of ignition and combustion present within oxygen systems.

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 forty percent oxygen must be cleaned and maintained for oxygen service.

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

UNITED STATES COAST GUARD OXYGEN SPECIFICATIONS

Title 46 — Shipping, revised as of October 1, 1992
Chapter I — Coast Guard, Department of Transportation
Subchapter V — Marine Occupational Safety and Health Standards
Part 197 — General Provisions
Subpart B — Commercial Diving Operations
Periodic Tests and Inspection of Diving Equipment

§ 197.452 Oxygen cleaning.
46 CFR 197.451

The diving supervisor shall ensure that equipment used with oxygen or oxygen mixtures greater than 40 percent by volume is cleaned of flammable materials —

- (a) Before being placed into service; and
- (b) After any repair, alteration, modification, or suspected contamination.

SOURCE: CGD 76-009, 43 FR 53683, Nov. 16, 1978.

Authority: 33 U.S.C. 1509; 43 U.S.C. 1333; 46 U.S.C. 3306, 3703, 6101; 49 CFR 1.46

For systems with oxygen content greater than 40% by volume, oxygen systems components shall be cleaned in accordance with the requirements of MIL-STD-1330.

The International Association of Nitrox and Technical Divers, Inc. (IANTD), is very much concerned with the safe handling and safety for the use of oxygen. IANTD has set forth standards for oxygen service, oxygen cleaning and oxygen compatible systems for all mixtures of oxygen enriched air and trimixtures. IANTD complies with the safety standards of OSHA, USN, NFPA, and NOAA, for handling oxygen mixtures with less than 40 percent and oxygen mixtures above 40 percent. Regulations regarding oxygen mixtures less than 40 percent are set forth in the USN, NOAA and OSHA Standards for Mixed Gas Diving Operations as above.

If the diving manufacturers insisting all diving equipment using oxygen mixtures over 22 percent would have performed some research, they would have discovered the scientific facts. All medical and welding cylinders, valves and regulators are made of the same brass and chrome as diver equipment. Luxfer stated openly that they have no problems with nitrox mixtures in their tanks. Some diving equipment manufacturers claim their diving equipment is for nitrox use. As for the recreational diving community, as long as the user never uses more than a 40 percent oxygen mixture, he can use his equipment the same as air safely, as it has been done for over 50 years. Divers who are using more than 40 percent oxygen in their tanks or regulators for in-water use of oxygen for decompression, special gas mixtures for deep diving, or persons mixing any trimix or nitrox mix in their SCUBA tanks must comply with the following rule: ***Any piece of equipment that handles more than 40 percent oxygen by volume must be cleaned for pure oxygen service.*** This is the warning DEMA should be issuing, and I will support this warning 100%.

The 40% oxygen clean regulation study was conducted by the American Society for Testing and Materials in the 1960s for NASA White Sands Proving Grounds.

SPECIAL REGULATORS AND TANK VALVES FOR NITROX MIXTURES

It appears that certain diving equipment manufacturers 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 percent. As I have pointed out earlier, this is erroneous.

U.S. Navy rules regarding 23-25 percent oxygen containing equipment for recompression chambers (pressure vessel for human occupancy), occupied by humans or a flammable material, is in no way related to breathing gases in high pressure cylinders. Compressed gas cylinders are a completely different case and should be treated accordingly. An FO_2 less than 25 percent is for living in chambers (mechanical ignition), greater than 40 percent oxygen is for chemical ignition.

Because of DEMA's warning, a 2-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 13-14, 1992 at the Hyatt Regency, Houston, Texas. Minutes of this workshop are available from SDRG, P.O. Box 3229, Boulder, CO 80307 for \$12.00.

Since DEMA's warning to 2,200 dive shops has been contradicted by scientific facts, we should require the DEMA board members who still insist on not complying with government regulations, be made to rescind their erroneous warnings. If DEMA warns any dive shops regarding equipment, it needs to be clearly stated that the warning **only affects equipment servicing more than 40 percent oxygen, not 22 percent.**

Dick Rutkowski retired as the Deputy NOAA Diving Coordinator with 35 years of Federal service and is the past director of the NOAA Hyperbaric Facility, founder of Hyperbarics International, Inc., IANTD (1985), and co-founder of ANDI (1989). (305) 451-2551.