



**STANDARDS FOR SCIENTIFIC DIVING CERTIFICATION
&
OPERATION OF SCIENTIFIC DIVING PROGRAMS**

**University of California, Santa Cruz
Institute of Marine Sciences**

The American Academy of Underwater Sciences
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FOREWORD

A researcher's presence in the environment has proven to be an improved method of collecting data. Specifically the effectiveness of the underwater scientist lies in having the trained mind and eye at sites of primary interest. The superior observational capabilities of the human eye in depth perception and color sensitivity, the use in diving of the sense of touch and the special ability of the human mind to integrate the field observation and to provide rapid feedback, are of prime importance in such areas as spatial distribution, population dynamics, behavior and dynamic geological processes (Jim Stewart, 1988).

In short, diving, when conducted in a manner, which will maximize protection of the scientific diver while allowing efficiency of observation, is a tool of great potential value, a means of collecting data, which in many cases is available through no other means.

This document is drawn from the American Academy of Underwater Sciences (AAUS) *Standards for Scientific Diving Certification and Operations of Scientific Diving Programs*, of August 2006. Since 1951 the scientific diving community has endeavored to promote safe, effective diving through self-imposed diver training and education programs. Over the years, manuals for diving safety have been circulated between organizations, revised and modified for local implementation, and have resulted in an enviable safety record. The AAUS document represents the minimum safety standards for scientific diving at the present day. It will be continuously reviewed by the University of California at Santa Cruz's Chancellor, Diving Control Board and Diving Safety Officer to see that it always reflects state of the art, safe diving practices.

VOLUME I

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 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 scientific agencies. Fulfillment of the purposes shall be consistent with the furtherance of research and safety.

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

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

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

The University of California, Santa Cruz (UCSC) has adopted additional standards, which extend this document, according to local procedure.

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):

- A. The Diving Control Board consists of a majority of active scientific divers and has autonomous and absolute authority over the scientific diving program's operation.
- B. The purpose of the project using scientific diving is the advancement of science; therefore, information and data resulting from the project are non-proprietary.
- C. The tasks of a scientific diver are those of an observer and data gatherer. Construction and trouble-shooting tasks traditionally associated with commercial diving are not included within scientific diving.
- D. Scientific divers, based on the nature of their activities, must use scientific expertise in studying the underwater environment and therefore, are scientists or scientists-in-training.
- E. In addition, the scientific diving program shall contain at least the following elements:
 1. Diving safety manual which includes at a minimum: Procedures covering all diving operations specific to the program; including procedures for emergency care, recompression and evacuation; and the criteria for diver training and certification.

2. Diving Control 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, ensure compliance with the manual, certify the depths to which a diver has been trained, take disciplinary action for unsafe practices, and ensure adherence to the buddy system (a diver is accompanied by and is in constant communication with another diver in the water) for scuba diving.

1.14 Review of Standards

Any recommendations for modifications of these standards, made by the DCB, shall be submitted to the AAUS for consideration at least annually by the Diving Safety Officer.

1.15 Liability

In adopting the policies set forth in this manual, UCSC and AAUS assume 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.

1.16 Release and Waiver

All students and other personnel diving under UCSC auspices shall execute a current UCSC Waiver, Release and Indemnity Agreement holding the Regents harmless from any claims which might arise as a result of any diving or diving related activity.

1.20 OPERATIONAL CONTROL

1.21 University of California, Santa Cruz Auspices Defined

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

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

1.22 UCSC Scientific Diving Standards and Safety Manual

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

- A. The AAUS Standards may be used as a set of minimum guidelines for the development of UCSC scientific diving safety manual.
- B. Emergency evacuation and medical treatment procedures.
- C. The criteria for diver training and certification.
- D. Standards written or adopted by reference for diving modes utilized including the following:
 1. Safety procedures for the diving operation.
 2. Responsibilities of the dive team members.
 3. Equipment use and maintenance procedures.
 4. Emergency procedures.

1.23 The Diving Safety Officer

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

A. Qualifications

1. Shall be appointed by the responsible administrative officer or his/her designee, with the advice and counsel of the DCB.
2. Shall be trained as a scientific diver.
3. Shall be a member as defined by the AAUS.
4. Shall be an active underwater instructor from a nationally recognized agency.

B. Duties and Responsibilities

1. Shall be responsible, through the DCB, to the responsible administrative officer or his/her designee, for the conduct of the scientific diving program of the membership organization. The routine operational authority for this program, including the conduct of training and certification, approval of dive plans, maintenance of diving records, and ensuring compliance with this manual and all relevant regulations of the membership organization, rests with the Diving Safety Officer.
2. May permit portions of this program to be carried out by a qualified delegate, although the Diving Safety Officer may not delegate responsibility for the safe conduct of the local diving program.
3. Shall be guided in the performance of the required duties by the DCB, but operational responsibility for the conduct of the local diving program will be retained by the Diving Safety Officer.
4. Shall suspend diving operations, which he/she considers to be unsafe or unwise.

1.24 The Diving Control Board

A. The DCB shall consist of a majority of active scientific divers. Voting members shall include the Diving Safety Officer, the responsible administrative officer, or his/her designee, and should include other representatives of the diving program such as qualified divers and members selected by procedures established by the UCSC Chancellor through the Dean of Physical and Biological Sciences. A chairperson and a secretary may be chosen from the membership of the board according to DCB procedure.

B. Has autonomous authority over the scientific diving program.

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

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

E. Shall sit as a board of investigation to inquire into the nature and cause of diving accidents or violations of UCSC diving manual.

F. Acting through the DSO, the DCB shall oversee the following:

1. Approve and monitor diving projects.
2. Review and revise the diving safety manual.
3. Ensure compliance with the manual.
4. Certify the depths to which a diver has been trained.

5. Take disciplinary action for unsafe practices.
6. Ensure adherence to the buddy system for scuba diving.
7. Act as the official representative of the membership organization in matters concerning the scientific diving program.
8. Recommend the issue, reissue, or the revocation of diving certifications.
9. Recommend changes in policy and amendments to UCSC and the AAUS scientific diving manual as the need arises.
10. Establish and/or approve training programs through which the applicants for certification can satisfy the requirements of UCSC diving safety manual.
11. Suspend diving programs, which it considers to be unsafe or unwise.
12. Establish criteria for equipment selection and use.
13. Recommend new equipment or techniques.
14. Establish and/or approve facilities for the inspection and maintenance of diving and associated equipment.
15. Shall ensure that UCSC air station(s) meet air quality standards as described in Section 3.60 of this manual.
16. Shall establish University regulations that meet or exceed current National Association of Underwater Instructors (NAUI) standards, as interpreted by the DCB, for all UCSC OPERS, recreational, scientific, extension, and other diving activities.
17. Shall ensure that all UCSC OPERS, recreational, scientific, extension, and other diving activities meet all relevant community, University, state, and federal diving safety regulations and to make recommendations to the Director of the Institute of Marine Sciences (IMS) and Office of Physical Education, Recreation and Sports (OPERS) concerning the management and safe operation of diving programs.

1.25 Instructional Personnel

A. Qualifications

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

B. Selection

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

1.26 Lead Diver

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

- A. Coordination with other known activities in the vicinity, which are likely to interfere with diving operations.
- B. Ensuring all dive team members possess current certification and are qualified for the type of diving operation.
- C. Planning dives in accordance with section 2.21.

- D. Ensuring safety and emergency equipment is in working order and at the dive site.
- E. Briefing the dive team members on:
 1. Dive objectives.
 2. Unusual hazards or environmental conditions likely to affect the safety of the diving operation.
 3. Modifications to diving or emergency procedures necessitated by the specific diving operation.
 4. Suspending diving operations if in his/her opinion conditions are not safe.
 5. Reporting to the DSO and DCB any physical problems or adverse physiological effects including symptoms of pressure-related injuries.

1.27 Reciprocity And Visiting Scientific Diver

- A. Two or more AAUS organizational members engaged jointly in diving activities, or engaged jointly in the use of diving resources, shall designate one of the participating Diving Control Boards to govern the joint dive project.
- B. A scientific diver from an organizational member shall apply for permission to dive under the auspices of another organizational member by submitting to the Diving Safety Officer of the host organizational member a document containing all the information described in Appendix 2 (letter of reciprocity), signed by the Diving Safety Officer or Chairperson of the home DCB.
- C. A visiting scientific diver may be asked to demonstrate his/her knowledge and skills for the planned diving.
- D. If a host organizational member denies a visiting scientific diver permission to dive, the host DCB shall notify the visiting scientific diver and his/her DCB with an explanation of all reasons for the denial.

1.28 Waiver of Requirements

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

1.30 CONSEQUENCES OF VIOLATION OF REGULATIONS BY SCIENTIFIC DIVERS

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

1.40 CONSEQUENCES OF VIOLATION OF REGULATIONS BY UCSC

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

1.50 RECORD MAINTENANCE

The Diving Safety Officer or his/her designee shall maintain records for each active scientific diver. The file shall include evidence of certification level, log sheets, results of current physical examination, waiver(s), reports of disciplinary actions by the UCSC DCB, and other pertinent information deemed necessary.

1.51 Availability of Records:

- A. Medical records shall be made available to the attending physician of a diver or former diver when released in writing by the diver.
- B. Records and documents required by this standard shall be retained by UCSC for the following period:
 - 1. Physician's written reports of medical examinations for dive team members - 10 years.
 - 2. Manual for diving safety - current document only.
 - 3. Certification Records - 10 years.
 - 4. Diving Logs - 30 years after termination of employment.
 - 5. Incident Reports - Permanently.
 - 6. Equipment inspection and testing records - 10 years.

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 UCSC scientific diving program unless he/she holds a current certification issued pursuant to the provisions of this manual.

2.20 PRE-DIVE PROCEDURES**2.21 Dive Proposal**

Dives should be planned around the competency of the least experienced diver. Before conducting any diving operations under the auspices of UCSC, the lead diver for a proposed operation must formulate and submit a dive proposal to the DSO at least one month prior to the project start. The proposal form is available on-line at www2.ucsc.edu/sci-diving. The proposal should include the following:

- A. Divers' qualifications, and the type of certificate or certification held by each diver.
- B. Emergency plan with the following information:
 - 1. Name, telephone number, and relationship of person to be contacted for each diver in the event of an emergency.
 - 2. Nearest operational recompression chamber
 - 3. Nearest accessible hospital
 - 4. Available means of transport
- C. Approximate number of proposed dives.
- D. Location(s) of proposed dives.
- E. Estimated depth(s) and bottom time(s) anticipated.
- F. Decompression status and repetitive dive plans, if required.
- G. Proposed work, equipment, and boats to be employed.

H. Any hazardous conditions anticipated.

2.22 Pre-dive Safety Checks

A. Diver's Responsibility:

1. Each scientific diver shall conduct a functional check of his/her diving equipment in the presence of the diving buddy or tender.
2. It is the diver's responsibility and duty to refuse to dive if, in his/her judgment, conditions are unfavorable, or if he/she would be violating the precepts of his/her training, or UCSC diving manual.
3. No dive team member shall be required to be exposed to hyperbaric conditions against his/her will.
4. No dive team member shall be permitted to dive for the duration of any known condition, which is likely to adversely affect the safety and health of the diver or other dive members.
5. Each scientific diver and their buddy shall follow pre-determined limits on air management, dive depth and dive duration for each dive.

B. Equipment Evaluations

1. Each diver shall ensure that his/her equipment is in proper working order and that the equipment is suitable for the type of diving operation.
2. Each diver shall have the capability of achieving and maintaining positive buoyancy.

2.30 DIVING PROCEDURES

2.31 Solo Diving Prohibition

All diving activities shall assure adherence to the buddy system (two suitably equipped divers in the water in constant communication). This buddy system is based upon mutual assistance, especially in the case of an emergency. Exceptions to this policy may be made by the DSO, particularly in the case of surface supported diving and diving in overhead environments.

2.32 Refusal to Dive

A. 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.

B. Safety - The ultimate responsibility for safety rests with the individual diver. It is the diver's responsibility and duty to refuse to dive if, in 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 manual.

2.33 Termination of the Dive

A. 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.

B. The dive shall be terminated while there is still sufficient cylinder pressure to permit the diver to safely reach the surface, including a safety stop (or decompression stop) or to safely reach an additional air source at the decompression station. It is recommended that cylinder pressure should not fall below 500psi before reaching the surface.

2.34 Emergencies and Deviations from Regulations

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

2.40 POST-DIVE PROCEDURES

2.41 Post-Dive Safety Checks

- A. After the completion of a dive, each diver shall report any physical problems, symptoms of decompression sickness, or equipment malfunctions to their buddy and Lead Diver.
- B. When diving outside the no-decompression limits, the divers should remain awake for at least one hour after diving, and in the company of a dive team member who is prepared to transport him/her to a hyperbaric chamber if necessary.
- C. See Appendix 7 for post dive prophylactic oxygen use protocols.

2.50 EMERGENCY PROCEDURES

Each dive project leader will develop emergency procedures, which follow the standards of care of the community and must include procedures for emergency care, recompression and evacuation for each dive location.

2.60 FLYING AFTER DIVING

Divers should have a minimum surface interval of 18 hours (24 hours preferred) **and** be cleared by their dive computer before flying.

2.70 RECORDKEEPING AND REQUIREMENTS

2.71 Logging Dives

Each certified scientific diver shall log every dive made under the auspices of the UCSC program, and is encouraged to log all other dives. Dives should be logged at least monthly into the on-line dive log database. Details of the submission procedures are left to the discretion of the Diving Safety Officer. The diving log shall be in a form specified by the Diving Safety Officer and shall include at least the following:

- A. Name of diver, partner, and Lead Diver.
- B. Date, time, and location.
- C. Diving modes used.
- D. General nature of diving activities.
- E. Approximate surface and underwater conditions.
- F. Maximum depths, bottom time and surface interval time.
- G. Diving tables or computers used.
- H. Detailed report of any near or actual incidents. An incident is defined as, "An occurrence that interrupts normal procedure or brings about a crisis."

2.72 Required Incident Reporting

All diving incidents shall be reported to the UCSC DSO. UCSC regular procedures for incident reporting, including those required by the AAUS shall be followed. The report will specify the circumstances of the incident and the extent of any injuries or illnesses. Additional information must meet the following reporting requirements:

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

- B. If pressure-related injuries are suspected, or if symptoms are evident, the following additional information shall be permanently recorded and retained by UCSC, with the record of the dive:
1. Complete UCSC Incident Report Form (Appendix 6).
 2. Written descriptive report to include:
 - a) Name, address, and phone numbers of the principal parties involved.
 - b) Summary of experience of divers involved.
 - c) Location, description of dive sites and description of conditions that led up to incident.
 - d) Description of symptoms, including depth and time of onset.
 - e) Description and results of treatment.
 - f) Disposition of case.
 - g) Recommendations to avoid repetition of incident.
- C. The DCB shall investigate and document any incident of pressure-related injury and prepare a report, which is to be forwarded to the AAUS during the annual reporting cycle. This report must first be reviewed and released by UCSC DCB.

SECTION 3.00 DIVING EQUIPMENT

3.10 GENERAL POLICY

- A. All equipment shall meet standards as determined by the Diving Safety Officer and the DCB. Equipment that is subjected to extreme usage under adverse conditions should require more frequent testing and maintenance.
- B. All equipment shall be regularly examined by the person using them.

3.20 EQUIPMENT

3.21 Regulators

- A. Approval. Only those makes and models specifically approved by the Diving Safety Officer and the DCB shall be used.
- B. Inspection and testing. Scuba regulators shall be inspected and tested prior to first use and every twelve months thereafter.
- C. Regulators must include a primary second stage as well as a redundant second stage or the diver must carry an approved redundant air supply.

3.22 Breathing Masks and Helmets

Breathing masks and helmets shall have:

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

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

3.23 Scuba Cylinders

- A. Scuba cylinders shall be designed, constructed, and maintained in accordance with the applicable provisions of the Unfired Pressure Vessel Safety Orders.
- B. Scuba cylinders must be hydrostatically tested in accordance with DOT standards.
- C. Scuba cylinders must have an internal inspection at intervals not to exceed twelve months.
- D. Scuba cylinder valves shall be functionally tested at intervals not to exceed twelve months.

3.24 Backpacks

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

3.25 Gauges

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

3.26 Flotation Devices

- A. Each diver shall have the capability of achieving and maintaining positive buoyancy, independent of the exposure suit.
- B. Personal flotation systems, buoyancy compensators, dry suits, or other variable volume buoyancy compensation devices shall be equipped with an exhaust valve.
- C. These devices shall be functionally inspected and tested at intervals not to exceed twelve months.

3.27 Timing Devices, Depth and Pressure Gauges

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

3.28 Determination of Decompression Status: Dive Tables, Dive Computers

- A. A set of diving tables, approved by the DCB, must be available at the dive location.
- B. Dive computers may be utilized in place of diving tables. Before using a dive computer, UCSC Scientific Divers must have a UCSC Dive Computer waiver on file. At no time should the remaining time displayed at depth be less than 10 minutes.

3.30 AUXILIARY EQUIPMENT

3.31 Hand held underwater power tools.

Power tools and equipment used underwater shall be specifically approved for this purpose by the DCB. 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 should not be supplied with power from the dive location until requested by the diver.

3.40 SUPPORT EQUIPMENT

3.41 First aid supplies.

First aid kit, emergency oxygen and communication device shall be available at each dive site.

3.42 Diver's Flag

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

3.43 Compressor Systems - UCSC Controlled

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

- A. Low pressure compressors used to supply air to the diver if equipped with a volume tank shall have a check valve on the inlet side, a relief valve, and a drain valve.
- B. Compressed air systems over 500 psig shall have slow-opening shut-off valves.
- C. All air compressor intakes shall be located away from areas containing exhaust or other contaminants.

3.44 Oxygen Systems

- A. Equipment used with oxygen or mixtures containing over forty percent (40%) by volume of oxygen shall be designed and maintained for oxygen service.
- B. Components exposed to oxygen or mixtures containing over forty percent (40%) by volume of oxygen shall be cleaned of flammable materials before being placed into service.
- C. Oxygen systems over 125 psig shall have slow-opening shut-off valves.

3.50 EQUIPMENT MAINTENANCE**3.51 Recordkeeping**

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

- A. Regulators
- B. Submersible pressure gauges
- C. Depth gauges
- D. Scuba cylinders
- E. Cylinder valves
- F. Diving helmets
- G. Submersible breathing masks
- H. Compressors
- I. Gas control panels
- J. Air storage cylinders
- K. Air filtration systems
- L. Analytical instruments

M. Buoyancy control devices

N. Dry suits

3.52 Compressor Operation and Air Test Records

A. Gas analyses and air tests shall be performed on each UCSC controlled breathing air compressor at regular intervals of no more than 100 hours of operation or six months, whichever occurs first. A copy of the results of these tests shall be posted at each compressor and the original shall be kept on file.

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

3.60 AIR QUALITY STANDARDS

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

CGA Grade E Standards

Component	Maximum
Oxygen	20-22%/v
Carbon Monoxide	10 PPM/v
Carbon Dioxide	1000 PPM/v
Condensed Hydrocarbons	5 mg/m ³
Total Hydrocarbons as Methane	25 PPM/v
Water Vapor	2 PPM/v
Objectionable Odors	None

SECTION 4.00 ENTRY-LEVEL TRAINING REQUIREMENTS

This section describes training for the non-diver applicant and Scientific Divers In Training (DIT).

4.10 EVALUATION

4.11 Medical Examination

The applicant for training shall be certified by a licensed physician to be medically qualified for diving before proceeding with the training as designated in Section 6.00.

4.12 Swimming Evaluation

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

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

4.20 SCUBA TRAINING

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:

- A. Enter water with full equipment.
- B. Clear facemask.
- C. Demonstrate air sharing, including both buddy breathing and the use of alternate air source, as both donor and recipient, with and without a facemask.
- D. Demonstrate ability to alternate between snorkel and scuba while kicking.
- E. Demonstrate understanding of underwater signs and signals.
- F. Demonstrate simulated in-water mouth-to-mouth resuscitation.
- G. Rescue and transport, as a diver, a passive simulated victim of an accident.
- H. Demonstrate ability to remove and replace equipment while submerged.
- I. Demonstrate watermanship ability, which is acceptable to the instructor.

4.22 Written Examination

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

- A. Function, care, use, and maintenance of diving equipment.
- B. Physics and physiology of diving.
- C. Diving regulations and precautions.
- D. Near-shore currents and waves.
- E. Dangerous marine animals.
- F. Emergency procedures, including buoyant ascent and ascent by air sharing.
- G. Currently accepted decompression procedures.
- H. Demonstrate the proper use of dive tables.
- I. Underwater communications.
- J. Aspects of freshwater and altitude diving.
- K. Hazards of breath-hold diving and ascents.
- L. Planning and supervision of diving operations.
- M. Diving hazards.

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

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:

- A. Surface dive to a depth of 10 feet in open water without scuba.
- B. Demonstrate proficiency in air sharing, including both buddy breathing and the use of alternate air source, as both donor and receiver.
- C. Enter and leave open water or surf, or leave and board a diving vessel, while wearing scuba gear.
- D. Kick on the surface 400 yards while wearing scuba gear, but not breathing from the scuba unit.
- E. Demonstrate judgment adequate for safe diving.
- F. Demonstrate, where appropriate, the ability to maneuver efficiently in the environment, at and below the surface.
- G. Complete a simulated emergency swimming ascent.
- H. Demonstrate clearing of mask and regulator while submerged.
- I. Demonstrate ability to achieve and maintain neutral buoyancy while submerged.
- J. Demonstrate techniques of self-rescue and buddy rescue.
- K. Navigate underwater.
- L. Plan and execute a dive.
- M. Successfully complete 5 open water dives for a minimum total time of 3 hours, of which 1-1/2 hours cumulative bottom time must be on scuba. No more than 3 training dives shall be made in any one-day.

SECTION 5.00 SCIENTIFIC DIVER CERTIFICATION

5.10 CERTIFICATION TYPES

5.11 Scientific Diver Certification.

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

5.12 Temporary Diver Permit.

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

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

5.13 Scientific Aquarium Diver

A scientific aquarium diver is a diver who has completed and been certified as at least an open water/basic SCUBA diver and a Rescue Diver through a nationally or internationally recognized certifying agency. They will also:

- have met the requirements of Sections 4.12, 4.21 and 4.23
- have undergone specific aquarium diving orientation
- be diving solely within an aquarium.

An aquarium is a shallow, confined body of water, which is operated by or under the control of an institution and is used for the purposes of specimen exhibit, education, husbandry, or research. See requirements which are listed in Section 8.00.

5.14 Scientific Skin Diver

A scientific skin diver is a diver who has at least met the guidelines outlined in Appendix 3 and has had specific skin diving orientation and who is diving solely as a skin diver.

5.20 GENERAL POLICY

The AAUS requires that no person shall engage in scientific diving unless that person is authorized by UCSC pursuant to the provisions of this manual. The following are considered minimum standards for a scientific diver certification. Only a person diving under the auspices of an organization that subscribes to the practices of the AAUS is eligible for a scientific diver certification.

5.30 REQUIREMENTS FOR SCIENTIFIC DIVER CERTIFICATION

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

5.31 Prerequisites

- A. UCSC application for certification, including a UCSC Waiver, Release and Indemnity Agreement.
- B. Medical approval - Each applicant for diver certification shall submit a statement from a licensed physician, based on an approved medical examination, attesting to the applicant's fitness for diving (see Section 6.0).
- C. Diver-In-Training (DIT) Permit - This permit signifies that a diver has completed and been certified as at least a Rescue SCUBA diver through a nationally or internationally recognized certifying agency. Each DIT shall meet the requirements of Sections 4.12, 4.21 and 4.23 in order to be eligible for Scientific Diver Certification.

D. Emergency Care Training

The trainee must provide proof of current training in the following:

1. Cardiopulmonary resuscitation (CPR);
2. Emergency oxygen administration;
3. Standard first aid for diving accidents (see OSHA Instruction CPL 2-2.53, Jan. 7, 1991).

5.32 Training

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

- A. Required Topics (include, but not limited to):
 1. Diving Emergency Care Training
 - Cardiopulmonary Resuscitation (CPR)

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

B. Suggested Topics (include, but not limited to):

1. Specific Dive Modes (methods of gas delivery)
 - Open Circuit
 - Hookah
 - Surface Supplied diving
2. Small Boat Operation
3. Rebreathers
 - Closed
 - Semi-closed
4. Specialized Breathing Gas
 - Nitrox
 - Mixed Gas
5. Specialized Environments and Conditions
 - Blue Water Diving,
 - Ice and Polar Diving (Cold Water Diving)
 - Zero Visibility Diving
 - Polluted Water Diving,
 - Saturation Diving
 - Decompression Diving
 - Overhead Environments
 - Aquarium Diving
 - Night Diving
 - Kelp Diving

- Strong Current Diving (Live-boating)
 - Potential Entanglement
6. Specialized Diving Equipment
- Full Face Mask
 - Dry Suit
 - Communications

C. Practical training must include a checkout dive with evaluation of the skills listed in Section 4.23 with the DSO or qualified delegate followed by at least 12 ocean or open water dives in a variety of dive sites and diving conditions, for a cumulative bottom time of 6 hours. Dives following the checkout dive must be supervised by a certified Scientific Diver with experience in the type of diving planned, with the knowledge and permission of the DSO.

D. Examinations

1. Written examination
 - General exam required for scientific diver certification.
 - Examination covering the suggested topics at the DSO's discretion.
2. Examination of equipment.
 - Personal diving equipment
 - Task specific equipment

5.40 DEPTH CERTIFICATIONS

5.41 Progression To Next Depth Level

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

5.42 Depth Certification Levels

A. Certification to 30-Foot Depth

This is the initial permit level, approved upon the successful completion of training listed in Sections 5.30, 5.31 and 5.32.

B. Certification to 45-Foot Depth

A diver holding a 30-foot certificate may be certified to a depth of 45 feet after successfully completing, under supervision, 12 logged training dives to depths between 31 and 45 feet, for a minimum total bottom time of 4 hours.

C. Certification to 70-Foot Depth

A diver holding a 45-foot certificate may be certified to a depth of 70 feet after successfully completing, under supervision, 12 logged training dives to depths between 46 and 70 feet, for a minimum total bottom time of 4 hours.

D. Certification to 100-Foot Depth

A diver holding a 70-foot certificate may be certified to a depth of 100 feet after successfully completing a 100' certification course.

E. Certification to 130-Foot Depth

A diver holding a 100-foot certificate may be certified to a depth of 130 feet after successfully completing a 130' certification course.

F. Certification to 150-Foot Depth

A diver holding a 130-foot certificate may be certified to a depth of 150 feet after successfully completing a 150' certification course.

G. Certification to 190-Foot Depth

A diver holding a 150-foot certificate may be certified to a depth of 190 feet after successfully completing a 190' certification course.

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

5.50 CONTINUATION OF CERTIFICATION

5.51 Minimum Activity to Maintain Certification

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

5.52 Emergency Care Training

The scientific diver must provide proof of training in the following:

- Adult CPR (must be current).
- Emergency oxygen administration (must be current)
- First aid for diving accidents (must be current)

5.53 Requalification of Depth Certificate

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

5.54 Medical Examination

All certified scientific divers shall pass a medical examination at the intervals specified in Section 6.12. After each major illness or injury, as described in Section 6.12, a certified scientific diver shall receive clearance to return to diving from a physician before resuming diving activities.

5.60 REVOCATION OF CERTIFICATION

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

5.70 RECERTIFICATION

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

SECTION 6.00 MEDICAL STANDARDS

All required forms for the UCSC scientific diving physical exam are available at: www2.ucsc.edu/sci-diving

6.10 MEDICAL REQUIREMENTS

6.11 General

A. The UCSC DCB shall determine that divers have passed a current diving physical examination and have been declared by the examining physician to be fit to engage in diving activities, which may be limited or restricted in the medical evaluation report.

B. All medical evaluations required by this standard shall be performed by, or under the direction of, a licensed physician of the applicant-diver's choice, preferably one trained in diving/undersea medicine. A UCSC Health Center physician will review all divers' medical evaluations.

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

6.12 Frequency of Medical Evaluations

Medical evaluation shall be completed:

A. Before a diver may begin diving, unless an equivalent initial medical evaluation has been given within the preceding 5 years (3 years if over the age of 39, 2 years if over 59), the member and those results have been reviewed and found satisfactory by a UCSC Health Center physician.

B. Thereafter, at five-year intervals up to age 39, three-year intervals age 40 up to age 59 and every two years age 60 and older.

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

6.13 Information Provided Examining Physician

The UCSC Diving Safety Program shall provide a copy of the medical evaluation requirements of this standard to the scientific diver to present to the examining physician.

6.14 Content of Medical Evaluations

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

- A. Applicant agreement for release of medical information to the Diving Safety Officer and the DCB.
- B. Medical history
- C. Diving physical examination (Section 6.16).

6.15 Conditions for which Restriction from Diving is Possible (Adapted from Bove, 1998).

1. Abnormalities of the tympanic membrane, such as perforation, presence of a monomeric membrane, or inability to autoinflate the middle ears.
2. Vertigo including Meniere's Disease.
3. Stapedectomy or middle ear reconstructive surgery.
4. Recent ocular surgery.
5. Psychiatric disorders including claustrophobia, suicidal ideation, psychosis, anxiety states, untreated depression.
6. Substance abuse, including alcohol.
7. Episodic loss of consciousness.
8. History of seizure.
9. History of stroke or a fixed neurological deficit.
10. Recurring neurologic disorders, including transient ischemic attacks.
11. History of intracranial aneurysm, other vascular malformation or intracranial hemorrhage.
12. History of neurological decompression illness with residual deficit.
13. Head injury with sequelae.
14. Hematologic disorders including coagulopathies.
15. Evidence of coronary artery disease or high risk for coronary artery disease.
16. Atrial septal defects.
17. Significant valvular heart disease - isolated mitral valve prolapse is not disqualifying.
18. Significant cardiac rhythm or conduction abnormalities.

19. Implanted cardiac pacemakers and cardiac defibrillators (ICD).
20. Inadequate exercise tolerance.
21. Severe hypertension.
22. History of spontaneous or traumatic pneumothorax.
23. Asthma.
24. Chronic pulmonary disease, including radiographic evidence of pulmonary blebs, bullae or cysts.
25. Diabetes mellitus.
26. Pregnancy

6.16 Laboratory Requirements for Diving Medical Examination:

A. Initial examination under age 40:

Medical History
 Complete Physical Exam, emphasis on neurological and otological components
 Chest X-ray
 Spirometry
 Audiogram
 Complete Blood Count (CBC)
 Urinalysis
 Chem Panel
 Any further tests deemed necessary by the physician to qualify the patient for scuba diving

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

Medical History
 Complete Physical Exam, emphasis on neurological and otological components
 Audiogram
 Complete Blood Count (CBC)
 Urinalysis
 Chem Panel
 Any further tests deemed necessary by the physician to qualify the patient for scuba diving

C. Initial Exam age 40 and older:

Medical History
 Complete Physical Exam, emphasis on neurological and otological components
 Assessment of coronary artery disease risk factors including lipid profile and diabetic screening
 Resting EKG
 Chest X-ray
 Spirometry
 Audiogram
 Urinalysis
 Complete Blood Count (CBC)
 Chem Panel
 Any further tests deemed necessary by the physician

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

Medical History
 Complete Physical Exam, emphasis on neurological and otological components
 Assessment of coronary artery disease risk factors including lipid profile and diabetic screening
 Resting EKG
 Chest X-ray (every 6 years or at the discretion of examiner)
 Spirometry
 Audiogram
 Urinalysis
 Complete Blood Count (CBC)
 Chem Panel
 Any further tests deemed necessary by the physician

E. Physician's Written Report

1. After any medical examination relating to the individual's fitness to dive, UCSC 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.
2. UCSC shall make a copy of the physician's written report available to the individual.

VOLUME II

SECTION 7.00 NITROX DIVING GUIDELINES

The following guidelines address the use of nitrox by scientific divers under the auspices of UCSC. Nitrox is defined for these guidelines as any gas mixture comprised predominately of nitrogen and oxygen, most frequently containing between 22% and 40% oxygen. Also referred to as Enriched Air Nitrox, or EANx, it is most commonly produced by the addition of oxygen or the removal of nitrogen from air.

7.10 PREREQUISITES

Only a certified Scientific Diver or Scientific Diver In Training (Sections 4.00 and 5.00) diving under the auspices of UCSC is eligible for authorization to use nitrox. After completion, review and acceptance of application materials and training and qualification as per Section 7.21 of these guidelines, an applicant will be authorized to use nitrox within his/her depth authorization, as specified in Section 5.40.

7.20 REQUIREMENTS FOR AUTHORIZATION TO USE NITROX

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

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

7.21 Training

The diver must complete additional theoretical and practical training beyond the Scientific Diver In Training air certification level, to the satisfaction of UCSC's DSO or his/her designee (see Section 7.20).

7.22 Examinations

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

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

7.23 Minimum Activity to Maintain Authorization

The diver shall log at least one (1) nitrox dive every 6 months. If one nitrox dive has not been made in the past 6 months the diver must demonstrate O₂ analyzer use and EANx calculations to an active UCSC Nitrox diver. Failure to meet this minimum activity level may be cause for restriction or revocation of nitrox authorization.

7.30 NITROX TRAINING GUIDELINES

Training in these guidelines shall be in addition to training for Diver In Training authorization (Section 4.00). It may be included as part of training to satisfy the Scientific Diver training requirements (Section 5.32).

7.31 Classroom Instruction

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

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

7.32 Practical Training

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

- A. Oxygen analysis of nitrox mixtures.
- B. Determination of MOD (maximum operating depth), oxygen partial pressure exposure, and oxygen toxicity time limits, for various nitrox mixtures at various depths.
- C. Determination of nitrogen-based dive limits status by EAD (equivalent air depth) method using air dive tables, and/or using nitrox dive tables, as approved by the DCB.
- D. Nitrox dive computer use may be included, as approved by the DCB.

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

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

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

H. Nitrox operational guidelines (Section 7.40), dive planning, and dive station components.

7.34 Open Water Dives

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

7.35 Surface-Supplied Training

All training as applied to surface-supplied diving (practical, classroom, and open water) will follow UCSC's surface-supplied diving standards, including additions listed in Sections 7.31 and 7.32.

7.40 SCIENTIFIC NITROX DIVING REGULATIONS

7.41 Dive Personnel Requirements

A. Nitrox Diver In Training

A Diver In Training, who has completed the requirements of Section 4.00 and the training and authorization sections of these guidelines, may be authorized by the DSO to use nitrox under the direct supervision of a Scientific Diver who also holds nitrox authorization. Dive depths shall be restricted to those specified in the diver's authorization.

B. Scientific Diver

A Scientific Diver, who has completed the requirements of Section 5.00 and the training and authorization sections of these guidelines, may be authorized by the DSO to use nitrox. Depth authorization to use nitrox shall be the same as those specified in the diver's authorization, as described in Section 5.40.

C. Lead Diver

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

In addition to responsibilities listed in Section 1.26, the Lead Diver shall:

1. As part of the dive planning process, verify that all divers using nitrox on a dive are properly qualified and authorized.
2. As part of the pre-dive procedures, confirm with each diver the nitrox mixture the diver is using, and establish dive team maximum depth and time limits according to the shortest time limit or shallowest depth limit among the team members.
3. The Lead Diver shall also reduce the maximum allowable pO₂ exposure limit for the dive team if on-site conditions so indicate (see Section 7.42.A).

7.42 Dive Parameters

A. Oxygen Exposure Limits

1. The inspired oxygen partial pressure experienced at depth shall not exceed 1.40 ATA. At safety stops and decompression stops oxygen partial pressure shall not exceed 1.60 ATA. All dives performed using nitrox-breathing mixtures shall comply with the current *NOAA Diving Manual* "Oxygen Partial Pressure Limits for 'Normal' Exposures" (table available in the dive locker).
2. The maximum allowable exposure limit shall be reduced in cases where cold or strenuous dive conditions, or extended exposure times are expected. The DCB shall consider this in the review of any dive plan application that proposes to use nitrox. The Lead Diver shall also review on-site conditions and reduce the allowable pO_2 exposure limits if conditions indicate.
3. If using the equivalent air depth (EAD) method, the maximum depth of a dive shall be based on the oxygen partial pressure for the specific nitrox breathing mix used.

B. Bottom Time Limits

1. Maximum bottom time shall be based on the depth of the dive and the nitrox mixture being used.
2. Bottom time for a single dive shall not exceed the NOAA maximum allowable "Single Exposure Limit" for a given oxygen partial pressure, (table available in the dive locker).

C. Decompression Tables and Gases

1. A set of DCB approved nitrox decompression tables shall be available at the dive site.
2. When using the equivalent air depth (EAD) method, dives shall be conducted using air decompression tables approved by the DCB.
3. If nitrox is used to increase the safety margin of air-based dive tables, the MOD and oxygen exposure and time limits for the nitrox mixture being dived shall not be exceeded.
4. Breathing mixtures used while performing in-water decompression, or for bail-out purposes, shall contain the same or greater oxygen content as that being used during the dive, within the confines of depth limitations of Section 7.42.A and the oxygen partial pressure limits set forth in Section 7.42.A.

D. Nitrox Dive Computers

1. Dive Computers may be used to compute decompression status during nitrox dives. Manufacturer guidelines and operations instructions shall be followed.
2. Use of nitrox dive computers shall comply with dive computer guidelines included in the UCSC Standards (Section 3.28 B).
3. Nitrox dive computer users shall demonstrate a clear understanding of the display, operations, and manipulation of the unit being used for nitrox diving prior to using the computer, to the satisfaction of the DSO or his/her designee.
4. If nitrox is used to increase the safety margin of an air-based dive computer, the MOD and oxygen exposure and time limits for the nitrox mixture being dived shall not be exceeded.
5. Dive computers capable of pO_2 limit and fO_2 adjustment shall be checked by the diver prior to the start of each dive to ensure compatibility with the mix being used.

E. Repetitive Diving

1. Repetitive dives using nitrox mixtures shall be performed in compliance with procedures required of the specific dive tables used.
2. Residual nitrogen time shall be based on the EAD for the specific nitrox mixture to be used on the repetitive dive, and not that of the previous dive.
3. The total cumulative exposure (bottom time) to a partial pressure of oxygen in a given 24 hour period shall not exceed the current *NOAA Diving Manual* 24-hour Oxygen Partial Pressure Limits for "Normal Exposures" (table available in the dive locker).
4. When repetitive dives expose divers to different oxygen partial pressures from dive to dive, divers shall account for accumulated oxygen exposure from previous dives when determining acceptable exposures for repetitive dives. Both acute (CNS) and chronic (pulmonary) oxygen toxicity concerns shall be addressed.

F. Oxygen Parameters

1. Authorized Mixtures - Mixtures meeting the criteria outlined in Section 7.42.A may be used for nitrox diving operations, upon approval of the DCB.
2. Purity
 - a) Oxygen used for mixing nitrox breathing gas shall meet the purity levels for "Medical Grade" (U.S.P.) or "Aviator Grade" standards.
 - b) In addition to the AAUS Air Purity Guidelines (AAUS Section 3.60), the following standard shall be met for breathing air that is either
 - 1) Placed in contact with oxygen concentrations greater than 40%, or
 - 2) Used in nitrox production by the partial pressure mixing method with gas mixtures containing greater than 40% oxygen as the enriching agent:

Air Purity:

CGA Grade E (AAUS Sec. 3.60) AND

Total Volatile Hydrocarbons <math>< 5\text{mg}/\text{m}^3</math>

Total Hydrocarbon Contaminants (TCH): <math>< 0.1\text{ mg}/\text{m}^3</math>

G. Gas Mixing and Analysis for UCSC Fill Stations

1. Personnel Requirements
 - a) Individuals responsible for producing and/or analyzing nitrox mixtures shall be knowledgeable and experienced in all aspects of the technique.
 - b) Only those individuals approved by the DSO or his/her designee shall be responsible for mixing and/or analyzing nitrox mixtures.
2. Production Methods - It is the responsibility of the DCB to approve the specific nitrox production method used.
3. Analysis Verification by User
 - a) It is the responsibility of each diver to analyze prior to the dive the oxygen content of his/her scuba cylinder and acknowledge in writing the following information for each cylinder: $f\text{O}_2$, MOD, cylinder pressure, date of analysis, and user's name.

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

7.50 NITROX DIVING EQUIPMENT

All of the designated equipment and stated requirements regarding scuba equipment required in the Standards shall apply to nitrox scuba operations. Minimum equipment necessary for nitrox diving operations includes: labeled SCUBA Cylinders and oxygen analyzers.

7.51 Oxygen Cleaning and Maintenance Requirements

A. Requirement for Oxygen Service

1. All equipment, which during the dive or cylinder filling process is exposed to concentrations greater than 40% oxygen at pressures above 150 psi, shall be cleaned and maintained for oxygen service.
2. This shall include the following equipment: scuba cylinders, cylinder valves, scuba and other regulators, cylinder pressure gauges, hoses, diver support equipment, compressors, and fill station components and plumbing.

B. Scuba Cylinder Identification Marking

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

1. Cylinders shall be marked "NITROX", or "EANx", or "Enriched Air".
2. Other markings that identify the cylinder as containing gas mixes other than air may be used only with the approval of the DCB.
3. A contents label shall be affixed, to include the current fO_2 , date of analysis, and MOD.
4. The cylinder shall be labeled to indicate whether the cylinder is prepared for oxygen or nitrox mixtures containing greater than 40% oxygen.

C. Regulators

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

D. Other Support Equipment

1. An oxygen analyzer is required which is capable of determining the oxygen content in the scuba cylinder. Two analyzers are recommended to reduce the likelihood of errors due to a faulty analyzer. The analyzer shall be capable of reading a scale of 0 to 100% oxygen, within (one) 1% accuracy.
2. All diver and support equipment shall be suitable for the fO_2 being used.

E. Compressor system

1. The compressor/filtration system must produce oil-free air.
2. An oil-lubricated compressor placed in service for a nitrox system shall be checked for oil and hydrocarbon contamination at least quarterly.

F. Fill Station Components

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

SECTION 8.00 AQUARIUM DIVING OPERATIONS

8.10 GENERAL POLICY

This Section 8.00 applies to scientific aquarium divers only.

Definition - A scientific aquarium diver is a diver who has at least met the entry level scientific diving training requirements (as defined in section 4.00) and has undergone specific aquarium diving orientation and who is diving solely within an aquarium. An aquarium is a shallow, confined body of water, which is operated by or under the control of an institution and is used for the purposes of specimen exhibit, education, husbandry, or research.

It is recognized that within scientific aquarium diving there are environments and equipment that fall outside the scope of those addressed in this manual. In those circumstances it is the responsibility of the Diving Control Board to establish the requirements and protocol under which diving will be safely conducted.

Note: All of the standards set forth in other sections of this manual shall apply, except as otherwise provided in this Section 8.00.

8.20 THE BUDDY SYSTEM IN SCIENTIFIC AQUARIUM DIVING

All scuba diving activities in the confined environment of an aquarium shall be conducted in accordance with the buddy system, whereby both divers, or a diver and a tender as provided below, are always in visual contact with one another, can always communicate with one another, and can always render prompt and effective assistance either in response to an emergency or to prevent an emergency.

A diver and tender comprise a buddy team in the confined environment of an aquarium only when the maximum depth does not exceed 30 feet, and there are no overhead obstructions or entanglement hazards for the diver, and the tender is equipped, ready and able to conduct or direct a prompt and effective in-water retrieval of the diver at all times during the dive.

8.30 DIVING EQUIPMENT

Section 3.27 of this manual is modified to read as follows:

In an aquarium of a known maximum obtainable depth:

- A. A depth indicator is not required, except that a repetitive diver shall use the same computer used on any prior dive.
- B. Only one buddy must be equipped with a timing device.
- C. The maximum obtainable depth of the aquarium shall be used as the diving depth.

8.40 SCIENTIFIC AQUARIUM DIVER CERTIFICATION

Scientific Aquarium Diver

A Scientific Aquarium Diver is a certification enabling the qualified diver to participate in scientific diving in accordance with the standards of this Section 8.00 as provided below. All of the standards set forth in sections 4.00 and 5.00 of this manual shall apply, except that Section 5.32.2 of this manual is modified to read as follows: Practical training shall include at least 12 supervised aquarium dives for a cumulative bottom time of 6 hours. No more than 3 of these dives shall be made in one day.

8.50 SCIENTIFIC AQUARIUM DIVING USING OTHER DIVING TECHNOLOGY

8.51 Surface Supplied Scientific Aquarium Diving

Definition: For purposes of scientific aquarium diving, surface supplied diving is described as a mode of diving using open circuit, surface supplied compressed gas which is provided to the diver at the dive location and may or may not include voice communication with the surface tender.

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

Scientific aquarium divers using conventional scuba masks, full-face masks or non-lockdown type helmets are exempt from this standard provided:

1. There are no overhead obstructions or entanglements, and
2. The diver is proficient in performing a Controlled Emergency Swimming Ascent from at least as deep as the maximum depth of the aquarium, and
3. The diver is proficient in performing out of air emergency drills, including ascent and mask/helmet removal.

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

Scientific aquarium divers are exempt from this standard, provided the tender is monitoring only one air source, there is mutual assistance between divers and there are no overhead obstructions or entanglements.

C. Divers using the surface supplied mode shall maintain communication with the surface tender. The surface supplied breathing gas supply (volume and intermediate pressure) shall be sufficient to support all surface supplied divers in the water for the duration of the planned dive.

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

Scientific aquarium divers are exempt from this standard, provided the tender is equipped, ready and able to conduct a prompt and effective in-water retrieval of the diver at all times during the dive.

E. Surface supplied equipment must be configured to allow retrieval of the diver by the surface tender without risk of interrupting air supply to the diver.

F. All surface supplied applications used for scientific aquarium diving shall have a non-return valve at the attachment point between helmet or mask hose, which shall close readily and positively.

SECTION 9.00 REBREATHERS

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

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

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

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

No diver shall conduct planned operations using rebreathers without prior review and approval. In all cases, trainers shall be qualified for the type of instruction to be provided. Training shall be conducted by agencies or instructors approved by DSO and DCB.

9.10 DEFINITIONS AND GENERAL INFORMATION

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

life support systems, in that the breathing gas composition is dynamic rather than static.

1. Advantages of rebreathers may include increased gas utilization efficiencies that are often independent of depth, extended no-decompression bottom times and greater decompression efficiency, and reduction or elimination of exhaust bubbles that may disturb aquatic life or sensitive environments.
2. Disadvantages of rebreathers include high cost and, in some cases, a high degree of system complexity and reliance on instrumentation for gas composition control and monitoring, which may fail. The diver is more likely to experience hazardous levels of hypoxia, hyperoxia, or hypercapnia, due to user error or equipment malfunction, conditions which may lead to underwater blackout and drowning. Inadvertent flooding of the breathing loop and wetting of the carbon dioxide absorbent may expose the diver to ingestion of an alkaline slurry ("caustic cocktail").
3. An increased level of discipline and attention to rebreather system status by the diver is required for safe operation, with a greater need for self-reliance. Rebreather system design and operation varies significantly between make and model. For these reasons when evaluating any dive plan incorporating rebreathers, risk-management emphasis should be placed on the individual qualifications of the diver on the specific rebreather make and model to be used, in addition to specific equipment requirements and associated operational protocols.

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

C. Semi-Closed Circuit Rebreathers. Semi-closed circuit rebreathers (SCR) recycle the majority of exhaled breathing gas, venting a portion into the water and replenishing it with a constant or variable amount of a single oxygen-enriched gas mixture. Gas addition and venting is balanced against diver metabolism to maintain safe oxygen levels by means which differ between SCR models, but the mechanism usually provides a semi constant fraction of oxygen (FO₂) in the breathing loop at all depths, similar to open circuit SCUBA.

D. Closed-Circuit Mixed Gas Rebreathers. Closed circuit mixed gas rebreathers (CCR) recycle all of the exhaled gas and replace metabolized oxygen via an electronically controlled valve, governed by electronic oxygen sensors. Manual oxygen addition is available as a diver override, in case of electronic system failure. A separate inert gas source (diluent), usually containing primarily air, heliox, or trimix, is used to maintain oxygen levels at safe levels when diving below 20fsw. CCR systems operate to maintain a constant oxygen partial pressure (PPO₂) during the dive, regardless of depth.

9.20 PREREQUISITES

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

9.21 Training Prerequisites

- A. Active scientific diver status, with depth qualification sufficient for the type, make, and model of rebreather, and planned application.
- B. Completion of a minimum of 50 open-water dives on SCUBA.

C. For SCR or CCR, a minimum 100-fsw-depth qualification is generally recommended, to ensure the diver is sufficiently conversant with the complications of deeper diving. If the sole expected application for use of rebreathers is shallower than this, a lesser depth qualification may be allowed with the approval of the DCB.

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

9.22 Training

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

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

B. Classroom training shall include:

1. A review of those topics of diving physics and physiology, decompression management, and dive planning included in prior scientific diver, nitrox, staged decompression and/or mixed gas training, as they pertain to the safe operation of the selected rebreather system and planned diving application.
2. In particular, causes, signs and symptoms, first aid, treatment and prevention of the following must be covered:
 - Hyperoxia (CNS and Pulmonary Oxygen Toxicity)
 - Middle Ear Oxygen Absorption Syndrome (oxygen ear)
 - Hyperoxia-induced myopia
 - Hypoxia
 - Hypercapnia
 - Inert gas narcosis
 - Decompression sickness
3. Rebreather-specific information required for the safe and effective operation of the system to be used, including:
 - System design and operation, including:
 - Counter lung(s)
 - CO₂ scrubber
 - CO₂ absorbent material types, activity characteristics, storage, handling and disposal
 - Oxygen control system design, automatic and manual
 - Diluent control system, automatic and manual (if any)
 - Pre-dive set-up and testing
 - Post-dive breakdown and maintenance
 - Oxygen exposure management
 - Decompression management and applicable decompression tracking methods
 - Dive operations planning
 - Problem recognition and management, including system failures leading to hypoxia, hyperoxia, hypercapnia, flooded loop, and caustic cocktail
 - Emergency protocols and bailout procedures

9.23 Practical Training (with model of rebreather to be used)

A. Minimum number of hours of underwater time.

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

* Dives should not exceed 20 fsw.

** First two dives should not exceed 60 fsw. Subsequent dives should be at progressively greater depths, with at least one dive in the 80 to 100 fsw range.

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

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

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

9.24 Practical Evaluations

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

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

9.25 Written Evaluation

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

9.26 Supervised Rebreather Dives

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

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

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

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

* Dives should not exceed 20 fsw.

** First two dives should not exceed 60 fsw. Subsequent dives should be at progressively greater depths, with at least one dive in the 80 to 100 fsw range.

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

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

9.27 Extended Range, Required Decompression and Helium-Based Inert Gas

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

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

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

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

9.28 Maintenance of Proficiency

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

B. For a diver in arrears, the DCB shall approve a program of remedial knowledge and skill tune-up training and a course of dives required to return the diver to full authorization.

The extent of this program should be directly related to the complexity of the planned rebreather diving operations.

9.30 EQUIPMENT REQUIREMENTS

9.31 General Requirements

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

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

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

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

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

- Operational depth range
- Operational temperature range
- Breathing gas mixtures that may be used
- Maximum exercise level that can be supported as a function of breathing gas and depth
- Breathing gas supply duration's as a function of exercise level and depth
- CO₂ absorbent duration's, as a function of depth, exercise level, breathing gas, and water temperature
- Method, range and precision of inspired PPO₂ control, as a function of depth, exercise level, breathing gas, and temperature
- Likely failure modes and backup or redundant systems designed to protect the diver if such failures occur
- Accuracy and precision of all readouts and sensors
- Battery duration as a function of depth and temperature
- Mean time between failures of each subsystem and method of determination

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

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

9.32 Minimum Equipment

- A. A surface/dive valve in the mouthpiece assembly, allowing sealing of the breathing loop from the external environment when not in use.
- B. An automatic gas addition valve, so that manual volumetric compensation during descent is unnecessary.
- C. Manual gas addition valves, so that manual volumetric compensation during descent and manual oxygen addition at all times during the dive are possible.
- D. The diver shall carry alternate life support capability (open-circuit bail-out or redundant rebreather) sufficient to allow the solution of minor problems and allow reliable access to a pre-planned alternate life support system.

9.33 Oxygen Rebreathers

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

9.34 Semi-Closed Circuit Rebreathers

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

9.35 Closed Circuit Mixed-gas Rebreathers

- A. CCR shall incorporate a minimum of three independent oxygen sensors.
- B. A minimum of two independent displays of oxygen sensor readings shall be available to the diver.
- C. Two independent power supplies in the rebreather design are desirable. If only one is present, a secondary system to monitor oxygen levels without power from the primary battery must be incorporated.
- D. CCR shall be equipped with manual diluent and oxygen addition valves, to enable the diver to maintain safe oxygen levels in the event of failure of the primary power supply or automatic gas addition systems.
- E. Redundancies in onboard electronics, power supplies, and life support systems are highly desirable.

9.40 OPERATIONAL REQUIREMENTS

9.41 General Requirements

- A. All dives involving rebreathers must comply with applicable operational requirements for open-circuit SCUBA dives to equivalent depths.
- B. No rebreather system should be used in situations beyond the manufacturer's stated design limits (dive depth, duration, water temperature, etc).
- C. Modifications to rebreather systems shall be in compliance with manufacturer's recommendations.
- D. Rebreather maintenance is to be in compliance with manufacturer's recommendations

including sanitizing, replacement of consumables (sensors, CO₂ absorbent, gas, batteries, etc) and periodic maintenance.

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

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

9.42 Buddy Qualifications

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

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

9.43 Oxygen Exposures

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

B. Planned oxygen partial pressure set point for CCR shall not exceed 1.4 atm. Set point at depth should be reduced to manage oxygen toxicity according to the (Oxygen Exposure Limits (table available in the dive locker).

C. Oxygen exposures should not exceed the oxygen single and daily exposure limits (table available in the dive locker). Both CNS and pulmonary (whole-body) oxygen exposure indices should be tracked for each diver.

9.44 Decompression Management

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

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

1. Oxygen rebreathers: Not applicable.

2. SCR (presumed constant FO₂):

- Use of any method approved for open-circuit scuba diving breathing air, above the maximum operational depth of the supply gas.
- Use of open-circuit nitrox dive tables based upon expected inspired FO₂. In this case, contingency air dive tables may be necessary for active addition SCR's in the event that exertion level is higher than expected.
- Equivalent air depth correction to open-circuit air dive tables, based upon expected inspired FO₂ for planned exertion level, gas supply rate, and gas composition. In this case, contingency air dive tables may be necessary

for active-addition SCR's in the event that exertion level is higher than expected.

3. CCR (constant PPO2):

- Integrated constant PPO2 dive computer.
- Non-integrated constant PPO2 dive computer.
- Constant PPO2 dive tables.
- Open-circuit (constant FO2) nitrox dive computer, set to inspired FO2 predicted using PPO2 set point at the maximum planned dive depth.
- Equivalent air depth (EAD) correction to standard open-circuit air dive tables, based on the inspired FO2 predicted using the PPO2 set point at the maximum planned dive depth.
- Air dive computer, or air dive tables used above the maximum operating depth (MOD) of air for the PPO2 set point selected.

9.45 Equipment Logs and Pre-Dive Checks

A. Maintenance Logs, CO2 Scrubber Logs, Battery Logs, and Pre-And Post-Dive Checklists will be developed for the rebreather used, and will be used before and after every dive. Diver shall indicate by initialing that checklists have been completed before and after each dive. Such documents shall be filed and maintained as permanent project records.

B. No rebreather shall be dived which has failed any portion of the pre-dive check, or is found to not be operating in accordance with manufacturer's specifications. Pre-dive checks shall include:

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

9.46 Alternate Life Support System

The diver shall have reliable access to an alternate life support system designed to safely return the diver to the surface at normal ascent rates, including any required decompression in the event of primary rebreather failure. The complexity and extent of such systems are directly related to the depth/time profiles of the mission. Examples of such systems include, but are not limited to:

- A. Open-circuit bailout cylinders or sets of cylinders, either carried or pre-positioned
- B. Redundant rebreather

C. Pre-positioned life support equipment with topside support

9.47 CO2 Absorbent Material

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

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

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

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

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

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

9.49 Unit Disinfecting

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

9.50 OXYGEN REBREATHERS

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

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

9.60 SEMI-CLOSED CIRCUIT REBREATHERS

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

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

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

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

E. Prior to ascent to the surface the diver shall flush the breathing loop with fresh gas or switch to an open-circuit system to avoid hypoxia. The flush should be at a depth of approximately 30 fsw during ascent on dives deeper than 30 fsw, and at bottom depth on dives 30 fsw and shallower.

9.70 CLOSED CIRCUIT REBREATHERS

- A. The FO₂ of each diluent gas supply used shall be chosen so that, if breathed directly while in the depth range for which its use is intended, it will produce an inspired PPO₂ greater than 0.20 atm but no greater than 1.4 atm.
- B. Maximum operating depth shall be based on the FO₂ of the diluent in use during each phase of the dive, so as not to exceed a PO₂ limit of 1.4 atm.
- C. Divers shall monitor both primary and secondary oxygen display systems at regular intervals throughout the dive, to verify that readings are within limits, that redundant displays are providing similar values, and whether readings are dynamic or static (as an indicator of sensor failure).
- D. The PPO₂ set point shall not be lower than 0.4 atm or higher than 1.4 atm.

SECTION 10.00 OTHER DIVING TECHNOLOGY

Certain types of diving, some of which are listed below, may include equipment and/or procedures, which require supplemental training. Guidelines for these technologies are in development by the AAUS. UCSC divers using these technologies must follow the guidelines established by the DCB. Divers shall comply with all SCUBA diving procedures in this manual unless specified otherwise.

10.10 BLUE WATER DIVING

No diver shall plan or conduct blue water dives without prior approval of the DCB or their designee. Blue water diving is defined as diving in open water where the bottom is generally >200 feet deep. It requires special training and the use of multiple-tethered diving techniques. Specific guidelines that should be followed are outlined in "Scientific Blue-Water Diving" (California Sea Grant Publ. No. T-057, ISBN 1-888691-13-1, 2005).

10.20 ICE AND POLAR DIVING

No diver shall plan or conduct ice or polar dives without prior approval of the DCB or their designee. Divers planning to dive under ice or in polar conditions should use the following: "Antarctic Scientific Diving Manual", National Science Foundation, Office of Polar Programs, 1994.

10.30 OVERHEAD ENVIRONMENTS

No diver shall plan or conduct dives within overhead environments without prior approval of the DCB or their designee. 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.

10.40 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. No diver shall plan or conduct staged decompression dives without prior approval of the DCB or their designee.

10.50 HOOKAH

While similar to Surface Supplied in that the breathing gas is supplied from the surface by means of a pressurized hose, the supply hose does not require a strength member, pneumofathometer hose, or communication line. Hookah equipment may be as simple as a long hose attached to a standard scuba cylinder supplying a standard scuba second stage. If a scuba second stage is not being used to supply the breathing gas, then a non-return valve must be part of the system. The diver is responsible for the monitoring his/her own depth, time, and diving profile.

No diver shall plan or conduct hookah dives without prior approval of the DCB or their designee.

- A. Divers using the hookah mode shall be equipped with a diver-carried independent reserve breathing gas supply.
- B. Each hookah diver shall be hose-tended by a separate dive team member while in the water.

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.

10.60 SURFACE SUPPLIED DIVING

Dives where the breathing gas is supplied from the surface by means of a pressurized umbilical hose. The umbilical generally consists of a gas supply hose, strength member, pneumofathometer hose, and communication line. The umbilical supplies a helmet or full-face mask. The diver may rely on the tender at the surface to keep up with the divers' depth, time and diving profile.

Surface supplied divers shall comply with all scuba diving procedures in this manual (except Section 2.31). All masks and helmets must comply with Section 3.22. Surface supplied diving shall not be conducted at depths greater than 190 fsw (58 msw). No diver shall plan or conduct surface supplied dives without prior approval of the DCB or their designee.

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

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

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

D. 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.

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

10.70 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. No diver shall plan or conduct mixed gas dives without prior approval of the DCB.

10.80 DRY SUIT DIVING

All UCSC divers diving with drysuits under the auspices of UCSC must demonstrate proficiency to the DSO or his or her designee before diving with a drysuit without supervision.

10.90 DIVE COMPUTERS

All UCSC divers using dive computers while diving under the auspices of UCSC shall have a dive computer waiver on file. Maximum time allowed at depth as displayed by the computer shall not be less than 10 minutes.

10.100 ALTITUDE DIVING

Divers planning to dive at sites with elevations greater than 700 meters must have specialized training (see NOAA Dive Manual, Chapter 10 - manual available in DSP office) and prior approval of the DCB or their designee.

10.110 SCIENTIFIC SKIN DIVING

Divers planning to use Skin Diving as their mode of data collection must have prior approval of the DCB or their designee and must follow the guidelines in Appendix 3.

APPENDIX 1 DEFINITION OF TERMS

Air sharing - The sharing of an air supply between divers.

ATA(s) - Abbreviation for "Atmospheres Absolute", defines as the total pressure exerted on an object, by a gas or mixture of gases, at a specific depth or elevation, including normal atmospheric pressure.

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 reaches the surface upon ascent. **Includes** precautionary decompression time ("safety stop").

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

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

Buddy Diver - Second member of the dive team.

Buddy system - Two comparably equipped scuba divers in the water in constant communication.

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

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

Certified Diver - A diver who holds a recognized valid certification from UCSC or a recognized training agency.

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

Cylinder - A pressure vessel for the storage of gases.

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

Decompression Sickness - A condition with a variety of symptoms, which may result from gas, and bubbles in the tissues of divers after pressure reduction.

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 or exposures. (Also called dive tables.)

Dive - A descent into the water, an underwater diving activity utilizing compressed gas, an ascent, and return to the surface.

Dive Computer - A microprocessor based device which computes a diver's theoretical decompression status, in real time, by using pressure(depth) and time as input to a decompression model, or set of decompression tables, programmed into the device.

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

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

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

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

Diver-Carried Reserve Breathing Gas - A diver-carried independent supply of air or mixed gas (as appropriate) sufficient under standard operating conditions to allow the diver to reach the surface, or another source of breathing gas, or to be reached by another diver.

Diving Mode - A type of diving requiring specific equipment, procedures, and techniques; for example, snorkel, scuba, surface-supplied air, or mixed gas.

Diving Control Board (DCB) - The group of individuals who act as the official representative of the membership organization in matters concerning the scientific diving program (see Section 1.24).

Diving Safety Officer (DSO) - The individual responsible for the safe conduct of the scientific diving program of the membership organization (see Section 1.23).

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

Enriched Air (EANx) - a name for a breathing mixture of air and oxygen when the percent of oxygen exceeds 22%. This term is considered synonymous with the term "nitrox".

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

fN₂ - fraction of nitrogen in a gas mixture, expressed as either a decimal or percentage, by volume.

fO₂ - fraction of oxygen in a gas mixture, expressed as either a decimal or percentage, by volume.

FSW - Feet of seawater, or equivalent static head.

Hookah Diving - A type of shallow water surface-supplied diving where there is no voice communication with the surface.

Hyperbaric Chamber - See decompression chamber.

Hyperbaric Conditions - Pressure conditions in excess of normal atmospheric pressure at the dive location.

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

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, which adheres to the standards of the AAUS as, set forth in the AAUS Standards for Scientific Diving Certification and Operation of Scientific Diving Programs.

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

MOD - Maximum Operating Depth, usually determined as the depth at which the pO₂ for a given gas mixture reaches a predetermined maximum.

MSW - Meters of seawater or equivalent static head.

Nitrox - Any gas mixture comprised predominately of nitrogen and oxygen, most frequently containing between 22% and 40% oxygen. Also be referred to as Enriched Air Nitrox, abbreviated EAN_x.

NOAA Diving Manual - refers to the *NOAA Diving Manual, Diving for Science and Technology*, fourth edition, 2001. National Oceanic and Atmospheric Administration, Office of Undersea Research, US Department of Commerce.

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 prescribed by the decompression strategy being used (generally 30 feet per minute or less).

Oxygen Clean - All combustible contaminants have been removed.

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

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

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

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

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

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 - Abbreviation for the unit of pressure, "pounds per square inch".

psig - pounds per square inch gauge.

Recompression Chamber - see decompression chamber.

Safety Stop – a recommended interruption of each ascent from depths greater than thirty feet, so as to stop for 3 to 5 minutes at a depth of 10 to 15 feet. A typical safety stop is 3 minutes at 15 feet.

Scientific Diving - 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.

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

Skin Diving – A diving mode in which the diver uses breath-holding as the sole means to make excursions below the water’s surface.

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

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

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

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.

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

APPENDIX 2
UCSC/AAUS REQUEST FOR DIVING RECIPROCITY
VERIFICATION OF DIVER TRAINING AND EXPERIENCE

A scientific diver that is currently certified under the auspices of an organizational member institution of the American Academy of Underwater Sciences (AAUS) shall be recognized by any other organizational member of AAUS and may apply for reciprocity in order to dive with the host organization. Organizational members that are in good standing with AAUS operate, at a minimum, under the AAUS Standards for Scientific Diving Certification and Operation of Scientific Diving Programs (2006 edition). The visiting diver will comply with the diving regulations of the host organization's Diving Safety Manual unless previously arranged by both organizations' DCB's.

The host organization has the right to approve or deny this request and may require, at a minimum, a checkout dive with the Diving Safety Officer (DSO) or designee of the host organization. If the request is denied, the host organization should notify the 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 of Request:
Institution:		Other Certifications
Research Site:		Nitrox
Investigator:		Dry Suit
Event	Date	Closed Circuit
Medical Exam Expiration		Blue Water
Scientific Diving Certification		Altitude
Equipment Inspection Expiration		Decompression
CPR Training Expiration		Cave
Oxygen Administration Expiration		Ice/Polar
First Aid Training Expiration		Instructor
Rescue Certification		Divemaster
Last logged dive		Dive Accident Management
Number of dives within 12 mos.		EMT
Depth certification	fsw	Mixed Gas
DAN# / Insurance Level		Chamber Crew

Any restrictions to diving? (Y/N)		If yes, explain:

Person to Notify in an Emergency:	Home Phone:	Work Phone:
Relationship:		

Note: This document is only valid if signed below, by the Diving Safety Officer.

This is to verify that the above individual is currently a certified scientific diver at University of California Santa Cruz and that UC Santa Cruz is an organizational member of AAUS. If you have questions about this diver or the information provided, please contact me.

Diving Safety Officer:	Date:
Steve Clabuesch	(valid until December 31, yyyy)

APPENDIX 3 GUIDELINES FOR SCIENTIFIC SKIN DIVERS

1. Must be current in CPR, First Aid and Oxygen Administration.
2. Must have a current UCSC Sports physical.
3. If not certified as a SCUBA diver, individual must attain a Skin Diving certification from a nationally recognized certifying organization.
4. All Skin Diver candidates may be asked to pass a confined water swimming and snorkeling evaluation consisting of:

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

Swim 450 yards in less than 12 minutes without swim aids.

Tread water for 10 minutes without swim aids.

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

Swim 900 yards in less than 20 minutes in full skin diving gear using only fin kicks.

Swim 50 yards underwater in full skin diving gear, surfacing only twice for breaths.

Perform a surface rescue on an unconscious skin diver, which includes transporting while performing rescue breathing.

Perform a weight belt ditch and recovery in at least 8 feet of water.

Perform a skin ditch and recovery in at least 8 feet of water.

5. All Skin Diver candidates may be asked to perform each of the below skills in confined water:

Enter and exit water with full equipment both from a simulated shore and vessel.

Clear facemask and snorkel.

Demonstrate understanding of hand signals.

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

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

Demonstrate self-rescue and buddy assist techniques.

Perform at least 3 different surface dives.

Demonstrate waterman ship ability, which is acceptable to the instructor.

6. All Skin Diver candidates may be asked to pass a written examination covering the below topics:

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

Physics and physiology involved in Free Diving.

Planning and supervision of diving operations.

GUIDELINES FOR SCIENTIFIC SKIN DIVERS cont.

Diving regulations and precautions.

Near-shore currents and waves.

Dangerous marine animals.

Emergency procedures.

Skin Diving hazards.

Hand signals.

Cause, symptoms, treatment, and prevention of the following: near drowning, carbon dioxide excess, squeezes, exhaustion and panic, respiratory fatigue, motion sickness, hypothermia, hyperthermia and hypoxia/anoxia.

7. All Skin Divers may be asked to perform the below listed skills in open water:

Surface dive to a depth of at least 10 feet in open water once to ditch the weight belt and the second time to recover and replace it.

Enter and leave open water fully suited from the shore and a vessel.

Kick on the surface 650 yards while fully suited as a skin diver using only fin kicks.

Demonstrate judgment adequate for safe diving including safely planning and executing a dive.

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

Demonstrate clearing of mask and snorkel.

Demonstrate ability to perform 3 different surface dives.

Demonstrate techniques of self-rescue and buddy rescue, performing a complete rescue of an unconscious diver.

Swim underwater at least 25 yards on one breath.

Demonstrate the ability to remove and replace all skin diving gear on the surface.

Dive to a depth of at least 10 feet three times to retrieve an object from the bottom.

APPENDIX 4
UCSC DIVING PROGRAM EMERGENCY TELEPHONE NUMBERS

IN ANY EMERGENCY, THE CORRECT PROCEDURE IS TO CALL 911. THE FOLLOWING IS SUPPLEMENTARY INFORMATION ONLY. IT IS SUBJECT TO CHANGE SO PLEASE CHECK EACH INSTITUTION'S WEBSITE PRIOR TO FILLING OUT YOUR PROJECT PROPOSAL.

Emergency Personnel University of California Santa Cruz

Diving Safety Officer	DSP Office	(831) 459-4286
Recreational Diving Program	OPERS Office	(831) 459-4518
Drew Malloy MD, UCSC Medical Director	Business	(831) 459-2869 Mon-Fri, 8a-5p

Other References

<u>Divers Alert Network (DAN)</u>	Emergency	(919) 684-9111
	Nonemergency	(919) 684-2948
<u>Community Hospital of the Monterey Peninsula (CHOMP)</u> 23625 WR Holman Highway, Monterey	Emergency	(831) 625-4900
<u>Dominican Hospital</u> 1555 Soquel Dr., Santa Cruz	Emergency	(831) 462-7710
<u>Catalina Hyperbaric Chamber</u>	Emergency	(310) 510-1053
	Business	(310) 510-4020
<u>LA CO/USC Med. Alert Center</u>	Emergency	(866) 940-4401
<u>Northridge Med Center</u>	Emergency	(818) 885-5396
<u>Doctors Medical Center</u> East Bay Area, San Pablo only Paul Cianci MD, Med. Supervisor Ben Slade MD	Emergency	(510) 970-5430 7 days 8a-5p
<u>John Muir Medical Center</u> Walnut Creek	Emergency	(925) 939-5800
<u>Saint Francis Hospital</u> San Francisco	Emergency	(415) 353-6300

**APPENDIX 5
DIVING EMERGENCY MANAGEMENT PROCEDURES**

Introduction

A diving accident victim could be any person who has been breathing air underwater regardless of depth. It is essential that emergency procedures are pre-planned and that medical treatment is initiated as soon as possible. As part of each UCSC Diving Project proposal, procedures for diving emergencies, including evacuation and medical treatment for each dive location, will be described in detail and approved by the Diving Safety Officer.

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 or rescue as required.**
- 2. Establish (A)irway, (B)reathing, (C)irculation as required.**
- 3. Administer 100% oxygen, if appropriate (in cases of Decompression Illness, or Near Drowning).**
- 4. Call local Emergency Medical System (EMS) for transport to nearest medical treatment facility.**
- 5. Notify DSO or designee according to the Emergency Action Plan of UCSC.**
- 7. Complete and submit Incident Report Form to DSP.**

List of Emergency Contact Numbers Appropriate For Dive Location:

APPENDIX 6
UCSC Diving Incident Report Form

Required Incident Reporting: All diving incidents that interrupt the agreed upon dive plan and/or involve more than on-scene basic first aid. 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 UCSC Diving Control Board must review and release this report before it is submitted to the AAUS Statistics Committee. All injuries/incidents must also be reported to UCSC Risk Services (831-459-1859).

Check all appropriate spaces & complete the form on the backside of this page:

Diving Classification:	Decompression Profile Method:		
Scientific	Dive Tables		
Training / Proficiency	Dive Computer		
	PC Computer Deco Software		
Diving Mode:			
Open Circuit SCUBA	Incident Classification:		
Surface Supplied	Hyperbaric		
Hookah	Simple Barotrauma		
Rebreather	Near Drowning		
	Hyperoxia		
Breathing Gas(s):	Hypoxia		
Air	Hypercapnea		
Nitrox (% gases)	Fatality		
Mixed Gas (% gases)	Other		
Referred to Physician:	Depth Range (ft):		
Yes	0-30	101-130	191-200
No	31-60	131-150	
	61-100	151-190	
Hyperbaric Treatment:			
Yes No	Did this incident involve a workers compensation claim?		
(If Yes, complete & submit DAN form)	Yes	No	

Organizational Member Name: _____

Name & Title of Person Submitting Report: _____

Signature: _____ Date: _____

Mailing Address _____

Telephone/FAX _____

Email _____

PLEASE COMPLETE THE DESCRIPTIVE REPORT ON THE SECOND SHEET

(use additional sheets as needed)

UCSC/AAUS Diving Injury/Incident Report Form NAME: _____

Descriptive Report (use additional sheets if necessary) Date of Incident: _____

Describe the circumstances of the incident and the extent of the injuries or illnesses:

Treatment provided and results:

Recommendations to avoid repetition of this incident:

APPENDIX 7 **PROPHYLACTIC OXYGEN USE**

Any diver wishing to use O2 to flush out nitrogen following a series of dives as a prophylactic measure may do so under the following conditions:

1 - They are not jeopardizing the O2 supply in case there is someone that needs O2 treatment - using all the O2 for prophylactic use and not having any for a potential treatment is not acceptable.

2 - They must report this use to the DSP so that the equipment can be cleaned and O2 bottle(s) refilled.

Using O2 in this way, as long as you are asymptomatic for DCS, does not initiate a treatment sequence resulting in a visit to a medical facility or an ***incident report***.

You should never use O2 to self-diagnose DCS, always consult with the DSP and DAN if you feel you might have symptoms of DCS. It is better to begin O2 therapy and contact the DSP and DAN than to delay use of O2. Not all symptoms seeming to be DCS are DCS and result in treatment, however you should not make this diagnosis on your own. Again consult with the DSP and DAN to make a treatment decision if the symptoms are ambiguous.

"DCS" treatments that do not result in a DCS diagnosis (flu, strained muscle, over-exertion...) will not restrict your diving activities as long as the doctor clears you to dive.

After diving, monitor yourself, hydrate, rest and if there is a question on symptoms please contact the DSP, we are here to help!

APPENDIX 8 **SHARK ACTIVITY RECOMMENDATIONS**

Sharks are part of the environment we work in but rarely do we see evidence of their presence. However there may be times when there is evidence of shark activity at a dive site. If shark activity is apparent at your dive site, it is recommended that diving operations be cancelled for the day. When subsequent diving at the site and in the areas adjacent to the site is necessary, it is advisable to incorporate as many of the recommendations listed below as are operationally possible.

1. All dive plans should be pre-approved by the DSO prior to departure - this can be done by email or verbally. You will need to provide days and location of operations, members of team, shore contact and planned operations.
2. All divers, boat operators and shore contacts should be made aware of the inherent hazards associated with operations during times of shark activity and be especially attentive to surroundings during the operations. Shore contacts should be able to be contacted at anytime during the hours of operations. All vessels need to have at least two means of communicating with the shore contact.
3. All boat operations should have a person on the boat at all times that can render immediate aid (bringing an injured diver into the boat and providing first aid) and should be able to operate all aspects of the vessel. An efficient method of coming aboard the vessel in an emergency should be discussed prior to departure. A first aid kit should be onboard the vessel. Diver recall strategies also should be discussed. Boats should be anchored well into the kelp bed, avoid anchoring in open water.
4. Surface swimming should be minimized, know compass headings back to the anchor line and as a backup, to shore. If the situation dictates a direct ascent to the surface, do not make a safety stop but do ascend as slow as you can but as fast as you need to with your buddy. Be prepared to enter the vessel as quickly as possible, ditching BC and weight belt if necessary.
5. Buddy teams should stay within touching distance at all times, especially on the surface. This "safety in numbers" statistically proves to be effective when reviewing shark attacks on SCUBA divers. Each dive team should carry a surface float that can be deployed to notify the boat driver of their location.
6. Each diver needs to assess the risks of each dive and make their own decision as to their ability to safely complete the assigned dive. Any diver may refuse to make a dive, even if their decision will lead to the cancellation of the day's activities.