



**Halmos College of Natural
Sciences and Oceanography**

SCIENTIFIC DIVING PROGRAM MANUAL

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2017

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SECTION 1.0 GENERAL POLICY

1.1 SCIENTIFIC DIVING STANDARDS

1.1.1 Purpose

The purpose of these Scientific Diving Standards is to ensure that all scientific diving is conducted in a manner that will maximize protection of scientific divers from accidental injury and/or illness, and to set forth standards for training and certification which will allow a working reciprocity between Nova Southeastern University Halmos College of Natural Sciences and Oceanography (HCNSO) and other AAUS organizational members. Fulfillment of the purposes shall be consistent with the furtherance of research and safety.

This document sets minimal standards for the establishment of the American Academy of Underwater Sciences (AAUS)-recognized scientific diving programs, the organization for the conduct of these programs, and the basic regulations and procedures for safety in scientific diving operations. It also establishes a framework for reciprocity between HCNSO and other AAUS organizational members which adhere to these minimum standards.

This manual was developed and written by the AAUS by compiling the policies set forth in the diving manuals of several university, private, and governmental scientific diving programs. These programs share a common heritage with the scientific diving program at the Scripps Institution of Oceanography (SIO). Adherence to the SIO standards has proven both feasible and effective in protecting the health and safety of scientific divers since 1954.

In 1982, OSHA exempted scientific diving from commercial diving regulations (29 CFR Part 1910, Subpart T) under certain conditions, which are outlined below. The final guidelines for the exemption became effective in 1985 (Federal Register, Vol. 50, No.6, p.1046). The AAUS is recognized by OSHA as the scientific diving standard-setting organization.

Additional standards, which extend this document, may be adopted by each organizational member, according to local procedure.

1.1.2 Scientific Diving Definition

Scientific diving is defined (29 CFR 1910.402) as diving performed solely as a necessary part of a scientific, research, or educational activity by employees whose sole purpose for diving is to perform scientific research tasks.

1.1.3 Scientific Diving Exemption

OSHA has granted an exemption for scientific diving from commercial diving regulations under the following guidelines (Appendix B to Subpart T):

1.1.3.1 The Diving Control Board consists of a majority of active scientific divers and has autonomous and absolute authority over the scientific diving program's operation.

1.1.3.2 The purpose of the project using scientific diving is the advancement of science; therefore, information and data resulting from the project are non-proprietary.

1.1.3.3 The tasks of a scientific diver are those of an observer and data gatherer. Construction and trouble-shooting tasks traditionally associated with commercial diving are not included within scientific diving.

1.1.3.4 Scientific divers, based on the nature of their activities, must use scientific expertise in studying the underwater environment and therefore, are scientists or scientists-in training.

1.1.3.5 In addition, the scientific diving program shall contain at least the following elements:

1.1.3.5.1 Diving safety manual which includes at a minimum procedures covering all diving operations specific to the program including: procedures for emergency care, recompression and evacuation, and the criteria for diver training and certification.

1.1.3.5.2 Diving control (safety) board, with the majority of its members being active scientific divers, which shall at a minimum have the authority to: approve and monitor diving projects, review and revise the diving safety manual, assure compliance with the manual, certify the depths to which a diver has been trained, take disciplinary action for unsafe practices, and assure adherence to the buddy system (a diver is accompanied by and is in continuous contact with another diver in the water) for scuba diving.

1.1.4 Representations, Warranties, Assumption of the Risk, Release, Hold Harmless and Indemnification of AAUS

1.1.4.1 By adopting some or all of the standards and policies set forth in this manual, each adopting member thereby represents and warrants to AAUS that the adopting member has thoroughly reviewed the appropriateness of these standards and policies for its own programs and purposes, that the adopting member has made a professionally informed, independent decision that the AAUS standards and policies are in every instance and every detail suitable for the intended use by that member, and that the adopting member freely and voluntarily makes an informed choice to assume all risks associated with the application and use of these standards and policies in any diving or diving related activities.

1.1.4.2 By adopting some or all of the standards and policies set forth in this manual, each adopting member represents and agrees that the same adopting member has made a professionally informed decision to release AAUS, and thereby does release AAUS, from any and all losses, costs, injuries, death or damages, including attorney fees, caused in whole or in part by, or resulting in whole or part from, the implementation, use or application of these standards and policies to any diving or diving-related activities, or caused in whole or in part

by, or resulting in whole or in part from, acts or omissions of the adopting member, its officers, directors, employees, students, volunteers or invitees.

1.1.4.3 By adopting some or all of the standards and policies set forth in this manual, each adopting member represents and agrees that the same adopting member has made a professionally informed decision to hold harmless and indemnify AAUS, and thereby does hold harmless and indemnify AAUS, from and against any and all losses, costs, injuries, death or damages, including attorney fees, caused in whole or in part by, or resulting in whole or in part from, the implementation, use or application of these standards and policies to any diving or diving-related activities, or caused in whole or in part by, or resulting in whole or in part from, acts or omissions of the adopting member, its officers, directors, employees, students, volunteers or invitees.

1.1.5 Review of Standards

As part of HCNSO annual report, any recommendations for modifications of these standards shall be submitted to the AAUS for consideration.

1.2 OPERATIONAL CONTROL

1.2.1 HCNSO Auspices Defined

For the purposes of these standards the auspices of HCNSO includes any scientific diving operation in which HCNSO is connected because of ownership of any equipment used, locations selected, or relationship with the individual(s) concerned. This includes all cases involving the operations of employees of the HCNSO or employees of auxiliary organizations, where such employees are acting within the scope of their employment, and the operations of other persons who are engaged in scientific diving of HCNSO or are diving as members of an organization recognized by the AAUS and HCNSO.

It is the HCNSO's responsibility to adhere to the AAUS Standards for Scientific Diving Certification and Operation of Scientific Diving Programs. The administration of the local diving program will reside with the HCNSO's Diving Control Board (DCB).

The regulations herein shall be observed at all locations where scientific diving is conducted.

1.2.2 HCNSO's Scientific Diving Standards and Safety Manual

HCNSO shall develop and maintain a scientific diving safety manual which provides for the development and implementation of policies and procedures that will enable HCNSO to meet requirements of local environments and conditions as well as to comply with the AAUS scientific diving standards. The HCNSO's scientific diving standards shall include, but not be limited to:

1.2.2.1 The AAUS Standards may be used as a set of minimal guidelines for the development of a HCNSO's scientific diving safety manual.

1.2.2.2 Emergency evacuation and medical treatment procedures.

1.2.2.3 The criteria for diver training and certification.

1.2.2.4 Standards written or adopted by reference for each diving mode utilized which include the following:

1.2.2.4.1 Safety procedures for the diving operation.

1.2.2.4.2 Responsibilities of the dive team members.

1.2.2.4.3 Equipment use and maintenance procedures.

1.2.2.4.4 Emergency procedures.

1.2.3 The Diving Safety Officer (DSO)

The DSO serves as a member of the Diving Control Board. This person should have broad technical and scientific expertise in research related diving.

1.2.3.1 Qualifications

1.2.3.1.1 Shall be appointed by the responsible administrative officer or his/her designee, with the advice and counsel of the Diving Control Board.

1.2.3.1.2 Shall be trained as a scientific diver.

1.2.3.1.3 Shall be a member as defined by the AAUS.

1.2.3.1.4 Shall be certified as a scuba diving instructor from a internationally recognized certifying agency.

1.2.3.2 Duties and Responsibilities

1.2.3.2.1 Shall be responsible, through the DCB, to the responsible administrative officer or his/her designee, for the conduct of the scientific diving program of the membership organization. The routine operational authority for this program, including the conduct of training and certification, approval of dive plans, maintenance of diving records, and ensuring compliance with this manual and all relevant regulations of the membership organization, rests with the Diving Safety Officer.

1.2.3.2.2 May permit portions of this program to be carried out by a qualified delegate, although the Diving Safety Officer may not delegate responsibility for the safe conduct of the local diving program.

1.2.3.2.3 Shall be guided in the performance of the required duties by the advice of the DCB, but operational responsibility for the conduct of the local diving program will be retained by the Diving Safety Officer.

1.2.3.2.4 Shall suspend diving operations, which he/she considers to be unsafe or unwise.

1.2.4 The Diving Control Board

1.2.4.1 The Diving Control Board (DCB) shall consist of a majority of active scientific divers. Voting members shall include the Diving Safety Officer, the responsible administrative officer, or his/her designee, and should include other representatives of the diving program such as qualified divers and members selected by procedures established by each organizational member. A chairperson and a secretary may be chosen from the membership of the board according to local procedure.

1.2.4.2 Has autonomous and absolute authority over the scientific diving program's operation.

1.2.4.3 Shall approve and monitor diving projects.

1.2.4.4 Shall review and revise the diving safety manual.

1.2.4.5 Shall assure compliance with the manual.

1.2.4.6 Shall certify the depths to which a diver has been trained.

1.2.4.7 Shall take disciplinary action for unsafe practices.

1.2.4.8 Shall assure adherence to the buddy system for scuba diving.

1.2.4.9 Shall act as the official representative of the membership organization in matters concerning the scientific diving program.

1.2.4.10 Shall act as a board of appeal to consider diver-related problems.

1.2.4.11 Shall recommend the issue, reissue, or the revocation of diving certifications.

1.2.4.12 Shall recommend changes in policy and amendments to the AAUS and the membership organization's scientific diving manual as the need arises.

1.2.4.13 Shall establish and/or approve training programs through which the applicants for certification can satisfy the requirements of the HCNSO's diving safety manual.

1.2.4.14 Shall suspend diving programs, which it considers to be unsafe or unwise.

1.2.4.15 Shall establish criteria for equipment selection and use.

1.2.4.16 Shall recommend new equipment or techniques.

1.2.4.17 Shall establish and/or approve facilities for the inspection and maintenance of diving and associated equipment.

1.2.4.18 Shall ensure that the HCNSO's air station(s) meet air quality standards as described in Sec. 3.6 of this manual.

1.2.4.19 Shall periodically review the Diving Safety Officer's performance and program.

1.2.4.20 Shall sit as a board of investigation to inquire into the nature and cause of diving accidents or violations of the HCNSO's diving manual.

1.2.5 Instructional Personnel

1.2.5.1 Qualifications

All personnel involved in diving instruction under the auspices of the organizational member shall be qualified for the type of instruction being given.

1.2.5.2 Selection

Instructional personnel will be selected by the responsible administrative officer, or his/her designee, who will solicit the advice of the DCB in conducting preliminary screening of applicants for instructional positions.

1.2.6 Lead Diver

For each dive, one individual shall be designated as the Lead Diver. He/she shall be at the dive location during the diving operation. The Lead Diver shall be responsible for:

1.2.6.1 Coordinating with other known activities in the vicinity which are likely to interfere with diving operations.

1.2.6.2 Ensuring all dive team members possesses current certification and is qualified for the type of diving operation.

1.2.6.3 Planning dives in accordance with section 2.2.1

1.2.6.4 Ensuring safety and emergency equipment is in working order and at the dive site.

1.2.6.5 Briefing the dive team members on:

1.2.6.5.1 Dive objectives.

1.2.6.5.2 Unusual hazards or environmental conditions likely to affect the safety of the diving operation.

1.2.6.5.3 Modifications to diving or emergency procedures necessitated by the specific diving operation.

1.2.6.6 Suspending diving operations if in his/her opinion conditions are not safe.

1.2.6.7 Reporting to the DSO and DCB any physical problems or adverse physiological effects including symptoms of pressure-related injuries.

1.2.7 Reciprocity and Visiting Scientific Diver

1.2.7.1 Two or more AAUS organizational members engaged jointly in diving activities, or engaged jointly in the use of diving resources, shall designate one of the participating Diving Control Boards to govern the joint dive project.

1.2.7.2 A scientific diver from one organizational member shall apply for permission to dive under the auspices of another organizational member by submitting to the Diving Safety Officer of the host organizational member a document containing all the information described in Appendix 8 (Letter of Reciprocity) signed by the Diving Safety Officer or Chairperson of the home Diving Control Board.

1.2.7.3 A visiting scientific diver may be asked to demonstrate his/her knowledge and skills for the planned diving.

1.2.7.4 If a host Organizational member denies a visiting scientific diver permission to dive, the host Diving Control Board shall notify the visiting scientific diver and his/her Diving Control Board with an explanation of all reasons for the denial.

1.2.8 Waiver of Requirements

The organizational Diving Control Board may grant a waiver for specific requirements of training, examinations, depth certification, and minimum activity to maintain certification.

1.2.9 Consequence of Violation of Regulations by Scientific Divers

Failure to comply with the regulations of the HCNSO's diving manual may be cause for the revocation or restriction of the diver's scientific diving certificate by action of HCNSO's Diving Control Board.

1.3 CONSEQUENCES OF VIOLATION OF REGULATIONS

Failure to comply with the regulations of this standard may be cause for the revocation or restriction of HCNSO's recognition by the AAUS.

1.4 RECORD MAINTENANCE

The Diving Safety Officer or his/her designee shall maintain permanent records for each individual scientific diver certified. The file shall include evidence of certification level, log sheets, results of current physical examination, reports of disciplinary actions by the HCNSO Diving Control Board, and other pertinent information deemed necessary.

1.4.1 Availability of Records:

1.4.1.1 Medical records shall be available to the attending physician of a diver or former diver when released in writing by the diver.

1.4.1.2 Records and documents required by this standard shall be retained by the HCNSO for the following period:

1.4.1.2.1 Physician's written reports of medical examinations for dive team members - 5 years.

1.4.1.2.2 Manual for diving safety - current document only.

1.4.1.2.3 Records of dive - 1 year, except 5 years where there has been an incidence of pressure-related injury.

1.4.1.2.4 Pressure-related injury assessment - 5 years.

1.4.1.2.5 Equipment inspection and testing records - current entry or tag, or until equipment is withdrawn from service.

SECTION 2.0 DIVING REGULATIONS FOR SCUBA (OPEN CIRCUIT, COMPRESSED AIR)

2.1 INTRODUCTION

No person shall engage in scientific diving operations under the auspices of HCNSO scientific diving program unless he/she holds a current certification issued pursuant to the provisions of this manual.

2.2 PRE-DIVE PROCEDURES

2.2.1 Dive Plans

Dives should be planned around the competency of the least experienced diver. Before conducting any diving operations under the auspices of HCNSO, the lead diver for a proposed operation must formulate a dive plan which should include the following:

2.2.1.1 Diver's qualifications, and the type of certificate or certification held by each diver.

2.2.1.2 Emergency plan (see Appendix 10) with the following information:

2.2.1.2.1 Name, telephone number, and relationship of person to be contacted for each diver in the event of an emergency

2.2.1.2.2 Nearest operational recompression chamber

2.2.1.2.3 Nearest accessible hospital

2.2.1.2.4 Available means of transport

2.2.1.3 Approximate number of proposed dives.

2.2.1.4 Location(s) of proposed dives.

2.2.1.5 Estimated depth(s) and bottom time(s) anticipated.

2.2.1.6 Decompression status and repetitive dive plans, if required.

2.2.1.7 Proposed work, equipment, and boats to be employed.

2.2.1.8 Any hazardous conditions anticipated.

2.2.2 Pre-dive Safety Checks

2.2.2.1 Diver's Responsibility:

2.2.2.1.1 Each scientific diver shall conduct a functional check of his/her diving equipment in the presence of the diving buddy or tender.

2.2.2.1.2 It is the diver's responsibility and duty to refuse to dive if, in his/her judgement, conditions are unfavorable, or if he/she would be violating the precepts of his/her training or HCNSO's diving manual.

2.2.2.1.3 No dive team member shall be required to be exposed to hyperbaric conditions against his/her will, except when necessary to prevent or treat a pressure-related injury.

2.2.2.1.4 No dive team member shall be permitted to dive for the duration of any known condition which is likely to adversely affect the safety and health of the diver or other dive members.

2.2.2.2 Equipment Evaluations

2.2.2.2.1 Each diver shall ensure that his/her equipment is in proper working order and that the equipment is suitable for the type of diving operation.

2.2.2.2.2 Each diver shall have the capability of achieving and maintaining positive buoyancy.

2.2.2.3 Site Evaluation

The environmental conditions at the site will be evaluated.

2.3 DIVING PROCEDURES

2.3.1 Solo Diving Prohibition

All diving activities shall assure adherence to the buddy system (two comparably equipped scuba divers in the water in constant communication) for scuba diving. This buddy system is based upon mutual assistance, especially in the case of an emergency.

2.3.2 Refusal to Dive

2.3.2.1 The decision to dive is that of the diver. A diver may refuse to dive, without fear of penalty, whenever he/she feels it is unsafe for them to make the dive (see Sec. 2.2.2.1.2).

2.3.2.2 Safety - The ultimate responsibility for safety rests with the individual diver. It is the diver's responsibility and duty to refuse to dive if, in his/her judgement, conditions are unsafe or unfavorable, or if he/she would be violating the precepts of his/her training or the regulations in this manual.

2.3.3 Termination of the Dive

2.3.3.1 It is the responsibility of the diver to terminate the dive, without fear of penalty, whenever he/she feels it is unsafe to continue the dive, unless it compromises the safety of another diver already in the water (see Sec. 2.2.2.1.2).

2.3.3.2 The dive shall be terminated while there is still sufficient cylinder pressure to permit the diver to safely reach the surface, including decompression time, or to safely reach an additional air source at the decompression station.

2.3.4 Emergencies and Deviations from Regulations

Any diver may deviate from the requirements of this manual to the extent necessary to prevent or minimize a situation which is likely to cause death, serious physical harm, or major environmental damage. A written report of such actions must be submitted to the Diving Control Board explaining the circumstances and justifications.

2.4 POST-DIVE PROCEDURES

2.4.1 Post-Dive Safety Checks

2.4.1.1 After the completion of a dive, each diver shall report any physical problems, symptoms of decompression sickness, or equipment malfunctions.

2.4.1.2 When diving outside the no-decompression limits, the divers should remain awake for at least one hour after diving, and in the company of a dive team member who is prepared to transport him/her to a hyperbaric chamber if necessary.

2.5 EMERGENCY PROCEDURES

HCNSO will develop emergency procedures which follow the standards of care of the community and must include procedures for emergency care, recompression and evacuation for each dive location (See Appendix 10).

2.6 FLYING AFTER DIVING

Divers should have a minimum surface interval of 12 hours before ascending to altitude.

2.7 RECORDKEEPING AND REQUIREMENTS

2.7.1 Personal Diving Log

Each certified scientific diver shall log every dive made under the auspices of the HCNSO's program, and is encouraged to log all other dives. Standard forms will be provided by each membership organization. Log sheets shall be submitted to the Diving Safety Officer to be placed in the diver's permanent file. Details of the submission procedures are left to the discretion of the Diving Safety Officer. The diving log shall be in a form specified by the organization and shall include at least the following:

- 2.7.1.1 Name of diver, partner, and Lead Diver.
- 2.7.1.2 Date, time, and location.
- 2.7.1.3 Diving modes used.
- 2.7.1.4 General nature of diving activities.
- 2.7.1.5 Approximate surface and underwater conditions.
- 2.7.1.6 Maximum depths, bottom time and surface interval time.
- 2.7.1.7 Diving tables or computers used.
- 2.7.1.8 Detailed report of any near or actual incidents.

2.7.2 Required Incident Reporting

All diving incidents requiring recompression treatment, or resulting in moderate or serious injury, or death shall be reported to the HCNSO's Diving Control Board and the AAUS. The HCNSO's regular procedures for incident reporting, including those required by the AAUS, shall be followed. The report will specify the circumstances of the incident and the extent of any injuries or illnesses. Additional information must meet the following reporting requirements:

- 2.7.2.1 HCNSO shall record and report occupational injuries and illnesses in accordance with requirements of the appropriate Labor Code section.

2.7.2.2 If pressure-related injuries are suspected, or if symptoms are evident, the following additional information shall be recorded and retained by the HCNSO, with the record of the dive, for a period of 5 years:

2.7.2.2.1 Complete AAUS Incident Report at www.aaus.org.

2.7.2.2.2 Written descriptive report to include:

2.7.2.2.2.1 Name, address, and phone numbers of the principal parties involved.

2.7.2.2.2.2 Summary of experience of divers involved.

2.7.2.2.2.3 Location, description of dive site and description of conditions that led up to incident.

2.7.2.2.2.4 Description of symptoms, including depth and time of onset.

2.7.2.2.2.5 Description and results of treatment.

2.7.2.2.2.6 Disposition of case.

2.7.2.2.2.7 Recommendations to avoid repetition of incident.

2.7.2.3 HCNSO shall investigate and document any incident of pressure-related injury and prepare a report which is to be forwarded to the AAUS during the annual reporting cycle. This report must first be reviewed and released by the organizational member's Diving Control Board.

SECTION 3.0 DIVING EQUIPMENT

3.1 GENERAL POLICY

3.1.1 All equipment shall meet standards as determined by the Diving Safety Officer and the Diving Control Board. Equipment that is subjected to extreme usage under adverse conditions should require more frequent testing and maintenance.

3.1.2 All equipment shall be regularly examined by the person using them.

3.2 EQUIPMENT

3.2.1 Regulators

3.2.1.1 Approval. Only those makes and models specifically approved by the Diving Safety Officer and the Diving Control Board shall be used.

3.2.1.2 Inspection and testing. Scuba regulators shall be inspected and tested prior to first use and every twelve months thereafter.

3.2.1.3 Regulators will consist of a primary second stage and an alternate air source (such as an octopus second stage or redundant air supply).

3.2.2 Breathing Masks and Helmets

Breathing masks and helmets shall have:

3.2.2.1 A non-return valve at the attachment point between helmet or mask hose, which shall close readily and positively.

3.2.2.2 An exhaust valve.

3.2.2.3 A minimum ventilation rate capable of maintaining the diver at the depth to which he/she is diving.

3.2.3 Scuba Cylinders

3.2.3.1 Scuba cylinders shall be designed, constructed, and maintained in accordance with the applicable provisions of the Unfired Pressure Vessel Safety Orders.

3.2.3.2 Scuba cylinders must be hydrostatically tested in accordance with DOT standards.

3.2.3.3 Scuba cylinders must have an internal inspection at intervals not to exceed twelve months.

3.2.3.4 Scuba cylinder valves shall be functionally tested at intervals not to exceed twelve months.

3.2.4 Backpacks

Backpacks without integrated flotation devices and weight systems shall have a quick release device designed to permit jettisoning with a single motion from either hand.

3.2.5 Gauges

Gauges shall be inspected and tested before first use and every twelve months thereafter.

3.2.6 Flotation Devices

3.2.6.1 Each diver shall have the capability of achieving and maintaining positive buoyancy.

3.2.6.2 Personal flotation systems, buoyancy compensators, dry suits, or other variable volume buoyancy compensation devices shall be equipped with an exhaust valve.

3.2.6.3 These devices shall be functionally inspected and tested at intervals not to exceed twelve months.

3.2.7 Timing Devices, Depth and Pressure Gauges

Both members of the diving pair must have an underwater timing device, an approved depth indicator, and a submersible pressure gauge.

3.2.8 Determination of Decompression Status: Dive Tables, Dive Computers

3.2.8.1 A set of diving tables, approved by the Diving Control Board, must be available at the dive location.

3.2.8.2 Dive computers may be utilized in place of diving tables, and must be approved by the Diving Control Board.

3.3 AUXILIARY EQUIPMENT

3.3.1 Hand-Held Underwater Power Tools.

Electrical tools and equipment used underwater shall be specifically approved for this purpose. Electrical tools and equipment supplied with power from the surface shall be de-energized before being placed into or retrieved from the water. Hand held power tools shall not be supplied with power from the dive location until requested by the diver.

3.4 SUPPORT EQUIPMENT

3.4.1 First Aid Supplies

A first aid kit and emergency oxygen shall be available on all vessels during diving operations.

3.4.2 Diver's Flag

A diver's flag shall be displayed prominently whenever diving is conducted under circumstances where required or where water traffic is probable.

3.4.3 Compressor Systems - HCNSO Controlled

The following will be considered in design and location of compressor systems:

3.4.3.1 Low pressure compressors used to supply air to the diver if equipped with a volume tank shall have a check valve on the inlet side, a relief valve, and a drain valve.

3.4.3.2 Compressed air systems over 500 psig shall have slow-opening shut-off valves.

3.4.3.3 All air compressor intakes shall be located away from areas containing exhaust or other contaminants.

3.4.4 Oxygen Systems

3.4.4.1 Equipment used with oxygen or mixtures containing over forty percent (40%) by volume oxygen shall be designed and maintained for oxygen service.

3.4.4.2 Components exposed to oxygen or mixtures containing over forty percent (40%) by volume oxygen shall be cleaned of flammable materials before being placed into service.

3.4.4.3 Oxygen systems over 125 psig shall have slow-opening shut-off valves.

3.5 EQUIPMENT MAINTENANCE

3.5.1 Record keeping

Each equipment modification, repair, test, calibration, or maintenance service shall be logged, including the date and nature of work performed, serial number of the item, and the name of the person performing the work for the following equipment:

3.5.1.1. Regulators

3.5.1.2 Submersible pressure gauges

3.5.1.3 Depth gauges

3.5.1.4 Scuba cylinders

3.5.1.5 Cylinder valves

3.5.1.6 Diving helmets

3.5.1.7 Submersible breathing masks

3.5.1.8 Compressors

3.5.1.9 Gas control panels

3.5.1.10 Air storage cylinders

3.5.1.11 Air filtration systems

3.5.1.12 Analytical instruments

3.5.1.13 Buoyancy control devices

3.5.1.14 Dry suits

3.5.2 Compressor Operation and Air Test Records

3.5.2.1 Gas analyses and air tests shall be performed on each HCNSO-controlled breathing air compressor at regular intervals of no more than 100 hours of operation or six months, whichever occurs first. The results of these tests shall be entered in a formal log and be maintained.

3.5.2.2 A log shall be maintained showing operation, repair, overhaul, filter maintenance, and temperature adjustment for each compressor.

3.6 AIR QUALITY STANDARDS

Breathing air for scuba shall meet the following specifications as set forth by the Compressed Gas Association (CGA Pamphlet G-7.1) and referenced in OSHA 29 CFR 1910.134

CGA Grade E

Component	Maximum
Oxygen	20 - 22%/v
Carbon Monoxide	10 PPM/v
Carbon Dioxide	500 PPM/v
Condensed Hydrocarbons	5 mg/m ³
Water Vapor	NS
Objectionable Odors	None

SECTION 4.0 ENTRY-LEVEL TRAINING REQUIREMENTS

This section describes training for the non-diver applicant, previously not certified for diving, and equivalency for the certified diver.

4.1 EVALUATION

4.1.1 Medical Examination

The applicant for training shall be certified by a licensed physician to be medically qualified for diving before proceeding with the training as designated in Sec. 4.2 (see Sec. 6.0 and Appendices 1 through 6).

4.1.2 Swimming Evaluation

The applicant for training shall successfully perform the following tests, or their equivalent, in the presence of the Diving Safety Officer, or an examiner approved by the Diving Safety Officer.

4.1.2.1 Swim underwater without swim aids for a distance of 25 yards without surfacing.

4.1.2.2 Swim 400 yards in less than 12 minutes without swim aids.

4.1.2.3 Tread water for 10 minutes, or 2 minutes without the use of hands, without swim aids.

4.1.2.4 Without the use of swim aids, transport another person of equal size a distance of 25 yards in the water.

4.2 SCUBA TRAINING

4.2.1 Practical Training

At the completion of training, the trainee must satisfy the Diving Safety Officer or the instructor of his/her ability to perform the following, as a minimum, in a pool or in sheltered water:

4.2.1.1 Enter water with full equipment.

4.2.1.2 Clear face mask.

4.2.1.3 Demonstrate air sharing, including both buddy breathing and the use of alternate air source, as both donor and recipient, with and without a face mask.

4.2.1.4 Demonstrate ability to alternate between snorkel and scuba while kicking.

4.2.1.5 Demonstrate understanding of underwater signs and signals.

4.2.1.6 Demonstrate simulated in-water mouth-to-mouth resuscitation.

4.2.1.7 Rescue and transport, as a diver, a passive simulated victim of an accident.

4.2.1.8 Demonstrate ability to remove and replace equipment while submerged.

4.2.1.9 Demonstrate watermanship ability which is acceptable to the instructor.

4.2.2 Written Examination

Before completing training, the trainee must pass a written examination that demonstrates knowledge of at least the following:

4.2.2.1 Function, care, use, and maintenance of diving equipment.

4.2.2.2 Physics and physiology of diving.

4.2.2.3 Diving regulations and precautions.

4.2.2.4 Near-shore currents and waves.

4.2.2.5 Dangerous marine animals.

4.2.2.6 Emergency procedures, including buoyant ascent and ascent by air sharing.

4.2.2.7 Currently accepted decompression procedures.

4.2.2.8 Demonstrate the proper use of dive tables.

4.2.2.9 Underwater communications.

4.2.2.10 Aspects of freshwater and altitude diving.

4.2.2.11 Hazards of breath-hold diving and ascents.

4.2.2.12 Planning and supervision of diving operations.

4.2.2.13 Diving hazards.

4.2.2.14 Cause, symptoms, treatment, and prevention of the following: near drowning, air embolism, carbon dioxide excess, squeezes, oxygen poisoning, nitrogen narcosis, exhaustion and panic, respiratory fatigue, motion sickness, decompression sickness, hypothermia, and hypoxia/anoxia.

4.2.3 Open Water Evaluation

The trainee must satisfy an instructor, approved by the Diving Safety Officer, of his/her ability to perform at least the following in open water:

4.2.3.1 Surface dive to a depth of 10 feet in open water without scuba.

4.2.3.2 Demonstrate proficiency in air sharing, as both donor and receiver.

4.2.3.3 Enter and leave open water or surf, or leave and board a diving vessel, while wearing scuba gear.

4.2.3.4 Kick on the surface 400 yards while wearing scuba gear, but not breathing from the scuba unit.

4.2.3.5 Demonstrate judgement adequate for safe diving.

4.2.3.6 Demonstrate, where appropriate, the ability to maneuver efficiently in the environment, at and below the surface.

4.2.3.7 Complete a simulated emergency swimming ascent.

4.2.3.8 Demonstrate clearing of mask and regulator while submerged.

4.2.3.9 Demonstrate ability to achieve and maintain neutral buoyancy while submerged.

4.2.3.10 Demonstrate techniques of self-rescue and buddy rescue.

4.2.3.11 Navigate underwater.

4.2.3.12 Plan and execute a dive.

4.2.3.13 Successfully complete 5 open water dives for a minimum total time of 3 hours, of which 1-1/2 hours cumulative bottom time must be on scuba. No more than 3 training dives shall be made in any one day.

SECTION 5.0 SCIENTIFIC DIVER CERTIFICATION

5.1 CERTIFICATION TYPES

5.1.1 Scientific Diver Certification.

This is a permit to dive, usable only while it is current and for the purpose intended.

5.1.2 Temporary Diver Permit.

This permit constitutes a waiver of the requirements of Sec. 5.0 and is issued only following a demonstration of the required proficiency in diving. It is valid only for a limited time, as determined by the Diving Safety Officer. This permit is not to be construed as a mechanism to circumvent existing standards set forth in this manual.

Requirements of Sec. 5.3.1 and 5.3.2 may be waived by the Diving Safety Officer if the person in question has demonstrated proficiency in diving and can contribute measurably to a planned dive. A statement of the temporary diver's qualifications shall be submitted to the Diving Safety Officer as a part of the dive plan. Temporary permits shall be restricted to the planned diving operation and shall comply with all other policies, regulations, and standards of this manual, including medical requirements.

5.2 GENERAL POLICY

No person shall engage in scientific diving unless that person is authorized by HCNSO pursuant to the provisions of this manual. The following are considered minimal standards for a scientific diver certification.

5.2.1 Prerequisites

Diver-In-Training Permit

This permit signifies that a diver has completed and been certified as at least an open water diver through a nationally or internationally recognized certifying agency, scientific diving program, or its equivalent (Section 4.0).

5.2.2 Eligibility

Only a person diving under the auspices of an organization that subscribes to the practices of the AAUS is eligible for a scientific diver certification.

5.2.3 Application

Application for certification shall be made to the Diving Safety Officer on the form prescribed by the HCNSO.

5.2.4 Medical Examination

Each applicant for diver certification shall submit a statement from a licensed physician, based on an approved medical examination, attesting to the applicant's fitness for diving (see Sec. 6.0 and Appendices 1-4).

5.3 REQUIREMENTS FOR SCIENTIFIC DIVER CERTIFICATION

Submission of documents and participation in aptitude examinations does not automatically result in certification. The applicant must convince the Diving Safety Officer and members of the DCB that he/she is sufficiently skilled and proficient to be certified. This skill will be acknowledged by the signature of the Diving Safety Officer. Any applicant who does not possess the necessary judgement, under diving conditions, for the safety of the diver and his/her partner, may be denied HCNSO scientific diving privileges. Minimum documentation and examinations required are as follows:

5.3.1 Prerequisites

- a) Application - Application for certification shall be made to the Diving Safety Officer on the form prescribed by the organizational member.
- b) Medical approval. Each applicant for diver certification shall submit a statement from a licensed physician, based on an approved medical examination, attesting to the applicant's fitness for diving (Section 6.00 and Appendices 1 through 4).
- c) Scientific Diver-In-Training Permit - This permit signifies that a diver has completed and been certified as at least an open water diver through an internationally recognized certifying agency or scientific diving program, and has the knowledge skills and experience to that gained by successful completion of training as specified in Section 4.00.
- d) Emergency Care Training. The trainee must provide proof of training in the following:
 - Adult CPR (must be current).
 - Emergency oxygen administration (must be current).
 - First aid for diving accidents (must be current).

5.3.2 Training

5.3.2 Theoretical and Practical Training

The diver must complete theoretical aspects and practical training for a minimum cumulative time of 100 hours. Theoretical aspects shall include principles and activities appropriate to the intended area of scientific study.

- a) Required Topics (include, but not limited to):

1. Diving Emergency Care Training

- Cardiopulmonary Resuscitation (CPR)
- Recognition of DCS and AGE
- Accident Management
- Field Neurological Exam
- Oxygen Administration
- 2. Dive Rescue
- 3. Dive Physics
- 4. Dive Physiology
- 5. Dive Environments
- 6. Decompression Theory and its Application
- 7. AAUS Scientific Diving Regulations and History
 - Scientific Dive Planning
 - Coordination with other Agencies
 - Appropriate Governmental Regulations
- 8. Scientific Method
- 9. Data Gathering Techniques (Items specific to area of study are required)
 - Quadrating
 - Transecting
 - Mapping
 - Coring
 - Photography
 - Tagging
 - Collecting
 - Animal Handling
 - Archaeology
 - Common Biota
 - Organism Identification
 - Behavior
 - Ecology
 - Site Selection, Location, and Re-location
 - Specialized Equipment for data gathering
- 10. HazMat Training
 - HP Cylinders
 - Chemical Hygiene, Laboratory Safety (Use Of Chemicals)

b) Suggested Topics (include, but not limited to):

1. Specific Dive Modes (methods of gas delivery)
 - Open Circuit
 - Hooka
 - Surface Supplied diving
2. Small Boat Operation
3. Rebreathers
 - Closed
 - Semi-closed

4. Specialized Breathing Gas

- Nitrox
- Mixed Gas

5. Specialized Environments and Conditions

- Blue Water Diving,
- Ice and Polar Diving (Cold Water Diving)
- Zero Visibility Diving
- Polluted Water Diving,
- Saturation Diving
- Decompression Diving
- Overhead Environments
- Aquarium Diving
- Night Diving
- Kelp Diving
- Strong Current Diving (Live-boating)
- Potential Entanglement

6. Specialized Diving Equipment

- Full face mask
- Dry Suit
- Communications

c) Practical training must include a checkout dive with evaluation of the skills listed in Section 4.23 with the DSO or qualified delegate followed by at least 11 ocean or open water dives in a variety of dive sites and diving conditions, for a cumulative bottom time of 6 hours. Dives following the checkout dive must be supervised by a certified Scientific Diver with experience in the type of diving planned, with the knowledge and permission of the DSO.

d) Examinations

1. Written examination

- General exam required for scientific diver certification.
- Examination covering the suggested topics at the DSO's discretion.

2. Examination of equipment.

- Personal diving equipment
- Task specific equipment

The diver must complete additional theoretical aspects and practical training beyond the diver-in-training permit level for a minimum cumulative time of 100 hours.

5.4 DEPTH CERTIFICATIONS

Diving is not permitted beyond a depth of 190 feet.

5.4.1 Depth Certification Levels

5.4.1.1 Certification to 30 Foot Depth

This is the initial permit level, approved upon the successful completion of training listed in Sec. 4.0.

5.4.1.2 Certification to 60 Foot Depth

A diver holding a 30 foot certificate may be certified to a depth of 60 feet after successfully completing, under supervision, 12 logged training dives to depths between 31 and 60 feet, for a minimum total time of 4 hours.

5.4.1.3 Certification to 100 and 130 Foot Depths

A diver holding a 60 foot certificate may be certified to depths of 100 and 130 feet, respectively, by logging four dives near the maximum depth category. These qualification dives shall be validated by the signature of two authorized individuals who are divers certified to at least the same depth. The diver shall also demonstrate proficiency in the use of the appropriate Decompression Tables.

5.4.1.4 Certification to Depths Over 130 Feet

A diver may be certified to depths of 150 and 190 feet after the completion of four dives near each depth. Dives shall be planned and executed under close supervision of a diver certified to this depth. The diver must also demonstrate a knowledge of the special problems of deep diving, and of special safety requirements. No diver shall plan or conduct dives over 130 feet without prior approval of the Dive Control Board.

5.4.2 Progression To Next Depth Level

A certified diver diving under the auspices of the HCNSO may exceed his/her depth certification only if accompanied by a diver certified to a greater depth. Under these circumstances the diver may exceed his/her depth limit by one step.

5.5 CONTINUATION OF CERTIFICATE

5.5.1 Minimum Activity to Maintain Certification

During any 12 month period, each certified scientific diver must log a minimum of 12 dives. At least one dive must be logged near the maximum depth of the diver's certification during each 6 month period. Divers certified to 150 feet or deeper may satisfy these requirements with dives to 130 feet or over. Failure to meet these requirements may be cause for revocation or restriction of certification.

5.5.2 Requalification of Depth Certificate

Once the initial certification requirements of Sec. 5.3.1 - 5.3.3 are met, divers whose depth certification has lapsed due to lack of activity may be requalified by procedures adopted by the organization's DCB.

5.5.3 Medical Examination

All certified scientific divers shall pass a medical examination at the intervals specified in Section 6.1.2. After each major illness or injury, as described in Sec. 6.1.2, a certified scientific diver shall receive clearance to return to diving from a physician before resuming diving activities.

5.6 REVOCATION OF CERTIFICATION

A diving certificate may be revoked or restricted for cause by the Diving Safety Officer or the DCB. Violations of regulations set forth in this manual, or other governmental subdivisions not in conflict with this manual, may be considered cause. The Diving Safety Officer shall inform the diver in writing of the reason(s) for revocation. The diver will be given the opportunity to present his/her case in writing for reconsideration and/or recertification. All such written statements and requests, as identified in this section, are formal documents which will become part of the diver's file.

5.7 RECERTIFICATION

If a diver's certificate expires or is revoked, he/she may be recertified after complying with such conditions as the Diving Safety Officer or the DCB may impose. The diver shall be given an opportunity to present his/her case to the DCB before conditions for recertification are stipulated.

SECTION 6.0 MEDICAL STANDARDS

6.1 MEDICAL REQUIREMENTS

6.1.1 General

6.1.1.1 HCNSO shall determine that divers have passed a current diving physical examination and have been declared by the examining physician to be fit to engage in diving activities as may be limited or restricted in the medical evaluation report.

6.1.1.2 All medical evaluations required by this standard shall be performed by, or under the direction of, a licensed physician of the applicant-diver's choice, preferably one trained in diving/undersea medicine.

6.1.1.3 The diver should be free of any chronic disabling disease and be free of any conditions contained in the list of conditions for which restrictions from diving are generally recommended (Appendix 1).

6.1.2 Frequency of Medical Evaluations

Medical evaluation shall be completed:

6.1.2.1 before a diver may begin diving, unless an equivalent initial medical evaluation has been given within the preceding 5 years (3 years if over the age of 40) (The HCNSO DSO and DCB needs to obtain results and review the examination).

6.1.2.2 thereafter, at 5 year intervals up to age 40 and every 3 years after the age of 40, and every 2 years after the age of 60.

6.1.2.3 clearance to return to diving must be obtained from a physician following any major injury or illness, or any condition requiring hospital care. If the injury or illness is pressure related, then the clearance to return to diving must come from a physician trained in diving medicine.

6.1.3. Information Provided Examining Physician

HCNSO shall provide a copy of the medical evaluation requirements of this standard to the examining physician (Appendices 1, 2, and 3).

6.1.4 Content of Medical Evaluations

Medical examinations conducted initially and at the intervals specified in section 6.1.2 shall consist of the following:

6.1.4.1 Applicant agreement for release of medical information to the Diving Safety Officer and the DCB (See Appendix 2).

6.1.4.2 Medical history (See Appendix 3)

6.1.4.3 Diving physical examination (Section 6.15 and Appendix 2).

6.1.5 Conditions Which May Disqualify Candidates from Diving

See Appendix 1 (Adapted from Bove, 1998).

6.1.6 Laboratory Requirements for Diving Medical Evaluation and Intervals:

6.1.6.1 Initial examination under age 40:

- Medical History
- Complete Physical Exam, emphasis on neurological and otological components
- Urinalysis
- Any further tests deemed necessary by the physician.

6.1.6.2 Periodic re-examination under age 40 (every 5 years):

- Medical History
- Complete Physical Exam, emphasis on neurological and otological components
- Urinalysis
- Any further tests deemed necessary by the physician

6.1.6.3 Initial Exam over age 40

- Medical History
- Complete Physical Exam, emphasis on neurological and otological components
- Assessment of coronary artery disease risk factors including lipid profile and diabetic screening
- Resting EKG
- Chest X-ray
- Urinalysis
- Any further tests deemed necessary by the physician.

*Exercise stress testing may be indicated based on risk factor analysis

6.1.6.4 Periodic re-examination over age 40 (every 3 years); over age 60 (every 2 years):

- Medical History
- Complete Physical Exam, emphasis on neurological and otological components
- Assessment of coronary artery disease risk factors including lipid profile and diabetic screening
- Resting EKG

- Urinalysis
 - Any further tests deemed necessary by the physician.
- *Exercise stress testing may be indicated based on risk factor analysis

6.1.7 Physician's Written Report.

6.1.7.1 After any medical examination relating to the individual's fitness to dive, the HCNSO shall obtain a written report prepared by the examining physician, which shall contain the examining physician's opinion of the individual's fitness to dive, including any recommended restrictions or limitations. This will be reviewed by the DCB.

6.1.7.2 HCNSO shall make a copy of the physician's written report available to the individual.

SECTION 7.0 NITROX DIVING GUIDELINES

The following guidelines address the use of nitrox by scientific divers under the auspices of HCNSO. Nitrox is defined for these guidelines as breathing mixtures composed predominately of nitrogen and oxygen, most commonly produced by the addition of oxygen or the removal of nitrogen from air.

7.1 PREREQUISITES

7.1.1 Eligibility

Only a certified Scientific Diver or Scientific Diver In Training (Sec. 4.0 and 5.0) diving under the auspices of a member organization is eligible for authorization to use nitrox. After completion, review and acceptance of application materials, training and qualification, an applicant will be authorized to use nitrox within his/her depth authorization, as specified in Sec 5.4.

7.1.2 Application and documentation

Application and documentation for authorization to use nitrox should be made on forms specified by the Diving Control Board.

7.2 Requirements for Authorization to Use Nitrox

Submission of documents and participation in aptitude examinations does not automatically result in authorization to use nitrox. The applicant must convince the DSO and members of the DCB that he/she is sufficiently skilled and proficient. The signature of the DSO authorization form will acknowledge authorization. After completion of training and evaluation, authorization to use nitrox may be denied to any diver who does not demonstrate to the satisfaction of the DSO or DCB the appropriate judgment or proficiency to ensure the safety of the diver and dive buddy.

Prior to authorization to use nitrox, the following minimum requirements should be met:

7.2.1 Training

The diver must complete additional theoretical and practical training beyond the Scientific Diver In Training air certification level, to the satisfaction of HCNSO's DSO and DCB (see Section 7.3).

7.2.2 Examinations

Each diver should demonstrate proficiency in skills and theory in written, oral, and practical examinations covering:

1. Written examinations covering the information presented in the classroom training session(s) (i.e., gas theory, oxygen toxicity, partial pressure determination, etc.);
2. Practical examinations covering the information presented in the practical training session(s) (i.e., gas analysis, documentation procedures, etc.);

3. Openwater checkout dives, to appropriate depths, to demonstrate the application of theoretical and practical skills learned.

7.2.3 Minimum Activity to Maintain Authorization

The diver should log at least one (1) nitrox dive per year. Failure to meet the minimum activity level may be cause for restriction or revocation of nitrox authorization.

7.3 NITROX TRAINING GUIDELINES

Training in these guidelines should be in addition to training for Diver In Training authorization (Sec. 4.0). It may be included as part of training to satisfy the Scientific Diver training requirements (Sec. 5.3).

7.3.1 Classroom Instruction

1. Topics should include, but are not limited to: review of previous training; physical gas laws pertaining to nitrox; partial pressure calculations and limits; equivalent air depth (EAD) concept and calculations; oxygen physiology and oxygen toxicity; calculation of oxygen exposure and maximum safe operating depth (MOD); determination of decompression schedules (both by EAD method using approved air dive tables and by using approved nitrox dive tables); dive planning and emergency procedures; mixing procedures and calculations; gas analysis; personnel requirements; equipment marking and maintenance requirements; dive station requirements.

2. The DCB may choose to limit standard nitrox diver training to procedures applicable to diving, and subsequently reserve training such as nitrox production methods, oxygen cleaning, and dive station topics to divers requiring specialized authorization in these areas.

7.3.2 Practical Training

The practical training portion will consist of a review of skills as stated for scuba (Sec. 4.00), with additional training as follows:

1. Oxygen analysis of nitrox mixtures;
2. Determination of MOD, oxygen partial pressure exposure, and oxygen toxicity time limits for various nitrox mixtures at various depths;
3. Determination of nitrogen-based dive limits status by EAD method using air dive tables, and/or using nitrox dive tables, as approved by the DCB;
4. Nitrox dive computer use may be included, as approved by the DCB.

7.3.3 Written Examination (based on classroom instruction and practical training)

Before authorization, the trainee should successfully pass a written examination demonstrating knowledge of at least the following:

1. Function, care, use, and maintenance of equipment cleaned for nitrox use;
2. Physical and physiological considerations of nitrox diving (ex.: O₂ and CO₂ toxicity);
3. Diving regulations and procedures as related to nitrox diving, either scuba or surface-supplied (depending on intended mode);
4. Given the proper information, calculation of:
 - a. Equivalent air depth (EAD) for a given fO₂ and actual depth;
 - b. pO₂ exposure for a given fO₂ and depth;
 - c. Optimal nitrox mixture for a given pO₂ exposure limit and planned depth;
 - d. Maximum operational depth (MOD) for a given mix and pO₂ exposure limit;
 - e. For nitrox production purposes, percentages/psi of oxygen present in a given mixture, and psi of each gas required to produce a fO₂ by partial pressure mixing.
5. Decompression table and dive computer selection and usage;
6. Nitrox production methods and considerations;
7. Oxygen analysis;
8. Nitrox operational guidelines (Section 7.4), dive planning, and dive station components.

7.3.4 Openwater Dives

A minimum of two supervised openwater dives using nitrox should be required for authorization. The mode used in the dives should correspond to the intended application (i.e., scuba or surface-supplied). If the MOD for the mix being used can be exceeded at the training location, direct, in-water supervision is required.

7.3.5 Surface-Supplied Training

All training as applied to surface-supplied diving (practical, classroom, and openwater) will follow HCNSO's surface-supplied diving standards (see the DSO and DCB before initiating surface-supplied diving activities).

7.4 SCIENTIFIC NITROX DIVING REGULATIONS

7.4.1 Dive Personnel Requirements

a) Nitrox Diver In Training

A Diver In Training, who has completed the requirements of Section 4.0 and the training and authorization sections of these guidelines, may be authorized by the DSO to use nitrox under the direct supervision a Scientific Diver who also holds nitrox authorization. Dive depths should be restricted to those specified in the diver's authorization.

b) Scientific Diver

A Scientific Diver who has completed the requirements of Section 5.0 and the training and authorization sections of these guidelines, may be authorized by the DSO to use nitrox. Depth authorization to use nitrox should be the same as those specified in the diver's authorization, as described in Sec. 5.4.

c) Lead Diver

On any dive during which nitrox will be used by any team member, the Lead Diver should be authorized to use nitrox, and hold appropriate authorizations required for the dive, as specified in this manual. Lead Diver authorization for nitrox dives by the DSO and/or DCB should occur as part of the dive plan approval process.

In addition to responsibilities listed in Section 1.2.6, the Lead diver should:

1. As part of the dive planning process, verify that all divers using nitrox on a dive are properly qualified and authorized;
2. As part of the pre-dive procedures, confirm with each diver the nitrox mixture the diver is using, and establish dive team maximum depth and time limits, according to the shortest time limit or shallowest depth limit among the team members.
3. The Lead Diver should also reduce the maximum allowable pO₂ exposure limit for the dive team if on-site conditions so indicate (see Sec. 7.4.)

7.4.2 Dive Parameters

a) Oxygen Exposure Limits

1. The inspired oxygen partial pressure experienced at depth should not exceed 1.6 ATA. All dives performed using nitrox breathing mixtures should comply with the current *NOAA Diving Manual* "Oxygen Partial Pressure Limits for 'Normal' Exposures".

2. The maximum allowable exposure limit should be reduced in cases where cold or strenuous dive conditions, or extended exposure times are expected. The DCB should

consider this in the review of any dive plan application which proposes to use nitrox. The Lead Diver should also review on-site conditions and reduce the allowable pO_2 exposure limits if conditions indicate.

3. If using the equivalent air depth (EAD), method the maximum depth of a dive should be based on the oxygen partial pressure for the specific nitrox breathing mix to be used.

b) Bottom Time Limits

1. Maximum bottom time should be based on the depth of the dive and the nitrox mixture being used.

2. Bottom time for a single dive should not exceed the NOAA maximum allowable “Single Exposure Limit” for a given oxygen partial pressure, as listed in the current NOAA Diving Manual.

c) Decompression Tables and Gases

1. A set of DCB approved nitrox decompression tables should be available at the dive site.

2. When using the equivalent air depth (EAD) method, dives should be conducted using air decompression tables approved by the DCB.

3. If nitrox is used to increase the safety margin of air-based dive tables, the maximum operating depth (MOD) and oxygen exposure and time limits for the nitrox mixture being dived should not be exceeded

4. Breathing mixtures used while performing in-water decompression, or for bail-out purposes, should contain the same or greater oxygen content as that being used during the dive, within the confines of depth limitations and the oxygen partial pressure limits set forth in Sec. 7.4.2

d) Nitrox Dive Computers

1. Dive computers may be used to compute decompression status during nitrox dives. Manufacturers’ guidelines and operations instructions should be followed.

2. Use of Nitrox dive computers should comply with dive computer guidelines included in the NSU-OC Standards.

3. Nitrox dive computer users should demonstrate a clear understanding of the display, operations, and manipulation of the unit being used for nitrox diving prior to using the computer, to the satisfaction of the DSO or his/her designee.

4. If nitrox is used to increase the safety margin of an air-based dive computer, the MOD and oxygen exposure and time limits for the nitrox mixture being dived should not be exceeded.

5. Dive computers capable of pO_2 limit and fO_2 adjustment should be checked by the diver prior to the start of each dive to assure compatibility with the mix being used.

e) Repetitive Diving

1. Repetitive dives using nitrox mixtures should be performed in compliance with procedures required of the specific dive tables used.

2. Residual nitrogen time should be based on the EAD for the specific nitrox mixture to be used on the repetitive dive, and not that of the previous dive.

3. The total cumulative exposure (bottom time) to a partial pressure of oxygen in a given 24 hour period should not exceed the current *NOAA Diving Manual* “24-hour Oxygen Partial Pressure Limits for ‘Normal’ Exposures”.

4. When repetitive dives expose divers to different oxygen partial pressures from dive to dive, divers should account for accumulated oxygen exposure from previous dives when determining acceptable exposures for repetitive dives. Both acute (CNS) and chronic (pulmonary) oxygen toxicity concerns should be addressed.

f) Oxygen Parameters

1. Authorized Mixtures - Mixtures meeting the criteria outlined in Sec. 7.4. may be used for nitrox diving operations, upon approval of the DCB.

2. Purity - Oxygen used for mixing nitrox breathing gas should meet the purity levels for “Medical Grade” (U.S.P.) or “Aviator Grade” standards.

In addition to the Air Quality Standards (Sec. 3.6), the following standard should be met for breathing air that is either

- a. placed in contact with oxygen concentrations greater than 40%, or
- b. used in nitrox production by the partial pressure mixing method with gas mixtures containing greater than 40% oxygen as the enriching agent:

Air Purity:	CGA Grade E (AAUS Sec. 3.60)
Condensed Hydrocarbons:	5mg/m ³
HydroCarbon Contaminants:	No greater than 0.1 mg/m ³

g) Gas Mixing and Analysis for Organizational Members

1. Personnel Requirements

a. Individuals responsible for producing and/or analyzing nitrox mixtures should be knowledgeable and experienced in all aspects of the technique.

b. Only those individuals approved by the DSO and/or DCB should be responsible for mixing and/or analyzing nitrox mixtures.

2. Production Methods

It is the responsibility of the DCB to approve the specific nitrox production method used.

3. Analysis Verification by User

a. It is the responsibility of each diver to analyze prior to the dive the oxygen content of his/her scuba cylinder and acknowledge in writing the following information for each cylinder: fO_2 , MOD, cylinder pressure, date of analysis, and user's name.

b. Individual dive log reporting forms should report fO_2 of nitrox used, if different than 21%.

7.5. NITROX DIVING EQUIPMENT

All of the designated equipment and stated requirements regarding scuba equipment required in this manual should also apply to nitrox scuba operations. Additional minimal equipment necessary for nitrox diving operations includes:

- Labeled SCUBA Cylinders
- Oxygen Analyzers

Oxygen Cleaning and Maintenance Requirements

a) Requirement for Oxygen Service

1. All equipment which during the dive or cylinder filling process is exposed to concentrations greater than 40% oxygen at pressures above 150 psi should be cleaned and maintained for oxygen service.

2. Equipment used with oxygen or mixtures containing over forty percent (40%) by volume oxygen shall be designed and maintained for oxygen service. Oxygen systems over 125 psig shall have slow-opening shut-off valves. This should include the following equipment: scuba cylinders, cylinder valves, scuba and other regulators, cylinder pressure gauges, hoses, diver support equipment, compressors, and fill station components and plumbing.

b) Scuba Cylinder Identification Marking

Scuba cylinders to be used with nitrox mixtures should have the following identification documentation affixed to the cylinder.

1. Cylinders should be marked “NITROX” or “EANx” or “Enriched Air”.

2. Nitrox identification color coding should include a 4-inch wide green band around the cylinder, starting immediately below the shoulder curvature. If the cylinder is not yellow, the green band should be bordered above and below by a 1-inch yellow band.

3. The alternate marking of a yellow cylinder by painting the cylinder crown green and printing the word “NITROX” parallel to the length of the cylinder in green print is acceptable.

4. Other markings which identify the cylinder as containing gas mixes other than air may be used at the approval of the DCB.

5. A contents label should be affixed, to include the current fO_2 , date of analysis, and MOD.

6. The cylinder should be labeled to indicate whether the cylinder is prepared for oxygen or nitrox mixtures containing greater than 40% oxygen.

c) Regulators

Regulators to be used with nitrox mixtures containing greater than 40% oxygen should be cleaned and maintained for oxygen service, and marked in an identifying manner.

d) Other Support Equipment

1. An oxygen analyzer is required which is capable of determining the oxygen content in the scuba cylinder. Two analyzers are recommended to reduce the likelihood of errors due to a faulty analyzer. The analyzer should be capable of reading a scale of 0 to 100% oxygen, within (one) 1% accuracy.

2. All diver and support equipment should be suitable for the fO_2 being used.

e) Compressor system

1. The compressor/filtration system **MUST** produce oil-free air.

2. An oil-lubricated compressor placed in service for a nitrox system should be checked for oil and hydrocarbon contamination at least quarterly.

f) Fill Station Components

All components of a nitrox fill station which will contact nitrox mixtures containing greater than 40% oxygen should be cleaned and maintained for oxygen service. This includes cylinders, whips, gauges, valves, and connecting lines.

SECTION 8.0 AQUARIUM DIVING OPERATIONS

No diver shall plan or conduct aquarium diving operations without prior approval of the Diving Control Board.

SECTION 9.0 STAGED DECOMPRESSION DIVING

No diver shall plan or conduct staged decompression dives without prior approval of the Diving Control Board. Decompression diving shall be defined as any diving during which the diver cannot perform a direct return to the surface without performing a mandatory decompression stop to allow the release of inert gas from the diver's body.

SECTION 10.0 MIXED GAS DIVING

No diver shall plan or conduct mixed gas dives without prior approval of the Diving Control Board.

SECTION 11.0 OTHER DIVING TECHNOLOGY

Certain types of diving, some of which are listed below, require equipment or procedures that require training. Supplementary guidelines for these technologies are in development by the AAUS. NSUOC scientific divers using these, must follow guidelines established by the Diving Control Board. Divers shall comply with all scuba diving procedures in this standard unless specified.

11.1 BLUE WATER DIVING

No diver shall plan or conduct blue water diving without prior approval of the Diving Control Board. Blue water diving is defined as diving in open water where the bottom is generally >200 feet deep. It requires special training and the use of multiple-tethered diving

techniques. Specific guidelines that should be followed are outlined in "Blue Water Diving Guidelines" (California Sea Grant Publ. No. T-CSGCP-014).

11.2 ICE AND POLAR DIVING

No diver shall plan or conduct ice and polar diving without prior approval of the Diving Control Board. Divers planning to dive under ice or in polar conditions should use the following: "Guidelines for Conduct of Research Diving" National Science Foundation, Division of Polar Programs, 1990.

11.3 OVERHEAD ENVIRONMENTS

No diver shall plan or conduct overhead environment diving without prior approval of the Diving Control Board. Where an enclosed or confined space is not large enough for two divers, a diver shall be stationed at the underwater point of entry and an orientation line shall be used.

11.4 SATURATION DIVING

No diver shall plan or conduct saturation diving without prior approval of the Diving Control Board. If using open circuit compressed air scuba in saturation diving operations, divers shall comply with the saturation diving guidelines of the HCNSO.

11.5 HOOKAH

No diver shall plan or conduct hookah diving without prior approval of the Diving Control Board.

Divers using the hookah mode shall be equipped with a diver-carried independent reserve breathing gas supply.

Each hookah diver shall be hose-tended by a separate dive team member while in the water.

The hookah breathing gas supply shall be sufficient to support all hookah divers in the water for the duration of the planned dive, including decompression.

11.6 SURFACE SUPPLIED DIVING

No diver shall plan or conduct surface supplied diving without prior approval of the Diving Control Board. Surface supplied divers shall comply with all scuba diving procedures

in this manual (except Sec. 2.3.1). Surface supplied diving shall not be conducted at depths greater than 190 fsw (58 msw).

Divers using the surface supplied mode shall be equipped with a diver-carried independent reserve breathing gas supply.

Each surface supplied diver shall be hose tended by a separate dive team member while in the water.

Divers using the surface supplied mode shall maintain voice communication with the surface tender.

The surface supplied breathing gas supply shall be sufficient to support all surface supplied divers in the water for the duration of the planned dive, including decompression.

During surface supplied diving operations when only one diver is in the water, there must be a standby diver in attendance at the dive location.

11.7 CLOSED AND SEMI-CLOSED CIRCUIT SCUBA (REBREATHERS)

No diver shall plan or conduct semi-closed circuit scuba diving without prior approval of the Diving Control Board. Closed and semi-closed circuit scuba (rebreathers) shall meet the following requirements:

Oxygen partial pressure in the breathing gas shall not exceed values approved by the HCNSO's DCB. The generally accepted maximum value is 1.5 atmospheres ppO₂ at depths greater than 25 fsw (7.6 msw).

Chemicals used for the absorption of carbon dioxide shall be kept in a cool, dry location in a sealed container until required for use.

The designated person-in-charge shall determine that the carbon dioxide absorption canister is used in accordance with the manufacturer's instructions.

Closed and semi-closed diving equipment will not be used at a depth greater than that recommended by the manufacturer of the equipment.

SECTION 12.0 REBREATHERS

This section defines specific considerations regarding the following issues for the use of rebreathers:

- Training and/or experience verification requirements for authorization
- Equipment requirements
- Operational requirements and additional safety protocols to be used

Application of this standard is in addition to pertinent requirements of all other sections of the AAUS Standards for Scientific Diving, Volumes 1 and 2.

For rebreather dives that also involve staged decompression and/or mixed gas diving, all requirements for each of the relevant diving modes shall be met. Diving Control Board reserves the authority to review each application of all specialized diving modes, and include any further requirements deemed necessary beyond those listed here on a case-by-case basis.

No diver shall conduct planned operations using rebreathers without prior review and approval of the DCB.

In all cases, trainers shall be qualified for the type of instruction to be provided. Training shall be conducted by agencies or instructors approved by DSO and DCB.

12.10 Definitions and General Information

Rebreathers are defined as any device that recycles some or all of the exhaled gas in the breathing loop and returns it to the diver. Rebreathers maintain levels of oxygen and carbon dioxide that support life by metered injection of oxygen and chemical removal of carbon dioxide. These characteristics fundamentally distinguish rebreathers from open-circuit life support systems, in that the breathing gas composition is dynamic rather than fixed.

Advantages of rebreathers may include increased gas utilization efficiencies that are often independent of depth, extended no-decompression bottom times and greater decompression efficiency, and reduction or elimination of exhaust bubbles that may disturb aquatic life or sensitive environments.

Disadvantages of rebreathers include high cost and, in some cases, a high degree of system complexity and reliance on instrumentation for gas composition control and monitoring, which may fail. The diver is more likely to experience hazardous levels of hypoxia, hyperoxia, or hypercapnia, due to user error or equipment malfunction, conditions which may lead to underwater blackout and drowning. Inadvertent flooding of the breathing loop and wetting of the carbon dioxide absorbent may expose the diver to ingestion of an alkaline slurry ("caustic cocktail").

An increased level of discipline and attention to rebreather system status by the diver is required for safe operation, with a greater need for self-reliance. Rebreather system design and operation varies significantly between make and model. For these reasons when evaluating any dive plan incorporating rebreathers, risk-management emphasis should be placed on the individual qualifications of the diver on the specific rebreather make and model to be used, in addition to specific equipment requirements and associated operational protocols.

Oxygen Rebreathers. Oxygen rebreathers recycle breathing gas, consisting of pure oxygen, replenishing the oxygen metabolized by the diver. Oxygen rebreathers are generally the least complicated design, but are normally limited to a maximum operation depth of 20fsw due to the risk of unsafe hyperoxic exposure.

Semi-Closed Circuit Rebreathers. Semi-closed circuit rebreathers (SCR) recycle the majority of exhaled breathing gas, venting a portion into the water and replenishing it with a constant or variable amount of a single oxygen-enriched gas mixture. Gas addition and venting is balanced against diver metabolism to maintain safe oxygen levels by means which differ between SCR models, but the mechanism usually provides a semi-constant fraction of oxygen (FO_2) in the breathing loop at all depths, similar to open-circuit SCUBA.

Closed-Circuit Mixed Gas Rebreathers. Closed-circuit mixed gas rebreathers (CCR) recycle all of the exhaled gas and replace metabolized oxygen via an electronically controlled valve, governed by electronic oxygen sensors. Manual oxygen addition is available as a diver override, in case of electronic system failure. A separate inert gas source (diluent), usually containing primarily air, heliox, or trimix, is used to maintain oxygen levels at safe levels when diving below 20fsw. CCR systems operate to maintain a constant oxygen partial pressure (PPO_2) during the dive, regardless of depth.

12.20 Prerequisites

Specific training requirements for use of each rebreather model shall be defined by DCB on a case-by-case basis. Training shall include factory-recommended requirements, but may exceed this to prepare for the type of mission intended (e.g., staged decompression or heliox/trimix CCR diving).

Training Prerequisites

Active scientific diver status, with depth qualification sufficient for the type, make, and model of rebreather, and planned application.

Completion of a minimum of 50 open-water dives on SCUBA.

For SCR or CCR, a minimum 100-fsw-depth qualification is generally recommended, to ensure the diver is sufficiently conversant with the complications of deeper diving. If the sole expected application for use of rebreathers is shallower

than this, a lesser depth qualification may be allowed with the approval of the DCB.

Nitrox training. Training in use of nitrox mixtures containing 25% to 40% oxygen is required. Training in use of mixtures containing 40% to 100% oxygen may be required, as needed for the planned application and rebreather system. Training may be provided as part of rebreather training.

Training

Successful completion of the following training program qualifies the diver for rebreather diving using the system on which the diver was trained, in depths of 130fsw and shallower, for dives that do not require decompression stops, using nitrogen/oxygen breathing media.

Satisfactory completion of a rebreather training program authorized or recommended by the manufacturer of the rebreather to be used, or other training approved by the DCB. Successful completion of training does not in itself authorize the diver to use rebreathers. The diver must demonstrate to the DCB or its designee that the diver possesses the proper attitude, judgment, and discipline to safely conduct rebreather diving in the context of planned operations.

Classroom training shall include:

A review of those topics of diving physics and physiology, decompression management, and dive planning included in prior scientific diver, nitrox, staged decompression and/or mixed gas training, as they pertain to the safe operation of the selected rebreather system and planned diving application.

In particular, causes, signs and symptoms, first aid, treatment and prevention of the following must be covered:

- Hyperoxia (CNS and Pulmonary Oxygen Toxicity)
- Middle Ear Oxygen Absorption Syndrome (oxygen ear)
- Hyperoxia-induced myopia
- Hypoxia
- Hypercapnia
- Inert gas narcosis
- Decompression sickness

Rebreather-specific information required for the safe and effective operation of the system to be used, including:

- System design and operation, including:
 - Counterlung(s)
 - CO₂ scrubber
 - CO₂ absorbent material types, activity characteristics, storage, handling and disposal
 - Oxygen control system design, automatic and manual
 - Diluent control system, automatic and manual (if any)
- Pre-dive set-up and testing
- Post-dive break-down and maintenance
- Oxygen exposure management
- Decompression management and applicable decompression tracking methods

- Dive operations planning
- Problem recognition and management, including system failures leading to hypoxia, hyperoxia, hypercapnia, flooded loop, and caustic cocktail
- Emergency protocols and bailout procedures

Practical Training (with model of rebreather to be used)

A minimum number of hours of underwater time.

Type	Pool/Confined Water	O/W Training	O/W Supervised
Oxygen Rebreather	1 dive, 90 min	4 dives, 120 min.*	2 dives, 60 min
Semi-Closed Circuit	1 dive, 90-120 min	4 dives, 120 min.**	4 dives, 120 min
Closed-Circuit	1 dive, 90-120 min	8 dives, 380 min.***	4 dives, 240 min
<p>* Dives should not exceed 20 fsw. ** First two dives should not exceed 60 fsw. Subsequent dives should be at progressively greater depths, with at least one dive in the 80 to 100 fsw range. *** Total underwater time (pool and open water) of approximately 500 minutes. First two open water dives should not exceed 60 fsw. Subsequent dives should be at progressively greater depths, with at least 2 dives in the 100 to 130 fsw range.</p>			

Amount of required in-water time should increase proportionally to the complexity of rebreather system used.

Training shall be in accordance with the manufacturer's recommendations.

Practical Evaluations

Upon completion of practical training, the diver must demonstrate to the DCB or its designee proficiency in pre-dive, dive, and post-dive operational procedures for the particular model of rebreather to be used. Skills shall include, at a minimum:

- Oxygen control system calibration and operation checks
- Carbon dioxide absorbent canister packing
- Supply gas cylinder analysis and pressure check
- Test of one-way valves
- System assembly and breathing loop leak testing
- Pre-dive breathing to test system operation
- In-water leak checks
- Buoyancy control during descent, bottom operations, and ascent
- System monitoring and control during descent, bottom operations, and ascent
- Proper interpretation and operation of system instrumentation (PO₂ displays, dive computers, gas supply pressure gauges, alarms, etc, as applicable)
- Unit removal and replacement on the surface.
- Bailout and emergency procedures for self and buddy, including:
 - System malfunction recognition and solution
 - Manual system control
 - Flooded breathing loop recovery (if possible)
 - Absorbent canister failure
 - Alternate bailout options
 - Symptom recognition and emergency procedures for hyperoxia, hypoxia, and

hypercapnia

- Proper system maintenance, including:
 - Full breathing loop disassembly and cleaning (mouthpiece, check-valves, hoses, counterlung, absorbent canister, etc.)
 - Oxygen sensor replacement (for SCR and CCR)
 - Other tasks required by specific rebreather models

Written Evaluation

A written evaluation approved by the DCB with a pre-determined passing score, covering concepts of both classroom and practical training, is required.

Supervised Rebreather Dives

Upon successful completion of open water training dives, the diver is authorized to conduct a series of supervised rebreather dives, during which the diver gains additional experience and proficiency.

Supervisor for these dives should be the DSO or designee, and should be an active scientific diver experienced in diving with the make/model of rebreather being used.

Dives at this level may be targeted to activities associated with the planned science diving application. See the following table for number and cumulative water time for different rebreather types.

Type	Pool/Confined Water	O/W Training	O/W Supervised
Oxygen Rebreather	1 dive, 90 min	4 dives, 120 min.*	2 dives, 60 min
Semi-Closed Circuit	1 dive, 90-120 min	4 dives, 120 min.**	4 dives, 120 min
Closed-Circuit	1 dive, 90-120 min	8 dives, 380 min.***	4 dives, 240 min

* Dives should not exceed 20 fsw.
 ** First two dives should not exceed 60 fsw. Subsequent dives should be at progressively greater depths, with at least one dive in the 80 to 100 fsw range.
 *** Total underwater time (pool and open water) of approximately 500 minutes. First two open water dives should not exceed 60 fsw. Subsequent dives should be at progressively greater depths, with at least 2 dives in the 100 to 130 fsw range.

Maximum ratio of divers per designated dive supervisor is 4:1. The supervisor may dive as part of the planned operations.

Extended Range, Required Decompression and Helium-Based Inert Gas

Rebreather dives involving operational depths in excess of 130 fsw, requiring staged decompression, or using diluents containing inert gases other than nitrogen are subject to additional training requirements, as determined by DCB on a case-by-case basis. Prior experience with required decompression and mixed gas diving using open-circuit SCUBA is desirable, but is not sufficient for transfer to dives using rebreathers without additional training.

As a prerequisite for training in staged decompression using rebreathers, the diver shall have logged a minimum of 25 hours of underwater time on the rebreather system to be used, with at least 10 rebreather dives in the 100 fsw to 130 fsw range.

As a prerequisite for training for use of rebreathers with gas mixtures containing **inert**

gas other than nitrogen, the diver shall have logged a minimum of 50 hours of underwater time on the rebreather system to be used and shall have completed training in stage decompression methods using rebreathers. The diver shall have completed at least 12 dives requiring staged decompression on the rebreather model to be used, with at least 4 dives near 130 fsw.

Training shall be in accordance with standards for required-decompression and mixed gas diving, as applicable to rebreather systems, starting at the 130 fsw level.

Maintenance of Proficiency

To maintain authorization to dive with rebreathers, an authorized diver shall make at least one dive using a rebreather every 8 weeks. For divers authorized for the conduct of extended range, stage decompression or mixed-gas diving, at least one dive per month should be made to a depth near 130 fsw, practicing decompression protocols.

For a diver in arrears, the DCB shall approve a program of remedial knowledge and skill tune-up training and a course of dives required to return the diver to full authorization. The extent of this program should be directly related to the complexity of the planned rebreather diving operations.

12.30 Equipment Requirements

General Requirements

Only those models of rebreathers specifically approved by DCB shall be used.

Rebreathers should be manufactured according to acceptable Quality Control/Quality Assurance protocols, as evidenced by compliance with the essential elements of ISO 9004. Manufacturers should be able to provide to the DCB supporting documentation to this effect.

Unit performance specifications should be within acceptable levels as defined by standards of a recognized authority (CE, US Navy, Royal Navy, NOAA, etc...).

Prior to approval, the manufacturer should supply the DCB with supporting documentation detailing the methods of specification determination by a recognized third-party testing agency, including unmanned and manned testing. Test data should be from a recognized, independent test facility.

The following documentation for each rebreather model to be used should be available as a set of manufacturer's specifications. These should include:

- Operational depth range
- Operational temperature range
- Breathing gas mixtures that may be used
- Maximum exercise level which can be supported as a function of breathing gas and depth
- Breathing gas supply durations as a function of exercise level and depth
- CO₂ absorbent durations, as a function of depth, exercise level, breathing gas, and water temperature
- Method, range and precision of inspired PPO₂ control, as a function of depth, exercise level, breathing gas, and temperature
- Likely failure modes and backup or redundant systems designed to protect

the diver if such failures occur

- Accuracy and precision of all readouts and sensors
- Battery duration as a function of depth and temperature
- Mean time between failures of each subsystem and method of determination

A complete instruction manual is required, fully describing the operation of all rebreather components and subsystems as well as maintenance procedures.

A maintenance log is required. The unit maintenance shall be up-to-date based upon manufacturer's recommendations.

Minimum Equipment

A surface/dive valve in the mouthpiece assembly, allowing sealing of the breathing loop from the external environment when not in use.

An automatic gas addition valve, so that manual volumetric compensation during descent is unnecessary.

Manual gas addition valves, so that manual volumetric compensation during descent and manual oxygen addition at all times during the dive are possible.

The diver shall carry alternate life support capability (open-circuit bail-out or redundant rebreather) sufficient to allow the solution of minor problems and allow reliable access to a pre-planned alternate life support system.

Oxygen Rebreathers

Oxygen rebreathers shall be equipped with manual and automatic gas addition valves.

Semi-Closed Circuit Rebreathers.

SCR's shall be equipped with at least one manufacturer-approved oxygen sensor sufficient to warn the diver of impending hypoxia. Sensor redundancy is desirable, but not required.

Closed Circuit Mixed-gas Rebreathers.

CCR shall incorporate a minimum of three independent oxygen sensors.

A minimum of two independent displays of oxygen sensor readings shall be available to the diver.

Two independent power supplies in the rebreather design are desirable. If only one is present, a secondary system to monitor oxygen levels without power from the primary battery must be incorporated.

CCR shall be equipped with manual diluent and oxygen addition valves, to enable the diver to maintain safe oxygen levels in the event of failure of the primary power supply or automatic gas addition systems.

Redundancies in onboard electronics, power supplies, and life support systems are highly desirable.

12.40 Operational Requirements

General Requirements

All dives involving rebreathers must comply with applicable operational requirements for open-circuit SCUBA dives to equivalent depths.

No rebreather system should be used in situations beyond the manufacturer's stated design limits (dive depth, duration, water temperature, etc).

Modifications to rebreather systems shall be in compliance with manufacturer's recommendations.

Rebreather maintenance is to be in compliance with manufacturer's recommendations including sanitizing, replacement of consumables (sensors, CO₂ absorbent, gas, batteries, etc) and periodic maintenance.

Dive Plan. In addition to standard dive plan components stipulated in AAUS Section 2.0, all dive plans that include the use of rebreathers must include, at minimum, the following details:

- Information about the specific rebreather model to be used
- Make, model, and type of rebreather system
- Type of CO₂ absorbent material
- Composition and volume(s) of supply gases
- Complete description of alternate bailout procedures to be employed, including manual rebreather operation and open-circuit procedures
- Other specific details as requested by DCB

Buddy Qualifications.

A diver whose buddy is diving with a rebreather shall be trained in basic rebreather operation, hazard identification, and assist/rescue procedures for a rebreather diver.

If the buddy of a rebreather diver is using open-circuit scuba, the rebreather diver must be equipped with a means to provide the open-circuit scuba diver with a sufficient supply of open-circuit breathing gas to allow both divers to return safely to the surface.

Oxygen Exposures

Planned oxygen partial pressure in the breathing gas shall not exceed 1.4 atmospheres at depths greater than 30 feet.

Planned oxygen partial pressure set point for CCR shall not exceed 1.4 atm. Set point at depth should be reduced to manage oxygen toxicity according to the NOAA Oxygen Exposure Limits.

Oxygen exposures should not exceed the NOAA oxygen single and daily exposure limits. Both CNS and pulmonary (whole-body) oxygen exposure indices

should be tracked for each diver.

Decompression Management

DCB shall review and approve the method of decompression management selected for a given diving application and project.

Decompression management can be safely achieved by a variety of methods, depending on the type and model of rebreather to be used. Following is a general list of methods for different rebreather types:

Oxygen rebreathers: Not applicable.

SCR (presumed constant FO_2):

- Use of any method approved for open-circuit scuba diving breathing air, above the maximum operational depth of the supply gas.
- Use of open-circuit nitrox dive tables based upon expected inspired FO_2 . In this case, contingency air dive tables may be necessary for active-addition SCR's in the event that exertion level is higher than expected.
- Equivalent air depth correction to open-circuit air dive tables, based upon expected inspired FO_2 for planned exertion level, gas supply rate, and gas composition. In this case, contingency air dive tables may be necessary for active-addition SCR's in the event that exertion level is higher than expected.

CCR (constant PPO_2):

- Integrated constant PPO_2 dive computer.
- Non-integrated constant PPO_2 dive computer.
- Constant PPO_2 dive tables.
- Open-circuit (constant FO_2) nitrox dive computer, set to inspired FO_2 predicted using PPO_2 set point at the maximum planned dive depth.
- Equivalent air depth (EAD) correction to standard open-circuit air dive tables, based on the inspired FO_2 predicted using the PPO_2 set point at the maximum planned dive depth.
- Air dive computer, or air dive tables used above the maximum operating depth (MOD) of air for the PPO_2 setpoint selected.

Maintenance Logs, CO2 Scrubber Logs, Battery Logs, and Pre-And Post-Dive Checklists

Logs and checklists will be developed for the rebreather used, and will be used before and after every dive. Diver shall indicate by initialing that checklists have been completed before and after each dive. Such documents shall be filed and maintained as permanent project records. No rebreather shall be dived which has failed any portion of the pre-dive check, or is found to not be operating in accordance with manufacturer's specifications. Pre-dive checks shall include:

- Gas supply cylinders full
- Composition of all supply and bail-out gases analyzed and documented
- Oxygen sensors calibrated
- Carbon dioxide canister properly packed
- Remaining duration of canister life verified
- Breathing loop assembled
- Positive and negative pressure leak checks
- Automatic volume addition system working
- Automatic oxygen addition systems working
- Pre-breathe system for 3 minutes (5 minutes in cold water) to ensure proper oxygen addition and carbon dioxide removal (be alert for signs of hypoxia or hypercapnia)
- Other procedures specific to the model of rebreather used
- Documentation of ALL components assembled
- Complete pre-dive system check performed
- Final operational verification immediately before to entering the water:
 - PO₂ in the rebreather is not hypoxic
 - Oxygen addition system is functioning;
 - Volumetric addition is functioning
 - Bail-out life support is functioning

Alternate Life Support System

The diver shall have reliable access to an alternate life support system designed to safely return the diver to the surface at normal ascent rates, including any required decompression in the event of primary rebreather failure. The complexity and extent of such systems are directly related to the depth/time profiles of the mission.

Examples of such systems include, but are not limited to:

Open-circuit bailout cylinders or sets of cylinders, either carried or pre-positioned

Redundant rebreather

Pre-positioned life support equipment with topside support

CO2 Absorbent Material

CO₂ absorption canister shall be filled in accordance with the manufacturer's specifications.

CO₂ absorbent material shall be used in accordance with the manufacturer's specifications for expected duration.

If CO₂ absorbent canister is not exhausted and storage between dives is planned, the canister should be removed from the unit and stored sealed and protected from ambient air, to ensure the absorbent retains its activity for subsequent dives.

Long-term storage of carbon dioxide absorbents shall be in a cool, dry location in a sealed container. Field storage must be adequate to maintain viability of material until use.

Consumables (e.g., batteries, oxygen sensors, etc.)

Other consumables (e.g., batteries, oxygen sensors, etc.) shall be maintained, tested, and replaced in accordance with the manufacturer's specifications.

Unit Disinfections

The entire breathing loop, including mouthpiece, hoses, counterlungs, and CO₂ canister, should be disinfected periodically according to manufacturer's specifications. The loop must be disinfected between each use of the same rebreather by different divers.

12.50 Oxygen Rebreathers

Oxygen rebreathers shall not be used at depths greater than 20 feet.

Breathing loop and diver's lungs must be adequately flushed with pure oxygen prior to entering the water on each dive. Once done, the diver must breathe continuously and solely from the intact loop, or re-flushing is required.

Breathing loop shall be flushed with fresh oxygen prior to ascending to avoid hypoxia due to inert gas in the loop.

12.60 Semi-Closed Circuit Rebreathers

The composition of the injection gas supply of a semi-closed rebreather shall be chosen such that the partial pressure of oxygen in the breathing loop will not drop below 0.2 atm, even at maximum exertion at the surface.

The gas addition rate of active addition SCR (e.g., Draeger Dolphin and similar units) shall be checked before every dive, to ensure it is balanced against expected workload and supply gas FO₂.

The intermediate pressure of supply gas delivery in active-addition SCR shall be checked periodically, in compliance with manufacturer's recommendations.

Maximum operating depth shall be based upon the FO₂ in the active supply cylinder.

Prior to ascent to the surface the diver shall flush the breathing loop with fresh gas or switch to an open-circuit system to avoid hypoxia. The flush should be at a

depth of approximately 30 fsw during ascent on dives deeper than 30 fsw, and at bottom depth on dives 30 fsw and shallower.

12.70 Closed-Circuit Rebreathers

The FO_2 of each diluent gas supply used shall be chosen so that, if breathed directly while in the depth range for which its use is intended, it will produce an inspired PPO_2 greater than 0.20 atm but no greater than 1.4 atm.

Maximum operating depth shall be based on the FO_2 of the diluent in use during each phase of the dive, so as not to exceed a PO_2 limit of 1.4 atm.

Divers shall monitor both primary and secondary oxygen display systems at regular intervals throughout the dive, to verify that readings are within limits, that redundant displays are providing similar values, and whether readings are dynamic or static (as an indicator of sensor failure).

The PPO_2 set point shall not be lower than 0.4 atm or higher than 1.4 atm.

SCIENTIFIC DIVING PROGRAM MANUAL



SCIENTIFIC DIVING PROGRAM MANUAL

APPENDICES

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APPENDIX 1

DIVING MEDICAL EXAM OVERVIEW FOR THE EXAMINING PHYSICIAN

TO THE EXAMINING PHYSICIAN:

This person, _____, requires a medical examination to assess their fitness for certification as a Scientific Diver for the Nova Southeastern University Oceanographic Center. Their answers on the Diving Medical History Form (attached) may indicate potential health or safety risks as noted. Your evaluation is requested on the attached scuba Diving Fitness Medical Evaluation Report. If you have questions about diving medicine, you may wish to consult one of the references on the attached list or contact one of the physicians with expertise in diving medicine whose names and phone numbers appear on an attached list. Please contact the undersigned Diving Safety Officer if you have any questions or concerns about diving medicine or the NSUOC standards. Thank you for your assistance.

<i>Lance Robinson</i> _____	_____
Diving Safety Officer	Date
<u>Lance Robinson</u> _____	954 262 3662 _____
Printed Name	Phone Number

Scuba and other modes of compressed-gas diving can be strenuous and hazardous. A special risk is present if the middle ear, sinuses, or lung segments do not readily equalize air pressure changes. The most common cause of distress is eustachian insufficiency. Most fatalities involve deficiencies in prudence, judgment, emotional stability, or physical fitness. Please consult the following list of conditions that usually restrict candidates from diving. (Adapted from Bove, 1998: bracketed numbers are pages in Bove)

CONDITIONS WHICH MAY DISQUALIFY CANDIDATES FROM DIVING

1. Abnormalities of the tympanic membrane, such as perforation, presence of a monomeric membrane, or inability to autoinflate the middle ears. [5 ,7, 8, 9]
2. Vertigo including Meniere's Disease. [13]
3. Stapedectomy or middle ear reconstructive surgery. [11]
4. Recent ocular surgery. [15, 18, 19]
5. Psychiatric disorders including claustrophobia, suicidal ideation, psychosis, anxiety states, untreated depression. [20 - 23]
6. Substance abuse, including alcohol. [24 - 25]
7. Episodic loss of consciousness. [1, 26, 27]
8. History of seizure. [27, 28]
9. History of stroke or a fixed neurological deficit. [29, 30]
10. Recurring neurologic disorders, including transient ischemic attacks. [29, 30]
11. History of intracranial aneurysm, vascular malformation or intracranial hemorrhage. [31]
12. History of neurological decompression illness with residual deficit. [29, 30]
13. Head injury with sequelae. [26, 27]

14. Hematologic disorders including coagulopathies. [41, 42]
15. Evidence of coronary artery disease or high risk for coronary artery disease. [33 - 35] (“Assessment of Cardiovascular Risk by Use of Multiple-Risk-Factor Assessment Equations.” Grundy et. al. 1999. AHA/ACC Scientific Statement. <http://www.acc.org/clinical/consensus/risk/risk1999.pdf>)
16. Atrial septal defects. [39]
17. Significant valvular heart disease - isolated mitral valve prolapse is not disqualifying. [38]
18. Significant cardiac rhythm or conduction abnormalities. [36 - 37]
19. Implanted cardiac pacemakers and cardiac defibrillators (ICD). [39, 40]
20. Inadequate exercise tolerance. [34]
21. Severe hypertension. [35]
22. History Medical Society, Kensington, MD. Page 46)
24. Chronic of spontaneous or traumatic pneumothorax. [45]
23. Asthma. [42 - 44] (“Are Asthmatics Fit to Dive?” Elliott DH, ed. 1996 Undersea and Hyperbaric pulmonary disease, including radiographic evidence of pulmonary blebs, bullae, or cysts. [45,46]
25. Diabetes mellitus. [46 - 47]
26. Pregnancy. [56]

SELECTED REFERENCES IN DIVING MEDICINE

Most of these are available from Best Publishing Company, P.O. Box 30100, Flagstaff, AZ 86003-0100, the Divers Alert Network (DAN) or the Undersea and Hyperbaric Medical Association (UHMS), Bethesda, MD.

- ACC/AHA Guidelines for Exercise Testing. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Exercise Testing). Gibbons RJ, et al. 1997. Journal of the American College of Cardiology. 30:260-311. <http://www.acc.org/clinical/guidelines/exercise/exercise.pdf>
- Alert Diver Magazine; Articles on diving medicine <http://www.diversalertnetwork.org/medical/articles/index.asp>
- “Are Asthmatics Fit to Dive?” Elliott DH, ed. 1996 Undersea and Hyperbaric Medical Society, Kensington, MD.
- “Assessment of Cardiovascular Risk by Use of Multiple-Risk-Factor Assessment Equations.” Grundy et. al. 1999. AHA/ACC Scientific Statement. <http://www.acc.org/clinical/consensus/risk/risk1999.pdf>
- DIVING MEDICINE, Third Edition, 1997. A. Bove and J. Davis. W.B. Saunders Company, Philadelphia
- DIVING AND SUBAQUATIC MEDICINE, Third Edition, 1994. C. Edmonds, C. Lowery and J. Pennefather. Butterworth-Heinemann Ltd. Oxford
- MEDICAL EXAMINATION OF SPORT SCUBA DIVERS, 1998. Alfred Bove, M.D., Ph.D. (ed.). Medical Seminars, Inc. San Antonio, TX
- NOAA DIVING MANUAL, NOAA. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.
- U.S. NAVY DIVING MANUAL. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.

APPENDIX 2

MEDICAL EVALUATION OF FITNESS FOR SCUBA DIVING REPORT

 Name of Applicant (Print or Type)

 Date (Mo/Day/Year)

To The PHYSICIAN:

This person is an applicant for training or is presently certified to engage in diving with self-contained underwater breathing apparatus (scuba). This is an activity that puts unusual stress on the individual in several ways. Your opinion on the applicant's medical fitness is requested. Scuba diving requires heavy exertion. The diver must be free of cardiovascular and respiratory disease. An absolute requirement is the ability of the lungs, middle ear and sinuses to equalize pressure. Any condition that risks the loss of consciousness should disqualify the applicant.

TESTS: Please initial that the following tests were completed.

(x) Initial Examination under age 40 Medical History Complete Physical Exam with emphasis on neurological and otological components Urinalysis Any further tests deemed necessary by the physician**() First exam over age 40** Medical History Complete Physical Exam with emphasis on neurological and otological components

Detailed assessment of coronary artery disease risk factors using Multiple-Risk Factor Assessment (age, family history, lipid profile, blood pressure, diabetic screening, smoking history). Further cardiac screening may be indicated based on risk factor assessment.

 Resting EKG Chest X-ray Urinalysis Any further tests deemed necessary by the physician

Periodic re-examination over age 40 (every 3 years); over age 60 (every 2 years):

-----Medical History

____ Complete Physical Exam with emphasis on neurological and otological components

-----Detailed assessment of coronary artery disease risk factors using Multiple-Risk Factor Assessment (age, family history, lipid profile, blood pressure, diabetic screening, smoking history). Further cardiac screening may be indicated based on risk factor assessment.

-----Resting EKG

-----Urinalysis

-----Any further tests deemed necessary by the physician

RECOMMENDATION:

[] APPROVAL. I find no medical condition(s) that I consider incompatible with diving.

[] RESTRICTED ACTIVITY APPROVAL. The applicant may dive in certain circumstances as described in REMARKS.

[] FURTHER TESTING REQUIRED. I have encountered a potential contraindication to diving. Additional medical tests must be performed before a final assessment can be made. See REMARKS.

[] REJECT. This applicant has medical condition(s), which, in my opinion, clearly would constitute unacceptable hazards to health and safety in diving

⁵ “Assessment of Cardiovascular Risk by Use of Multiple-Risk-Factor Assessment Equations.” Grundy et. al. 1999. AHA/ACC Scientific Statement. <http://www.acc.org/clinical/consensus/risk/risk1999.pdf>

⁶ Gibbons RJ, et al. ACC/AHA Guidelines for Exercise Testing. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Exercise Testing). Journal of the American College of Cardiology. 30:260-311, 1997. <http://www.acc.org/clinical/guidelines/exercise/exercise.pdf>

REMARKS:

have discussed the patient’s medical condition(s) which would not seriously interfere with diving but which may seriously compromise subsequent health. The patient understands the nature of the hazards and the risks involved in diving with these defects.

Date _____ Signature _____ **M.D.**

Name(Print/Type) _____

Address _____

Telephone Number _____

My familiarity with applicant is:

_____ With this exam only

_____ Regular Physician for _____ years

_____ Other (describe) _____

My familiarity with diving medicine is: _____

APPLICANT’S RELEASE OF MEDICAL INFORMATION FORM

I authorize the release of this information and all medical information subsequently acquired in association with my diving to the NSUOC Diving Safety Officer and Diving Control Board or their designee at (place) _____ on (date)_____.

Signature of Applicant _____

APPENDIX 3 DIVING MEDICAL HISTORY FORM

(To Be Completed By Applicant-Diver)

Name _____

Sex _____ Age _____ Wt. _____ Ht. _____

Sponsor: Nova Southeastern University Oceanographic Center Date ____/____/____

TO THE APPLICANT:

Scuba diving makes considerable demands on you, both physically and mentally. Diving with certain medical conditions may be asking for trouble not only for yourself, but also to anyone coming to your aid if you get into difficulty in the water. Therefore, it is prudent to meet certain medical and physical requirements before beginning a diving or training program. Your answers to the questions are as important, in determining your fitness as your physical examination. Obviously, you should give accurate information or the medical screening procedure becomes useless.

This form shall be kept confidential. If you believe any question amounts to invasion of your privacy, you may elect to omit an answer, provided that you shall subsequently discuss that matter with your own physician and they must then indicate, in writing, that you have done so and that no health hazard exists.

Should your answers indicate a condition, which might make diving hazardous, you will be asked to review the matter with your physician. In such instances, their written authorization will be required in order for further consideration to be given to your application. If your physician concludes that diving would involve undue risk for you, remember that they are concerned only with your well-being and safety.

Please respect the advice and the intent of this medical history form.

Have you ever had or do you presently have any of the following? Yes No Comments

1. Trouble with your ears, including ruptured eardrum, difficulty clearing your ears, or surgery. _____
2. Trouble with dizziness. _____
3. Eye surgery. _____
4. Depression, anxiety, claustrophobia, etc. _____
5. Substance abuse, including alcohol. _____
6. Loss of consciousness. _____
7. Epilepsy or other seizures, convulsions, or fits. _____
8. Stroke or a fixed neurological deficit. _____
9. Recurring neurologic disorders, including transient ischemic attacks. _____
10. Aneurysms or bleeding in the brain. _____
11. Decompression sickness or embolism. _____
12. Head injury. _____

- 13. Disorders of the blood, or easy bleeding. _____
- 14. Heart disease, diabetes, high cholesterol. _____
- 15. Anatomical heart abnormalities including patent foramen ovale, valve problems, etc. ____
- 16. Heart rhythm problems. _____
- 17. Need for a pacemaker. _____
- 18. Difficulty with exercise. _____
- 19. High blood pressure. _____
- 20. Collapsed lung. _____
- 21. Asthma. _____
- 22. Other lung disease. _____
- 23. Diabetes mellitus. _____
- 24. Pregnancy. _____
- 25 Surgery If yes explain below. _____
- 26. Hospitalizations. If yes explain below. _____
- 27. Do you take any medications? If yes list below. _____
- 28. Do you have any allergies to medications, foods, environmental?
If yes explain below. _____
- 29. Do you smoke? _____
- 30. Do you drink alcoholic beverages? _____
- 31. Is there a family history of high cholesterol? _____
- 32. Is there a family history of heart disease or stroke? _____
- 33. Is there a family history of diabetes? _____
- 34. Is there a family history of asthma? _____

Please explain any “yes” answers to the above questions.

I certify that the above answers and information represent an accurate and complete description of my medical history.

Signature _____ Date _____

APPENDIX 4
RECOMMENDED PHYSICIANS WITH EXPERTISE IN DIVING
MEDICINE

List of local Medical Doctors that have training and expertise in diving or undersea medicine:

1. _____

Name
Address
Telephone

2. _____

Name
Address
Telephone

3. _____

Name
Address
Telephone

4. _____

Name
Address
Telephone

APPENDIX 5

DEFINITION OF TERMS

- Air sharing - Sharing of an air supply between divers.
- ATA(s) - “Atmospheres Absolute”, Total pressure exerted on an object, by a gas or mixture of gases, at a specific depth or elevation, including normal atmospheric pressure.
- Breath-hold Diving - A diving mode in which the diver uses no self-contained or surface-supplied air or oxygen supply.
- Buddy Breathing - Sharing of a single air source between divers.
- Buddy Diver - Second member of the dive team.
- Buddy System - Two comparably equipped scuba divers in the water in constant communication.
- Buoyant Ascent - An ascent made using some form of positive buoyancy.
- Burst Pressure - Pressure at which a pressure containment device would fail structurally.
- Certified Diver - A diver who holds a recognized valid certification from an organizational member or internationally recognized certifying agency.
- Controlled Ascent - Any one of several kinds of ascents including normal, swimming, and air sharing ascents where the diver(s) maintain control so a pause or stop can be made during the ascent.
- Cylinder - A pressure vessel for the storage of gases.
- Decompression Chamber - A pressure vessel for human occupancy. Also called a hyperbaric chamber or decompression chamber.
- Decompression Sickness - A condition with a variety of symptoms which may result from gas and bubbles in the tissues of divers after pressure reduction.
- Dive - A descent into the water, an underwater diving activity utilizing compressed gas, an ascent, and return to the surface.
- Dive Computer- A microprocessor based device which computes a diver’s theoretical decompression status, in real time, by using pressure (depth) and time as input to a decompression model, or set of decompression tables, programmed into the device.
- Dive Location - A surface or vessel from which a diving operation is conducted.
- Dive Site - Physical location of a diver during a dive.
- Dive Table - A profile or set of profiles of depth-time relationships for ascent rates and breathing mixtures to be followed after a specific depth-time exposure or exposures.
- Diver - An individual in the water who uses apparatus, including snorkel, which supplies breathing gas at ambient pressure.
- Diver-In-Training - An individual gaining experience and training in additional diving activities under the supervision of a dive team member experienced in those activities.
- Diver-Carried Reserve Breathing Gas - A diver-carried independent supply of air or mixed gas (as appropriate) sufficient under standard operating conditions to allow the diver to reach the surface, or another source of breathing gas, or to be reached by another diver.
- Diving Mode - A type of diving required specific equipment, procedures, and techniques, for example: snorkel, scuba, surface-supplied air, or mixed gas.

- Diving Control Board (DCB) - Group of individuals who act as the official representative of the membership organization in matters concerning the scientific diving program (Section 1.24).
- Diving Safety Officer (DSO) - Individual responsible for the safe conduct of the scientific diving program of the membership organization (Section 1.23).
- EAD - Equivalent Air Depth (see below).
- Emergency Ascent - An ascent made under emergency conditions where the diver exceeds the normal ascent rate.
- Enriched Air (EAN_x) - A name for a breathing mixture of air and oxygen when the percent of oxygen exceeds 21%. This term is considered synonymous with the term “nitrox” (Section 7.00).
- Equivalent Air Depth (EAD) - Depth at which air will have the same nitrogen partial pressure as the nitrox mixture being used. This number, expressed in units of feet seawater or saltwater, will always be less than the actual depth for any enriched air mixture.
- fN₂ - Fraction of nitrogen in a gas mixture, expressed as either a decimal or percentage, by volume.
- fO₂ - Fraction of oxygen in a gas mixture, expressed as either a decimal or percentage, by volume.
- FFW – Feet or freshwater, or equivalent static head.
- FSW - Feet of seawater, or equivalent static head.
- Hookah Diving - A type of shallow water surface-supplied diving where there is no voice communication with the surface.
- Hyperbaric Chamber - See decompression chamber.
- Hyperbaric Conditions - Pressure conditions in excess of normal atmospheric pressure at the dive location.
- Lead Diver - Certified scientific diver with experience and training to conduct the diving operation.
- Maximum Working Pressure - Maximum pressure to which a pressure vessel may be exposed under standard operating conditions.
- Organizational Member - An organization which is a current member of the AAUS, and which has a program which adheres to the standards of the AAUS as set forth in the AAUS Standards for Scientific Diving Certification and Operation of Scientific Diving Programs.
- Mixed Gas - MG
- Mixed-Gas Diving - A diving mode in which the diver is supplied in the water with a breathing gas other than air.
- MOD - Maximum Operating Depth, usually determined as the depth at which the pO₂ for a given gas mixture reaches a predetermined maximum.
- MSW - Meters of seawater or equivalent static head.
- Nitrox - Any gas mixture comprised predominately of nitrogen and oxygen, most frequently containing between 21% and 40% oxygen. Also be referred to as Enriched Air Nitrox, abbreviated EAN.
- NOAA Diving Manual: Refers to the *NOAA Diving Manual, Diving for Science and Technology*, 2001 edition. National Oceanic and Atmospheric Administration, Office of Undersea Research, US Department of Commerce.

No-Decompression limits - Depth-time limits of the “no-decompression limits and repetitive dive group designations table for no-decompression air dives” of the U.S. Navy Diving Manual or equivalent limits.

Normal Ascent - An ascent made with an adequate air supply at a rate of 60 feet per minute or less.

Oxygen Clean - All combustible contaminants have been removed.

Oxygen Compatible - A gas delivery system that has components (o-rings, valve seats, diaphragms, etc.) that are compatible with oxygen at a stated pressure and temperature.

Oxygen Service - A gas delivery system that is both oxygen clean and oxygen compatible.

Oxygen Toxicity Unit - OTU

Oxygen Toxicity - Any adverse reaction of the central nervous system (“acute” or “CNS” oxygen toxicity) or lungs (“chronic”, “whole-body”, or “pulmonary” oxygen toxicity) brought on by exposure to an increased (above atmospheric levels) partial pressure of oxygen.

Pressure-Related Injury - An injury resulting from pressure disequilibrium within the body as the result of hyperbaric exposure. Examples include: decompression sickness, pneumothorax, mediastinal emphysema, air embolism, subcutaneous emphysema, or ruptured eardrum.

Pressure Vessel - See cylinder.

pN₂ - Inspired partial pressure of nitrogen, usually expressed in units of atmospheres absolute.

pO₂ - Inspired partial pressure of oxygen, usually expressed in units of atmospheres absolute.

Psi - Unit of pressure, “pounds per square inch.

Psig - Unit of pressure, “pounds per square inch gauge.

Recompression Chamber - see decompression chamber.

Scientific Diving - Scientific diving is defined (29CFR1910.402) as diving performed solely as a necessary part of a scientific, research, or educational activity by employees whose sole purpose for diving is to perform scientific research tasks.

Scuba Diving - A diving mode independent of surface supply in which the diver uses open circuit selfcontained underwater breathing apparatus.

Standby Diver - A diver at the dive location capable of rendering assistance to a diver in the water.

Surface Supplied Diving - A diving mode in which the diver in the water is supplied from the dive location with compressed gas for breathing.

Swimming Ascent - An ascent which can be done under normal or emergency conditions accomplished by simply swimming to the surface.

Umbilical - Composite hose bundle between a dive location and a diver or bell, or between a diver and a bell, which supplies a diver or bell with breathing gas, communications, power, or heat, as appropriate to the diving mode or conditions, and includes a safety line between the diver and the dive location.

Working Pressure - Normal pressure at which the system is designed to operate

APPENDIX 6

AAUS REQUEST FOR DIVING RECIPROCITY FORM VERIFICATION OF DIVER TRAINING AND EXPERIENCE

A scientific diver that is currently certified under the auspices of an organizational member institution of the American Academy of Underwater Sciences (AAUS) shall be recognized by any other organizational member of AAUS and may apply for reciprocity in order to dive with the host organization. Organizational members that are in good standing with AAUS operate, at a minimum, under the AAUS Standards for Scientific Diving Certification and Operation of Scientific Diving Programs (1996 edition). The visiting diver will comply with the diving regulations of the host organization's Diving Safety Manual unless previously arranged by both organization's Diving Control Boards. The host organization has the right to approve or deny this request and may require, at a minimum, a checkout dive with the Diving Safety Officer (DSO) or designee of the host organization. If the request is denied, the host organization should notify to the DSO of the visiting diver the reason for the denial. The DSO for the visiting scientific diver has confirmed the following information:

(Date)

_____ Written scientific diving examination

_____ Last diving medical examination

_____ Most recent checkout dive

_____ Scuba regulator/equipment service/test

_____ CPR training (Agency) _____

_____ Oxygen administration (Agency) _____

_____ First aid for diving _____

_____ Date of last dive

Number of dives completed within previous 12 months? _____

Depth certification _____

Any restrictions? (Y/N) _____ if yes, explain:

Please check any pertinent specialty certifications:

_____ Dry Suit	_____ Rescue	_____ Blue water
_____ Dive Computer	_____ Divemaster	_____ Altitude
_____ Nitrox	_____ Instructor	_____ Ice/Polar
_____ Mixed gas	_____ EMT	_____ Cave
_____ Closed Circuit	_____ Dive Accident Management	_____ Night
_____ Saturation	_____ Chamber Operator	Other
_____ Decompression	_____ Lifesaving	

Name of diver:

Emergency Information: (To notify in an emergency)

Name: Relationship:

Telephone: (work) (home)

Address:

This is to verify that the above individual is currently a certified scientific diver at:
Nova Southeastern University Oceanographic Center.

Diving Safety Officer: _____

(Signature) _____
(Date)

(Print) (Telephone, FAX, e-mail)

APPENDIX 7

DIVING EMERGENCY MANAGEMENT PROCEDURES

A diving accident victim could be any person who has been breathing air underwater regardless of depth. It is essential that emergency procedures are pre-planned and that medical treatment is initiated as soon as possible. It is the responsibility of each AAUS organizational member to develop procedures for diving emergencies including evacuation and medical treatment for each dive location.

General Procedures

Depending on and according to the nature of the diving accident:

1. Make appropriate contact with victim or rescue as required.
2. Establish (A)irway, (B)reathing, (C)irculation as required.
3. Stabilize the victim
3. Administer 100% oxygen, if appropriate (in cases of Decompression Illness, or Near Drowning).
4. Call local Emergency Medical System (EMS) for transport to nearest medical treatment facility.

Explain the circumstances of the dive incident to the evacuation teams, medics and physicians.

Do not assume that they understand why 100% oxygen may be required for the diving accident victim or that recompression treatment may be necessary.

5. Call appropriate Diving Accident Coordinator for contact with diving physician and decompression chamber. etc.
6. Notify DSO or designee according to the Emergency Action Plan of the organizational member.
7. Complete and submit Incident Report Form (www.aaus.org) to the DCB of the organization and the AAUS (Section 2.72).

List of Emergency Contact Numbers Appropriate For Dive Location

Available Procedures

- Emergency care
- Recompression
- Evacuation

Emergency Plan Content

- Name, telephone number, and relationship of person to be contacted for each diver in the event of an emergency.
- Nearest operational decompression chamber.
- Nearest accessible hospital.
- Available means of transport.

LIST OF EMERGENCY PHONE NUMBERS

NSUOC DIVE SAFETY OFFICER: 954-262-3600
SEARCH & RESCUE / CASUALTY EVACUATION

1. U.S. COAST GUARD FT LAUDERDALE: 954-927-1611

2. U.S. COAST GUARD MIAMI: 305-536-5636

EMERGENCY MEDICAL SERVICES DIAL: 911

DAN [DIVING ACCIDENT NETWORK]: 919-684-8111

RADIO EMERGENCY FREQUENCIES INTERNATIONAL DISTRESS
COMMUNICATION ON MARINE VHF-FM RADIO AT 156.8 KHZ
CHANNEL 16

ATMOSPHERE HYPERBARIC CHAMBERS

1. MERCY HOSPITAL, MIAMI: 305-854-0300

2. SAINT MARY'S HOSPITAL,
WEST PALM BEACH: 561-844-6300

SEE DAN UNDERWATER DIVING ACCIDENT MANUAL IN DAN O₂
RESCUE PACK FOR EMERGENCY PROCEDURES
