

UNIVERSITY OF DELAWARE

Graduate College of Marine Studies

MANUAL FOR SCIENTIFIC DIVING

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LETTER OF AUTHORITY

Purpose

In order for the College of Marine Studies, University of Delaware, to comply with the OSHA scientific diving requirements, a scientific Diving Control Board (DCB) must be established within the College. To meet this requirement, the Dean of the College of Marine Studies grants the authorities described within the OSHA Code of Federal Regulations [29 CFR 1910.401 (a)(2)(iv)(B); Sec. 1.10 this document] to the College of Marine Studies SDCB to regulate scientific diving activities under the auspices of the Dean of the College of Marine Studies at the University of Delaware (UD-CMS).

Responsibilities

Under the authority of the office of the Dean of the College of Marine Studies, the UD-CMS SDCB is charged with the following responsibilities:

- Assuring compliance of scientific diving activities under the regulatory powers granted by the Dean of the College of Marine Studies to enforce the UD-CMS Scientific Diving Safety Standards.
- Executing the responsibilities for regulating scientific diving activities independently and autonomously of the office of the Dean of the College of Marine Studies.
- Establishing a Scientific Diving Safety Standards manual for scientific diving under the auspices of UD-CMS.
- Issuing and revoking UD-CMS scientific diving certification for individual divers.
- Acting as a board of investigation to inquire into the nature and cause of all diving accidents and all reported violations of the diving safety standards.
- Acting as a board of inquiry, whenever necessary, to consider scientific diver-related problems encountered under the auspices of the DCB.
- Annually reviewing, the activities of the scientific diving program at UD-CMS and submitting a detailed activity report to the Dean of the College of Marine Studies.
- Annually meeting to review dive operations and diver status/clearances within the program with the prompt distribution of those meeting minutes to the Dean of the College of Marine Studies.
- Meeting upon the specific request of the Dean of the College of Marine Studies or any member of the DCB to address a specific issue or problem with the prompt distribution of those meeting minutes to the Dean of the College of Marine Studies.
- Promoting safe diving by making available or establishing training/refresher programs on diving, diving medicine and first aid.
- Establishing criteria for equipment selection and use, and recommending new equipment or techniques.
- Establishing criteria for the inspection and maintenance of diving equipment.
- Ensuring that UD-CMS-owned air and mixed gas equipment meet OSHA air and mixed gas quality standards.

These authorities and responsibilities are hereby established for the UD-CMS DCB under the auspices of the Dean of the College of Marine Studies.

Date

Prof. Nancy M. Targett,
Interim Dean, College of Marine Studies

VOLUME 1

Sections 1.00 through 6.00

SECTION 1.00 GENERAL POLICY

1.10 Scientific Diving Standards

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 that will allow a working reciprocity between organizational members. Fulfillment of the purposes shall be consistent with the furtherance of research and safety.

This standard 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 AAUS organizational members that adhere to these minimum standards.

This standard was developed and written by 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 (29CFR1910, Subpart T) under certain conditions that are outlined below. The final guidelines for the exemption became effective in 1985 (Federal Register, Vol. 50, No.6, p.1046). AAUS is recognized by OSHA as the scientific diving standard setting organization.

Additional standards which extend this document may be adopted by the University of Delaware, College of Marine Studies (UD-CMS hereafter), according to local procedure.

Scientific Diving Definition

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.

Scientific Diving Exemption

OSHA has granted an exemption for scientific diving from commercial diving regulations under the following guidelines (Appendix B to 29CFR1910 Subpart T):

- a) 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.
- b) The purpose of the project using scientific diving is the advancement of science; therefore, information and data resulting from the project are non-proprietary.
- c) 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.
- d) 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.
- e) In addition, the scientific diving program shall contain at least the following elements

(29CFR1910.401):

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.
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.

Review of Standards

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

1.20 Operational Control

University of Delaware-Graduate College of Marine Studies Auspices Defined

For the purposes of these standards the auspices of UD-CMS includes any scientific diving operation in which UD-CMS 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 UD-CMS 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 with UD-CMS or are diving as members of an organization recognized by UD-CMS.

It is UD-CMS 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 UD-CMS Diving Control Board.

The Dean of the College of Marine Studies has the ultimate authority for the scientific diving program and its related activities. The Dean or an appropriate designee of their administrative office shall:

1. Provide administrative oversight of, and policy approval for, matters relating to the SDP and the DCB;
2. Ensure that effective and adequate support is provided for activities of the DCB in the conduct of its official responsibilities, and for activities related to the administration of the SDP;
3. Appoint a Diving Safety Officer (DSO), based on the recommendation of the DCB, who shall serve as an advisor to the DCB. The DSO shall perform routine administrative and diving-related duties and shall report directly to the Dean or their designee;
4. Ensure that the responsibilities of all DCB members are included in their performance plans during their tenure on the DCB.

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

UD-CMS Scientific Diving Standards and Safety Manual

Adherence to strict Scientific Diving Program guidelines has proven both feasible and effective in protecting the health and safety of scientific divers since 1972. The standards set forth in this manual are written in

compliance with the guidelines proscribed by the American Academy of Underwater Sciences (AAUS). The purpose of this document (UD-CMS SDSS manual) is to:

1. Ensure that the UD-CMS-Scientific Diving Program (SDP) remains in compliance with applicable OSHA regulations and the scientific diving exemption from OSHA commercial diving standards [FR 47(228): 53357-53365, 26 Nov. 1982 and FR 50(6): 1046-1050, 9 Jan. 1985];
2. Assure that the UD-CMS Diving Control Board (DCB) has, at a minimum, the necessary authority to fulfill its specific obligations under OSHA regulations;
3. Ensure that scientific divers and their supervisors comply with UD-CMS scientific diving procedures; and,
4. Set forth minimal standards for the SDP, the organization for the conduct of this program, and the fundamental regulations and procedures for safety, training, emergency evacuation and medical treatment procedures in scientific diving operations. It also establishes a framework for reciprocity with organizations that adhere to these minimum standards for joint scientific diving projects.

In many sections of this document, reference will be made to the document in total as it represents the full extent of the UD-CMS Scientific Diving Program. It is designated as the “**UD-CMS SDSS manual**” and presents the written authority of the Dean of the College of Marine Studies to regulate scientific diving activities falling under the auspices of the College of Marine Studies in accordance with the OSHA exemptions for scientific diving activities. The UD-CMS Scientific Diving Program (SDP) and the UD-CMS Scientific Diving Safety Standards (SDSS) are synonymous in that the SDP refers to the full implementation of the SDSS manual.

Diving Safety Officer

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

a) Qualifications

1. The DSO shall: be appointed by the Dean of the College of Marine Studies with the advice, counsel and recommendation of the Diving Control Board.
2. Shall be trained as a scientific diver.
3. Shall be a full member as defined by AAUS.
4. Shall be an active underwater instructor from a internationally recognized certifying agency.

b) Duties and Responsibilities

1. Shall be responsible, through the DCB, to the to the Dean of the College of Marine Studies, for the conduct of the CMS scientific diving program. 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 standard and all relevant regulations of the UD-CMS, rests with the Diving Safety Officer.
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.
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.
4. Shall suspend diving operations considered to be unsafe or unwise.
5. The DSO may recommend a waiver for specific requirements of training, examinations,

depth certification and minimum activity to maintain or re-instate the certification status of a diver in the UD-CMS SDP. Any waiver of the SDP requirements or diving practice standards set forth in the UD-CMS SDSS manual shall require a majority approval of the UD-CMS Diving control board.

Diving Control Board

- a) The Diving Control Board (DCB) shall consist of a majority of active scientific divers (3 to 5) from UD-CMS and three non-voting members. Voting members shall include the Diving Safety Officer, the responsible DCB voting members, which consist of : chairperson, vice chairperson, and a secretary. The administrative officer, Dean of College of Marine Studies, will appoint replacement members as necessary.

The DCB shall also consist of the following non-voting members: (1) The UD-Office of Risk Management, or its designated representative, shall serve as an advisor to the DCB and the Dean of the College of Marine Studies on all matters relevant to the SDP, including, but not restricted to, continued compliance of the UD-CMS SDP with liability and insurance requirements of the University of Delaware. (2) The UD-Office of Occupational Health and Safety (OHS), or its designated representative, shall serve as an advisor to the DCB and the Dean of the College of Marine Studies on all safety matters relevant to the SDP, including, but not restricted to, continued compliance of the UD-CMS SDP with applicable OSHA regulations. (3) The Dean of the College of Marine Studies shall appoint a graduate student representative to serve as an advisor to the DCB.

The DCB will meet (at a minimum) of once each year to review and discuss the status and activity of the UD-CMS SDP. At this annual meeting, the Office of Risk Management of the University of Delaware shall appoint a non-voting advisor from his/her office. The Occupational Health and Safety Officer of the University of Delaware shall appoint a non-voting safety advisor from his/her office.

The DCB may convene a meeting at any time of the year to address any serious or urgent concerns, and this meeting may be called in an executive session at which only voting-members are present. In some cases, it may be necessary for DCB members to respond quickly, or over large geographic distances, and in such situations voting decisions may be made by electronic mail provided those messages are incorporated into the operational records of the DCB.

- b) Has autonomous and absolute authority over the scientific diving program's operation.
- c) Shall approve and monitor diving projects.
- d) Shall review and revise the diving safety manual.
- e) Shall assure compliance with the diving safety manual.
- f) Shall certify the depths to which a diver has been trained.
- g) Shall take disciplinary action for unsafe practices.
- h) Shall assure adherence to the buddy system for scuba diving.
- i) Shall act as the official representative of the membership organization in matters concerning the scientific diving program.
- j) Shall act as a board of appeal to consider diver-related problems.
- k) Shall recommend the issue, reissue, or the revocation of diving certifications.

- l) Shall recommend changes in policy and amendments to AAUS and the membership organization's diving safety manual as the need arises.
- m) Shall establish and/or approve training programs through which the applicants for certification can satisfy the requirements of the UD-CMS diving safety manual.
- n) Shall suspend diving programs that are considered to be unsafe or unwise.
- o) Shall establish criteria for equipment selection and use.
- p) Shall recommend new equipment or techniques.
- q) Shall establish and/or approve facilities for the inspection and maintenance of diving and associated equipment.
- r) Shall ensure that air station(s) meet air quality standards as described in Section 3.60.
- s) Shall periodically review the Diving Safety Officer's performance and program.
- t) Shall sit as a board investigation to inquire into the nature and cause of diving accidents or violations of UD-CMS diving safety manual.

Instructional Personnel

- a) Qualifications - All personnel involved in diving instruction under the auspices of UD-CMS shall be qualified for the type of instruction being given.
- b) Selection - Instructional personnel will be selected by the responsible administrative officer, or designee, who will solicit the advice of the DCB in conducting preliminary screening of applicants for instructional positions.

Lead Diver

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

- a) Coordination with other known activities in the vicinity that are likely to interfere with diving operations.
- b) Ensuring all dive team members possess current certification and are qualified for the type of diving operation.
- c) Planning dives in accordance with Section 2.20
- d) Ensuring safety and emergency equipment is in working order and at the divesite
- e) Briefing dive team members on:
 1. Dive objectives.
 2. Unusual hazards or environmental conditions likely to affect the safety of the diving operation.
 3. Modifications to diving or emergency procedures necessitated by the specific diving operation.
 4. Suspending diving operations if in their opinion conditions are not safe.
 5. Reporting to the DSO and DCB any physical problems or adverse physiological effects including symptoms of pressure-related injuries.

Reciprocity and Visiting Scientific Diver

- a) 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.
- b) A Scientific Diver from UD-CMS 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 6, signed by the Chairperson of the home Diving Control Board.
- c) A visiting Scientific Diver may be asked to demonstrate their knowledge and skills for the planned dive.
- d) If UD-CMS denies a visiting Scientific Diver permission to dive, the Diving Control Board shall notify the visiting Scientific Diver and their Diving Control Board with an explanation of all reasons for the denial.

Waiver of Requirements

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

1.30 Consequence of Violation of Regulations by Scientific Divers

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

1.40 Consequences of Violation of Regulations by UD-CMS

Failure to comply with the regulations of this standard may be cause for the revocation or restriction of the UD-CMS recognition by AAUS.

1.50 Record Maintenance

The Diving Safety Officer or designee shall maintain permanent records for each Scientific Diver certified. The file shall include evidence of certification level, log sheets, results of current physical examination, reports of disciplinary actions by the UD-CMS Diving Control Board, and other pertinent information deemed necessary.

Availability of Records:

- a) Medical records shall be available to the attending physician of a diver or former diver when released in writing by the diver.
- b) Records and documents required by this standard shall be retained by the organizational member for the following period:
 1. Physician's written reports of medical examinations for dive team members – 5 years.
 2. Diving safety manual - current document only.
 3. Records of dive - 1 year, except 5 years where there has been an incident of pressure-related injury.
 4. Pressure-related injury assessment - 5 years.
 5. Equipment inspection and testing records - current entry or tag, or until equipment is withdrawn from service.

SECTION 2.00 DIVING REGULATIONS FOR SCUBA (OPEN CIRCUIT, COMPRESSED AIR)

2.10 Introduction

No person shall engage in scientific diving operations under the auspices of UD-CMS scientific diving program unless they hold a current certification issued pursuant to the provisions of this standard.

2.20 Pre-Dive Procedures

Dive Plans

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

- a) Divers qualifications, and the type of certificate or certification held by each diver.
- b) Emergency plan (Appendix 7) with the following information:
 1. Name, telephone number, and relationship of person to be contacted for each diver in the event of an emergency.
 2. Nearest operational decompression chamber.
 3. Nearest accessible hospital.
 4. Available means of transport.
- c) Approximate number of proposed dives.
- d) Location(s) of proposed dives.
- e) Estimated depth(s) and bottom time(s) anticipated.
- f) Decompression status and repetitive dive plans, if required.
- g) Proposed work, equipment, and boats to be employed.
- h) Any hazardous conditions anticipated.

Pre-dive Safety Checks

- a) Diver's Responsibility:
 1. Scientific divers shall conduct a functional check of their diving equipment in the presence of the diving buddy or tender.
 2. It is the diver's responsibility and duty to refuse to dive if, in their judgment, conditions are unfavorable, or if they would be violating the precepts of their training, of this standard, or the UD-CMS diving safety manual.
 3. No dive team member shall be required to be exposed to hyperbaric conditions against their will, except when necessary to prevent or treat a pressure-related injury.
 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.

- b) Equipment Evaluations
 - 1. Divers shall ensure that their equipment is in proper working order and that the equipment is suitable for the type of diving operation.
 - 2. Each diver shall have the capability of achieving and maintaining positive buoyancy.
- c) Site Evaluation - Environmental conditions at the site will be evaluated.

2.30 Diving Procedures

Solo Diving Prohibition

All diving activities shall assure adherence to the buddy system for scuba diving. This buddy system is based upon mutual assistance, especially in the case of an emergency.

Refusal to Dive

- a) The decision to dive is that of the diver. A diver may refuse to dive, without fear of penalty, whenever they feel it is unsafe for them to make the dive.
- b) 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 their judgment, conditions are unsafe or unfavorable, or if they would be violating the precepts of their training or the regulations in this standard.

Termination of the Dive

- a) It is the responsibility of the diver to terminate the dive, without fear of penalty, whenever they feel it is unsafe to continue the dive, unless it compromises the safety of another diver already in the water.
- b) 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.

Emergencies and Deviations from Regulations

Any diver may deviate from the requirements of this standard to the extent necessary to prevent or minimize a situation that 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.

2.40 Post-Dive Procedures

Post-Dive Safety Checks

- a) After the completion of a dive, each diver shall report any physical problems, symptoms of decompression sickness, or equipment malfunctions.
- b) When diving outside the no-decompression limits, the divers should remain awake for at least 1 hour after diving, and in the company of a dive team member who is prepared to transport them to a decompression chamber if necessary.

2.50 Emergency Procedures

Each dive project leader 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 (Appendix 7).

2.60 Flying After Diving

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

2.70 Record Keeping Requirements

Personal Diving Log

Each certified scientific diver shall log every dive made under the auspices of the UD-CMS program, and is encouraged to log all other dives. Standard forms will be provided by UD-CMS. 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 UD-CMS and shall include at least the following:

- a) Name of diver, buddy, and Lead Diver.
- b) Date, time, and location.
- c) Diving modes used.
- d) General nature of diving activities.
- e) Approximate surface and underwater conditions.
- f) Maximum depths, bottom time, and surface interval time.
- g) Diving tables or computers used.
- h) Detailed report of any near or actual incidents.

Required Incident Reporting

All diving incidents requiring recompression treatment, or resulting in moderate or serious injury, or death shall be reported to UD-CMS Diving Control Board and the AAUS.

UD-CMS 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:

- a) UD-CMS shall record and report occupational injuries and illnesses in accordance with requirements of the appropriate Labor Code section.
- b) If pressure-related injuries are suspected, or if symptoms are evident, the following additional information shall be recorded and retained by UD-CMS, with the record of the dive, for a period of 5 years:
 1. Complete AAUS Incident Report at <http://www.aaus.org>.
 2. Written descriptive report to include:
 - Name, address, phone numbers of the principal parties involved.
 - Summary of experience of divers involved.
 - Location, description of dive site, and description of conditions that led up to incident.
 - Description of symptoms, including depth and time of onset.
 - Description and results of treatment.
 - Disposition of case.

- Recommendations to avoid repetition.
- c) UD-CMS shall investigate and document any incident of pressure-related injury and prepare a report that is to be forwarded to AAUS during the annual reporting cycle. This report must first be reviewed and released by the UD-CMS Diving Control Board.

SECTION 3.00 DIVING EQUIPMENT

3.10 General Policy

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.

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

3.20 Equipment

Regulators

- a) Only those makes and models specifically approved by the Diving Safety Officer and the Diving Control Board shall be used.
- b) Scuba regulators shall be inspected and tested prior to first use and every 12 months thereafter.
- c) Regulators will consist of a primary second stage and an alternate air source (such as an octopus second stage or redundant air supply).

Breathing Masks and Helmets

Breathing masks and helmets shall have:

- a) A non-return valve at the attachment point between helmet or mask and hose, which shall close readily and positively.
- b) An exhaust valve.
- c) A minimum ventilation rate capable of maintaining the diver at the depth to which they are diving.

Scuba Cylinders

- a) Scuba cylinders shall be designed, constructed, and maintained in accordance with the applicable provisions of the Unfired Pressure Vessel Safety Orders.
- b) Scuba cylinders must be hydrostatically tested in accordance with DOT standards.
- c) Scuba cylinders must have an internal and external inspection at intervals not to exceed 12 months.
- d) Scuba cylinder valves shall be functionally tested at intervals not to exceed 12 months.

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.

Gauges

Gauges shall be inspected and tested before first use and every 12 months thereafter.

Flotation Devices

- a) Each diver shall have the capability of achieving and maintaining positive buoyancy.
- b) Personal flotation systems, buoyancy compensators, dry suits, or other variable volume buoyancy compensation devices shall be equipped with an exhaust valve.

- c) These devices shall be functionally inspected and tested at intervals not to exceed 12 months.

Timing Devices, Depth, and Pressure Gauges

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

Determination of Decompression Status: Dive Tables, Dive Computers

- a) A set of diving tables, approved by the Diving Control Board, must be available at the dive location.
- b) Dive computers may be utilized in place of diving tables, and must be approved by the Diving Control Board. AAUS recommendations on dive computers are available at <http://www.aaus.org>

3.30 Auxiliary Equipment

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.

3.40 Support Equipment

First aid supplies

A first aid kit and emergency oxygen shall be available.

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.

Compressor Systems – UD-CMS Controlled

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

- a) 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.
- b) Compressed air systems over 500 psig shall have slow-opening shut-off valves.
- c) All air compressor intakes shall be located away from areas containing exhaust or other contaminants.

3.50 Equipment Maintenance

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:

- a) Regulators
- b) Submersible pressure gauges
- c) Depth gauges

- d) Scuba cylinders
- e) Cylinder valves
- f) Diving helmets
- g) Submersible breathing masks
- h) Compressors
- i) Gas control panels
- j) Air storage cylinders
- k) Air filtration systems
- l) Analytical instruments
- m) Buoyancy control devices
- n) Dry suits

Compressor Operation and Air Test Records

- a) Gas analyses and air tests shall be performed on each UD-CMS controlled breathing air compressor at regular intervals of no more than 100 hours of operation or 6 months, whichever occurs first. The results of these tests shall be entered in a formal log and be maintained.
- b) A log shall be maintained showing operation, repair, overhaul, filter maintenance and temperature adjustment for each compressor.

3.60 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).

CGA Grade E	
Component	Maximum
Oxygen	20 - 22%/v
Carbon Monoxide	10 PPM/v
Carbon Dioxide	1000 PPM/v
Condensed Hydrocarbons	5 mg/m ³
Water Vapor	NS
Objectionable Odors	None

SECTION 4.00 ENTRY-LEVEL TRAINING REQUIREMENTS

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

4.10 Evaluation

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 Section 4.20 (Section 6.00 and Appendices 1 through 4).

Swimming Evaluation

Applicant shall successfully perform the following tests, or equivalent, in the presence of the Diving Safety Officer, or an examiner approved by the Diving Safety Officer.

- a) Swim underwater without swim aids for a distance of 25 yards without surfacing.
- b) Swim 400 yards in less than 12 minutes without swim aids.
- c) Tread water for 10 minutes, or 2 minutes without the use of hands, without swim aids.
- d) Without the use of swim aids, transport another person of equal size a distance of 25 yards in the water.

4.20 Scuba Training

Practical Training

The University of Delaware Graduate College of Marine Studies does not provide any scuba certification courses. Individuals willing to be involved in research diving will either already be certified or willing to attend a dive shop that provides a nationally recognized certification course.

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

- a) Enter water with full equipment.
- b) Clear face mask.
- c) 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.
- d) Demonstrate ability to alternate between snorkel and scuba while kicking.
- e) Demonstrate understanding of underwater signs and signals.
- f) Demonstrate simulated in-water mouth-to-mouth resuscitation.
- g) Rescue and transport, as a diver, a passive simulated victim of an accident.
- h) Demonstrate ability to remove and replace equipment while submerged.
- i) Demonstrate watermanship ability, which is acceptable to the instructor.

Written Examination

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

- a) Function, care, use and maintenance of diving equipment.

- b) Physics and physiology of diving.
- c) Diving regulations and precautions.
- d) Near-shore currents and waves.
- e) Dangerous marine animals.
- f) Emergency procedures, including buoyant ascent and ascent by air sharing.
- g) Currently accepted decompression procedures.
- h) Demonstrate the proper use of dive tables.
- i) Underwater communications.
- j) Aspects of fresh water and altitude diving.
- k) Hazards of breath-hold diving and ascents.
- l) Planning and supervision of diving operations.
- m) Diving hazards.
- n) 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.

Open Water Evaluation

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

- a) Surface dive to a depth of 10 feet in open water without scuba.
- b) Demonstrate proficiency in air sharing as both donor and receiver.
- c) Enter and leave open water or surf, or leave and board a diving vessel, while wearing scuba gear.
- d) Kick on the surface 400 yards while wearing scuba gear, but not breathing from the scuba unit.
- e) Demonstrate judgment adequate for safe diving.
- f) Demonstrate, where appropriate, the ability to maneuver efficiently in the environment, at and below the surface.
- g) Complete a simulated emergency swimming ascent.
- h) Demonstrate clearing of mask and regulator while submerged.
- i) Demonstrate ability to achieve and maintain neutral buoyancy while submerged.
- j) Demonstrate techniques of self-rescue and buddy rescue.
- k) Navigate underwater.
- l) Plan and execute a dive.
- m) 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 1 day.

SECTION 5.00 SCIENTIFIC DIVER CERTIFICATION

5.10 Certification Types

Scientific Diver Certification

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

Temporary Diver Permit

This permit constitutes a waiver of the requirements of Section 5.00 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 standard.

- a) Requirements of this section 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 standard, including medical requirements.

5.20 General Policy

AAUS requires that no person shall engage in scientific diving unless that person is authorized by UD-CMS pursuant to the provisions of this standard. Only a person diving under the auspices of UD-CMS that subscribes to the practices of AAUS is eligible for a scientific diver certification.

5.30 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 they are 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 judgment, under diving conditions, for the safety of the diver and their partner, may be denied UD-CMS scientific diving privileges. Minimum documentation and examinations required are as follows:

Prerequisites

- a) Application - Application for certification shall be made to the Diving Safety Officer on the form prescribed by UD-CMS.
- 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.

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)
 - Standard or Basic First Aid
 - 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 (Only 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 4.20 (Open Water Evaluation), with the DSO 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.

5.40 Depth Certifications

Depth Certifications and Progression to Next Depth Level

The UD-CMS-Scientific Diver certification will authorize the holder to dive to the depth indicated on the authorized dive plan. A diver shall not exceed his/her depth certification, unless accompanied by a diver certified to a greater depth. Under these circumstances, the diver may not exceed his/her depth limit by more than one step.

- a) Certification to 30 Foot Depth - Initial permit level, approved upon the successful completion of training listed in Section 4.00 and 5.30.
- b) 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.
- c) Certification to 100 Foot Depth - A diver holding a 60 foot certificate may be certified to a depth of 100 feet after successfully completing, 4 dives to depths between 61 and 100 feet. The diver shall also demonstrate proficiency in the use of the appropriate Dive Tables.
- d) Certification to 130 Foot Depth - A diver holding a 100 foot certificate may be certified to a depth of 130 feet after successfully completing, 4 dives to depths between 100 and 130 feet. The diver shall also demonstrate proficiency in the use of the appropriate Dive Tables.
- e) Certification to 150 Foot Depth - A diver holding a 130 foot certificate may be certified

to a depth of 150 feet after successfully completing, 4 dives to depths between 130 and 150 feet. The diver must also demonstrate knowledge of the special problems of deep diving, and of special safety requirements.

Diving on air is not permitted beyond a depth of 150 feet.

5.50 Continuation of Certification

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 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.

Re-qualification of Depth Certificate

Once the initial certification requirements of Section 5.30 are met, divers whose depth certification has lapsed due to lack of activity may be re-qualified by procedures adopted by the DCB.

Medical Examination

All certified scientific divers shall pass a medical examination at the intervals specified in Section 6.10. After each major illness or injury, as described in Section 6.10, a certified scientific diver shall receive clearance to return to diving from a physician before resuming diving activities.

5.60 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 standard, or other governmental subdivisions not in conflict with this standard, may be considered cause. Diving Safety Officer shall inform the diver in writing of the reason(s) for revocation. The diver will be given the opportunity to present their case in writing for reconsideration and/or re-certification. All such written statements and requests, as identified in this section, are formal documents, which will become part of the diver's file.

5.70 Recertification

If a diver's certificate expires or is revoked, they may be re-certified after complying with such conditions as the Diving Safety Officer or the DCB may impose. The diver shall be given an opportunity to present their case to the DCB before conditions for re-certification are stipulated.

SECTION 6.00 MEDICAL STANDARDS

6.10 Medical Requirements

General

- a) UD-CMS 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.
- b) 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.
- c) 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)

Frequency of Medical Evaluations

Medical evaluation shall be completed:

- a) 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, 2 years if over the age of 60), the member organization has obtained the results of that examination, and those results have been reviewed and found satisfactory by the member UD-CMS.
- b) Thereafter, at 5 year intervals up to age 40, every 3 years after the age of 40, and every 2 years after the age of 60.
- c) 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.

Information Provided Examining Physician

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

Content of Medical Evaluations

Medical examinations conducted initially and at the intervals specified in Section 6.10 shall consist of the following:

- a) Applicant agreement for release of medical information to the Diving Safety Officer and the DCB (Appendix 2).
- b) Medical history (Appendix 3).
- c) Diving physical examination (Required tests listed below and in Appendix 2).

Conditions Which May Disqualify Candidates From Diving (Adapted from Bove, 1998)

- a) Abnormalities of the tympanic membrane, such as perforation, presence of a monomeric membrane, or inability to auto inflate the middle ears.
- b) Vertigo including Meniere's Disease.
- c) Stapedectomy or middle ear reconstructive surgery.
- d) Recent ocular surgery.

- e) Psychiatric disorders including claustrophobia, suicidal ideation, psychosis, anxiety states, untreated depression.
- f) Substance abuse, including alcohol.
- g) Episodic loss of consciousness.
- h) History of seizure.
- i) History of stroke or a fixed neurological deficit.
- j) Recurring neurologic disorders, including transient ischemic attacks.
- k) History of intracranial aneurysm, other vascular malformation or intracranial hemorrhage.
- l) History of neurological decompression illness with residual deficit.
- m) Head injury with sequelae.
- n) Hematologic disorders including coagulopathies.
- o) Evidence of coronary artery disease or high risk for coronary artery disease.
- p) Atrial septal defects.
- q) Significant valvular heart disease - isolated mitral valve prolapse is not disqualifying.
- r) Significant cardiac rhythm or conduction abnormalities.
- s) Implanted cardiac pacemakers and cardiac defibrillators (ICD).
- t) Inadequate exercise tolerance.
- u) Severe hypertension.
- v) History of spontaneous or traumatic pneumothorax.
- w) Asthma.
- x) Chronic pulmonary disease, including radiographic evidence of pulmonary blebs, bullae or cysts.
- y) Diabetes mellitus.
- z) Pregnancy.

Laboratory Requirements for Diving Medical Evaluation and Intervals.

- a) Initial examination under age 40:
 - * Medical History
 - * Complete Physical Exam, emphasis on neurological and otological components
 - * Chest X-ray
 - * Spirometry
 - * Hematocrit or Hemoglobin
 - * Urinalysis
 - * Any further tests deemed necessary by the physician.
- b) Periodic re-examination under age 40 (every 5 years):
 - * Medical History
 - * Complete Physical Exam, emphasis on neurological and otological components
 - * Hematocrit or Hemoglobin
 - * Urinalysis
 - * Any further tests deemed necessary by the physician
- c) Initial exam over age 40:
 - * Medical History
 - * Complete Physical Exam, emphasis on neurological and otological components
 - * Assessment of coronary artery disease using Multiple-Risk-Factor Assessment¹ (age, lipid profile, blood pressure, diabetic screening, smoker)
 - * Resting EKG
 - * Chest X-ray
 - * Spirometry

- * Urinalysis
 - * Hematocrit or Hemoglobin
 - * Any further tests deemed necessary by the physician
 - * Exercise stress testing may be indicated based on risk factor assessment.²
- d) 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 using Multiple-Risk-Factor Assessment¹ (age, lipid profile, blood pressure, diabetic screening, smoker)
 - * Resting EKG
 - * Urinalysis
 - * Hematocrit or Hemoglobin
 - * Any further tests deemed necessary by the physician
 - * Exercise stress testing may be indicated based on risk factor assessment.²
- e) Physician's Written Report
1. After any medical examination relating to the individual's fitness to dive, UD-CMS shall obtain a written report prepared by the examining physician, that 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.
 2. UD-CMS shall make a copy of the physician's written report available to the individual.

¹ "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>

² 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>

VOLUME 2

SECTION 7.00 NITROX DIVING GUIDELINES

The following guidelines address the use of nitrox by scientific divers under the auspices of UD-CMS. 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.

7.10 Prerequisites

Eligibility

Only a certified Scientific Diver or Scientific Diver In Training (Sections 4.00 and 5.00) diving under the auspices of UD-CMS 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 their depth authorization, as specified in Section 5.40.

Application and Documentation

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

7.20 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 they are sufficiently skilled and proficient. The signature of the DSO on the 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:

Training

The diver must complete additional theoretical and practical training beyond the Scientific Diver In Training air certification level, to the satisfaction of UD-CMS DSO and DCB (Section 7.30).

Examinations

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

- a) Written examinations covering the information presented in the classroom training session(s) (i.e., gas theory, oxygen toxicity, partial pressure determination, etc.);
- b) Practical examinations covering the information presented in the practical training session(s) (i.e., gas analysis, documentation procedures, etc.);
- c) Openwater checkout dives, to appropriate depths, to demonstrate the application of theoretical and practical skills learned.

Minimum Activity to Maintain Authorization

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

7.30 Nitrox Training Guidelines

Training in these guidelines should be in addition to training for Diver-In-Training authorization (Section 4.00). It may be included as part of training to satisfy the Scientific Diver training requirements (Section 5.30).

Classroom Instruction

- d) 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 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.
- e) 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.

Practical Training

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

- a) Oxygen analysis of nitrox mixtures.
- b) Determination of MOD, oxygen partial pressure exposure, and oxygen toxicity time limits, for various nitrox mixtures at various depths.
- c) 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.
- d) Nitrox dive computer use may be included as approved by the DCB.

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:

- a) Function, care, use, and maintenance of equipment cleaned for nitrox use.
- b) Physical and physiological considerations of nitrox diving (ex.: O₂ and CO₂ toxicity).
- c) Diving regulations and procedures as related to nitrox diving, either scuba or surface-supplied (depending on intended mode).
- d) Given the proper information, calculation of:
 1. Equivalent air depth (EAD) for a given fO₂ and actual depth;
 2. pO₂ exposure for a given fO₂ and depth;
 3. Optimal nitrox mixture for a given pO₂ exposure limit and planned depth;
 4. Maximum operational depth (MOD) for a given mix and pO₂ exposure limit;
 5. 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.
- e) Dive table and dive computer selection and usage;

- d) Nitrox production method and considerations.
- e) Oxygen analysis.
- f) Nitrox operational guidelines (Section 7.40), dive planning and dive station components.

Openwater Dives

A minimum of two supervised openwater dives using nitrox is 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.

Surface-Supplied Training

All training as applied to surface-supplied diving (practical, classroom, and openwater) will follow UD-CMS surface-supplied diving standards, including additions listed in Section 11.60.

7.40 Scientific Nitrox Diving Regulations

Dive Personnel Requirements

- a) Nitrox Diver In Training - A Diver In Training, who has completed the requirements of Section 4.00 and the training and authorization sections of these guidelines, may be authorized by the DSO to use nitrox under the direct supervision of 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 5.00 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 Section. 5.40.
- 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 AAUS Standards. 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 1.20, 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. 7.42.).

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) Dive Tables and Gases

1. A set of DCB approved nitrox dive tables should be available at the dive site.
2. When using the equivalent air depth (EAD) method, dives should be conducted using air dive tables approved by the DCB.
3. If nitrox is used to increase the safety margin of air-based dive tables, the 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 oxygen partial pressure limits set forth in Section 7.40 Dive Parameters.

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 AAUS 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.
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 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 Section 7.40 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 AAUS Air Purity Guidelines (Section 3.60), the following standard should be met for breathing air that is either:

- a. Placed in contact with oxygen concentrations greater than 40%.
- 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 (Section 3.60)

Condensed Hydrocarbons 5mg/m³

Hydrocarbon Contaminants No greater than 0.1 mg/m³

g) Gas Mixing and Analysis for UD-CMS

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: fO₂, MOD, cylinder pressure, date of analysis, and user’s name.
 - b. Individual dive log reporting forms should report fO₂ of nitrox used,

if different than 21%.

7.50 Nitrox Diving Equipment

All of the designated equipment and stated requirements regarding scuba equipment required in the AAUS Standards should 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 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 as 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 1% accuracy.

2. All diver and support equipment should be suitable for the fO_2 being used.
- e) Compressor system
1. 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 that 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 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. Organizational member's using these, must have guidelines established by their Diving Control Board. Divers shall comply with all scuba diving procedures in this standard unless specified.

8.10 Blue Water Diving

Blue water diving is defined as diving in open water where the bottom is generally greater than 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).

8.20 Ice And Polar Diving

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.

8.30 Overhead Environments

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.

8.40 Saturation Diving

If using open circuit compressed air scuba in saturation diving operations, divers shall comply with the saturation diving guidelines of the AAUS member institute where this diving is conducted.

8.50 Hookah

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.

8.60 Surface Supplied Diving

Surface supplied divers shall comply with all scuba diving procedures in this standard (Section 2.30). Surface supplied diving shall not be conducted at depths greater than 150 feet. 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.

8.70 Closed and Semi-Closed Circuit Scuba (Rebreathers)

Oxygen partial pressure in the breathing gas shall not exceed values approved by the organizational member's DCB. The generally accepted maximum value is 1.5 atmospheres pO_2 at depths greater than 25 feet.

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.

Appendices

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 University of Delaware, College of Marine Studies.

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 University of Delaware, College of Marine Studies standards.

Thank you for your assistance.

_____	_____
Diving Safety Officer	Date
_____	_____
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, other 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 disease³. [33 -35]
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 of spontaneous or traumatic pneumothorax. [45]
23. Asthma⁴. [42 - 44]

- 24. Chronic 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.

³ “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>

⁴ “Are Asthmatics Fit to Dive? “ Elliott DH, ed. 1996 Undersea and Hyperbaric Medical Society, Kensington, MD.

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.

Initial Examination

Re-examination (Every 5 years under age 40, first exam over age 40, every 3 years over age 40, every 2 years over age 60)

- _____ Medical History
- _____ Complete Physical Exam with emphasis on neurological and otological components
- _____ Chest X-Ray
- _____ Spirometry
- _____ Hematocrit or Hemoglobin
- _____ Urinalysis
- _____ Any further tests deemed necessary by the physician

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

Additional testing for first over age 40

- _____ Resting EKG
- _____ Assessment of coronary artery disease using⁵ Multiple-Risk-Factor Assessment (age, lipid profile, blood pressure, diabetic screening, smoker) Note: Exercise stress testing may be indicated based on risk factor assessment⁶

Additional testing for over age 40

- _____ Resting EKG
- _____ Assessment of coronary artery disease using⁵ Multiple-Risk-Factor Assessment (age, lipid profile, blood pressure, diabetic screening, smoker) Note: Exercise stress testing may be indicated based on risk factor assessment⁶

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:

PHYSICIAN'S STATEMENT:

I have evaluated the above-mentioned individual according to the American Academy of Underwater Sciences medical standards for scientific diving (Section 6.00), and find no conditions that may be disqualifying. I have discussed with the patient any medical condition(s) that would not disqualify him/her from diving but which may seriously compromise subsequent health. The patient understands the nature of the hazards and the risks involved in diving with these conditions.

_____ M.D.
Date Signature

Name (Print or 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 UD College of Marine Studies 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 _____ Date ____/____/____
 (Dept./Project/Program/School, etc.) (Mo/Day/Yr)

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 neurological 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.	Surgeries, 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, and environmentalals? 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?			

Pease 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:
5. 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 1.20).

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 self-contained 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 (2003 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) Expires
- _____ Oxygen administration (Agency) Expires
- _____ First aid for diving (Agency) Expires
- _____ 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: University of Delaware-Graduate College of Marine Studies

Diving Safety Officer:

(Signature)

(Date)

(Print)

(Telephone, FAX, email)

APPENDIX 7

DIVING EMERGENCY MANAGEMENT PROCEDURES

Introduction

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 UD-CMS.
7. Complete and submit Incident Report Form (www.aaus.org) to the DCB of the organization and the AAUS (Section 2.70 Required Incident Reporting).

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

**APPENDIX 8:
UD-CMS DIVING LOG SHEET**

A diving log sheet must be submitted after each scientific diving expedition or quarterly at the latest. A separate detailed report must be filed immediately for any accident or equipment failures. The UD-CMS-Scientific Diving Program (UD-CMS SDSS manual) requires current scientific diver status and an approved dive plan on file with the Scientific Diving Officer prior to engaging in official diving activities.

Diver: _____ UD-CMS Affiliation: _____ Depth qualified: _____ Month: _____ Year: _____

Diver's signature: _____ Dive Plan Authorization Number: _____

#	Date	Dive Buddy	Location	Depth (ft)	Dive Time	Repet Group	Surface Interval	Repet Group	Stop min/ft	Remarks
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										

Total your diving activity for scientific diving expedition or quarter below (record dive time in minutes)

Depth	0-30'	31-60'	61-100'	101-130'	131'+	Totals	Tables or Dive Computers used
# Dives							
Dive Time (mins.)							

**APPENDIX 9
SCIENTIFIC DIVE PLAN**

From: _____ Date: _____

To: _____, College of Marine Studies, Scientific Diving Officer

Dates of research dives: _____

Location of research dives: _____

1. PARTICIPATING SCIENTIFIC DIVERS:

Diver names	Email Address	Depth Certification	Science Diving Program
Lead Diver: 1.			
2.			
3.			
4.			
5.			
6.			

2. EMERGENCY INFORMATION:

Diver name	Emergency Phone	Contact Person	Relationship
Lead Diver: 1.			
2.			
3.			
4.			
5.			
6.			

3. EMERGENCY PLAN: Lead Diver must ensure that oxygen unit, first aid kit, & radio or cell phone are on-site.

1. Method for contacting EMS notification:
2. Contact DAN: (919) 684-8111 for chamber information.

Nearest operational hyperbaric chamber location/phone: _____

Nearest emergency medical facility/phone: _____

Method of transport/contact: _____

UD-CMS Emergency Phone: (302) 645-XXXX; SDO: (302) 645-XXXX; DAN: (919) 684-8111

4. Approximate number of proposed dives: _____

5. Estimated depths and bottom times anticipated: _____

6. Repetitive dives: _____

7. Proposed work, equipment and boats to be employed: _____

- Any hazardous conditions anticipated: _____

APPROVED: _____ DATE: _____ AUTHORIZATION #: _____

UD-CMS Scientific Diving Officer

NOTE: Dive plan must be filed with, and approved by SDO **PRIOR** to your departure

APPENDIX 10
Release and Waiver and Informed Consent Agreement
For Scientific Diving

University of Delaware-Graduate College of Marine Studies
Diving Control Board

In consideration of being permitted to participate as a diver in the research diving program, scuba diving activities, and incidental activities related thereto ("Diving Activities") and described below, that are to be conducted under the auspices of or in cooperation with the University of Delaware/College of Marine Studies I, _____, the undersigned participant, hereby represent that I

1. Am over eighteen years of age; and
2. Hold at least a scuba diving certification from a nationally recognized certification organization and have twelve logged dives in the past one year and/or a recent refresher course;
3. Have obtained a copy of the UD/CMS Dive Safety Manual and familiar with its contents including safety requirements <http://www.ocean.udel.edu/divingmanual>;
4. Am fully aware of and understand the obligations and requirements to maintain my diving skills, physical fitness and mental preparation for all dives; the dangers associated with diving activities, including but not limited to near drowning, air embolism, carbon dioxide excess, squeezes, oxygen poisoning, nitrogen narcosis, exhaustion and panic, respiratory fatigue, motion sickness, decompression sickness, hypothermia, hypoxia/anoxia, barotrauma, hyperbaric treatment, hyperoxic, hypercapnia D.C.S., pneumothorax, mediastinal emphysema, air embolism, subcutaneous emphysema, ruptured eardrum or round window rupture, paralysis, arterial gas embolism and being fully informed of these obligations, requirements and dangers, I assume all risk of loss, damage, illness, injury to my person or property and death that may result from my participation in diving activities; and
5. Have and will continue to have for the duration of research diving activities current insurance that is adequate to cover any injuries or illnesses that I may sustain in connection with research diving activities and that will apply to research diving activities conducted outside the United States.

I further agree to:

6. Conduct all research diving activities as no-decompression dives; and
7. Indemnify and hold harmless the University of Delaware College of Marine Studies and their officers, agents and employees from and against any and all claims or causes or action by whomever or wherever made or presented for personal injuries, property damage or wrongful death related to or arising out of research diving activities; and
8. Fully and finally waive and release the University of Delaware College of Marine Studies and their officers, agents and employees from and against any and all actions or causes of action, claims, or demands that are associated with or related in any way to the research diving activities whether or not such actions, claims, or demands arise out of the negligence, omission, default or other action of the University, its officers, agents, employees and/or any person or entity associated with research diving activities.

This agreement represents my complete understanding with UD/CMS regarding the subject of this agreement. I understand that this agreement may not be modified, in the event of a dispute regarding its terms; the laws of the State of Delaware will govern this agreement. I certify that I have read this agreement, have been afforded the right to consult an advisor or attorney prior to signing it, understand its terms and conditions and voluntarily execute this agreement.

Participant (print name) _____ Signature _____

Address _____ Telephone No. _____ Date _____