The Pennsylvania State University
Science Diving Program

Standards for Scientific Diving

REV. 1-1
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GENERAL POLICY

PREAMBLE

The Science diving program (SDP) is an administrative unit functioning under the Office of the Vice Provost and Dean for Undergraduate Education of the Pennsylvania State University. The SDP supervises all compressed gas diving for scientific purposes at the University. Solely recreational diving operates under the student organization --*Nittany Divers* -- and adheres to an independent Standard Operating Procedure.

Section 1 and Appendices 1-3 detail the General Policy and Medical Examination procedures. Sections 2 – 7 and Appendices 4-8 represent the Penn State Dive Safety Manual. Together they constitute the Penn State Science Diving Program *Standards for Scientific Diving*.

The Diving Control Board (DCB), established under the policies enumerated in this document, is responsible only for research diving and related instructional activities at Penn State. This specifically excludes the *Nittany Divers* scuba club, and use of University facilities for non-academic scuba instruction.

The purpose of these science diving standards is to ensure that all science diving under the auspices of The Pennsylvania State University is conducted in a manner that will maximize protection of science divers from accidental injury and/or illness, while also maximizing their underwater research potential.

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

Scientific Diving Definition

At PSU, Scientific Diving is defined as all diving performed by individuals that is part of, and necessary to, a research or educational activity conducted by employees or students of the Pennsylvania State University.

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.

Liability

Each diver is assumed under this policy to be voluntarily performing activities for which he/she assumes all risks, consequences, and potential liability. At no time may a person be forced against their will to dive under this standard.

Each diver will be provided a copy of the standards and the diving safety manual and will acknowledge that they have read, and will abide by, the standards and established diving practices by signing the *Safe Diving Practices* form (Appendix 8)

Review of Standards

As part of each organizational member's annual report, any recommendations for modifications of these standards shall be submitted to the AAUS for consideration..

1.20 OPERATIONAL CONTROL

Penn State's Auspices Defined

At PSU, Scientific Diving is defined as all diving performed by individuals that is part of, and necessary to, a research or educational activity conducted by employees or students of the Pennsylvania State University.

For the purposes of these standards, the auspices of the Pennsylvania State University includes any research or educational diving operation in which Penn State is connected because of ownership of any equipment used, locations selected, or relationship with the individual(s) concerned. This includes all cases involving the operations of employees of the organization, or employees of auxiliary organizations, where such employees are acting within the scope of their employment. In addition, this includes the operations of other persons who are engaged in the science or educational diving programs of Penn State, or are diving as members of an organization through which Penn State has established reciprocity.

Administrative Authority

a) The Vice President and Dean for Undergraduate Education of the Pennsylvania State University has administrative authority for the Science Diving Program and its related activities.

b) The DCB has autonomous and absolute authority over the operations of the Science Diving Program (see 1.2.2.1).

Organization Policy

Policy recommendations relating to the Science Diving Program shall be made to the Vice President and Dean for Undergraduate Education of the Pennsylvania State University. The development of these recommendations is the joint responsibility of the DCB and the DSO. The administration of these policies is the responsibility of the DSO, under the advice of the DCB.

It is Penn State's responsibility to adhere to the AAUS Standards for Scientific Diving Certification and Operation of Scientific Diving Programs. The administration of the local diving program will reside with Penn State's Diving Control Board (DCB). The regulations herein shall be observed at all locations where scientific diving is conducted.

Penn State's Scientific Diving Standards and Safety Manual

The PSU Science Diving Standards incorporate a scientific diving safety manual that provides for the development and implementation of policies and procedures that will enable Penn State to meet requirements of local environments and conditions as well as to comply with the AAUS scientific diving standards. The scientific diving manual shall include, but not be limited to:

a) AAUS standards are used as a set of minimal guidelines for the development of Penn State's scientific diving safety manual. Volume 1, Sections 1.00 through 6.00 and the Appendices are required for all AAUS Organizational Members. Volume 2, Sections 7.00 through 9.00 are required only when an Organizational Member conducts that diving activity. Penn State specific sections are placed in Volume 2.

b) Emergency evacuation and medical treatment procedures.

c) Criteria for diver training and certification.

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

    1) Safety procedures for the diving operation.

    2) Responsibilities of the dive team members.

    3) Equipment use and maintenance procedures.

    4) Emergency procedures.

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) Shall be appointed by the responsible administrative officer or designee, with the advice and counsel 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 an internationally recognized certifying agency.

b) Duties and Responsibilities

    1) Shall be responsible, through the DCB, to the administrative officer or designee, for the conduct of Penn State's 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 membership organization, 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.

Diving Control Board

a) The Diving Control Board (DCB) shall consist of:

1) A Chairperson elected by the Board

2) The University Dive Safety Officer

3) A representative from each College/Campus actively involved in Scientific diving for research or education

4) A representative (dive instructor) from the Kinesiology program

5) A representative of the Vice President and Dean for Undergraduate Education

A member of the Board may serve in multiple roles, except that separate members must hold the positions of Chairperson and DSO. The minimum board size is four members. The Board shall consist of a majority of active scientific divers. The Board:

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

b) Shall approve and monitor diving projects.

c) Shall review and revise the diving safety manual.

d) Shall assure compliance with the diving safety manual.

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

f) Shall take disciplinary action for unsafe practices.

g) Shall assure adherence to the buddy system for scuba diving.

h) Shall act as Penn State's official representative in matters concerning the scientific diving program.

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

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

k) Shall recommend changes in policy and amendments to AAUS and the Penn State's diving safety manual as the need arises.

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

m) Shall suspend diving programs that are considered to be unsafe or unwise.

n) Shall establish criteria for equipment selection and use.

o) Shall recommend new equipment or techniques.

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

q) Shall ensure that air station(s) under the control of the Science Diving Program meet air quality standards as described in Section 3.60.

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

s) Shall sit as a board of investigation to inquire into the nature and cause of diving accidents or violations of Penn State's diving safety manual.

Instructional Personnel

a) Qualifications - All personnel involved in diving instruction under the auspices of the organizational member 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 is at the dive site.

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.

Note: The dive leader as his or her discretion, can refuse permission for any team member to participate in a given dive activity.

Program Participants

a) Qualifications: The Pennsylvania State University requires that all persons engaged in Scientific Diving hold a recognized valid certificate attesting to their diving status according to Section 5.

b) Responsibilities: Individual divers have the responsibility to:

1) Adhere to the diving standards as set forth by this manual.

2) Refuse to dive, with no administrative or academic repercussions, if dive conditions become unacceptable.

3) Report unsafe practices to the DSO.

4) Report injuries to the DSO and the proper authorities immediately, and to seek appropriate treatment.

c) The Penn State Science Diving Program requires that all members hold current membership in the Diver's Alert Network (DAN) and have current DAN insurance

Reciprocity and Visiting Scientific Diver

a) Where Penn State is engaged jointly with other AASU Organization Members in diving activities, or engaged jointly in the use of diving resources, one of the participating Diving Control Boards shall be designated to govern the joint dive project.

b) A visiting Scientific Diver from an AAUS Organizational Member may apply for permission to dive under the auspices of Penn State's Science Diving Program by submitting to the PSU Diving Safety Officer a document containing all the information described in Appendix 6, signed by the Diving Safety Officer or 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 Penn State denies a visiting Scientific Diver permission to dive, the Penn State 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 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 Penn State's diving safety manual may be cause for the revocation or restriction of the diver's scientific diving certificate by action of the PSU Diving Control Board.

1.40 CONSEQUENCES OF VIOLATION OF REGULATIONS BY ORGANIZATIONAL MEMBERS

Failure to comply with the regulations of this standard may be cause for the revocation or restriction of Penn State's 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 Penn State's 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) The remainder of the participant's records are open only to the individual participant (during working hours), the University DSO and his/her designee (administrative assistant), and the Chairperson of the DCB. These files are considered closed and confidential.

c) 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)

PREAMBLE

Penn State distinguishes between scientific diving employed in conjunction with research projects and topical (applications) courses in, for example, geosciences, biology, archaeology, etc., and recreational dive training courses.

Participants engaged in scientific diving projects are subject to the standards and practices established in this manual.

Recreational dive training courses may be individual introductory, advanced, or specialty courses offered by an internationally recognized scuba diving training agency, or a package of such courses, offered for academic credit.

Recreational dive courses may carry Penn State General Education credits in the category of *Health and Physical Activity*; they may also be used to acquire dive skills and experience that will be used to meet Scientific Diving qualifications.

Scientific diving certification, however, will only be awarded to divers who meet all of the requirements and qualifications established in this manual.

Scientific diving involves the conduct of many standard underwater activities plus some unique procedures necessitated by research objectives. Diving safety depends upon:

> Close adherence to the policies outlined in this document plus an intelligent extrapolation of this manual when a situation arises that is not specifically covered, and clearly defined areas of responsibility.

While the dive regulations, dive management procedures, and dive team responsibilities and assignments are all designed to maximize the safety of each diver, ultimately dive safety and the decision to dive or not dive and the conduct of the dive are the responsibility of the individual.

Every diver is expected to adhere to these regulations and to use good judgment if circumstances develop that necessitate deviation from the regulations.

Although all possible situations cannot be anticipated, most new circumstances can be dealt with by extrapolation of existing policies. Genuinely novel cases, actually requiring noncompliance with PSU Standard Operating Procedures, must be outlined in writing and approved by the University DSO ***before*** the dive takes place.

2.10 INTRODUCTION

No person shall engage in scientific diving operations under the auspices of The Pennsylvania State University Science Diving Program unless he/she holds a current diving status issued pursuant to the provisions of this manual and is adequately trained for the environment and on the technology that will be used.

2.20 PRE-DIVE PROCEDURES

Dive Approval

a) Compressed-gas diving conducted under the auspices of the Pennsylvania State University Science Diving Program required pre-project approval by the DCB before implementation.
b) Projects are DCB pre-approved if all of the following conditions are met:

    1) Be shallower than 130 feet sea water (FSW)
    2) Require no decompression stops (other than a precautionary safety stop)
    3) Use open circuit air SCUBA as a breathing medium.
    4) Be in currents under 1 knot
    5) Not involve overhead environments (caves, caverns, ice wrecks, etc.)
    6) Not be conducted in polluted waters
    7) Not involve live-boating (boat engine in gear during the dive)
    8) Be conducted with an in-water diving partner (a dive buddy)
    9) Be in water temperatures above 40ºF/5ºC
    10) Be subject to unlimited inspection access by the University Dive Safety Officer

c) Projects that do not satisfy the pre-approval conditions require the approval of the DCB via the University Dive Safety Officer. The participant (project Principal Investigator/course instructor) must submit a description of the intended activities, staff, equipment needs, and location of the project to the DSO with an adequate time period for review and response. The participant is encouraged to discuss the project with the DSO in person.

Dive Team Organization

a) ***For dives greater than 40 FSW***, the team must be composed of no fewer than three (3) members (four in the case of boat dives): The Dive Leader, two divers, and a boat captain. One member of the team must be:

    1) Boat operations qualified if a boat is involved,

    2) Appropriately outfitted as a safety diver (as defined by the Dive Leader), and must stand by on the surface.

b) Regardless of the size of the dive team, selected site-management areas of responsibility (functions) must be observed as part of the Penn State dive safety procedures. All but two of these functions (Dive Leader and Chief Scientist) may be combined and accomplished by the same individual. However, as the workload and conditions require, additional people must be added to the team to prevent dangerous task overload. The following site management functions must be maintained:

    1) Chief Scientist: responsible for defining the science objectives of the dive and for

the efficient collection of data. At no time may this person take on the responsibility of Dive Leader.

2) Dive Leader: responsible for planning and supervising the dive, and for the safety and efficiency of the team while in the water collecting data.

   The minimum team size, for dives less than 40 FSW, is a buddy pair where one has primary responsibility for the science activities, and the other takes on the role of Dive Leader responsible for dive safety.

3) For dive operations involving multiple dives and/or multiple days of diving, a Dive Supervisor may be appointed who will assume overall responsibility for dive planning and safety. Dive Leaders will then be appointed for individual dives.

4) Time Keeper: an assistant to the Dive Leader recording dive profiles and related data. This function may be shared by anyone, but preferably a member of the surface support team.

5) Safety Diver (if applicable): a person outfitted with the appropriate life-support equipment for the site and its conditions as defined by the Dive Leader and this manual.

6) Boat Captain (if applicable): The U.S. Coast Guard dictates that the boat captain is ultimately responsible for the safety of all those aboard the boat. The Dive Leader must work closely with the Boat Captain when diving from a boat.

7) Individual diver: responsible for adhering to safe diving practices at all times. When diving safely is not possible, it is the responsibility of each diver to alert the Dive Leader of the problem, and if necessary, not to dive.

Dive Plans

Dives should be planned around the competency of the least experienced diver. Before conducting any diving operations under the auspices of the Penn State Science Diving Program, the Dive Supervisor or Lead Diver for a proposed operation must formulate a dive plan that should include at least the following:

a) Divers qualifications, and the type of certificate or certification held by each diver.

b) PSU Standards for Scientific Diving

c) 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) Contact information for Diver's Alert Network. In the event of an emergency, the dive leader or designate will consult DAN at the earliest opportunity. Contact with DAN should be considered a high priority in managing an emergency

   3) Nearest accessible hospital.

4) Available means of transport.

d) Dive mode and breathing gas supply.

e) Dive equipment and thermal protection.

f) Approximate number of proposed dives.

g) Dive team assignments.

h) Location(s) of proposed dives.

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

j) Decompression status and repetitive dive plans, if required.

k) Proposed work, equipment, and boats to be employed.

l) Any hazardous conditions anticipated.

Pre-dive Safety Checks

Note: Dive Leader Responsibilities are listed in section 1.20

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 organizational member's 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

a) All diving activities shall assure adherence to the buddy system (two comparably equipped scuba divers in the water in constant communication) for scuba diving. The buddy system is based upon mutual assistance, especially in the case of an emergency. Therefore, dives should be planned around the competency of the least experienced diver.

b) If communication/contact between buddy pairs (or a group of divers working together underwater) is lost, each diver will search for their buddy for no longer than one minute. All divers in the group will then surface and re-establish communications.

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 and a dive buddy, in the event of an out-of-air situation, to safely reach the surface. This must include a sufficient reserve of breathing air to conduct safety stops and/or 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

AAUS standards require that each organizational member develop emergency procedures that follow the standards of care of the community and include procedures for emergency care, recompression and evacuation for each dive location (Emergency procedures are outlined in Appendix 7). Given that a significant proportion of Science Diving activities take place outside of the local area, it is important that the Dive Leader develops similar and appropriate procedures for each dive destination. Note that international travel involving undergraduate students requires clearance by the Penn State Office of Risk Management and that students are required to have supplemental international medical insurance provided by the University. Contact the DSO for further information. All active members of the Penn State Science Diving Program are required to have current Diver's Alert Network membership and insurance.

2.60 FLYING AFTER DIVING

a) A diver who has completed a single no-decompression dive on air while following standard air no-decompression tables (e.g. the U.S. Navy tables, the PADI RDP tables), or using an approved dive computer, must wait at sea level breathing air for a period of 12 hours before flying.

b) A diver who completes a series of repetitive dives on air in a single day, dives for several days in a row, or conducts even a single dive that is close to the no-decompression limit of the table or computer, must wait at sea level for 24 hours before flying.

c) When flying after diving, the aircraft cabin pressure must not be less (psi) than the equivalent of 8000 feet altitude (7.35 psi).

Note: These same limitations apply to diving at altitudes over 2500 feet after diving

2.70 RECORD KEEPING REQUIREMENTS

Personal Diving Log

Each certified scientific diver shall log every dive made under the auspices of the Penn State Science Diving program, and is encouraged to log all other dives. Standard forms are provided and can be found on the Science Diving website (www.ems.psu.edu/sciencediving), however, divers are encouraged to use the on-line dive log that can also be accessed through the Science Diving web site. 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 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 the Penn State's Diving Control Board and the AAUS. 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) Organizational member 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 the organizational member, 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:

3) Name, address, phone numbers of the principal parties involved.

4) Summary of experience of divers involved.

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

6) Description of symptoms, including depth and time of onset.

7) Description and results of treatment.
8) Disposition of case.
9) Recommendations to avoid repetition of incident.

c) The Penn State Science Diving Program will investigate and document any incident of pressure-related injury and prepare a report that will be forwarded to AAUS during the annual reporting cycle. This report must first be reviewed and released by Penn State's 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 Dive-program approved medical 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 – Penn State Science Diving Program 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 organizational member-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/m3
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

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 freshwater 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 which1-1/2 hours cumulative bottom time must be on scuba. No more than 3 training dives shall be made in any day

SECTION 5.00 SCIENTIFIC DIVER CERTIFICATION

5.10 CERTIFICATION TYPES

Scientific Diver Certification

This is a permit to dive under the auspices of the Penn State Science Diving program, 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 manual.

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 manual, **including medical requirements**.

5.20 GENERAL POLICY

AAUS requires that no person shall engage in scientific diving unless that person is authorized by an organizational member pursuant to the provisions of this standard. Only a person diving under the auspices of the organizational member 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 Penn State 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 the organizational member.

b) Medical approval. Each applicant for diver certification shall submit a statement from a licensed physician, based on an approved medical examination, attesting to the applicant's fitness for diving (Section 6.00 and Appendices 1 through 4).

c) Scientific Diver-In-Training Permit - This permit signifies that a diver has completed and been

certified as at least an open water diver through an internationally recognized certifying agency or scientific diving program, and has the knowledge skills and experience to that gained by successful completion of training as specified in Section 4.00.

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 Decompression Sickness and Arterial Gas Embolism
   - 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

- o Organism Identification
- o Behavior
- o 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 or qualified delegate followed by at least 11 ocean or open water dives in a variety of dive sites and diving conditions, for a cumulative bottom time of 6 hours. Dives following the checkout dive must be supervised by a certified Scientific Diver with experience in the type of diving planned, with the knowledge and permission of the DSO.

d) Examinations

1) Written examination

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

2) Examination of equipment.

- Personal diving equipment
- Task specific equipment

5.40 DEPTH CERTIFICATIONS

Depth Certifications and Progression to Next Depth Level

A certified diver diving under the auspices of Penn State's Science Diving Program may progress to the next depth level after successfully completing the required dives for the next level. Under these circumstances the diver may exceed their depth limit. Dives shall be planned and executed under close supervision of a diver certified to this depth, with the knowledge and permission of the DSO.

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.

f) Certification to 190 Foot Depth - A diver holding a 150 foot certificate may be certified to a depth of 190 feet after successfully completing, 4 dives to depths between 150 and 190 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 190 feet.

5.50 CONTINUATION OF CERTIFICATE

Minimum Activity to Maintain Certification

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

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 organization's 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 recertification. All such written statements and requests, as identified in this section, are formal documents, which will become part of the diver's file.

5.70 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 REQUIREMENT*S*

General

a) The organizational member 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 organization.

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) 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 to Examining Physician

The organizational member 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 , 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:
    1) Medical History
    2) Complete Physical Exam, emphasis on neurological and otological components
    3) Chest X-ray
    4) Spirometry
    5) Hematocrit or Hemoglobin
    6) Urinalysis
    7) Any further tests deemed necessary by the physician.

b) Periodic re-examination under age 40 (every 5 years):
    1) Medical History
    2) Complete Physical Exam, emphasis on neurological and otological components
    3) Hematocrit or Hemoglobin
    4) Urinalysis
    5) Any further tests deemed necessary by the physician

c) Initial exam over age 40:

1) Medical History
2) Complete Physical Exam, emphasis on neurological and otological components
3) Assessment of coronary artery disease using Multiple-Risk-Factor Assessment [1] (age, lipid profile, blood pressure, diabetic screening, smoker)
4) Resting EKG
5) Chest X-ray
6) Spirometry
7) Urinalysis
8) Hematocrit or Hemoglobin
9) Any further tests deemed necessary by the physician
10) 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):

1) Medical History
2) Complete Physical Exam, emphasis on neurological and otological components
3) Assessment of coronary artery disease using Multiple-Risk-Factor Assessment [1](age, lipid profile, blood pressure, diabetic screening, smoker)
4) Resting EKG
5) Urinalysis
6) Hematocrit or Hemoglobin
7) Any further tests deemed necessary by the physician
8) 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, the organizational member 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) The organizational member shall make a copy of the physician's written report

[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

Sections 7.00 through 11.00
Required Only When Conducting Described Diving Activities
and
Organizational Member Specific Sections

SECTION 7.00 NITROX DIVING GUIDELINES

The following guidelines address the use of nitrox by scientific divers under the auspices of an AAUS Organizational Member. 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 a member organization is eligible for authorization to use nitrox. After completion, review and acceptance of application materials, training and qualification, an applicant will be authorized to use nitrox within 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 the member organizations 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

a) 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.

b) 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.: O_2 and CO_2 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 fO_2 and actual depth;
    2) pO_2 exposure for a given fO_2 and depth;
    3) Optimal nitrox mixture for a given pO_2 exposure limit and planned depth;
    4) Maximum operational depth (MOD) for a given mix and pO_2 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 fO_2 by partial pressure mixing.
e) Dive table and dive computer selection and usage;
f) Nitrox production methods and considerations.
g) Oxygen analysis.
h) 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 the member organization’s 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 pO_2 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 Absolute Atmospheres. 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 or designee.

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

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

e) Repetitive Diving

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

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

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

4) When repetitive dives expose divers to different oxygen partial pressures from

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

f) Oxygen Parameters

1) Authorized Mixtures - Mixtures meeting the criteria outlined in 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/m^3
Hydrocarbon Contaminants	No greater than 0.1 mg/m^3

g) Gas Mixing and Analysis for Organizational Members

1) Personnel Requirements

a. Individuals responsible for producing and/or analyzing nitrox mixtures should be knowledgeable and experienced in all aspects of the technique.
b. Only those individuals approved by the DSO and/or DCB should be responsible for mixing and/or analyzing nitrox mixtures.

2) Production Methods - It is the responsibility of the DCB to approve the specific nitrox production method used.

3) Analysis Verification by User

a. It is the responsibility of each diver to analyze prior to the dive the oxygen content of his/her scuba cylinder and acknowledge in writing the following information for each cylinder: fO_2, MOD, cylinder pressure, date of analysis, and user's name.
b. Individual dive log reporting forms should report fO_2 of nitrox used, if different than 21%.

7.50 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 at the approval of the DCB.

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

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

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

d) Other Support Equipment

1) An oxygen analyzer is required which is capable of determining the oxygen content in the scuba cylinder. Two analyzers are recommended to reduce the likelihood of

errors due to a faulty analyzer. The analyzer should be capable of reading a scale of 0 to 100% oxygen, within 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 8.00 AQUARIUM DIVING OPERATIONS

SECTION 9.00 STAGED DECOMPRESSION DIVING

SECTION 10.00 MIXED GAS DIVING

SECTION 11.00 OTHER DIVING TECHNOLOGY

These diving operations are not presently conducted by the PSU Science Diving Program. If there is a future requirement for any of these diving activities, standards will be developed and included in a revised version of the manual.

Appendices

Appendix 1 through 9
Required For All Organizational Members

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 Penn State Science Diving Program. 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 Penn State Science Diving Program standards. Thank you for your assistance.

_____ _____

Robert G. Crane Date
Diving Safety Officer
(814) 865-7482

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 istory of neurological decompression illness with residual deficit. [29, 30]
13 Head injury with sequelae. [26, 27]
14 Hematologic disorders including coagulopathies. [41, 42]
15 Evidence of coronary artery disease or high risk for coronary artery disease[3]. [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 Asthma [4]. [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 860030100, 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

_____ 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

[ ] 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
_____ 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 using Multiple-Risk Factor Assessment[5] (age, lipid profile, blood pressure, diabetic screening, smoker) Note: Exercise stress testing may be indicated based on risk factor assessment [6]

Additional testing for over age 40

_____ Resting EKG
_____ Assessment of coronary artery disease using Multiple-Risk-Factor Assessment (age, lipid profile, blood pressure, diabetic screening, smoker) Note: Exercise stress testing may be indicated based on risk factor assessment[6]

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 _____ 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 neurologic disorders, including transient ischemic attacks.			
10.	Aneurysms or bleeding in the brain.			
11.	Decompression sickness or embolism.			
12.	Head injury.			
13.	Disorders of the blood, or easy bleeding.			
14.	Heart disease, diabetes, high cholesterol.			

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

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

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

_____

Signature Date

APPENDIX 4

RECOMMENDED PHYSICIANS WITH EXPERTISE IN DIVING MEDICINE

List of local Medical Doctors who 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
- 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 requiring 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 to AAUS 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 (EANx) - 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.
- fN_2 - Fraction of nitrogen in a gas mixture, expressed as either a decimal or percentage, by volume.
- fO_2 - Fraction of oxygen in a gas mixture, expressed as either a decimal or percentage, by volume.
- FFW – Feet of 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.
- MG – Mixed Gas
- 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 pO_2 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 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 – OUT
- 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.
- pN_2 - Inspired partial pressure of nitrogen, usually expressed in units of atmospheres absolute.
- pO_2 - 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 who 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 the reason for the denial to the DSO of the visiting diver. 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	

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:

(Name of AAUS Organizational Member)
Diving Safety Officer:
_____
(Signature) (Date)

Print: (phone, FAX, e-mail)

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.

Pre-Dive Emergency Procedures

Most diving emergencies can be avoided by careful planning prior to the commencement of diving activities. However, in the event of a diving accident, preparedness is paramount and will include the following:

Emergency Evacuation Procedure

An emergency evacuation procedure will be established prior to the diving component of the project and made known to all participants. The procedure:

- Will cover the transportation of the injured person from the research site either to a hospital or an operational multi-lock decompression chamber as indicated by the injury and as dictated by the Site Diving Supervisor.
- Must have the confidence of all members of the project at all times.
- Will include contact information for Emergency Services, multi-lock recompression chambers, hospital emergency rooms, and trauma centers in the dive region. This contact information will be available to all dive team members.

First Aid Kit

An appropriate first aid kit approved by the DSO will be available at all dive sites.

Emergency Oxygen

Medical breathing oxygen will be available at the surface on all dives.

Dive Accident Management Procedures

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

Conduct Initial Assessment

- Make appropriate contact with victim, or rescue as required.
- Establish (**A**)irway, (**B**)reathing, (**C**)irculation as required.

Administer 100% Oxygen if Appropriate

Oxygen will be appropriately administered for a minimum of 30 minutes to a diver if:

- Omitted decompression has occurred.
- An uncontrolled or too rapid an ascent has occurred.

Oxygen will be appropriately administered continuously (for as long as it is available) until the diver has been released to the care of hospital or Emergency Services personnel:

- If suspected DCS or lung over-distension hyperbaric injury has occurred.
- If symptoms of DCS or lung over-distension injury are present.

Activate Emergency Medical System

Contact the Diver's Alert Network (DAN) for medical advice or the coordination of treatment and/or evacuation procedures. Emergency and non-emergency contact numbers for DAN should be included in the Emergency Evacuation Plan.

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.

In the event of a near-drowning or if any form of Decompression Illness (DCI) is suspected, or symptoms are present, the diver must be transported to a hospital or decompression facility for assessment and treatment by a physician. This must occur even if symptoms are reduced or relieved by first aid and oxygen treatment on site.

Post-Accident Procedure

Reporting and Notification

The University DSO or his/her designee must be notified as soon as possible after the incident.

An Incident Report Form must be completed and submitted to the DCB within 10 days of the incident. See also Section 5.5.2.1.

An Incident Report Form should be completed for any serious emergency (e.g. involving equipment failure), even if no injuries occur.

APPENDIX 8

SCIENTIFIC DIVING – SAFE DIVING PRACTICES

Your signature on this statement is required as proof that you have read the standards for scientific diving established by the Penn State Science Diving Program. Read and discuss this statement with the University Dive Safety Officer, or his/her designee, before signing.

Your signature on this form acknowledges your agreement to adhere to the regulations and procedures for scientific diving detailed in the Penn State Standards for Scientific Diving.

I, _____, understand that as a scientific diver I must:

1) Read and understand the Penn State Dive Safety Manual.

2) Adhere to the regulations and procedures established for scientific diving at Penn State. This includes, but is not limited to:
   - Diving within my certification limits unless on a training dive with an Active diver or instructor authorized to supervise the dive.
   - Refusing to dive, or terminating a dive, if dive conditions become unacceptable.
   - Reporting unsafe practices to the DSO.
   - Reporting any injuries to the DSO and the proper authorities immediately, and seeking appropriate treatment.
   - Abiding by basic safe diving practices: listening carefully to dive briefings, following the dive plan, maintaining proper buoyancy, never holding my breath, being proficient in dive table/computer use.
   - Adhering to the buddy system (two comparably equipped scuba divers in the water in constant communication) on all scuba dives. The buddy system is based upon mutual assistance, especially in the case of an emergency.
   - Carrying the appropriate equipment for every dive including an alternate air source (at least an alternate second stage, and preferably a redundant gas supply).
   - Conducting a functional check of my diving equipment in the presence of my diving buddy or tender.
   - Carrying out a safety stop on every dive below 60 FSW, provided I have sufficient breathing gas to reach the surface safely, and ascending slowly from every dive.
   - Terminating all dives while there is still sufficient tank pressure to permit me to safely reach the surface - including decompression if necessary.
   - Ensuring that I understand the emergency evacuation procedure for each dive that I undertake, and staying current in CPR, first aid, and emergency oxygen delivery.

3) Not engage in dive activities in an underwater environment with an overhead restriction back to the surface without obtaining the appropriate advanced training and the approval of the University Dive Safety Officer.

4) Understand that I can deviate from the requirements of the Penn State Dive Safety Manual to the extent necessary to prevent or minimize a situation that is likely to cause death, serious physical harm, or major environmental damage.

Scuba diving is a potentially dangerous activity. The ultimate responsibility for safety rests with the individual diver. It is my responsibility and duty to refuse to dive if, in my judgment, conditions are unsafe or unfavorable, or if I would be violating the precepts of my training or the regulations of the Penn State Dive Safety Manual.

I have read the above statements and have had any questions answered to my satisfaction.

_____

Participant's Signature Date .

APPENDIX 9: Application for Diving Certification - Diving Resume

The Penn State Science Diving Program

Name_____Program Entry Date_____ Date of Birth_____

Date of Last Physical_____Date of Last Chest x-ray_____ Date of Last EKG_____

Are there any medical conditions that limit your diving? _____ Yes _____ No. If yes, explain on back of form.

Have you ever suffered a diving accident (hyperbaric trauma, gas embolism, decompression sickness)? If yes, explain on back of form.

Certifications:

Attach copies of certification cards or records of training, record agency, type, and year below

Basic diving certification_____ CPR _____ First Aid _____

Oxygen Admin._____ Specialty Certifications_____

_____

_____

Career Open-Water Dives (estimate):

Dives _____ # Hours _____ Max. Depth.(fsw) _____ Date & Depth (fsw) of last dive _____ Self-imposed depth limit _____

Indicate your diving experience in the following categories:

E=Extensive (>20) Moderate (5-20) Limited (1-4) N=None

Diving From Boats/Ships:
_____ Small Boats (up to 20')
_____ Vessels 21'-100'
_____ Ships >100'

Shore Diving:
_____ Rocks or "Ironshore"
_____ Surf

Overhead Environments Diving:
_____ Ice Diving
_____ Cave Diving
_____ Cavern Diving
_____ Wreck Diving

Freshwater Diving:
_____ Ponds, Lakes, Quarries
_____ Rivers

Other:
_____ Night Diving
_____ Decompression Diving
_____ Diving at Sea (Blue Water)
_____ Diving EMT/Chamber Operator
_____ Cold Water (<45°F) Diving
_____ Turbid Water (0-5' visibility) Diving
_____ Very Clear Water (>50' vis.) Diving
_____ Saltwater Diving
_____ Mud or Silt Bottom Diving
_____ Kelp Forest Diving
_____ Coral Reef Diving
_____ Current (>½ knot) Diving
_____ Altitude (>2000') Diving
_____ Dry Suit Diving
_____ Nitrox/Enriched Gas Diving
_____ Commercial/Military/Scientific Diving
_____ Surface-Supplied Diving
_____ Saturation Diving
_____ Towed Diving

Research Diving Experience

Level of Experience _____ Examples of Research Diving Projects _____

_____

_____

I acknowledge that I have read and understand the PSU Standards for Scientific Diving, and that the information that I have provided is accurate to the best of my knowledge.

Signature _____ Date _____

Witness: Name _____ Signature _____ Date _____

(revised 11/01)

APPENDIX 10: The Pennsylvania State University
Statement of Voluntary Consent
General Release and Waiver of Liability

In consideration of my participation in **SCIENTIFIC DIVING**, and for other good and valuable consideration received by me, receipt of which is hereby acknowledged,

I _____, hereby affirm that I am least eighteen (18) years of age or older, and having actual knowledge and conscious appreciation of the particular dangers involved in SCUBA DIVING and the activities described herein, including but not limited to: **COMPRESSED GAS DIVING**, do hereby volunteer consent to the my participation in the aforementioned activity and assume the risk arising therefrom, as well as hereby hold harmless and release and forever discharge The Pennsylvania State University, its Board of Trustees, the Penn State Diving Control Board, the Penn State Dive Safety Officer and any and all of its agents, officers, assistants and employees, either in their individual capacities or by reason of their relationship to the Pennsylvania State University and its Board of Trustees, and their successors, from any and all claims and demands whatsoever, which the undersigned and any of them and their heirs, representatives, executors and administrators thereof, or any other persons acting in their behalf, or in behalf of their respective agents, have or may have against the said Board of Trustees of the Pennsylvania State University, or any or all of the aforementioned persons or their successors, by reason of any accident, illness, injury or death, or any other consequences arising or resulting directly or indirectly from participation in all DIVING activities under the auspices of the Pennsylvania State University, and occurring during said participation, or at any time subsequent thereto.

I HEREBY further declare and represent that I am on notice, this being evidence and acknowledgement thereof, that The Pennsylvania State University has no medical insurance that covers me, and it has been strongly recommended to me that I obtain medical insurance and supplementary dive accident and medical evacuation insurance prior to the aforesaid **SCIENTIFIC DIVING** activities are performed.

FINALLY, I HEREBY declare and represent that in making, executing and tendering this Statement of Voluntary Consent, General Release and Waiver of Liability, I fully understand and acknowledge that I am relying wholly upon my own judgment, belief and knowledge of the circumstances involved in my participation in the described activity, and that I have read this statement, understood its contents, and executed it of my own free will and choice.

IN WITNESS WHEREOF, I have executed this instrument as of _____.
(date)

_____ _____

(WITNESS SIGNATURE) **(SIGNATURE OF STUDENT)**