



**UNIVERSITY OF CALIFORNIA, DAVIS**  
**SCIENTIFIC DIVING PROGRAM**

**DIVING SAFETY MANUAL**

REVISED - OCTOBER 2005

## FOREWORD

This DIVING SAFETY MANUAL is based upon the American Academy of Underwater Sciences (AAUS) Standards for Scientific Diving and Certification and Operation of Scientific Diving Programs, August 2003 revision. This manual and the AAUS revision it is based on, represents the minimal safety standards for state-of-the-art scientific diving. As diving science progresses so shall this manual. It is the responsibility of every scientific diver that this manual always reflects state of the art, safe diving practices.

The Diving Control Board of the University of California, Davis, wishes to acknowledge the fine work of the AAUS, and in the spirit of the AAUS, has used the aforementioned document as a model for our manual. We have tried to retain the format of the AAUS manual (e.g., sections, numbering, etc.) while adding or changing that which we believe to be necessary to fit our local conditions.

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Diving and Boating Safety Officer

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## SECTION 1.00

### GENERAL POLICY

#### 1.10 THE SCIENTIFIC DIVING STANDARDS

##### 1.11 Purpose

The purpose of these scientific diving standards is to ensure that all scientific diving under the auspices of the University of California, Davis is conducted in a manner that will maximize protection of scientific divers from accidental injury and/or illness, and to set forth standards for training and certification which will allow a working reciprocity between campuses, other institutions, and state and federal agencies engaged in research diving. Fulfillment of these purposes shall be consistent with the furtherance of research and safety.

The policies, procedures and standards set forth in this Diving Safety Manual are intended to govern the training and diving operations of all personnel participating in the Diving Program at UC Davis. It applies to all dives operating under University auspices, including visiting divers, volunteers, and campus officers responsible for the management and administration of the scientific diving program.

In 1982, OSHA exempted scientific diving from commercial diving regulations (20 CFR Part 1910, Subpart T) under certain conditions which are outlined below. The final guidelines for the exemption became effective in 1985 (Federal Register, Vol.50, No.6, p.1046). The American Academy of Underwater Sciences (AAUS) is recognized by OSHA as the organization that sets scientific diving standards in the US. UC Davis is an organizational member of the AAUS.

##### 1.12 Scientific Diving Definition

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

##### 1.13 Scientific Diving Exemption

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

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

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

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

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

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

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

#### 1.14 Liability

In adopting the policies set forth in this manual, the University assumes no liability not otherwise imposed by law. Each diver is assumed under this policy to be voluntarily performing activities for which he/she assumes all risks, consequences, and potential liability.

#### 1.15 Release and Waiver

All students and other personnel (other than University employees) diving under University auspices shall execute a release holding the Regents harmless from any claims which might arise.

#### 1.16 Review of Standards

This document will be reviewed and revised by the UCD Diving Control Board annually. Any recommendations for modifications shall be submitted to the AAUS for consideration.

#### 1.20 OPERATIONAL CONTROL

##### 1.21 University Auspices

For the purposes of these standards the auspices of the University includes any scientific diving operation, or training for diving certificate, in which the University is connected because of ownership of any equipment, locations selected, or relationship with the individual(s) concerned.

This includes all cases involving the operations of employees of the University, or of employees or volunteers of auxiliary organizations, where such personnel are acting within the scope of their job duties. This also includes the operations of other persons who are engaged in scientific diving of the University or are diving as a member of an organization recognized by the University.

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

##### 1.22 The Diving Safety Manual

The purpose of this Diving Safety Manual is to set forth the basic underwater diving safety policy, organization, regulations and procedures for safety in diving operations conducted under University auspices.

## 1.23 The Diving Safety Officer

### 1.23.1 Qualifications

- a. Shall be appointed by the Vice Chancellor - Administration, with the advice and counsel of the Diving Control Board.
- b. Shall be trained as a scientific diver.
- c. Shall be a full member as defined by the AAUS.
- d. Shall be an active scuba instructor from a nationally recognized training agency.

### 1.23.2 Duties and Responsibilities

- a. Shall be responsible, through the DCB, and Director, Environmental Health & Safety to the Vice Chancellor - Administration or his/her designee, for the conduct of the scientific diving and diver training programs. The operational authority for this program, including the conduct of training and certification, approval of dive plans, maintenance of diving records, and ensuring compliance with this manual and all relevant regulations rests with the Diving Safety Officer.
- b. 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.
- c. 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.
- d. Shall suspend diving operations which he/she considers to be unsafe or unwise.

## 1.24 The Diving Control Board

### 1.24.1 Mission

The mission of the UCD Diving Control Board is to ensure that University of California, Davis, sanctioned scuba or surface supplied diving is done as safely as possible. The Board will accomplish this mission by ensuring that all diving performed under the auspices of the University adheres to established training and safety standards for scientific diving. The Board will also promote the University's subtidal research programs.

### 1.24.2 Composition

The Board shall be composed of twelve (12) members. At least seven of the members shall be active certified scientific divers. Membership shall consist of three faculty, one staff, one student representative, and a member of the general diving public. The Chair of the Board shall be a faculty member, and will represent the Vice Chancellor-Administration. Other members will be the Diving Safety Officer, a physician who is familiar with diving medicine (The Diving Medical Officer), a representative of the UCD instructional staff, the Senior Divers at the Tahoe Research Group and Bodega Marine Laboratory, and the campus Scuba Technician.

#### 1.24.3 Method of Appointment

Appointments to the Board shall be made annually by the Vice Chancellor-Administration. The Diving Control Board shall review application for membership and make recommendations to the Vice Chancellor-Administration.

#### 1.24.4 Term of Appointment

The Diving Safety Officer, the Senior Divers at the research units, and the campus Scuba Technician shall be members as long as they hold their positions. All other appointments shall be for one year to coincide with the University fiscal year. Individual members may be reappointed. The Chairperson of the Board shall be chosen by the Vice Chancellor-Administration from the membership.

#### 1.24.5 Responsibilities

The Diving Control Board shall:

- a. Act as the official representative of the University in matters concerning its diving program.
- b. Report to the Vice Chancellor-Administration. This will normally be through the Director of Environmental Health and Safety. Copies of meetings, reports, plans, programs, etc., are to be submitted to the Director of Environmental Health and Safety and to the Vice Chancellor-Administration. These records shall be maintained as stated in Section 1.40.1. The Diving Safety Officer shall be the custodian of records, including training records.
- c. Issue, reissue or revoke scientific diving certifications. When issuing certifications the Board will take into consideration the prospective diver's ocean, pool and classroom experience and demonstrated performance. Other diving experience and the medical and first aid training requirements also shall be considered. The Board may grant reciprocity certification upon application by candidates.
- d. Promulgate the UCD Diving Safety Manual. This shall be kept current and will be reviewed and revised, as needed, at least annually.
- e. Establish and/or approve training programs through which applicants can satisfy the requirements of the Diving Safety Manual.
- f. Approve or revoke approval of and/or suspend diving programs/activities it considers unsafe or imprudent.

- g. Establish criteria for equipment selection and use and ensure that campus equipment is maintained in a safe and prudent manner.
- h. Recommend new equipment, training methods or diving techniques.
- i. Establish and/or approve facilities for the inspection and maintenance of diving equipment.
- j. Ensure that all UCD breathing gas compressors meet appropriate quality standards.
- k. Sit as a board of investigation to inquire into the nature and cause of diving accidents or violations of the University Diving Safety Manual and make appropriate recommendations based upon the findings of the inquiry.
- l. Make recommendations and provide advice to the Diving Safety Officer regarding the performance of his/her required duties. Operational conduct of the Diving Program will be the responsibility of the Diving Safety Officer.
- m. Act as a board of appeal to consider University diver/diving-related problems.
- n. Promote and support the University's subtidal research programs.
- o. Promote and support professional development of campus diving program staff.

#### 1.24.6 Meetings

The Board shall have open meetings at least once a quarter. Special meetings may be called by the Chairperson, as needed. A quorum must be present at all meetings in order that business may be legally transacted. A quorum shall consist of a simple majority of the members and the Diving Safety Officer or his/her designated representative.

### 1.25 Instructional Personnel

#### 1.25.1 Qualifications

All personnel involved in diving instruction under the auspices of UC Davis shall be qualified for the type of instruction being given, be certified as scientific divers, and hold active leadership certification from a nationally recognized training agency.

- a. An exception to Section 1.25.1 is that Teaching Assistants (TAs) need not be active as scientific divers. TAs must have completed PE 128A, or equivalent training, and meet all other requirements as stated in Section 5.31. TAs must also be signed up as volunteers.

#### 1.25.2 Selection

Instructional personnel will be selected by the Vice Chancellor-Administration, or her/his designee, who will solicit the advice of the DCB in conducting preliminary screening of applicants for instructional positions.

## 1.26 Lead Diver

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

- 1.26.1 Coordination. Diving shall be coordinated with other known activities in the vicinity which are likely to interfere with diving operations.
- 1.26.2 Ensuring that all team members possess current certification and are qualified for the type of diving operation.
- 1.26.3 Planning dives in accordance with section 2.21 and to include:
  - a. Diving mode.
  - b. Surface and underwater conditions and hazards.
  - c. Breathing gas supply.
  - d. Thermal protection.
  - e. Diving equipment.
  - f. Dive team assignments.
  - g. Residual inert gas status of dive team members.
  - h. Decompression schedules and altitude corrections.
  - i. Emergency procedures.
- 1.26.4 Ensuring safety and emergency equipment is in working order and at the dive site.
- 1.26.5 Briefing. The dive team members shall be briefed on:
  - a. Dive objectives.
  - b. Unusual hazards or environmental conditions likely to affect the safety of the diving operation.
  - c. Modifications to diving or emergency procedures necessitated by the specific diving operation.
- 1.26.6 Suspending diving operations if in his/her opinion conditions are not safe.
- 1.26.7 Reporting to the DSO and DCB any physical problems or adverse physiological effects including signs or symptoms of pressure-related injuries.
- 1.26.8 Dive Planning. Planning of a diving operation shall include considerations of the safety and health aspects of the following:

## 1.27 Reciprocity and Visiting Scientific Diver

1.27.1 If UCD is engaged in diving activities with another AAUS organizational member, or UC campus, or engaged jointly in use of diving resources, one of the participating Diving Control Boards shall be designated to govern the joint diving project.

1.27.2 A scientific diver from one AAUS organizational member (such as UCD) shall apply for permission to dive under the auspices of another AAUS organizational member by submitting to the Diving Safety Officer of the host organization a document containing all the information described in Appendix 6 (letter of reciprocity), signed by the DSO or Chair of the home Diving Control Board.

1.27.3 A visiting scientific diver may be asked to demonstrate his/her knowledge and skills for the planned diving. An example of items to be demonstrated is presented in Appendix 6A (checkout dive).

1.27.4 If a visiting diver is denied permission to dive, the UCD DCB shall notify the visiting diver and his/her Diving Control Board with an explanation of all the reasons for the denial.

## 1.28 Waiver of Requirements

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

## 1.29 Consequence of Violation of Regulations by Scientific Divers

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

## 1.30 CONSEQUENCES OF VIOLATION OF REGULATIONS BY AAUS ORGANIZATIONAL MEMBERS

Failure to comply with the regulations as set forth in the AAUS' Standards for Scientific Diving Certification and Operation of Scientific Diving Programs, upon which this manual is based, may be cause for the revocation or restriction of UC Davis' Organizational Member recognition by the AAUS.

## 1.40 RECORD MAINTENANCE

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

### 1.40.1 Availability of Records:

- a. Medical records shall be available to the diver, or to the attending physician of a diver or former diver when released in writing by the diver.
- b. Records and documents required by this manual shall be retained by DSO for the following periods:

- Physician's written reports of medical examinations for dive team members - five (5) years.
- Diving Safety Manual - current revision only.
- Dive logs - one (1) year, except five (5) years where there has been an incident of pressure-related injury.
- Pressure-related injury assessment - five (5) years.
- Equipment inspection and testing records - current entry or tag, or until equipment is withdrawn from service.

## SECTION 2.00

### DIVING REGULATIONS FOR SCUBA (OPEN CIRCUIT, COMPRESSED AIR)

#### 2.10 INTRODUCTION

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

Scientific diving shall not be conducted unless procedures have been established for basic life support, first aid treatment, and emergency evacuation of the diver(s) to a hyperbaric chamber or appropriate medical facility.

#### 2.20 PRE-DIVE PROCEDURES

##### 2.21 Dive Plans

Dives should be planned around the competency of the least experienced diver. Before conducting any diving operations under University auspices, the lead diver for a proposed operation must formulate a dive plan which should include the following and shall be presented to the Diving Control Board for approval:

- 2.21.1 Name of project.
- 2.21.2 Name of primary researcher.
- 2.21.3 Research project description and goals.
- 2.21.4 New or reauthorization of an ongoing project.
- 2.21.5 Location of research project.
- 2.21.6 Divers working on the project: (name, UCD certification #, date of last physical, CPR class, and first aid training.)
- 2.21.7 Dive plan expected: number of dives, maximum and average depths, number of dives per day, method (e.g., scuba, surface supplied, bluewater, rebreather, etc.).
- 2.21.8 Subtidal research methods to be used. Describe any special or unusual equipment and/or procedures.
- 2.21.9 Dates of beginning and end of diving operations.
- 2.21.10 Safety procedures to be followed during operations.
- 2.21.11 Emergency procedures, including name and number of nearest hyperbaric chamber facility, nearest hospital, EMS activation method, nearest emergency communications (telephone, marine radio) See Appendix 8.
- 2.21.12 Describe any potentially hazardous conditions (decompression diving, altitude, etc.).
- 2.21.13 Funding source(s).

2.21.14 Other universities, institutions, or groups involved with the project.

2.21.15 Additional information pertinent to the diving operations.

This information will be presented to the DCB with ample time for Board review and discussion before diving operations begin. The DCB has the authority to suspend diving for all programs that do not obtain approval for the dive plan. A Project Approval Request form is available from the DSO.

## 2.22 Pre-Dive Safety Checks

### 2.22.1 Diver's Responsibility:

- a. Each diver shall conduct a functional check of his/her diving equipment in the presence of the diving buddy or tender.
- b. It is the diver's responsibility and duty to refuse to dive if, in his/her judgment, conditions are unfavorable, or if he/she would be violating the precepts of his/her training, or of this manual.
- c. No dive team member shall be required to be exposed to hyperbaric conditions against his/her will, except when necessary to prevent or treat a pressure-related injury.
- e. 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 team members.

### 2.22.2 Equipment Evaluations

- a. Each diver should perform a check of the submersible pressure gauge, timing device, depth gauge, and compass.
- b. Each diver shall have the capability of achieving and maintaining positive buoyancy.
- c. If gas other than air is used as the breathing media, appropriate diving tables shall be used, and the dive log filled out appropriately.
- d. Closed and semi-closed circuit scuba (rebreathers) shall meet the requirements as outlined in Section 11.70. Use of rebreathers for diving operations must have prior approval of the DCB.

### 2.22.3 Site Evaluation

The environmental conditions at the dive site will be evaluated by all dive team members.

## 2.30 DIVING PROCEDURES

### 2.31 Solo Diving Prohibition

All diving conducted under the auspices of UC Davis shall be planned and executed in such a manner as to ensure that every diver maintains constant, effective communication with at least one other comparably equipped diver in the water. This buddy system is based upon mutual assistance, especially in the case of an emergency. Dives should be planned around the competency of the least experienced diver. If loss of effective communication occurs within a buddy team, all divers shall surface and re-establish contact (except as specified in Section 11.60).

## 2.32 Refusal to Dive

2.32.1 The decision to dive is that of the diver. A diver may refuse to dive, without fear of penalty, whenever he/she feels it is unsafe for them to make the dive (see Section 2.22.1).

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

## 2.33 Termination of the Dive

2.33.1 It is the responsibility of the diver to terminate the dive, without fear of penalty, whenever he/she feels it is unsafe to continue the dive, unless it compromises the safety of another diver already in the water (see Section 2.22.1).

2.33.2 The dive shall be terminated while there is still sufficient cylinder pressure to permit the diver to safely reach the surface, including decompression time, or to safely reach an additional breathing gas source at the decompression station and to obtain positive buoyancy.

## 2.34 Emergencies and Deviations from Regulations

2.34.1 No local or remote scientific diving shall be conducted unless procedures have been established for basic life support, first aid, and emergency evacuation of the divers to a hyperbaric chamber and other appropriate medical facility. All such emergency plans shall be approved by the Diving Safety Officer or Chair of the Diving Control Board.

The Diving Safety Officer will prepare, distribute, and update, as necessary, an emergency diver evacuation plan for local areas utilized by UCD scientific divers.

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

## 2.40 POST-DIVE PROCEDURES

### 2.41 Post-Dive Safety Checks

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

2.41.2 When a diver exceeds the no-decompression limits, the diver should remain awake for at least one hour after diving and in the company of a dive team member who is prepared to transport him/her to a medical facility if necessary.

## 2.50 EMERGENCY PROCEDURES

Each supervisor for a dive project will develop emergency procedures which follow the current standards of care of the community and must include procedures for emergency care, recompression, and evacuation for each dive location (See Section 2.21 and Appendix 7).

## 2.60 FLYING AFTER DIVING

Divers should have a minimum surface interval of twelve (12) hours after diving before flying (cabin pressure equal to 8,000 feet altitude). Longer surface intervals are strongly recommended if a repetitive and/or aggressive dive schedule has been followed.

## 2.70 RECORD KEEPING

### 2.71 Personal Dive Log

2.71.1 Each certified scientific diver shall log every dive made under the auspices of the University program, and is encouraged to log all other dives. Log sheets shall be submitted to the DSO to be placed in the diver's permanent file. The diving log shall be in the form specified.

Name:	As in Diving Program records.
Month/year:	In which the diving was performed.
Certification #:	UCD Scientific Diver identification #.
Date:	Date of the day of the dives.
Location:	Simple, accurate description of where diving occurred.
Purpose:	Enter one of the following: "Research" or "Training/Proficiency" or "Other"
Buddy:	Required (See Section 2.31).
Method:	"Scuba" if using open circuit scuba. Otherwise respond accordingly (e.g., bluewater, hookah, surface supplied, saturation, semi or fully closed rebreather).
DC Model:	The method of determining decompression requirements (e.g., tables or computer).
FO <sub>2</sub> :	(Fraction of oxygen) Leave blank if breathing normal air, otherwise respond accordingly.
Depth:	Record actual maximum depth in feet of fresh or saltwater.

- TBT: Total Bottom Time. Measured from when the diver leaves the surface until he/she arrives at the precautionary (safety) or required decompression stop, or otherwise, back at the surface.
- DC Stops: Either precautionary (safety) or required stop(s) (See Appendix 10).
- Comments: Further description of dive (e.g., altitude, polar, night, etc.).

The log is available as an Excel spreadsheet from the DSO or at the website <http://www.bml.ucdavis.edu/facility/diveops.html>. It can be e-mailed to the DSO monthly. (preferred). The DSO fax # is (707) 875-2089. Mail is PO Box 247, Bodega Bay, CA 94923.

- 2.71.2 Students in UCD Scuba diving classes will fill out the Student Dive Log. The course instructor(s) will insure the students fill out the dive log properly and submit them to the DSO at the end of the course.
- 2.71.3 Report all incidents, equipment failures, or potentially dangerous experiences to the UCD Diving Safety Officer, Bodega Marine Laboratory 94923-0249.
- 2.71.4 If pressure-related injuries are suspected, or if symptoms are evident, the following additional information shall be recorded:
- a. Complete Incident/Accident Report Form (see Appendix 8).
  - b. Description of symptoms, including time of onset.
  - c. Description and results of treatment.
- 2.71.5 The DCB shall investigate and document any incident of pressure-related injury and prepare a report that will be forwarded to the AAUS.

## 2.72 Required Incident/Accident Reporting

All diving accidents requiring recompression, resulting in serious injury, requiring medical evaluation, hospitalization, or exhibiting symptoms consistent with decompression illness (DCI), pulmonary barotrauma, gas embolism (AGE), or near drowning shall be reported to the DSO in a timely manner. All such instances automatically constitute suspension of the diver's scientific diver certification and require medical clearance by the Diving Medical Officer before resuming diving activities. In addition, UCD must meet the following reporting requirements:

- 2.72.1 The DSO and the Board shall record and report occupational injuries and illnesses in accordance with requirements of the appropriate Labor Code section.
- 2.72.2 If pressure-related injuries are suspected, or if symptoms are evident, the following additional information shall be recorded and retained by the DSO/DCB, with the record of the dive, for a period of five (5) years:
- a. Complete AAUS Accident or Incident Report Form (Apx 8 or [www.aaus.org](http://www.aaus.org)).
  - b. Written descriptive report to include:
    - Name, address, phone numbers of the principal parties involved.
    - Summary of experience of divers involved.
    - Location, description of dive site and description of conditions that led up to the incident/accident.
    - Description of symptoms, including time of onset.

- Description of results of treatment.
- Disposition of case.
- Recommendations to avoid repetition of incident.

2.72.3 The DCB shall investigate and document any occurrence of pressure-related injury and prepare a report for release. The report shall then be forwarded to the AAUS.

## SECTION 3.00

### DIVING EQUIPMENT

#### 3.10 GENERAL POLICY

- 3.10.1 All equipment (whether University or privately owned) shall meet standards as determined by the DSO and the DCB. Equipment that is subject to extreme usage under adverse conditions should require more frequent testing and maintenance.
- 3.10.2 Divers shall submit proof of service for all privately owned equipment at least once every twelve (12) months.

#### 3.20 EQUIPMENT

##### 3.21 Regulators

- 3.21.1 For dives made at altitudes greater than 1000 meters, and with a water temperature less than 7 C, and/or depths deeper than 40 meters, only regulators that meet or exceed the standards originally set forth by the US Navy for "Class A" service (breathing performance rating) shall be used during scientific or training diving operations.
- 3.21.2 Scuba regulators shall be inspected and tested prior to first use and serviced every twelve (12) months thereafter. Those scientific divers who own their regulators shall submit copies of receipts for regulator service to the DSO annually. Scuba regulators used in the Physical Education Department scuba training courses shall be inspected and serviced every six (6) months.
- 3.21.3 Regulators will consist of a primary second stage and an alternate or redundant air source.

##### 3.22 Breathing Masks and Helmets

Breathing masks and helmets shall have:

- 3.22.1 A non-return valve at the attachment point between helmet or mask hose, which shall close readily and positively.
- 3.22.2 An exhaust valve.
- 3.22.3 A minimum ventilation rate capable of maintaining the diver at the depth to which he/she is diving.
- 3.22.4 Voice communications to the surface.
- 3.22.5 Oral mask to prevent carbon dioxide buildup.

##### 3.23 Scuba Cylinders

- 3.23.1 Scuba cylinders must be designed, constructed, and maintained in accordance with the applicable provisions of the Unfired Pressure Vessel Safety Orders.
- 3.23.2 Scuba cylinders must be hydrostatically tested in accordance with Department of Transportation standards.

- 3.23.3 Scuba cylinders must have an internal inspection at intervals not to exceed twelve (12) months.
- 3.23.4 Scuba cylinder valves shall be functionally tested for proper operation at intervals not to exceed twelve (12) months and serviced as needed.
- 3.23.5 Scuba cylinders for use with nitrox shall be oxygen cleaned and have oxygen compatible value components and lubrication. The cylinders shall be color coded per Section 7.52, be marked “Nitrox”, “EANx” or “DNAx,” and have a properly filled out contents tag. (Refer to Section 7.50)
- 3.24 Backpacks and Weight Systems
- 3.24.1 Backpacks with or without integrated flotation devices and weight systems shall have a quick release device designed to permit jettisoning with a single motion from either hand.
- 3.24.2 Backpacks and weight systems shall be regularly examined for function, signs of wear and unsafe condition by the person using them.
- 3.25 Gauges
- Inaccurate gauges shall not be used. Gauges must be tested before first use and every twelve months thereafter. A record of inspections, tests, and repairs shall be maintained.
- 3.26 Flotation Devices
- 3.26.1 Each diver shall have the capability of achieving and maintaining positive buoyancy.
- 3.26.2 Personal flotation systems, buoyancy compensators, dry suits, or other variable volume buoyancy compensation devices shall be equipped with an exhaust valve. These devices shall be functionally inspected and tested at intervals not to exceed twelve (12) months.
- 3.27 Timing Devices, Depth and Pressure Gauges, and Compass
- Both members of the diving pair must have an underwater time-keeping device, an approved depth indicator, a submersible tank pressure gauge, a compass, and a dive knife or other cutting device.
- 3.28 Determination of Decompression Status: Dive Tables, Dive Computers
- 3.28.1 A set of diving tables, approved by the DCB, must be available at the dive location.
- 3.28.2 Dive computers may be utilized in place of diving tables.
- a. Although improvements in dive computer technology continue, not all computers are appropriate for all dive profiles. It is the responsibility of the individual diver to read the owners manual and follow its directions. If a computer is not fully functional (e.g., compute and display actual dive depth and time, no-stop decompression limits, as well as depth and time of required decompression stops corrected for altitude, if necessary) for the diving profile, then it may not be used to determine the diver’s decompression obligation.
- b. For dives at an elevation greater than 300 meters only those computers that are fully functional at the dive site altitude are allowed.

- c. Any diver desiring to use dive computers must demonstrate understanding and proficiency in its use to the Diving Safety Officer, or his/her designee.
- d. After the diver has been approved for computer use, by the Diving Safety Officer he/she must agree to follow all policies and procedures as set forth items 3-13 of the AAUS Guidelines for use of Dive Computers.  
(see Appendix 9)

### 3.30 AUXILIARY EQUIPMENT

#### 3.31 Hand held underwater power tools.

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

#### 3.41 First Aid Supplies

A first aid kit and emergency oxygen shall be available at the dive location.

#### 3.42 Diver's Flag

Diver's flags, either national (red with white diagonal) or alpha, shall be displayed prominently whenever diving is conducted under circumstances where boat traffic is probable, or whenever required by state or federal regulations.

#### 3.43 Compressor Systems

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

- 3.43.1 Low pressure compressors used to supply air to the diver shall be equipped with a volume tank with a check valve on the inlet side, a pressure gauge, a relief valve, and a drain valve.
- 3.43.2 Compressed air systems over 500 psig shall have slow-opening shut-off valves.
- 3.43.3 All air compressor intakes shall be located away from areas containing exhaust or other contaminants.
- 3.43.4 Non oil-lubricated compressors are required for blending nitrox.  
(Refer to Section 7.55)

#### 3.44 Oxygen Systems

3.44.1 Equipment used with oxygen or mixtures containing over forty percent (40%) by volume oxygen shall be designed and maintained for oxygen service, except cylinders as described in Section 3.23.

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

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

### 3.50 EQUIPMENT MAINTENANCE

#### 3.51 Record Keeping

For University owned equipment, and all regulator first, second and alternate air stages, 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: (Refer to Section 3.10.2)

3.51.1 Regulators.

3.51.2 Submersible pressure gauges.

3.51.3 Depth gauges.

3.51.4 Scuba cylinders.

3.51.5 Cylinder valves.

3.51.6 Buoyancy control devices, including inflator valves.

3.51.7 Diving helmets.

3.51.8 Submersible breathing masks.

3.51.9 Compressors.

3.51.10 Gas control panels.

3.51.11 Gas storage cylinders.

3.51.12 Gas filtration systems.

3.51.13 Analytical instruments.

3.51.14 Dry suits.

#### 3.52 Compressor Operation and Air Test Records

- 3.52.1 Gas analyses and air tests shall be performed on each breathing gas compressor at regular intervals of no more than 100 hours of operation or six (6) months, whichever occurs first. The results of these tests shall be entered in a formal log, posted, and be maintained by the DSO.
- 3.52.2 A log shall be maintained showing operation, repair, overhaul, and filter maintenance 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-9.1) and referenced in OSHA 29 CFR 1910.134:

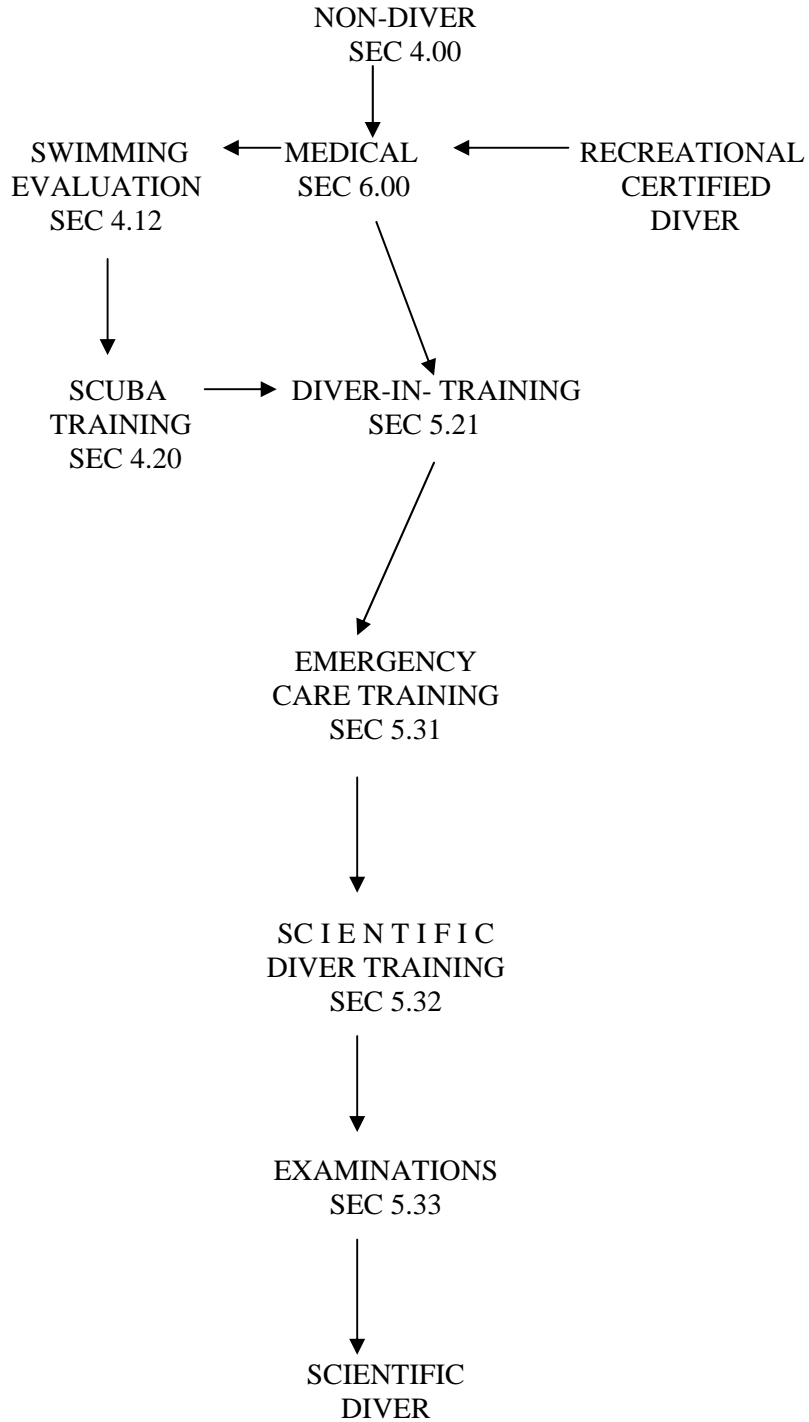
CGA Grade E

Breathing air for scuba shall meet the Compressed Gas Association Grade ‘E’ standards

- 3.60.1 Minimum oxygen. . . . .atmospheric
- 3.60.2 Oxygen content ..... Special mixtures must be approved by the DSO.  
(Refer to Section 7.20)
- 3.60.3 Maximum carbon monoxide.. .....<0.001% (10 ppm)
- 3.60.4 Maximum carbon dioxide ..... <0.050 (500 ppm)
- 3.60.5 Dust and droplets of oil and water . . ..... absent
- 3.60.6 Dewpoint..... -40
- 3.60.7 Odors and vapors ..... absent
- 3.60.8 Air used for blending nitrox shall meet requirements of “oil-free” air.

**SECTION 4.00  
ENTRY-LEVEL TRAINING REQUIREMENTS**

**AAUS SCIENTIFIC DIVER TRAINING FLOWCHART**



## ENTRY-LEVEL TRAINING REQUIREMENTS

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

### 4.10 EVALUATION

#### 4.11 Medical Examination

In accordance with American Academy of Underwater Sciences (AAUS) Guidelines and the Diving Safety Manual, each applicant for diver training shall submit a statement signed by a licensed physician to be medically qualified for diving before proceeding with the training as designated in Section 4.20 (see Section 6.00 and Appendices 1 through 4).

The Diving Medical Officer shall review any significant finding from medical examinations. The Diving Medical Officer shall determine the medical significance and the medical suitability of all divers participating in diving at UC Davis. The Diving Control Board is available if a diver wishes to appeal the decision regarding medical fitness to dive by the Diving Medical Officer. The decision of the Diving Control Board is final.

#### 4.12 Swimming Evaluation

4.12.1 25 yard (23 meters) underwater swim, do not surface.

4.12.2 400 yard (366 meters) swim in less than 12 minutes.

4.12.3 Tread water for 10 minutes, or for 2 minutes without use of hands, ears and chin out of the water.

4.12.4 Transport another person of equal size a distance of 25 yards (23 meters) in the water without the use of swim aids.

### 4.20 SCUBA TRAINING

#### 4.21 Practical Training

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

4.21.1 Enter water with full equipment.

4.21.2 Clear face mask.

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

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

4.21.5 Demonstrate understanding and use of underwater signs and signals.

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

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

4.21.8 Demonstrate ability to remove and replace equipment while submerged.

4.21.9 Demonstrate watermanship ability which is acceptable to the instructor.

#### 4.22 Written Examination

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

- 4.22.1 Function, care, use, and maintenance of diving equipment.
- 4.22.2 Physics and physiology of diving.
- 4.22.3 Diving regulations and precautions.
- 4.22.4 Near-shore currents and waves.
- 4.22.5 Dangerous marine animals.
- 4.22.6 Emergency procedures, including buoyant ascent and ascent by air sharing.
- 4.22.7 Currently accepted decompression procedures.
- 4.22.8 Demonstrate the proper use of dive tables.
- 4.22.9 Underwater communications.
- 4.22.10 Aspects of freshwater and altitude diving.
- 4.22.11 Hazards of breath-hold diving and ascents.
- 4.22.12 Planning and supervision of diving operations.
- 4.22.13 Diving hazards.
- 4.22.14 Cause, symptoms, treatment, and prevention of the following: near drowning, air embolism, carbon dioxide excess, squeezes, oxygen poisoning, nitrogen narcosis, exhaustion and panic, respiratory fatigue, motion sickness, decompression sickness, hypothermia, and hypoxia/anoxia.

#### 4.23 Open Water Evaluation

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

- 4.23.1 Surface dive to a depth of fifteen (15) feet in open water without scuba.
- 4.23.2 Demonstrate proficiency in air sharing, including both buddy breathing and the use of alternate air source, as both donor and receiver.
- 4.23.3 Enter and leave open water or surf, or leave and board a diving vessel, while wearing scuba gear.
- 4.23.4 Kick on the surface 400 yards (366 meters) while wearing scuba gear, but not breathing from the scuba unit.
- 4.23.5 Demonstrate judgment adequate for safe diving.
- 4.23.6 Demonstrate, where appropriate, the ability to maneuver efficiently in the environment, at and below the surface.
- 4.23.7 Complete a simulated emergency swimming ascent.

- 4.23.8 Demonstrate clearing of mask and regulator while submerged.
- 4.23.9 Demonstrate ability to achieve and maintain neutral buoyancy while submerged.
- 4.23.10 Demonstrate techniques of self-rescue and buddy rescue.
- 4.23.11 Navigate underwater.
- 4.23.12 Plan and execute a dive.
- 4.23.13 Successfully complete  $\geq$  six open water scuba dives for a minimum total time of two hours. No more than three training dives, only two of which may be using scuba, shall be made in any one day.

#### 4.30 DIVER-IN-TRAINING PERMIT LEVEL

- 4.30.1 This permit signifies that a diver has completed a minimum of forty hours of training with at least twelve ocean or open water dives, and possesses a nationally recognized diving certificate. The diver also must have passed a diving-specific medical examination (see Section 6).
- 4.30.2 If the Diver's entry-level training was not under UC Davis auspices the DSO or designee shall evaluate the diver and verify that s/he possesses skills and knowledge substantially similar to those stated in Sections 4.10 and 4.20.

## SECTION 5.00

### SCIENTIFIC DIVER AUTHORIZATION

#### 5.10 AUTHORIZATION TYPES

##### 5.10.1 Scientific Diver Permit

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

##### 5.10.2 Temporary Diver Permit

This permit constitutes a waiver of Section 5.00 (except the Medical Evaluation Form and the “Release and Waiver”) 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 DSO/DCB. This permit is not to be construed as a mechanism to circumvent existing standards set forth in this manual.

Requirements of Section 5.31 & 5.32 may be waived by the DSO for a scuba diver who has demonstrated the required proficiency in diving and can contribute substantially to the specific dives planned. A statement of the temporary diver’s qualifications shall be submitted to the DSO as part of the dive plan. The Temporary Certified Diver Certificate shall be restricted to the planned diving operation and shall comply with all other policies, regulations and standards of this manual. The permit will be valid only for the period specified.

#### 5.20 GENERAL POLICY

The following are considered minimal standards for a scientific diver permit.

#### 5.21 Prerequisites

##### 5.21.1 Diver-In-Training Permit

This permit signifies the diver has completed a nationally recognized sport diving course and has successfully completed a minimum of forty hours of training and a minimum of five open water dives since completion of initial scuba training. This diver participates in a supervised training program and shall log twelve additional training dives with an approved certified buddy under normal working conditions. The diver shall have current two-person CPR, oxygen administration, and first aid training, obtain diver rescue techniques training, and have passed a diving specific physical within the previous twelve months. (See Section 4.0)

##### 5.21.2 Swimming, Skin and Scuba Diving Tests

The applicant for scientific diver training shall successfully perform the following skills, or their equivalent, in the presence of an examiner specified by the DSO.

a. In Confined Water:

- In Swimsuits Only:

- 450 yard (366 meters) swim in less than 12 minutes.
- 25 yard (23 meters) swim underwater, do not surface.
- Tread water for 2 minutes without use of hands, ears and chin out of the water.

- In Skin Diving Gear:

- 50 yard (46 meters) swim on surface while breathing through a snorkel without a mask on.
- Skin diving “Ditch and Don” mask and fins only, mask and snorkel cleared before surfacing.
- In Scuba Equipment:
  - Perform a simulated rescue of a scuba diver from a depth of at least 4 meters and transport on the surface at least 50 yards (46 meters).
  - Scuba unit removal & replacement
  - Weight belt removal and replacement
  - Mid-water macro and micro buoyancy control.
  - Out of air emergency actions – alternate air sharing and buddy breathing. As donor & recipient and stationary & while ascending.
  - Controlled emergency swimming ascent

b. In Open Water, in scuba equipment

- Buddy check.
- Entry.
- Buoyancy check.
- Surface swim.
- Descent on a line.
- Equipment removal and replacement. Clearing where necessary
- Alternate air sharing ascent.
- Buddy breathe as donor and as recipient.
- Neutral buoyancy.
- Controlled emergency swimming ascent.
- Exit.

5.22 Eligibility

Only a person diving under University auspices is eligible for a scientific diver permit from the UC Davis Diving Control Board.

5.23 Application

Application for scientific diver authorization shall be made to the Diving Safety Officer.

5.24 Medical Examination

In accordance with American Academy of Underwater Sciences (AAUS) Guidelines and this Diving Safety Manual, each applicant for diver training shall submit a statement signed by a licensed physician, based on an appropriate medical evaluation, attesting to the applicant’s physical fitness for diving with compressed gas.

The Diving Medical Officer shall review any significant finding from medical examinations. The Diving Medical Officer shall determine the medical significance and the medical suitability of all divers participating in scientific diving at UC Davis. The Diving Control Board is available if a diver wishes to appeal the decision regarding medical fitness to dive by the Diving Medical Officer. The decision of the Diving Control Board is final.

Medical requalification will follow the schedule stated in section 6.12. An appropriate evaluation must also be accomplished after each significant illness or injury. (See Section 6.00 and Appendices 1-4).

5.30 REQUIREMENTS FOR SCIENTIFIC DIVER AUTHORIZATION

Submission of documents and participation in aptitude examinations does not automatically result in authorization. The applicant must convince the Diving Safety Officer and members of the Diving Control Board that she/he is sufficiently skilled and proficient to participate in UC diving operations. This aptitude 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 her/his partner, may be denied UCD scientific diving privileges. Minimum documentation and examinations required are as follows:

### 5.31 Documents

#### 5.31.1 Application

5.31.2 Medical Evaluation Form (See Section 6 and Appendix 2).

5.31.3 Release and Waiver Form

5.31.4 Proof of diver-in-training status or its equivalent.

5.31.5 Log of  $\geq$  twelve ocean dives.

5.31.6 Emergency care training. The trainee must provide proof of training in the following:

- a. Two-person CPR (must be current).
- b. Emergency oxygen administration (must be current).
- c. First aid, including for diving accidents (must be current).
- d. Diver rescue techniques.

### 5.32 Training

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

5.32.1 Theoretical aspects should include principles and activities appropriate to the intended area of scientific study. Suggested topics include, but are not limited to; data gathering techniques, collecting, common biota, behavior, installation of scientific apparatus, use of chemicals, site selection, site location and relocation, animal and plant identification, ecology, tagging, photography, scientific dive planning, coordination with other agencies, appropriate governmental regulations, and small boat operation.

5.32.2 Practical training shall include additional dives to ensure a cumulative total of at least twelve supervised ocean or open water dives in a variety of dive sites and diving conditions, for a cumulative bottom time of four hours. No more than three of these dives shall be made in one day.

5.32.3 Rescue, first aid, two-person CPR, and oxygen administration training are required.

5.32.4 Refer to Section 7.30 for guidelines for nitrox diver training.

### 5.33 Examinations

5.33.1 Written examination for the qualification level.

5.33.2 Examination of equipment.

5.33.3 Sheltered water check-out examination including emergency ascent techniques.

5.33.4 Open water check-out dives to appropriate depths with evaluation of the skills in Section 4.23 and Appendix 6A.

#### 5.40 DEPTH LEVELS

Diving on air is not permitted beyond a depth of 190 feet.

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

#### 5.41 Depth Qualification Levels

5.41.1 Qualification to 2 ATA Depth (10 meters). This is the initial certification, approved upon the successful completion of training.

5.41.2 Qualification to 3 ATA (20 meters) Depth Level. A diver qualified to 2 ATA may be qualified to a depth of 3 ATA after successfully completing, under supervision, twelve logged dives to depths between 2 ATA and 3 ATA, for a minimum total bottom time of four hours.

a. A redundant breathing gas supply is recommended for dives deeper than 3 ATA.

5.41.3 Qualifying to 4 and 5 ATA depths (30 & 40 meters). A diver qualified to 3 ATA may gain 4 and 5 ATA depth qualifications respectively by logging four dives near each maximum depth category. These qualification dives shall be made with the DSO or his/her designee.

a. The diver shall demonstrate proficiency in the use of the appropriate decompression tables and methods.

b. A redundant breathing gas supply is very strongly recommended for dives deeper than 4 ATA.

5.41.4 Qualifying for depths greater than 5 ATA. Divers needing qualification to depths beyond 5 ATA must apply to the DCB. The diver must also demonstrate a knowledge of the special problems of deep diving, and of special safety requirements.

#### 5.50 MAINTAINING AUTHORIZATION

##### 5.51 Minimum Activity to Maintain Scientific Diver Authorization

During any twelve month period each scientific diver must log a minimum of twelve dives. At least one dive must be logged near the maximum of the diver's depth level during each six month period. Divers qualified to 6 ATA or deeper may satisfy these requirements with dives to 5 ATA or deeper.

Failure to meet these requirements may be cause for revocation or restriction of authorization.

##### 5.52 Requalification of Depth Level

Once the initial requirements of Section 5.40 are met, divers whose depth qualification has lapsed due to lack of activity may be requalified by procedures to be adopted by the DCB.

### 5.53 Medical Examination

All scientific divers shall pass an initial medical examination, and thereafter be examined at five year intervals until age 40. After 40, medical examinations will be given every three years until age 60, then every two years. After each major illness or injury, a scientific diver shall submit to medical interview and/or examination before resuming diving activities. See Section 6.00 for examination criteria.

### 5.54 Emergency Care Training

Each diver shall maintain current status in first aid, 2-person CPR and oxygen administration training. Those volunteering with the scuba training classes shall also be current in first aid for scuba diver training and hold diver rescue certification from a nationally recognized training agency.

### 5.55 Equipment Service

Divers shall submit proof of regulator service to the DSO annually.

### 5.60 REVOCATION OF AUTHORIZATION

A diving permit may be revoked or restricted for cause by the DSO or the DCB. Violations of regulations set forth in this manual, or other governmental subdivisions not in conflict with this manual, may be considered cause. The DSO shall inform the diver in writing of the reason(s) for revocation. The diver will be given the opportunity to present his/her case in writing for reconsideration and/or requalification. 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 REAUTHORIZATION

If a diver's permit expires or is revoked, he/she may be requalified after complying with such conditions as the DSO or the DCB may impose. The diver shall be given an opportunity to present his/her case to the DCB before conditions for requalification are stipulated.

## SECTION 6.00

### MEDICAL STANDARDS

#### 6.10 MEDICAL REQUIREMENTS OF DIVE TEAM

#### 6.11 General

6.11.1 The DCB shall determine that dive team members who are exposed to hyperbaric conditions have passed a current diving physical examination and have been declared by the examining physician to be fit to engage in diving activities as may be limited or restricted in the medical evaluation report.

6.11.2 All medical evaluations required by this standard shall be performed by, or under the direction of, a licensed physician of the applicant-diver's choice, preferably one trained in diving/undersea medicine. All medical evaluations are subject to review by the Diving Medical Officer who may require additional examinations/tests to determine the medical suitability for scientific diving.

6.11.3 The diver shall 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. (See Section 6.15)

#### 6.12 Frequency of Medical Evaluations

Medical evaluation shall be completed:

6.12.1 Before a diver may begin diving, unless an equivalent initial medical evaluation has been given within the preceding 5 years (3 years if over the age of 40), the member organization has obtained the results of that examination, and those results have been reviewed and found satisfactory by the member organization.

6.12.2 Thereafter, at five year intervals up to age 40, every three years after the age of 40, and every two years after the age of 60

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

#### 6.13. Information Provided Examining Physician

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

#### 6.14 Content of Medical Evaluations

Medical examinations conducted initially and at the intervals specified in Section 6.12 shall consist of the following:

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

6.14.2 Medical history (See Appendix 3)

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

#### 6.15 Conditions which may disqualify candidates from diving. (Adapted from Bove, 1998)

(See Appendix 1).

- 6.15.1 Abnormalities of the tympanic membrane, such as perforation, presence of a monomeric membrane, or inability to autoinflate the middle ears.
- 6.15.2 Vertigo including Meniere's Disease.
- 6.15.3 Stapedectomy or middle ear reconstructive surgery.
- 6.15.4 Recent ocular surgery.
- 6.15.5 Psychiatric disorders including claustrophobia, suicidal ideation, psychosis, anxiety states, untreated depression.
- 6.15.6 Substance abuse, including alcohol.
- 6.15.7 Episodic loss of consciousness.
- 6.15.8 History of seizure.
- 6.15.9 History of stroke or a fixed neurological deficit.
- 6.15.10 Recurring neurologic disorders, including transient ischemic attacks.
- 6.15.11 History of intracranial aneurysm, other vascular malformation or intracranial hemorrhage.
- 6.15.12 History of neurological decompression illness with residual deficit.
- 6.15.13 Head injury with sequelae.
- 6.15.14 Hematologic disorders including coagulopathies.
- 6.15.15 Evidence of coronary artery disease or high risk for coronary artery disease.
- 6.15.16 Atrial septal defects.
- 6.15.17 Significant valvular heart disease - isolated mitral valve prolapse is not disqualifying.
- 6.15.18 Significant cardiac rhythm or conduction abnormalities.
- 6.15.19 Implanted cardiac pacemakers and cardiac defibrillators (ICD).
- 6.15.20 Inadequate exercise tolerance.
- 6.15.21 Severe hypertension.
- 6.15.22 History of spontaneous or traumatic pneumothorax.
- 6.15.23 Asthma.
- 6.15.24 Chronic pulmonary disease, including radiographic evidence of pulmonary blebs, bullae or cysts.
- 6.15.25 Diabetes mellitus.
- 6.15.26 Pregnancy.

#### 6.16 Laboratory Requirements for Diving Medical Evaluation and Intervals.

- 6.16.1 Initial examination under age 40:
  - a. Medical History
  - b. Complete Physical Exam, emphasis on neurological and otological components
  - c. Chest X-ray
  - d. Spirometry
  - e. Hematocrit or Hemoglobin
  - f. Urinalysis
  - g. Any further tests deemed necessary by the physician.
- 6.16.2 Periodic re-examination under age 40 (every 5 years)
  - a. Medical History
  - b. Complete Physical Exam, emphasis on neurological and otological components
  - c. Hematocrit or Hemoglobin
  - d. Urinalysis
  - e. Any further tests deemed necessary by the physician

- 6.16.3 Initial exam over age 40:
  - a. Medical History

- b. Complete Physical Exam, emphasis on neurological and otological components
- c. Assessment of coronary artery disease risk factors including lipid profile and diabetic screening
- d. Resting EKG
- e. Chest X-ray
- f. Spirometry
- g. Urinalysis
- h. Hematocrit or Hemoglobin
- i. Any further tests deemed necessary by the physician
- j. Exercise stress testing may be indicated based on risk factor analysis

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

- a. Medical History
- b. Complete Physical Exam, emphasis on neurological and otological components
- c. Assessment of coronary artery disease risk factors including lipid profile and diabetic screening
- d. Resting EKG
- e. Urinalysis
- f. Hematocrit or Hemoglobin
- g. Any further tests deemed necessary by the physician
- h. Exercise stress testing may be indicated based on risk factor analysis

6.17 Physician's Written Report.

6.17.1 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, which shall contain the examining physician's opinion of the individual's fitness to dive, including any recommended restrictions or limitations. This will be reviewed by the DCB.

6.17.2 The DCB make a copy of the physician's written report available to the individual.

## **Volume 2**

### Sections 7.00 through 11.00 Required Only When Conducting Described Diving Activities

Certain types of diving, some of which are listed below, require specialized equipment or procedures that require training beyond Scientific Diver. Those needing to use methods listed in these sections shall request, and must have, authorization from the Diving Control Board prior to commencing diving activities. (See Section 2.21)

## SECTION 7.00

### NITROX GUIDELINES

These guidelines are supplemental to those specified in Sections 1 through 11 of this Diving Safety Manual. All procedures and requirements in those sections of this manual are in effect unless specifically modified or exempted.

#### 7.10 PREREQUISITES

##### 7.11 Eligibility

Only a certified scientific diver, or diver-in-training under the auspices of UC Davis is authorized to engage in nitrox (EAN<sub>x</sub>, or DN<sub>Ax</sub>) dive training and/or operations.

##### 7.12 Application

Application for nitrox use shall be made in writing to the Diving Safety Officer.

#### 7.20 REQUIREMENTS FOR AUTHORIZATION TO USE NITROX.

Submission of documents does not automatically result in nitrox use authorization. The candidate must convince the DSO and members of the DCB that he/she is sufficiently skilled and proficient to be certified. The skills will be acknowledged by the signature of the DSO on the certification form. After completion of nitrox user training and evaluation, diving certification may be denied to any applicant who does not demonstrate, to the satisfaction of the DSO and DCB, the appropriate judgment and/or proficiency to ensure the safety of the diver and dive partner. Minimum certification documentation and examination required are listed in Sections 7.21 and 7.22.

##### 7.20.1 Documentation

The applicant will provide to the DSO, for review by the DCB:

- a. A completed application form.
- b. Proof of UC Davis scientific diver, or diver-in-training status, including current physical exam and emergency care training.
- c. Proof of twelve (12) or more open water scuba dives.
- d. Proof of successful completion of an Nitrox User course, both classroom and open-water sections. (see Section 7.3)

##### 7.20.2 Waiver of Requirements

The DSO and the DCB may grant a waiver for specific requirements of, and experience and training for, applicant certification if evidence of qualifying knowledge and experience for nitrox diving can be demonstrated.

#### 7.21 Examinations

Each prospective nitrox diver shall demonstrate additional theoretical and practical proficiency beyond scientific diver air certification level in examinations covering:

7.21.1 Review of information presented in the classroom session(s) (e.g., gas theory, oxygen toxicity, EAD concept, maximum operating depth, gas laws, etc.).

7.22.2 Practical examinations covering the information presented in the practical training session(s). (e.g., gas analysis, cylinder and contents tag marking, dive planning, etc.)

7.22.3 Two (2) open water checkout dives with the DSO or his/her designee to demonstrate the application of theoretical and practical skills.

#### 7.23 Minimum Activity to Maintain Certification

In addition to standards set forth in section 5.51 at least one nitrox dive must be logged every six months. Failure to meet these criteria may be cause for revocation or restriction of UC Davis nitrox use authorization. (See Section 5.60)

#### 7.30 NITROX TRAINING GUIDELINES

The diver must complete additional theoretical and practical training beyond the Scientific Diver in Training air level, to the satisfaction of the DSO and DCB. (see Section 7.20)

Nitrox training should be in addition to Diver in Training authorization (Section 4.0). It may be included in the Scientific Diver curriculum. (Section 5.32)

#### 7.31 Classroom Instruction

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 concept and calculations, oxygen physiology and toxicity, calculation of oxygen exposure and maximum safe operating depth, determination of decompression schedules (both by equivalent air depth and using nitrox dive tables), dive planning and emergency procedures, mixing methods, gas analysis, personnel requirements, equipment marking and maintenance requirements, dive station requirements.

#### 7.32 Practical Training

The practical training will consist of a review of skills listed in Section 4 with additional training as follows:

7.32.1 Oxygen analysis of nitrox mixtures

7.32.2 Determination of MOD, oxygen partial pressure, and oxygen toxicity time limits for various nitrox mixtures at various depths

7.32.3 Determination of nitrogen-based dive limits status by EAD and nitrox dive tables. Nitrox dive computer use may be included.

#### 7.33 Written Examination

Before authorization, the diver shall pass a written examination based on classroom and practical training. The exam shall include at the minimum:

7.33.1 Function, care, use and maintenance of nitrox equipment

7.33.2 Physical and physiological considerations of nitrox diving

7.33.3 Diving regulations and procedures as related to nitrox use

7.33.4 Given the proper information, calculation of:

- a. Equivalent air depth (EAD) for a given  $FO_2$  and depth
- b.  $PO_2$  exposure and time limit for any given  $FO_2$  and depth
- c. Optimal nitrox mixture for a given  $PO_2$  exposure limit and depth
- d. Maximum Operating Depth (MOD) for any mix and  $PO_2$  limit

7.33.5 Decompression table and dive computer selection and use.

7.33.6 Oxygen analysis

7.33.7 Nitrox guidelines (Section 7.40), dive planning, equipment marking

7.34 Openwater Dives

A minimum of two supervised openwater dives using nitrox is required for authorization. If the MOD for the mix being used can be exceeded at the training location, direct, in-water supervision is required.

7.40 SCIENTIFIC NITROX DIVING REGULATIONS

7.41 Dive Personnel Requirements

7.41.1 Diver in Training – A diver in training who has completed the requirements of Section 4.0 may be authorized to by the DSO to use nitrox under the direct supervision of a nitrox qualified Scientific Diver. Dive depth limits are restricted to 3 atmospheres absolute.

7.41.2 Scientific Diver – A scientific diver who has completed nitrox training and is current with requirements of Section 5.0 may be authorized by the DSO to use nitrox. Depth authorization would be the same as those specified in the diver's authorization, as described in Section 5.40, or the MOD of the mix used, whichever is shallower.

7.41.3 Lead Diver – On any dive where nitrox is being used by any team member, the Lead Diver should be authorized to use nitrox. Lead Diver authorization for nitrox dives by the DSO and DCB should occur as part of the dive plan approval process.

- a. As part of the dive planning process, verify that all divers using nitrox on a dive are properly qualified and authorized.
- b. As part of the pre-dive procedures, confirm with each diver the nitrox mixture being used, its MOD and time limits, according to the shortest time limit or shallowest depth limit among the team members.
- c. The Lead Diver should also reduce the maximum allowable  $PO_2$  exposure limit for the dive team if on-site conditions so indicate (Section 7.42.1.b)

7.42 Dive Parameters

#### 7.42.1 Oxygen Exposure Limits

- a. If using the equivalent air depth (EAD) method, the maximum depth of a dive shall be based on the partial pressure of the oxygen for the specific breathing mixture to be used. The oxygen partial pressure experienced at depth shall not exceed 1.45 ATA.
- b. An exception to 7.42.1.a is that for precautionary or required decompression stops the partial pressure of oxygen shall not exceed 1.6 ATA. These mixes must be either diver carried in a separate, independent scuba system (pony bottle), or if surface supplied, come from a separate source cylinder.
- c. The maximum allowable exposure limits should be reduced in cases where cold or strenuous dive conditions or extended exposures are expected. The DCB should consider this in review of any dive plan application. The Lead Diver should also review on-site conditions and reduce the allowable PO<sub>2</sub> exposure if conditions indicate.

#### 7.42.2 Bottom Time Limitations

- a. Maximum bottom time shall be based on the depth of the dive and the nitrox breathing mixture being used.
- b. Bottom time of a single dive shall not exceed the NOAA maximum allowable "Single Exposure Limit" for a given partial pressure of oxygen, as listed in Section 7.43.3.

#### 7.42.3 Decompression Tables and Gases

- a. A set of appropriate decompression tables must be available at the dive site.
- b. When using the EAD method, dives shall be conducted using decompression tables that are equal to, or more conservative than the current US Navy tables. An air-based dive computer may also be used.
- c. If nitrox is used to increase the safety margin of air-based tables or dive computer, the MOD and oxygen exposure limits for the mix being used shall not be exceeded.
- d. Breathing gases used during either precautionary or required decompression stops, as a transit mix, or for bail out purposes, shall contain the same or greater oxygen content as that used during the dive, within the confines of depth limitations of Section 7.31 and the oxygen partial pressure limits set forth in Section 7.32.
- e. It is the responsibility of each individual diver to determine their own decompression obligation, EAD, Maximum Operating Depth (MOD) and CNS dose for the oxygen content of the cylinder(s) they use.

#### 7.42.4 Nitrox Dive Computers

- a. Dive computers may be used to compute decompression status during nitrox dives. Manufacturers' guidelines and instructions shall be followed.
- b. Use of all computers shall comply with dive computer guidelines included in Appendix 9.
- c. Computer users must demonstrate a clear understanding of the display, operations, and manipulation of the unit being used for nitrox diving prior to using the computer, to the satisfaction of the DSO or his/her designee.

- d. Dive computers capable of PO<sub>2</sub> limit and FO<sub>2</sub> adjustment should be checked by the diver prior to the start of each dive to assure compatibility with the mix being used.

#### 7.42.5 Repetitive Diving

- a. Repetitive diving using nitrox mixtures shall be performed in compliance with procedures required of the specific decompression tables used.
- b. Residual nitrogen time shall be based on the EAD for the specific nitrox mixture to be used for the repetitive dive and not on that of the previous dive.
- c. The total exposure to a partial pressure of oxygen in a given 24 hour period shall not exceed the “Total Exposure per Twenty-four (24) Hour Period” given in Section 7.43.2.
- d. When repetitive dives expose divers to different partial pressures of oxygen from dive to dive, divers should account for accumulated oxygen exposure from previous dives when determining acceptable exposures for repetitive dives. Both CNS and pulmonary oxygen toxicity should be addressed.
- e. When doing repetitive dives with different nitrox mixtures it is suggested to use the mix that gives the deepest EAD first, the next shallower second, etc.

### 7.43 Oxygen Parameters

#### 7.43.1 Authorized Mixtures

Other mixtures of 22% to 50% oxygen meeting the criteria outlined in Sections 7.42.1 and 7.43.2 may be used. There are special requirements for equipment that is used with oxygen percents higher than 40% by volume (Section 7.51).

#### 7.43.2 Purity Standards

- a. Oxygen used for mixing nitrox shall meet the purity levels for “Medical Grade” (USP) standards at the minimum.
- b. Air purity shall meet standards for oil-free air as shown in Section 7.43.2.c. The use of an “non-oil lubricated” or “oil-less” compressor is required.
- c. Oil-Free Compressor: A non-oil lubricated compressor is required when mixing Nitrox using compressed air and oxygen. The compressor shall meet or exceed these “oil free air” standards for air purity:

Carbon Monoxide	≤10 ppm
Carbon Dioxide	≤500 ppm
gaseous hydrocarbon (methane)	≤25 ppm
condensed hydrocarbons	≤ 0.5 mg/M <sup>3</sup>
moisture/water vapor dewpoint	<- 40 C
solid/particulate matter	≤1 mg/M <sup>3</sup>

#### 7.43.3 Oxygen Partial Pressure Limits (CNS Dose).

All dives performed using nitrox breathing mixtures shall comply with the following NOAA Oxygen Partial Pressure Limits for “normal” exposures:

Oxygen	Single	24 Hour
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PO <sub>2</sub> (ATA)	Exposure Limit (min)	Maximum Limit (min)
1.60	45	150
1.45	135	180
1.40	150	180
1.30	180	210
1.20	210	240
1.10	240	270
1.00	300	300
0.90	360	360
0.80	570	570
0.70	570	570
0.60	720	720

Source: NOAA Diving Manual, 4<sup>th</sup> edition, 2001, Page 15.5, Table 15.2

## 7.44 Gas Mixing and Analysis

### 7.44.1 Personnel Requirements

- a. Individuals responsible for mixing and analyzing mixtures shall be trained, have proof of certification and experience in all aspects of the technique.
- b. Only those individuals approved by the DSO shall be responsible for blending and analyzing mixtures.

### 7.44.2 Mixing Methods

It is the responsibility of the DSO or his/her designee to approve which of the various methods of blending is utilized.

### 7.44.3 Analysis Verification

- a. It is the responsibility of each diver to confirm, by direct observation the oxygen content of his/her scuba cylinder and acknowledge, in writing on both the Nitrox Validation sheet and the cylinder contents tag the following:
  - The percents of oxygen ( $\pm 1\%$ ) and nitrogen.
  - The Maximum Operating Depth (MOD) for the mix.
  - The cylinder pressure.
  - The date of analysis.
  - The diver's signature (validation sheet) and initials (contents tag).
  - The cylinder serial number (on validation sheet).
- b. Gases shall be analyzed for O<sub>2</sub> content to an accuracy of  $\pm 1\%$  total. This analysis shall be performed both by the person preparing the mixture and by the diver.
- c. If a greater variance exists, the cylinder will not be used for that dive or, at the discretion of the Lead Diver, the dive plan modified to meet the limits and restrictions corresponding to the actual oxygen content.

## 7.50 NITROX DIVING EQUIPMENT

All the designated equipment and stated requirements regarding scuba equipment in these standards also apply to nitrox scuba operations. Additional minimal equipment necessary and requirements are shown below.

## 7.51 Oxygen Cleaning and Maintenance Requirements

### 7.51.1 Diver-worn and Support Equipment:

All diver-worn and support equipment used (in contact) with high pressure oxygen or oxygen mixtures greater than 40% by volume should be prepared, maintained, and designated for oxygen service in compliance with ASTM Pamphlet G88-84, "Designing Systems for Oxygen Service."

### 7.51.2 Nitrox Containers

All containers used for the storing, mixing or dispensing (including scuba cylinders) of nitrox shall be designated "Nitrox," "EANx" or "DNAx" and color coded yellow with; a 4 inch green band with yellow lettering beginning at the shoulder curvature of the cylinder or a 4 inch green band with 1 inch yellow borders, or a green cap on the top quarter of the cylinder, with green lettering on the yellow bottom 3/4 of the cylinder. The cylinders shall be cleaned for oxygen service and have oxygen compatible components and lubrication.

### 7.51.3 Scuba Regulators

Scuba regulators can be used with any oil-free breathing gas (air or nitrox). It is required that regulators that are used with blends of more than 40% by volume have the first stages cleaned for oxygen service. It is recommended that first stages of regulators that have been used with air derived from an oil lubricated compressor not be used for nitrox (of 22% to 40%) service.

### 7.51.4 Other Equipment

All other diving and auxiliary equipment shall be cleaned, maintained, and stored in compliance with this manual.

- 7.52 Dedicated cylinders, (storage and scuba): Shall be oxygen clean and compatible. Cylinders shall be marked "Nitrox," "DNAx" or "EANx," shall be color coded as per Section 7.51.2. The cylinders shall have a contents tag affixed. The tag will be permanently marked with the cylinder's serial number. The user shall record: Percent oxygen, percent nitrogen, cylinder pressure, Maximum Operating Depth, date of analysis, and user/analyzer's initials. The cylinders are restricted for use with nitrox only. Cylinders not so designated or prepared shall not be used with nitrox blends.
- 7.53 Dedicated regulators: When using a nitrox scuba cylinder containing more than 40% oxygen the diver must also use an oxygen clean and compatible regulator. The regulator shall be marked for nitrox use only. Dedicated regulators used with cylinders filled by an oil-lubricated compressor cannot be used with mixtures over 40% again until they have been cleaned.
- 7.54 Oxygen analyzers: An oxygen analyzer capable of determining the oxygen content in the diver's cylinder prior to diving is required. The analyzer must be accurate to within plus or minus one percent. The use of two analyzers in parallel is recommended for comparative and verification purposes.
- 7.55 Oil-Free Compressor: A non-oil lubricated compressor is required when mixing nitrox using compressed air and oxygen. The compressor shall meet or exceed "oil free air" standards for air purity as shown in Section 7.43.2.c.
- 7.56 Fill Station: The fill station shall be equipped with oxygen clean components (e.g., fill whips, gauges, valves, regulators, etc.) Nitrox components shall be clearly marked as such.



## **SECTION 8.00**

### **AQUARIUM DIVING OPERATIONS**

UC Davis does not perform aquarium diving.  
Those interested in, or needing to see these standards, should contact the DSO or AAUS.

## SECTION 9.00

### STAGED DECOMPRESSION DIVING

Decompression diving shall be defined as any diving during which the diver cannot perform a direct return to the surface without performing a mandatory decompression stop to allow the release of inert gas from the diver's body.

The following procedures shall be observed when conducting dives requiring planned decompression stops.

#### 9.10 MINIMUM EXPERIENCE AND TRAINING REQUIREMENTS

Divers wishing to perform staged deco diving must get prior approval from the DSO/DCB.

- a) Prerequisites:
  1. Scientific Diver qualification according to Section 5.00.
  2. Minimum of 100 logged dives.
  3. Demonstration of the ability to safely plan and conduct dives deeper than 100 feet.
  4. Nitrox certification/authorization according to Section 7.00 recommended.
  
- b) Training shall be appropriate for the conditions in which dive operations are to be conducted.
  
- c) Minimum Training shall include the following:
  1. A minimum of 6 hours of classroom training to ensure theoretical knowledge to include: physics and physiology of decompression; decompression planning and procedures; gas management; equipment configurations; decompression method, emergency procedures.
  2. It is recommended that at least one training session be conducted in a pool or sheltered water setting, to cover equipment handling and familiarization, swimming and buoyancy control, to estimate gas consumption rates, and to practice emergency procedures.
  3. At least 6 open-water training dives simulating/requiring decompression shall be conducted, emphasizing planning and execution of required decompression dives, and including practice of emergency procedures.
  4. Progression to greater depths shall be by 4-dive increments at depth intervals as specified in Section 5.40.
  5. No training dives requiring decompression shall be conducted until the diver has demonstrated acceptable skills under simulated conditions.
  6. The following are the minimum skills the diver must demonstrate proficiently during dives simulating and requiring decompression:
    - Buoyancy control
    - Proper ascent rate
    - Proper depth control
    - Equipment manipulation
    - Stage/decompression bottle use as pertinent to planned diving operation
    - Buddy skills
    - Gas management
    - Time management
    - Task loading
    - Emergency skills

7. Divers shall demonstrate to the satisfaction of the DSO or the DSO's designee proficiency in planning and executing required decompression dives appropriate to the conditions in which diving operations are to be conducted.
8. Upon completion of training, the diver shall be authorized to conduct required decompression dives with DSO approval.

#### 9.20 MINIMUM EQUIPMENT REQUIREMENTS:

- a) Valve and regulator systems for primary (bottom) gas supplies shall be configured in a redundant manner that allows continuous breathing gas delivery in the event of failure of any one component of the regulator/valve system.
- b) Cylinders with volume and configuration adequate for planned diving operations.
- c) One of the second stages on the primary gas supply shall be configured with a hose of adequate length to facilitate effective emergency gas sharing in the intended environment.
- d) Minimum dive equipment shall include:
  1. Snorkel is optional at the DCB's discretion, as determined by the conditions and environment.
  2. Diver location devices adequate for the planned diving operations and environment.
  3. Compass
- e) Redundancy in the following components is desirable or required at the discretion of the DCB or DSO:
  1. Decompression Schedules
  2. Dive Timing Devices
  3. Depth gauges
  4. Buoyancy Control Devices
  5. Cutting devices
  6. Lift bags and line reels

#### 9.30 MINIMUM OPERATIONAL REQUIREMENTS

- a) Approval of dive plan applications to conduct required decompression dives shall be on a case-by-case basis.
- b) The maximum PO<sub>2</sub> to be used for planning required decompression dives is 1.45. A PO<sub>2</sub> of no more than 1.6 be may be used at decompression stops.
- c) Divers gas supplies shall be adequate to meet planned operational requirements and foreseeable emergency situations.
- d) Decompression dives may be planned using dive tables, dive computers, and/or PC software approved by the DSO/DCB.
- e) Breathing gases used while performing in-water decompression shall contain the same or greater oxygen content as that used during the bottom phase of the dive.
- f) The dive team prior to each dive shall review emergency procedures appropriate for the planned dive.

- g) If breathing gas mixtures other than air are used for required decompression, their use shall be in accordance with those regulations set forth in the appropriate sections of this standard.
- h) The maximum depth for required decompression using air as the bottom gas shall be 190 fsw (6.7 atm absolute).
- i) Use of additional nitrox and/or high-oxygen fraction decompression mixtures as travel and decompression gases to decrease decompression obligations is encouraged.
- j) Use of alternate inert gas mixtures to limit narcosis is encouraged for depths greater than 150 fsw (5.5 atm absolute).
- k) If a period of more than 6 months has elapsed since the last mixed gas dive, a series of progressive workup dives to return the diver(s) to proficiency status prior to the start of project diving operations are recommended.
- l) Mission specific workup dives are recommended.
- m) Only one dive with required decompression stop(s) is allowed in any twenty-four (24) hour period
- n) For required decompression diving there will be surface personnel support, a staged decompression station with the proper stops clearly marked and adequate breathing gas supply. Each diver must carry a redundant breathing gas supply appropriate to the depth and conditions of the dive, and adequate to complete the full decompression schedule. An emergency float that may be inflated at depth and attached to a reel with sufficient line to reach the surface from the maximum dive depth is recommended.
- o) Divers who unintentionally enter required decompression mode on a dive are exempted from the equipment requirements but must complete their decompression obligation. If required decompression was omitted, or the diver experienced an out of control, rapid ascent, divers should breathe 100 percent oxygen for at least thirty (30) minutes (providing there is enough oxygen on board to handle any possible subsequent emergency), be monitored for DCI symptoms, and contact the DSO. They may not dive again for twenty-four (24) hours.

## SECTION 10.00

### MIXED GAS DIVING

Mixed gas diving is defined as dives done while breathing gas mixes containing proportions greater than 1% by volume of an inert gas other than nitrogen.

Divers wishing to perform mixed gas diving must get prior approval from the DSO/DCB.

#### 10.10 MINIMUM EXPERIENCE AND TRAINING REQUIREMENTS

- a) Prerequisites:
  - 1. Nitrox certification and authorization. (Section 7.00)
  - 2. If the intended use entails required decompression stops, divers will be previously certified and authorized in decompression diving (Section 9.00).
  - 3. Divers shall demonstrate to the DSO/DCB's satisfaction skills, knowledge, and attitude appropriate for training in the safe use of mixed gases.
  
- b) Classroom training including:
  - 1. Review of topics and issues previously outlined in nitrox and required decompression diving training as pertinent to the planned operations.
  - 2. The use of helium or other inert gases, and the use of multiple decompression gases.
  - 3. Equipment configurations
  - 4. Mixed gas decompression planning
  - 5. Gas management planning
  - 6. Thermal considerations
  - 7. END determination
  - 8. Mission planning and logistics
  - 9. Emergency procedures
  - 10. Mixed gas production methods
  - 11. Methods of gas handling and cylinder filling
  - 12. Oxygen exposure management
  - 13. Gas analysis
  - 14. Mixed gas physics and physiology
  
- c) Practical Training:
  - 1. Confined water session(s) in which divers demonstrate proficiency in required skills and techniques for proposed diving operations.
  - 2. A minimum of 6 open water training dives.
  - 3. At least one initial dive shall be in 130 feet or less to practice equipment handling and emergency procedures.
  - 4. Subsequent dives will gradually increase in depth, with a majority of the training dives being conducted between 130 feet and the planned operational depth.
  - 5. Planned operational depth for initial training dives shall not exceed 260 feet.
  - 6. Diving operations beyond 260 fsw (8.7 atm absolute) requires additional training dives.

#### 10.20 EQUIPMENT AND GAS QUALITY REQUIREMENTS

- a) Equipment requirements shall be developed and approved by the DCB, and met by divers, prior to engaging in mixed-gas diving. Equipment shall meet other pertinent requirements set forth elsewhere in this standard.

- b) The quality of inert gases used to produce breathing mixtures shall be of an acceptable grade for human consumption.
- c) Equipment and gas mixtures shall be appropriate to the depth and degree of technical difficulty of the dive.

#### 10.30 MINIMUM OPERATIONAL REQUIREMENTS

- a) Approval of dive plan applications to conduct mixed gas dives shall be on a case-by-case basis.
- b) All applicable operational requirements for nitrox and decompression diving shall be met.
- c) Maximum partial pressure of oxygen shall be 1.45 ATA operational, 1.6 ATA decompression and 2.0 ATA for bailout. Maximum partial pressure of nitrogen shall be 5 ATA.
- d) Maximum planned Oxygen Toxicity Units (OTU) will be considered based on mission duration.
- e) Divers decompressing on high-oxygen concentration mixtures shall closely monitor one another for signs of acute oxygen toxicity.
- f) Breathing gases shall be analyzed such that the concentration of the various component gases is known. The oxygen component shall be known within  $\pm 1\%$  of the total mixture.
- g) Adequate surface support and in-water safety divers shall be present. The number of safety divers shall be appropriate to the depth and purpose of operations.
- h) Provisions for emergency treatment and evacuation shall be a part of the dive plan.

If a period of more than 6 months has elapsed since the last mixed gas dive, a series of progressive workup dives to return the diver(s) to proficiency status prior to the start of project diving operations are recommended.

## SECTION 11.00

## OTHER DIVING TECHNOLOGY

Certain types of diving, some of which are listed below, require specialized equipment or procedures, and require training beyond Scientific Diver. Those needing to use methods listed in this section (and sections 7, 9, & 10) shall request, and must have, authorization from the Diving Control Board prior to commencing diving activities. (See Section 2.21)

### 11.10 BLUEWATER DIVING

Bluewater diving is defined as any area where divers cannot see the bottom for visual orientation nor any of the fixed objects that normally aid in focal readjustment of the eye. Usually this applies to open water where depths are extreme.

In certain situations it may be desirable for a person to engage in blue water diving in the course of their research. This mode of diving has many unique problems, and thorough training in safety and blue water diving procedures are required. A separate manual for operation of a blue water dive and the training requirements is available from the Diving Safety Officer. "Blue Water Diving Guidelines" (California Sea Grant Publication # T-CSGCP-014).

### 11.20 ICE AND POLAR DIVING

Divers planning to dive under ice or in polar conditions should use the following: "Guidelines for Conduct of Research Diving," National Science Foundation, Division of Polar Programs, 1990.

### 11.30 OVERHEAD ENVIRONMENT DIVING

- a) Enclosed spaces
  1. Where an enclosed or confined space is not large enough for two divers, a diver shall be stationed at the underwater point of entry and an orientation line shall be used.
  2. Both divers shall be in visual or physical contact with the orientation line during the dive.
  
- b) Cave Diving
  1. Divers planning operations in caverns or caves must have specialized training in the unique conditions and problems associated with cave diving.
  2. Dive plans and diver training must be approved by the DCB before diving operations begin.
  3. See AAUS "Draft Cave Diving Standards"  
<http://www.aaus.org/standardsdraftword/standardsdraftword.doc>

### 11.40 SATURATION DIVING

Saturation divers shall comply with the saturation diving standards of the organization under which the saturation diving is to be done.

### 11.50 HOOKAH DIVING

Hookah divers shall comply with all scuba diving procedures in this manual, including the buddy system.

- a) Divers using the hookah mode shall be equipped with a diver-carried independent reserve breathing gas supply sufficient to reach the surface, including any decompression stops.
- b) Each hookah diver shall be hose-tended by a dive team member at the surface.
- c) The hookah breathing gas supply shall be sufficient to support all hookah divers in the water for the duration of the planned dive, including decompression.

#### 11.60 SURFACE SUPPLIED DIVING

- a) Surface supplied divers shall comply with all scuba diving procedures in this manual (except Section 2.31). Surface supplied diving shall not be conducted at depths greater than 6.7 ATA (190 fsw).
- b) Divers using the surface supplied mode shall be equipped with a diver-carried independent reserve breathing gas supply adequate to allow the diver to reach the surface, including decompression time.
- c) While in the water, each surface supplied diver shall be hose tended by a separate dive team member on the surface.
- d) Divers using the surface supplied mode shall maintain voice communication with the surface tender or dive supervisor. If voice communications fail, divers/tenders will switch to line pull signals and terminate the dive immediately. Divers using Hookah method are exempt from voice communication requirements.
- e) The surface supplied breathing gas supply shall be sufficient to support all surface supplied divers in the water for the duration of the planned dive, including decompression.
- f) During surface supplied diving operations, when only one diver is in the water, there must be a standby diver in attendance, in addition to the tender, at the dive location. The standby diver shall be able to enter the water appropriately suited and equipped in less than one (1) minute.

#### 11.70 CLOSED AND SEMI-CLOSED CIRCUIT SCUBA (REBREATHERS)

##### 11.71 Training and Qualification Requirements

- a) Prerequisites
  - 1. Active status as scientific scuba diver with a minimum of 100 logged dives
  - 2. Training in advanced nitrox or mixed gas diving. Theoretical training and proficiency shall comply with Section 7.00 of the UCD Diving Safety Manual.
- b) Rebreather-specific Training
  - 1. Satisfactory completion of a rebreather training program (60-80 hour minimum) authorized by the manufacturer of the rebreather to be used, or other training program approved by the UCD Diving Control Board. At a minimum, divers must be able to demonstrate proficiency in the specific rebreather to be used, including the following:

- Gas laws, diving physics, and physiology
  - Causes, signs and symptoms, treatment and prevention of CNS and pulmonary oxygen toxicity, hypoxia, hyperoxia, and hypercapnia
  - Rebreather components
  - Pre-dive and post-dive operational and maintenance procedures
  - Pre-dive testing procedures
  - Oxygen control system calibration and verification
  - Oxygen consumption rates
  - CO<sub>2</sub> absorbent canister packing
  - System monitoring
  - Manual system control
  - Descent and ascent procedures
  - Buoyancy control skills
  - Bailout and emergency procedures including: flooding of CO<sub>2</sub> canister, loss of diluent, loss of battery power, conversion to open circuit, alternate gas cross-over, loss of oxygen, malfunctioning oxygen sensors, malfunctioning oxygen and diluent valves
  - Maintenance and disinfecting procedures
  - Record keeping including pre-dive and post-dive checklists, and maintenance log
2. The instructor shall be approved by the DCB, and qualified by an agency approved by the manufacturer to teach the specific model of rebreather that is to be used.
  3. Diving experience with the particular model of rebreather to be used shall be, at the minimum, to the standards recommended by the manufacturer and will include at least 10 hours underwater.
    - A minimum of five hours in pool or confined-water conditions (<20 ft) prior to open water dives
    - Five to ten hours are required in open water conditions
    - Rebreather dives in depths in excess of 100 feet or requiring decompression stops are subject to additional training requirements.
  4. To remain qualified to use rebreathers, divers shall log a minimum of four dives or six hours bottom time every 12 months, with at least 2 dives or ninety minutes minimum total bottom time in the previous six months.

#### 11.72 Equipment and Supplies Requirements

- a) Only the models of rebreathers specifically approved by the UCD DCB shall be used.
- b) A minimum of three independent oxygen sensors shall be incorporated into the closed-circuit rebreather design, and a minimum of two independent displays of oxygen sensor readings shall be available to the diver.
- c) Each diver shall be equipped with an alternate breathing gas supply, such as redundant rebreather or open-circuit bailout capability, designed to return the diver to the surface at normal ascent rates, including a safety or required decompression stop(s), and within the proper PO<sub>2</sub> limits, for any rebreather component failure including a catastrophic unrecoverable breathing loop failure such as flooding of the CO<sub>2</sub> absorbent canister.
- d) An emergency float that may be inflated at depth and attached to a reel with sufficient line to reach the surface from the maximum dive depth is recommended on required decompression dives.

#### 11.73 Operational Procedures

Divers using rebreathers shall follow, at a minimum, these basic requirements.

- a) An independent reserve cylinder with separate regulator is required for each diver
- b) Divers shall assure strict adherence to the buddy system.
- c) Dive plans must include the following additional information:
  1. Name and model of rebreather
  2. Type, time rating, and logged duration of CO<sub>2</sub> absorbent material to be used
  3. Composition and volume of diluent gases to be used
  4. Complete description of bailout procedures, including manual rebreather operation and open circuit bailout procedures
  5. Maximum depth and PO<sub>2</sub> set-point limits
  6. Dive tables or computer to be used to determine decompression status
- d) Pre-dive checks shall, at a minimum, consist of the following:
  1. Pre-dive gas testing as necessary
  2. All rebreathers shall be pre-tested according to manufacturer's specifications prior to each dive
  3. Positive pressure test to indicate any leaks in the breathing loop
  4. Verification of the oxygen control system function. A three minute pre-breathe session, or flushing the breathing loop with diluent, activating the oxygen control system, and verifying that the solenoid operates correctly
  5. Verification of CO<sub>2</sub> absorbent and remaining canister life
  6. Verify accurate oxygen sensor calibration
  7. Verify correct PO<sub>2</sub> set-point
  8. Check battery voltage under load
  9. Check oxygen and diluent cylinder pressures
  10. Verify diluent gas composition
  11. Check for correct position of all valves
  12. Dip test for leaks
  13. Check other model-specific verifications as required
- e) The oxygen partial pressure in the breathing gas shall not exceed 1.4 atmospheres at depths greater than 20 feet and shall not be lower than 0.5 atmospheres.
- f) Maximum oxygen time/dose limits for single and daily oxygen exposures shall not exceed those defined by current NOAA standards (e.g., for PO<sub>2</sub>=1.4, TO<sub>2</sub> max =150 minutes single exposure, and 180 minutes maximum total exposure in a 24 hour period). See page 38.
- g) For multi-day missions oxygen tolerance units (OTUs) shall be tracked and the recommended maximum not be exceeded.
- h) The active diluent gas supply shall contain enough oxygen such that it will sustain a diver at all depths during the dive.
- i) Divers shall monitor both primary and secondary oxygen display systems at regular and brief intervals throughout the dive, and especially on descent and ascent, to verify that the readings are within the limits, to verify that both displays are giving the same value, and to determine whether the readings are dynamic or static.

- j) No rebreather unit shall be dived if any of the oxygen sensor displays are inoperable or not consistent with each other, or if the battery displays a low reading.

#### 11.74 Emergency and Bailout Procedures

The most valuable skills a rebreather diver must learn are the skills which enable recovery and/or bailout from various failure modes. Those skills recommended by the manufacturer should be practiced routinely. At the minimum they shall include,

- a) Oxygen Control System Failure.
  - 1. Solenoid failure in open position.
  - 2. Solenoid failure in shut position.
- b) Electronics Failure
  - 1. Partial electronics failure of either the primary or secondary PO<sub>2</sub> display systems at any time during the dive.
  - 2. Total electronics failure.
- c) Partial CO<sub>2</sub> Absorbent Canister Failure
- d) Catastrophic Unrecoverable Breathing Loop Failure
- e) Full bubble check

#### 11.75 Maintenance and Testing

- a) The entire breathing loop (including mouthpiece, hoses, counterlung, and CO<sub>2</sub> canister) should be disinfected periodically according to manufacturer's specifications; this should be done daily or weekly and between divers using the same rebreather unit.
- b) The CO<sub>2</sub> canister should be removed from the breathing loop following a dive; the canister should be sealed and protected from ambient air if the absorbent is not going to be changed prior to the next dive.
- c) Chemicals for the absorption of CO<sub>2</sub> should be kept in a cool dry location in sealed containers.
- d) Divers shall determine that the CO<sub>2</sub> absorption canister and material is used in accordance with the manufacturer's specifications; a CO<sub>2</sub> canister should be able to last two times the predicted total dive time for each dive.
- e) Each rebreather unit and its components (e.g., batteries, oxygen sensors, etc.) shall be maintained, tested, and replaced in accordance with the manufacturer's specifications.

#### 11.76 Record Keeping

- a) Each diver shall complete and sign a written pre-dive checklist prior to each dive.
- b) Each diver shall complete and sign a written post-dive checklist following each dive.
- c) A CO<sub>2</sub> scrubber log shall be kept indicating date and time used for each dive to determine available life of CO<sub>2</sub> absorbent material.
- d) A maintenance log shall be kept for each rebreather unit
- e) A damage or malfunction report shall be logged and maintained for each unit.

## 11.80 ALTITUDE DIVING

Dives at altitudes greater than 3,000 meters (10,000') require prior approval of the Diving Control Board.

## 11.81 Training Requirements

Persons diving at sites with elevations greater than 300 meters (1,000') must have specialized training in the unique conditions and problems associated with high altitude diving. This training shall include at least:

- a) Effects of the lower atmospheric pressure on equipment and human physiology.
- b) Selection, modification, and use of appropriate decompression tables.
- c) Dive planning; including acclimatization periods, altitude adjustments, table and computer review and/or corrections, limitations, ascent rates, and decompression stops.
- d) Buoyancy changes.
- e) Hypothermia
- f) Dehydration.
- g) Causes, signs, symptoms, and first aid for decompression illness, gas embolism, and altitude sickness.
- h) Emergency procedures, area EMS activation methods, location of and transport method to nearest hospital, and hyperbaric chamber.
- i) Ascending in elevation after diving.

## 11.82 Dive Tables and Computers

- a) A set of appropriate dive tables, correct for the altitude, must be at the dive site.
  1. Each diver shall have either an altitude adjustable depth gauge or dive computer.
  2. Students under direct supervision of an instructor approved by the DCB are exempted, but they must determine and carry corrections for the depth gauge used.
- b) Only those makes and models of dive computers that are fully functional at the altitude of the dive may be used to determine decompression obligation.
  1. "Fully functional at altitude" means those computers that record and display actual depth and time, compute no-stop decompression limits as well as decompression times and stop depths for the actual altitude of the dive. The computers should also take into account the amount of time passed since the diver's arrival at altitude and his/her acclimatization period (residual nitrogen time). There are some dive computers that do not compute residual nitrogen upon arrival, and the diver must wait eighteen (18) to twenty-four (24) hours before using these computers to figure decompression obligation.
  2. Divers must read and understand the owner's manual for the computer being used before diving

## 11.83 Buoyancy Check

Each person diving for the first time in fresh water will conduct a buoyancy check and adjust their weight system as needed before commencing diving operations.

#### 11.84 Regulators

Due to colder air and water temperature often encountered at altitude, only those scuba regulators that meet or exceed the breathing (inhalation and exhalation resistance) standards formerly set by the US Navy for class 'A' service, and are capable of being "environmentally sealed," shall be used by UCD divers at altitudes greater than 1000 meters and in water temperatures of less than 7 C.

## APPENDIX 1

### DIVING MEDICAL EXAM OVERVIEW FOR THE EXAMINING PHYSICIAN

TO THE EXAMINING PHYSICIAN:

This person, \_\_\_\_\_, requires a medical examination to assess his/her fitness for qualification as a Scientific Diver for the University of California, Davis. His /her 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 Univ. Calif. Davis/AAUS standards.

Thank you for your assistance.

\_\_\_\_\_  
Diving Safety Officer

\_\_\_\_\_  
Henry C. Fastenau  
Printed Name

\_\_\_\_\_  
Date

\_\_\_\_\_  
(707) 875-2032  
Phone Number

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

#### CONDITIONS WHICH MAY DISQUALIFY CANDIDATES FROM DIVING

(Adapted from Bove, 1998: 61 -63, bracketed numbers are pages in Bove)

1. Abnormalities of the tympanic membrane, such as perforation, presence of a monomeric membrane, or inability to autoinflate the middle ears. [5,7,8,9]
2. Vertigo including Meniere's Disease. [13]
3. Stapedectomy or middle ear reconstructive surgery. [11]
4. Recent ocular surgery. [15,18,19]
5. Psychiatric disorders including claustrophobia, suicidal ideation, psychosis, anxiety states, untreated depression. [20 - 23]
6. Substance abuse, including alcohol. [24-25]
7. Episodic loss of consciousness. [1, 26,27]
8. History of seizure. [27, 28]
9. History of stroke or a fixed neurological deficit. [29,30]
10. Recurring neurologic disorders, including transient ischemic attacks. [29,30]
11. History of intracranial aneurysm, other vascular malformation or intracranial hemorrhage. [31]
12. History of neurological decompression illness with residual deficit. [29,30]
13. Head injury with sequelae. [26, 27]
14. Hematologic disorders including coagulopathies. [41, 42]
15. Evidence of coronary artery disease or high risk for coronary artery disease<sup>1</sup>. [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<sup>2</sup>. [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]
- 

<sup>1</sup>“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>

<sup>2</sup>“Are Asthmatics Fit to Dive? ” Elliott DH, ed. 1996 Undersea and Hyperbaric Medical Society, Kensington, MD.

### SELECTED REFERENCES IN DIVING MEDICINE

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

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

Alert Diver Magazine; Articles on diving medicine  
<http://www.diversalertnetwork.org/medical/articles/index.asp>

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

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

DIVING MEDICINE, Third Edition, 1997. A. Bove and J. Davis. W.B. Saunders Company, Philadelphia

DIVING AND SUBAQUATIC MEDICINE, Third Edition, 1994. C. Edmonds, C. Lowery and J. Pennefather. Butterworth-Heinemann Ltd. Oxford

MEDICAL EXAMINATION OF SPORT SCUBA DIVERS, 1998. Alfred Bove, M.D.,Ph.D. (ed.). Medical Seminars, Inc. San Antonio, TX

NOAA DIVING MANUAL, NOAA. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.

U.S. NAVY DIVING MANUAL. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.

## APPENDIX 2

### MEDICAL EVALUATION OF FITNESS FOR SCUBA DIVING REPORT

\_\_\_\_\_  
Name of Applicant (Print or Type)

\_\_\_\_\_  
Date (Mo/Day/Year)

To The PHYSICIAN:

This person is an applicant for training or is presently certified to engage in diving with self-contained underwater breathing apparatus (scuba). This is an activity which 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

\_\_\_\_ **Additional testing for first over age 40**

\_\_\_\_ Resting EKG  
\_\_\_\_ Assessment of coronary artery disease  
using Multiple-Risk-Factor Assessment<sup>1</sup>  
(age, lipid profile, blood pressure,  
diabetic screening, smoker)

**Re-examination (Every 5 years under age 40,  
or 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 over age 40**

\_\_\_\_ Resting EKG  
\_\_\_\_ Assessment of coronary artery disease  
using Multiple-Risk-Factor Assessment<sup>1</sup>  
(age, lipid profile, blood pressure, diabetic  
screening, smoker)

**Note: Exercise stress testing may be indicated based on risk factor assessment<sup>2</sup>**

**RECOMMENDATION:**

- APPROVAL. I find no medical condition(s) which 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.

<sup>1</sup> "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>

<sup>2</sup> 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>

**OVER**

**REMARKS:**

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

\_\_\_\_\_ 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:

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**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 University California, Davis 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 he/she 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, his/her 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 he/she is 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

	Yes	No	Comments
20. <u>Collapsed lung</u>			
21. <u>Asthma.</u>			
22. <u>Other lung disease.</u>			
23. <u>Diabetes mellitus.</u>			
24. <u>Pregnancy</u>			
25. <u>Surgery. If yes explain below</u>			
26. <u>Hospitalizations. If yes explain below</u>			
27. <u>Do you take any medications? If yes list below</u>			
28. <u>Do you have any allergies to medications, foods, environmental? If yes explain below</u>			
29. <u>Do you smoke?</u>			
30. <u>Do you drink alcoholic beverages?</u>			
31. <u>Is there a family history of high cholesterol?</u>			
32. <u>Is there a family history of heart disease or stroke?</u>			
33. <u>Is there a family history of diabetes?</u>			
34. <u>Is there a family history of asthma?</u>			

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

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

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Signature

Date

**APPENDIX 4**

**RECOMMENDED PHYSICIANS WITH EXPERTISE IN DIVING MEDICINE**

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

1. John Ibarra, M.D.  
Name  
Cowell Student Health Center  
Address  
University of California, Davis  
(530) 752-2300  
Telephone
  
2. Thomas J. Ferguson, M.D.  
Name  
Cowell Student Health Center  
Address  
University of California, Davis  
(530) 752-2333                      (916) 762-6372  
Telephone                              Pager

**APPENDIX 5**

## DEFINITION OF TERMS

AAUS - American Academy of Underwater Sciences.

Air sharing - The sharing of an air supply between divers

ATA - Atmospheres Absolute, defined as the total pressure exerted on an object, by a gas or gases, at a specific depth or elevation, including normal atmospheric pressure. One atmosphere is equal to one Bar (14.7 pounds per square inch) or 10 meters (33 feet) seawater.

ATM - abbreviation for atmospheres

Bounce Dive - A dive of relatively short duration. Generally less than 10 minutes.

Bottom Time - The total elapsed time measured in minutes from the time when the diver leaves the surface in descent to the time that the diver arrives at a safety or decompression stop, or if no stop is made, at the surface.

Breath-hold Diving - A diving mode in which the diver uses no self-contained or surface-supplied air or oxygen supply. Also known as snorkeling or free diving.

Buddy Breathing - The sharing of a single air source between divers.

Buddy Diver - Second member of the dive team.

Buoyant Ascent - An ascent made using some form of positive buoyancy.

Burst Pressure - The pressure at which a pressure containment device would fail structurally.

Certified Diver - A diver who holds a recognized valid certificate from a member organization or recognized certifying agency.

CNS - Central Nervous System

Controlled Ascent - Any one of several kinds of ascents including normal, swimming, and buddy breathing ascents where the diver(s) maintains control so a pause or stop can be made during the ascent.

Cylinder - A pressure vessel for the storage of gases. Also referred to as a tank or bottle.

DCB - Diving Control Board.

Decompression Chamber - A pressure vessel for human occupancy. Also called a hyperbaric chamber or recompression chamber.

Decompression Illness - A condition with a variety of symptoms which may result from gas and bubbles in the tissues of divers after pressure reduction as in a return to the surface, or ascent in elevation after diving.

Decompression 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. (Also called dive tables.)

DIT - Diver-in-training.

Dive - An underwater diving activity utilizing compressed gas.

Dive Location - A surface or vessel where a diving operation is conducted.

Dive Location Reserve Breathing Gas - A supply of air or mixed gas (as appropriate) at the dive location which is independent of the primary air and sufficient to support divers during a planned or unplanned decompression dive.

Dive Site - The physical location of a diver during a dive.

Dive Team - Divers and support individuals who are exposed to or control the exposure of others to pressure conditions. (In water or in a chamber.)

Diver - An individual in the water who uses apparatus which supplies breathing gas at ambient pressure.

Diver-In-Training - An individual gaining experience and training in additional diving activities under the supervision of an experienced dive team member.

Diver-Carried Reserve Breathing Gas - A supply of air independent of the primary air source carried by the diver consisting of air or mixed gas (as appropriate) sufficient under standard operating conditions to allow the diver to reach the surface, other breathing gas supply or another diver. Such as a pony or bail-out bottle.

Diving Mode - A type of diving requiring specific equipment, procedures, and techniques, (i.e., snorkeling, scuba, surface-supplied air, or mixed gas).

Diving Control Board - or DCB. The group of individuals who act as the official representative of UC Davis in matters concerning the scientific diving program. (see Section 1.31)

Diving Safety Officer - The individual responsible for the safe conduct of the scientific diving program of the University of California, Davis (see Section 1.32)

DSO - Diving Safety Officer.

Emergency Ascent - An ascent made under emergency conditions where the diver may exceed the normal ascent rate.

EAD - Equivalent Air Depth (see below)

Nitrox - A breathing gas mix of air and oxygen in which the percent of oxygen exceeds 21%. Also called "Nitrox."

Equivalent Air Depth - The depth at which air will have the same nitrogen partial pressure as the Nitrox mixture being used. This number, expressed in feet of fresh or seawater, will always be less than the actual physical depth for any nitrox mixture.

FO<sub>2</sub> - Fraction of Oxygen - The percent by volume of oxygen present in a gas.

FFW - Feet of freshwater, or equivalent static head.

FSW - Feet of seawater, or equivalent static head.

Hookah Diving - A type of surface-supplied diving where there is no helmet worn and no voice communication with the surface. The diver uses a dive mask and air is supplied by a surface hose to a standard regulator second stage.

Hyperbaric Chamber - See decompression chamber.

Hyperbaric Conditions - Pressure conditions in excess of normal atmospheric pressure at the dive location, or in a decompression chamber.

Lead Diver - The scientific certified diver with experience and training to conduct the diving operations.

Maximum Operating Depth - The depth for any given gas mix, at which the partial pressure of oxygen in that mix is equal to 1.45 ATA.

Maximum Working Pressure - The maximum pressure to which a pressure vessel may be exposed under standard operating conditions.

Member Organization - An organization which is a current member of the AAUS, and which has a program adhering to the standards of the AAUS as set forth in the AAUS Standards for Scientific Diving Certification and Operation of Scientific Diving Programs.

MFW - Meters of freshwater or equivalent static head.

Mixed-Gas Diving - A diving mode in which the diver is supplied with a breathing gas other than air.

MOD - Maximum Operating Depth.

MSW - Meters of seawater or equivalent static head.

Nitrox - A gas mixture of nitrogen (or air) and oxygen. For use within the context of this Diving Safety Manual, the mixture will have a lower percent concentration of nitrogen than air (78.05%).

NOAA - National Oceanic and Atmospheric Administration

No-Decompression limits - The 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 40 feet per minute or less.

Oxygen Toxicity - Any adverse reaction of the central nervous system (acute oxygen toxicity) or lungs (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.

psi - A unit of pressure: “pounds per square inch.”

Psig - pounds per square inch gauge.

Recompression Chamber - see decompression chamber.

Research Diving - All diving performed by individuals necessary to and part of scientific, research, or educational activity, in conjunction with a project or study under the jurisdiction of any public or private research or educational institution or similarly recognized organization, department, or group.

Scientific Diving - All diving performed by individuals necessary to and part of scientific, research or educational activity, in conjunction with a project or study under the jurisdiction of any public or private research or educational institution or similarly recognized organization, department, or group.

Scuba Diving - A diving mode independent of surface supply in which the diver uses 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 by hoses from the dive location with compressed gas for breathing, and wears a diving helmet complete with communications to the surface.

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

Treatment Table - A depth-time and breathing gas profile designed to treat decompression sickness or air embolism in a hyperbaric chamber.

Umbilical - The 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.

U.S.P. - United States Pharmacopoeia, American Medical Association.

Volume Tank - A pressure vessel connected to the outlet of a compressor and used as an air reservoir.

Working Pressure - The normal pressure at which the system is designed to operate safely.

**APPENDIX 6**  
**AAUS REQUEST FOR DIVING RECIPROCITY FORM**  
**VERIFICATION OF DIVER TRAINING AND EXPERIENCE**

A scientific diver that is currently certified under the auspices of an organizational member institution of the American Academy of Underwater Sciences (AAUS) shall be recognized by any other organizational member of AAUS and may apply for reciprocity in order to dive with the host organization. Organizational members that are in good standing with AAUS operate, a minimum, under the AAUS Standards for Scientific Diving Certification and Operation of Scientific Diving Programs (1996 edition). The visiting diver will comply with the diving regulations of the host organization's Diving Safety Manual unless previously arranged by both organization's Diving Control Boards.

The host organization has the right to approve or deny this request and may require, at a minimum, a checkout dive with the Diving Safety Officer (DSO) or designee of the host organization. If the request is denied, the host organization should notify to the DSO of the visiting diver the reason for the denial. The DSO for the visiting scientific diver has confirmed the following information:

Name of diver: \_\_\_\_\_

(Date)

- \_\_\_\_\_ Written scientific diving examination
- \_\_\_\_\_ Last diving medical examination
- \_\_\_\_\_ Most recent checkout dive
- \_\_\_\_\_ Scuba regulator/equipment service/test
- \_\_\_\_\_ CPR training (Agency) \_\_\_\_\_
- \_\_\_\_\_ Oxygen administration (Agency) \_\_\_\_\_
- \_\_\_\_\_ First aid for diving (Agency) \_\_\_\_\_
- \_\_\_\_\_ 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                   | _____ Bluewater   |
| _____ 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)

(Telephone, Email, FAX)

**APPENDIX 6A**

## AAUS CHECKOUT DIVE AND TRAINING EVALUATION

Certified scientific divers and Divers-In-Training from AAUS organizational members should be able to demonstrate proficiency in the following skills during checkout dives or training evaluation dives with the Dive Safety Officer or designee:

- \_\_\_\_\_ Knowledge of AAUS diving standards and regulations
- \_\_\_\_\_ Pre-dive planning, briefing, site orientation, and buddy check
- \_\_\_\_\_ Use of dive tables and/or dive computer
- \_\_\_\_\_ Equipment familiarity
- \_\_\_\_\_ Underwater signs and signals
- \_\_\_\_\_ Proper buddy contact
- \_\_\_\_\_ Monitor cylinder pressure, depth, bottom time
- \_\_\_\_\_ Swim skills:
  - \_\_\_\_\_ Surface dive to 10 ft. Without scuba gear
  - \_\_\_\_\_ Demonstrate watermanship and snorkel skills
  - \_\_\_\_\_ Surface swim without swim aids (400 yd. <12 min)
  - \_\_\_\_\_ Underwater swim without swim aids (25 yd. without surfacing)
  - \_\_\_\_\_ Tread water without swim aids (10 min.), or without use of hands (2 min.)
  - \_\_\_\_\_ Transport another swimmer without swim aids (25 yds.)
- \_\_\_\_\_ Entry and exit (pool, boat, shore)
- \_\_\_\_\_ Mask removal and clearing
- \_\_\_\_\_ Regulator removal and clearing
- \_\_\_\_\_ Surface swim with scuba; alternate between snorkel and regulator (400 yd.)
- \_\_\_\_\_ Neutral buoyancy (hover motionless in midwater)
- \_\_\_\_\_ Proper descent and ascent with B.C.
- \_\_\_\_\_ Remove and replace weight belt while submerged
- \_\_\_\_\_ Remove and replace scuba cylinder while submerged
- \_\_\_\_\_ Alternate air source breathing with and without mask (donor/receiver)
- \_\_\_\_\_ Buddy breathing with and without mask (donor/receiver)
- \_\_\_\_\_ Simulated emergency swimming ascent
- \_\_\_\_\_ Compass and underwater navigation
- \_\_\_\_\_ Simulated decompression and safety stop
- \_\_\_\_\_ Rescue:
  - \_\_\_\_\_ Self rescue techniques
  - \_\_\_\_\_ Tows of conscious and unconscious victim
  - \_\_\_\_\_ Simulated in-water rescue breathing
  - \_\_\_\_\_ Rescue of submerged non-breathing diver (including equipment removal, simulated rescue breathing, towing, and recovery to boat or shore)
  - \_\_\_\_\_ Use of emergency oxygen on breathing and non-breathing victim
  - \_\_\_\_\_ Accident management and evacuation procedures

### Additional Training (optional)

- \_\_\_\_\_ Compressor/Fill station orientation and usage
- \_\_\_\_\_ Small boat handling

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## **DIVING EMERGENCY MANAGEMENT PROCEDURES**

### **Introduction**

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

### **General Procedures**

Depending on, and according to, the nature of the diving accident, stabilize the patient, administer 100% oxygen, contact local Emergency Medical System (EMS) for transport to medical facility, contact diving accident coordinator as appropriate. 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.

1. Make appropriate contact with victim, rescue as required.
2. Establish ABCs (Airway, Breathing, Circulation) as required.
3. Call local Emergency Medical System (911 in the most of US) for transport to nearest medical treatment facility.
4. Administer 100% oxygen, if appropriate (in suspected cases of decompression illness, barotrauma, shock, or near drowning).
5. Call Dr. Tom Ferguson at (530) 752-2330 office or (916) 762-6372 pager, for advice and to coordinate possible hospital to chamber transportation. Dr Ferguson will need to know: Destination of the ambulance, telephone number at the ambulance's destination, patient's signs and symptoms, first aid administered, patient's name, age, sex, usual physical condition, what happened and any contributing factors involved or suspected.
6. Contact Henry Fastenau (work 707-875-2032, Cell 707-771-9495 or home 707-829-5662) or his designee.
7. If the injured person is diving under UC Davis auspices, a report must also be made to UCD's Workman's Compensation carrier within 24 hours. Report to your Department Personnel Manager. The BML & scuba training program's contact is Conci Mack at BML (707) 875-2011, Fax (707) 875-2009.
8. Complete and submit AAUS Incident Report Form (Appendix 8 of the Diving Safety Manual) to the UCD Diving Control Board (As required in Section 2.72).

### **List additional emergency contact numbers appropriate for dive location:**

(See Appendix 7A and 7B for local emergency contact information)

Divers Alert Network (DAN) 24 hour EMERGENCY ONLY (919) 684-8111

DAN emergencies, collect (919) 684-4DAN

DAN non-emergency medical information (919) 684-2948

## **APPENDIX 7A BODEGA MARINE LABORATORY EMERGENCY SERVICES CONTACT INFORMATION**

Sonoma/Mendocino counties Emergency Medical Services, (EMS) Standards.....**911**  
 Sheriff Department Dispatch (cell phone) .....(707) 565-2121  
 Bodega Bay Fire Department, (Paramedics) .....(707) 875-3700 or 567-1365 or **911**  
 Palm Drive Hospital, 501 Petaluma Ave, Sebastopol (nearest).....(707) 823-8511  
 Memorial Hospital, 1165 Montgomery Dr, Santa Rosa (Helicopter destination) .....(707) 546-3210  
 Tom Ferguson, MD (UCD Diving Physician, Lifeflight Coordinator) Office .....(530) 752-2330  
[TJFerguson@UCDavis.edu](mailto:TJFerguson@UCDavis.edu).....Pager (916) 762-6372  
 Lifeflight (UCD Med Center helicopter -- Hospital to Chamber transport) ..... 1-800-862-5433  
 Henry Fastenau, (DSO), ..... Office (707) 875-2032  
 ..... Cell (707) 771-9495..... Home (707) 829-5662

Hyperbaric Treatment Chambers:

Travis AFB, business hours .....(707) 423-3987  
 Travis AFB; Weekends, after hours.....(707) 423-3829  
 Pacific Grove - Monterey area .....(831) 375-3147

Divers Alert Network (DAN) - General & medical information .....(919) 684-2948  
 DAN --- 24 hour EMERGENCIES ONLY! .....(919) 684-8111  
 DAN Website ..... [www.diversalertnetwork.org](http://www.diversalertnetwork.org)  
 DAN - Collect.. ..... (919) 684-4DAN

US Coast Guard Station Bodega Bay .....(707) 875-3596  
 USCG VHF radio frequency ..... Channel 16  
 Doran Beach County Park Ranger Station.....(707) 875-3540  
 Salt Pt State Park Ranger Station .....(707) 847-3221  
 Ft Ross Ranger Station.. .....(707) 847-3286  
 BML research vessel VHF radio call sign (channel 16) .....WTV 3405

Report any diving-related accident and/or injury to the DSO and Dr. Ferguson immediately

Dive teams must have an oxygen unit and first aid kit available.

Oxygen units and a small first aid kit are stored in Room 200, the Dive Locker.

Research vessels must have a VHF radio, or some other form of communication with shore, and all other USCG, State & UC required safety equipment on board when underway.

**APPENDIX 7B  
 TAHOE RESEARCH GROUP EMERGENCY SERVICES  
 CONTACT INFORMATION  
 RESEARCH DIVING PROGRAM**

## TAHOE RESEARCH GROUP

### EMERGENCY SERVICES CONTACT INFORMATION

Tahoe Basin emergency medical services (EMS).....	911
Give exact location of accident	
Truckee EMS .....	911
Truckee-Tahoe Medical Group (nearest) 24 hours .....	916 587-3887
Tahoe Forest Hospital (in Truckee) 24 hours .....	587-6011
Thomas Ferguson, MD (UCD Diving Physician, Lifeflight Coordinator)	(800) 482-3284
Pager: (916) 762-6372,	Office: (530) 752-2333
Lifeflight (Hospital to Chamber Transportation).....	1-800-862-5433
Hyperbaric Treatment Chamber - Travis Air Force Base:	
Weekdays, 8:00 - 5:00 .....	707 423-3987
Weekends & after hours.....	423-3828
Divers Alert Network - general information.	919 684-2948
DAN Emergency 24 hour service ....	684-8111
US Coast Guard Station, Lake Tahoe .....	916 583-4433
UCSG VHF radio frequency .....	Channel 16
Tahoe Research Group Lab.....	916 583-3279
TRG VHF radio frequency ..	Channel 16
TRG research vessel radio frequency .....	Channel 16
TRG Research Vessel Descriptions:	
R/V John Le Conte -	37' aluminum cabin/hull with 'A' frame
	# CF 1288 XS Radio Call Sign WYK 3721
R/V Ted Frantz -25' aluminum cabin/hull with 'A' frame	
	# CF 3071 XS

There is an oxygen unit and small first aid kit on board the R/V Frantz. These must be taken to all dive sites and returned to the boat after use.

### APPENDIX 8

#### AAUS Diving Injury/Incident Report Form

Required Incident Reporting: All diving incidents requiring recompression treatment, or resulting in moderate or serious injury, or death shall be reported the AAUS Statistics Committee. The report will specify the circumstances of the incident and the extent of any injuries or illnesses. This form is

confidential and for statistics purposes only. The Organizational Member's Diving Control Board must review and release this report before it is submitted to the AAUS Statistics Committee

Check the appropriate space(s) & complete the form:

<input type="checkbox"/> Simple Illness	<input type="checkbox"/> Referred to Physician	<input type="checkbox"/> Serious injury
<input type="checkbox"/> Barotrauma	<input type="checkbox"/> Hyperbaric Treatment	<input type="checkbox"/> Near Drowning
<input type="checkbox"/> Hyperoxic	<input type="checkbox"/> Hypercapnea	<input type="checkbox"/> Fatality
<input type="checkbox"/> Other _____		

Workers' Compensation Claim?      Yes \_\_\_\_\_      No \_\_\_\_\_

Descriptive Report (use additional sheets if necessary)      Date of Incident: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_  
Month      Day      Year

Circumstances and the extent of the injuries or illnesses:

Treatment provided and results:

Recommendations to avoid repetition of incident:

Organizational Member Name: \_\_\_\_\_

Name & Title of Person Submitting Report: \_\_\_\_\_  
(Please print)

Signature \_\_\_\_\_ Date \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

Mailing Address: \_\_\_\_\_

Telephone/FAX : \_\_\_\_\_ E-mail: \_\_\_\_\_

## APPENDIX 9

### AMERICAN ACADEMY OF UNDERWATER SCIENCES GUIDELINES FOR USE OF DIVE COMPUTERS

Dive computer users must demonstrate to the DSO that they have read the dive computer owners manual and understand how to use the instrument, including dealing with unexpected electronics failure.

From AAUS Dive Computer Workshop. Lang & Hamilton (Eds.) USC Sea Grant Program, Los Angeles, CA 1989.

1. Only those makes and models of dive computers specifically approved by the Diving Control Board may be used.
2. Any diver desiring the approval to use a dive computer as a means of determining decompression status must apply to the Diving Control Board, complete an appropriate practical training session and pass a written examination.
3. Each diver relying on a dive computer to plan dives and indicate or determine decompression status must have his own unit.
4. On any given dive, both divers in the buddy pair must follow the most conservative dive computer.
5. If the dive computer fails at any time during the dive, the dive must be terminated and appropriate surfacing procedures should be initiated immediately.
6. A diver should not dive for 18 hours before activating a dive computer to use it to control his diving.
7. Once the dive computer is in use, it must not be switched off until it indicates complete outgassing has occurred or 18 hours have elapsed, whichever comes first.
8. When using a dive computer, non-emergency ascents are to be at the rate specified for the make and model of dive computer being used.
9. Ascent rates shall not exceed 40 fsw/min in the last 60 fsw.
10. Whenever practical, divers using a dive computer should make a stop between 10 and 30 feet for 5 minutes, especially for dives below 60 fsw.
11. Only one dive on the dive computer in which the NDL of the tables or dive computer has been exceeded may be made in any 18-hour period.
12. Repetitive and multi-level diving procedures should start the dive, or series of dives, at the maximum planned depth, followed by subsequent dives of shallower exposures.
13. Multiple deep dives require special consideration.

## APPENDIX 10

### AAUS ASCENT RECOMMENDATIONS

From AAUS Biomechanics of Safe Ascents Workshop, 1990, Lang and Egstrom (Eds.)

It has long been the position of the American Academy of Underwater Sciences (AAUS) that the ultimate responsibility for safety rests with the individual diver.

The time has come to encourage divers to slow their ascents. In accordance with recommendations of the AAUS, a stop during ascent should be made in the 25 to 15-foot depth range on every dive, especially those approaching zero decompression limits or any dive over the 50-foot depth.

1. Buoyancy compensation is a significant problem in the control of ascents.
2. Training in, and understanding of, proper ascent techniques is fundamental to safe diving practice.
3. Before certification, the diver is to demonstrate proper buoyancy, weighing and a controlled ascent, including a “hovering” stop.
4. Ascent rates shall not exceed 40 fsw per minute.
5. A stop in the 10-30 fsw zone for 3-5 minutes is recommended on every dive.
6. When using a dive computer or tables, non-emergency ascents are to be at the rate specified for the system being used.
7. Each diver shall have instrumentation to monitor ascent rates.
8. Divers using dry suits shall have training in their use.
9. Dry suits shall have a hands-free exhaust valve.
10. BC's shall have a reliable rapid exhaust valve which can be operated in a horizontal swimming position.
11. A buoyancy compensator is required with dry suit use for ascent control and emergency flotation.
12. Breathing 100% oxygen above water is preferred to in-water air procedures for omitted decompression.

## APPENDIX 11

### REPETITIVE DIVING WORKSHOP

Michael A. Lang and Richard D. Vann, Co-Chairs  
March 18-19, 1991  
Duke University Medical Center, NC

Co-Sponsors:  
American Academy of Underwater Sciences  
Divers Alert Network and Duke University Medical Center  
NOAA  
DEMA  
Association of Diving Contractors

#### **Repetitive Diving Recommendations**

Although diving is a relatively safe activity, all persons who dive must be aware that there is an inherent risk to this activity. Currently, the risk of decompression illness in the United States is estimated at 1-2 incidents per 1,000-2,000 dives for the commercial diving sector, 2 incidents per 10,000 dives for recreational diving activities and 1 incident in 100,000 dives for the scientific diving community.

#### **Scientific Diving, Glen H. Egstrom, Moderator.**

1. The position of recommending slower ascent rates seems to have gained support.
2. Increasing knowledge regarding the incidence of DCS indicates that our ability to predict the onset of DCS on multi-level, multi-day diving is even less sensitive than our ability to predict DCS on single square dives.
3. Although there is little evidence supporting either a pro or con position on multi-level, multi-day dives and a higher probability of DCS, there is sufficient evidence to encourage additional research on the problem.
4. There appears to be good evidence that there are many variables which can affect the probability of the occurrence of DCS symptoms. The ability to mitigate these variables through education, good supervision and training appears to be possible in such variables as hydration, fitness, rate of ascent, fatigue et al. and should continue to be promoted. Divers are subject to a host of specific conditions which may increase risk if precautions are not taken.
5. There appears to be support for the use of nitrox nitrox and surface oxygen breathing in scientific diving where higher gas loadings are anticipated in multi-level, multi-day dives. Adequate technical support is fundamental.
6. Since there seems to be little likelihood that we can avoid all decompression illness in multi-level, multi-day diving, we should focus educational objectives on:
  - a. the development of an appreciation for the realities of risk for DCS;
  - b. encouraging maximal prevention strategies; and,
  - c. define, as clearly as possible, the conditions under which problems are known to occur.
7. There are techniques used in commercial diving applications which may be appropriate for some scientific diving applications which require unusual exposures.
8. The incidence of DCS in scientific diving appears to be about 1:100,000, in recreational diving at about 2:10,000 and in commercial diving at about 1:1,000-2,000. These levels are not unreasonable.

## APPENDIX 12

### REVERSE DIVE PROFILES WORKSHOP

Michael A. Lang and Charles E. Lehner  
Co-Chairs  
Smithsonian Institution  
October 29 - 30, 1999

Co-Sponsors:  
Smithsonian Institution  
Divers Alert Network  
American Academy of Underwater Sciences  
Diving Equipment and Marketing Association  
Dive Training Magazine

#### **Workshop Findings**

Historically neither the U.S. Navy nor the commercial sector have prohibited reverse dive profiles. Reverse dive profiles are being performed in recreational, scientific, commercial, and military diving. The prohibition of reverse dive profiles by recreational training organizations cannot be traced to any definite diving experience that indicates an increased risk of DCS. No convincing evidence was presented that reverse dive profiles within the no-decompression limits lead to a measurable increase in the risk of DCS.

#### **Workshop Conclusion**

We find no reason for the diving communities to prohibit reverse dive profiles for no-decompression dives less than 40 msw (130 fsw) and depth differentials less than 12 msw (40 fsw).

#### **Note:**

For full workshop proceedings contact DSO or the American Academy of Underwater Sciences at <http://www.aaus.org/>.