



Manual for Diving Safety

Scripps Institution of Oceanography
University of California, San Diego

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FOREWORD

The research diving program at the Scripps Institution of Oceanography, University of California, San Diego (SIO/UCSD) is the oldest of its type in the country. The first non-military class in the U.S. teaching the use of self-contained underwater breathing apparatus (SCUBA) was held by scientists for scientists on the Scripps campus during the summer of 1951.

In 1952, two individuals died using University of California-owned SCUBA equipment. This led to the President's Office restricting diving to those who had been trained through the program at Scripps. A statewide committee was formed to address the problems of training, equipment standards, air purity, physical examinations, recordkeeping, and diver certification.

These committee members were physicians, environmental health and safety specialists, biologists, physicists, engineers, most of whom were themselves divers. Their progress, the increasing availability of diving equipment, and development of training and certification procedures led President Sproul in 1953 to accept the use of research diving as a viable means of conducting academic research within the university. The committee published its first set of "Rules and Regulations" covering the use of diving in 1954. This manual represents the 2011 revision of that document. It should also be noted that in 1953 Los Angeles County sent three individuals to Scripps for diver training. This trio then developed the Los Angeles Underwater Instructors Program, the oldest such instructor certification program in the U.S.

The university decentralization of the early 1960's led to development, by the Scripps Diving Officer, of programs on each of the other campuses. At the request of the President's Office, the Diving Officer also developed the first "University Guide for Diving Safety." This document, first published in March 1967, allows reciprocity between the various campuses.

The safety record of research diving within the university is an enviable one and is the product of continued monitoring by the campus diving authorities.

In November 1982, scientific diving was exempted from the OSHA Commercial Diving Standard based upon the documented history of self regulation in the scientific community. The following is taken from the State of California General Industry Safety Orders [Title 8 Article 152] and the Federal Occupational Safety and Health Administration's (OSHA) Standards for Commercial Diving Operations [29 CFR Part 1910, Subpart T] noting the specific exception and necessary requirements for that exception.

Scientific diving is defined (29 CFR Part 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.

OSHA has granted an exemption for scientific diving from commercial diving regulations under the following guidelines (Appendix B to CFR 29 Part 1910 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 operations.
- 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 the 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 upon 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 (29 CFR Part 1910.401):
 1. Diving safety manual which includes at a minimum: procedures covering all diving operations specific to the program; procedures for emergency care, including recompression and evacuation; and criteria for diver training and certification.
 2. Diving control (safety) board, with the majority of its members being active divers, which shall at a minimum have the authority to: Approve and monitor diving projects; review and revise the diving safety manual; assure compliance with the manual; certify

the depths to which a diver has been trained; take disciplinary action for unsafe practices; and, assure adherence to the buddy system (a diver is accompanied by and is in continuous contact with another diver in the water) for SCUBA diving.

This manual was modified to comply with the American Academy of Underwater Sciences (AAUS) Standards for Scientific Diving first published in 1987. The AAUS document represents the minimal safety standards for scientific diving at the present state of the art.

The policies, procedures, and standards set forth in this Diving Safety Manual are intended to govern the training and diving operations of all personnel participating in the Scientific Diving Program at the Scripps Institution of Oceanography, University of California, San Diego. It applies to all divers operating under SIO/UCSD auspices, including visiting divers, and to those campus officers responsible for the management and administration of the scientific diving program.

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VOLUME 1: GENERAL POLICY

SECTION 1.00 POLICY ON DIVING

1.10 PURPOSE

1.11 The Diving Safety Program

The purpose of this diving safety program is to insure that all scientific diving under the auspices of the Scripps Institution of Oceanography at the University of California, San Diego (SIO/UCSD) is conducted in a manner most likely to minimize accidental injury or occupational illness, and to set forth standards for training and certification which will allow a working reciprocity between American Academy of Underwater Sciences (AAUS) member organizations.

1.12 The Diving Safety Manual

The purpose of this Diving Safety Manual is to set forth the basic underwater diving safety policy, organization, regulations, and procedures for safety in scientific diving operations for SIO/UCSD.

1.20 SCOPE

1.21 University Auspices

Underwater diving under SIO/UCSD auspices is limited to diving in connection with:

- Employment,
- Research,
- Academic work (instructional), and
- Training and certification for required University diving.

1.22 Training and Certification

Any person diving under SIO/UCSD auspices is required to observe the provisions of this Manual. Diving is not permitted by individuals until they have met the requirements for diving pertinent to the level of the proposed activity.

1.23 Equipment

All diving under SIO/UCSD auspices shall be done with equipment, regardless of ownership, which conforms to the standards set in Section 5.00 of this Manual.

1.24 Diving Rules

The regulations herein shall be observed at all locations, whether or not owned by SIO/UCSD, where diving is carried out under the SIO/UCSD auspices.

1.30 AUTHORITY AND RESPONSIBILITY OF THE CHANCELLOR

Maximum authority and operational responsibility for the conduct of the diving safety program under the auspices of SIO/UCSD is vested in the Chancellor. He/she is responsible for providing surveillance of campus diving activities, interpreting University policies, and developing additional campus policies, regulations and standards consistent with University policies.

1.40 ENVIRONMENT, HEALTH AND SAFETY OFFICE

1.41 Authority

1. The Environment, Health and Safety (EH&S) Office has the authority to suspend diving operations of programs that are considered unsafe.
2. A representative of the Environment, Health and Safety Office shall meet with the Diving Control Board as an ex-officio member.

1.42 Responsibilities

General surveillance over the health and safety aspects of the diving program in accordance with the existing authority delegated under the 1999 statement of "UCSD Health & Safety Policy (PPM 516-1)." (<http://adminrecords.ucsd.edu/ppm/docs/516-1.html>)

1.50 THE DIVING CONTROL BOARD

1.51 Composition

The Diving Control Board (DCB) is an administrative committee, appointed by the Vice Chancellor of Marine Sciences. It shall be composed of experienced scientific divers, a majority being currently active, including the Diving Safety Officer. A representative of EH&S will be an ex-officio member.

1.52 Authority

The DCB shall have autonomous and absolute authority over the SIO/UCSD Scientific Diving Program.

1.53 Responsibilities

The DCB is responsible for setting policy and shall:

1. Approve and monitor diving projects;
2. Review and revise SIO/UCSD, Manual for Diving Safety;
3. Assure compliance with SIO/UCSD, Manual for Diving Safety;
4. Assure compliance with the buddy system for scuba diving;
5. Certify and review the depth to which a SIO/UCSD Scientific Diver has been trained;
6. Review the recommendation of the SIO/UCSD Diving Safety Officer for issue, re-issue, or revocation of SIO/UCSD Scientific Diver certification;
7. Act as a board of inquiry to consider scientific diver-related problems;
8. Take disciplinary action for unsafe diving activities;
9. Suspend diving activities that are considered to be unsafe or unwise;
10. Approve locations where diving may be conducted under SIO/UCSD auspices;
11. Approve new equipment and techniques for use under SIO/UCSD auspices; and
12. Establish and/or approve facilities for the inspection and maintenance of SCUBA and associated equipment.

1.60 THE DIVING SAFETY OFFICER

1.61 Appointment and Qualifications

The Diving Safety Officer (DSO) is appointed by the Chancellor, with the advice of the DCB, and shall:

1. Serve on the DCB;
2. Be trained as a Scientific Diver and certified to a depth equal to the maximum depth for any diver under his/her surveillance; and
3. Be an active underwater instructor from an internationally recognized certifying agency.

1.62 Authority

The DSO shall have the authority to restrict or suspend any diving activity that is in his/her judgment unwise or unsafe. He/she shall inform the campus DCB immediately of any such restrictive actions. The DCB may recommend to the Chancellor that the restriction or suspension be overruled, but such a recommendation should require the approval by vote of a majority of the members of the DCB.

1.63 Duties and Responsibilities

1. Surveillance, coordination, and approval of all institutional diving programs (instructional, scientific, aquarium, etc.) and dive plans with special attention to safety, and to assure the implementation of all applicable campus policies and standards;
2. Evaluation and surveillance of equipment and equipment maintenance programs, including arranging for or conducting tests of breathing gases and the approval and/or certification of all University sources of breathing gases;

3. Supervision of instruction and evaluation of all training programs;
4. Preparation of recommendations for consideration by the DCB, such as changes in or additions to SIO/UCSD policy, standards, and regulations to promote diving safety and efficiency; changes in training programs; locations for SIO/UCSD sponsored diving programs; new equipment; and individuals or organizations qualified to inspect equipment;
5. Operation and conduct of the SIO/UCSD scientific diving program, although guided in the performance of these duties by the advice of the DCB;
6. Suspension of diving operations which he/she considers to be unsafe or unwise; and
7. Custody and audit of all diving program records pertaining to safety.

1.70 INSTRUCTIONAL PERSONNEL

1.71 Qualifications

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

1.72 Selection

Instructional personnel will be selected by the DSO, and approved by the DCB.

SECTION 2.00 DIVING REGULATIONS

2.10 GENERAL POLICY

Scientific diving shall be in compliance with the standards and regulations set forth in this manual. The ultimate responsibility for safety rests with the individual diver. It is the diver's responsibility and duty to refuse to dive if, in their judgment, conditions are unsafe or unfavorable, or if they would be violating the precepts of their training or the regulations in this manual.

2.20 DIVING PROCEDURE

2.21 Solo Diving Prohibition

All diving activities under the auspices of SIO/UCSD shall adhere to the buddy system for SCUBA diving. This buddy system is based upon mutual assistance, especially in the case of an emergency.

2.22 Emergency Procedures

No local or remote research diving shall be conducted unless procedures have been established for emergency evacuation of the divers to a hyperbaric chamber or other appropriate medical facility. All such emergency plans shall be approved by the DSO or Chairman of the DCB.

The DSO will prepare, distribute and update, as necessary, an emergency diver evacuation plan for local areas utilized by SIO/UCSD research divers (Appendix 5).

2.23 Enclosed or Confined Spaces

Diving in enclosed or confined space is not authorized without DCB review and approval. Additional training and operational standards are to be defined by the DCB.

2.24 Diver's Flag

The diver's flag (national or alpha) shall be prominently displayed whenever diving is conducted.

2.25 Dive Tables and Dive Computers

A set of dive tables must be available at the dive site. If US Navy Diving tables are not used, alternate tables must be at least as conservative as U.S Navy Diving Tables and approved by the DSO.

Dive computers may be utilized in the place of diving tables and must be used according to SIO/AAUS Guidelines for Computer Use (Appendix 7).

2.26 Depth Limits

Each scientific diver shall be certified to a specific depth limit by the DSO.

1. A scientific diver diving under the auspices of SIO/UCSD shall not exceed his/her depth certification, unless accompanied by a diver certified to a greater depth. Under these circumstances the diver may not exceed his/her depth limit by more than one step.
2. Dives between 0-130 feet in depth must be in accordance with Sec. 4.41-4.43.
3. Dives exceeding 130 feet in depth must be in accordance with Sec. 4.44.
4. Diving with compressed air is not permitted beyond a depth of 190 feet.

2.27 Refusal to Dive

The decision to dive is solely that of each diver. A diver may refuse to dive, without fear of penalty, whenever they feel it is unsafe to make the dive.

2.28 Termination of the Dive

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

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

2.29 Shipboard Scientific Diving Safety

All scientific diving activities carried out from SIO/UCSD research vessels shall conform to the standards of this manual, the R/V cruise manual, and those of the UNOLS (University-National Oceanographic Laboratory System). The on-board Diving Supervisor shall be designated by the DSO for each cruise.

2.30 SCIENTIFIC DIVING OPERATIONS

2.31 Lead Diver

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

1. Coordination with other known activities in the vicinity that are likely to interfere with diving operations.
2. Ensuring all dive team members possess current certification and are qualified for the type of diving operation.
3. Planning dives in accordance with Section 2.32.
4. Ensuring that first aid and adequate emergency oxygen equipment is in working order and at the dive location.
5. Briefing the dive team members on:
 - a. Dive objectives;
 - b. Unusual hazards or environmental conditions likely to affect the safety of the diving operation;
 - c. Modifications to diving or emergency procedures necessitated by the specific diving operation; and
 - d. Reporting to the DSO any physical problems or adverse physiological effects including symptoms of pressure-related injuries;

2.32 Dive Plans

Dives should be planned around the competency of the least experienced diver. Before conducting any diving operations under the auspices of the SIO/UCSD, the Lead Diver for a proposed operation should consider the following:

1. Diver's qualifications, depth certifications, and type of certification held by each diver;
2. Emergency plan (Appendix 5) including:
 - a. Emergency contact information for each diver;
 - b. Location and contact information for the nearest available hyperbaric chamber;
 - c. Location and contact information for the nearest available hospital; and
 - d. Contact information for means of emergency transport.
3. Approximate number of proposed dives;
4. Location(s) of proposed dives;
5. Estimated depth(s) and bottom time(s) anticipated;
6. Repetitive dives, if required;
7. Proposed work, equipment, and boats to be employed; and
8. Any hazardous conditions anticipated.

Note: A dive plan must be submitted and approved by the DSO or DCB prior to proposed operation for all scientific diving outside of established San Diego County diving operations.

2.33 Pre-dive Safety Checks

1. **Diver's Responsibility:**
 - a. Each scientific diver shall conduct a functional check of his/her diving equipment in the presence of the diving buddy or tender.
 - b. It is the diver's responsibility and duty to refuse to dive if, in his/her judgment, conditions are unfavorable, or if he/she would be violating the precepts of

- c. his/her training, or of this manual.
- c. No dive team member shall be required to be exposed to hyperbaric conditions against his/her will, except when necessary to prevent or treat a pressure-related injury.
- d. No dive team member shall be permitted to dive for the duration of any known condition which is likely to adversely affect the safety and health of the diver or other dive team members.

2. **Equipment Evaluations:**

- a. Each diver shall ensure that their equipment is in proper working order and that the equipment is suitable for the type of diving operation.
- b. Each diver shall have the capability of achieving and maintaining positive buoyancy.

3. **Site Evaluation:**

Environmental conditions at the site will be evaluated.

2.34 Post-dive Safety Checks

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

2.35 Flying After Diving or Ascending to Altitude (Over 1000 ft)

- 1. Following a single No-Decompression Dive: Divers should have a minimum preflight surface interval of 12 hours.
- 2. Following Multiple Dives per Day or Multiple Days of Diving: Divers should have a minimum preflight surface interval of 18 hours.
- 3. Following Dives Requiring Decompression Stops: Divers should have a minimum preflight interval of 24 hours.
- 4. Before ascending to Altitude above (1000 ft) by Land Transport: Divers should follow the appropriate guidelines for preflight surface intervals unless the decompression procedure used has accounted for the increase in elevation.
- 5. Requests for minimum preflight surface intervals determined by the NOAA's *Required Surface Interval Before Ascent to Altitude After Diving* table (TABLE 4.3) must be submitted to the DCB for evaluation and approval on a case by case basis.

2.36 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.

2.37 Consequences of Violations of Regulations by Scientific Divers

Failure to comply with the regulations contained in this manual may be cause for the revocation or restriction of SIO/UCSD's recognition by the AAUS.

2.40 RECORD KEEPING AND REQUIREMENTS

2.41 Personal Diving Log

- 1. Each certified scientific diver shall log every dive made under the auspices of the SIO/UCSD scientific diving program, and is encouraged to log all other dives. Web-based dive logs shall be submitted to the DSO at <http://sioscuba.ucsd.edu>. The SIO/UCSD dive log shall include at least:
 - a. Name of diver and dive buddy;
 - b. Date, time, and location;

- c. Maximum depths, bottom time, surface interval time, and mixed gas profiles, if used;
 - d. Dive tables and/or computer used;
 - e. Diving modes used;
 - f. Dive classification (scientific, aquarium, training and proficiency, or other); and
 - g. Detailed report of any accidents or potentially dangerous incidents.
2. If pressure-related injuries are suspected or if symptoms are evident, the following additional information shall be recorded and retained, with the record of the dive, for a period of 5 years:
 - a. Complete accident report;
 - b. Description of symptoms, including depth and time of onset; and
 - c. Description and results of treatment.
 3. The DCB shall investigate and document any incident of pressure-related injury and prepare a report which is to be forwarded to the AAUS.

2.42 Record Maintenance

The DSO or his/her designee shall maintain permanent records for each individual scientific diver certified. The file shall include evidence of certifications, log sheets, results of current physical examination, waivers, reports of disciplinary actions by the DCB, and other pertinent information deemed necessary.

2.43 Availability of Records

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

2.44 Required Accident Reporting

All diving accidents requiring recompression or resulting in moderate or serious injury, or death shall be reported to the DSO and DCB. All such instances automatically constitute revocation of the diver's scientific diving certification and require medical clearance before resuming diving activities.

Additional information must meet the following requirements:

1. The DSO and DCB shall record and report occupational injuries and illnesses in accordance with requirements of the appropriate Labor Code section.
2. The DSO and DCB shall record the occurrence of any diving-related injury or illness:
 - a. Requiring hospitalization for more than 24 hours;
 - b. Resulting in an episode of unconsciousness related to diving; and/or
 - c. Requiring treatment in a recompression chamber following a diving accident.

SECTION 3.00 SCIENTIFIC DIVER TRAINING REQUIREMENTS

3.10 GENERAL POLICY

Set forth, below, are the training requirements for SIO/UCSD Scientific Diver certification. No person shall engage in scientific diving activities under the auspices of SIO/UCSD until the DSO, acting on behalf of the DCB, has issued a Scientific Diving Authorization and approved a submitted SIO/UCSD Dive Plan.

Submission of documents and participation in aptitude examinations does not automatically result in certification. The applicant must convince the DSO that he/she is sufficiently skilled and proficient to be certified by the DCB. 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 SIO/UCSD Scientific Diver privileges.

3.20 PREREQUISITES

3.21 Eligibility

Only persons diving under SIO/UCSD auspices are eligible for SIO/UCSD Scientific Diver training and certification. Generally, these people will be affiliated with SIO/UCSD; however, non-affiliated trainees may be admitted to the training program with the permission of the DCB. The applicant for training and certification shall normally be at least eighteen years of age.

3.22 Application

Application for certification shall be made to the DSO on the SIO/UCSD Scientific Diver Application form.

3.23 Medical Evaluation

In accordance with American Academy of Underwater Sciences (AAUS) Guidelines and the SIO/UCSD Manual for Diving Safety, each applicant for SIO/UCSD Scientific Diver certification shall be medically certified (Appendices 2, 3, and 4) for diving by a licensed physician, according to the SIO Medical Standards (Section 6.00) before proceeding with scuba training as described in Section 3.30.

3.24 Swimming and Skin Diving Evaluation

The applicant for training shall successfully perform the following tests, or their equivalent, in the presence of the DSO, or designated representative:

1. Swim underwater without fins for a distance of 25 yards without surfacing;
2. Swim 400 yards in less than 12 minutes without swim aids;
3. Tread water for 10 minutes, or 2 minutes without the use of hands, without swim aids;
4. Without the use of swim aids, transport a person of equal size a distance of 25 yards in the water.

3.30 SCUBA TRAINING

The diver must complete theoretical and practical training for a minimum cumulative time of 100 hours.

3.31 Theoretical Training

Required topics include, but are not limited to:

1. Physics and Physiology of diving;
2. Diving Emergency Care Training:
 - a. Cardiopulmonary Resuscitation (CPR);
 - b. Diving First Aid;
 - c. Recognition, prevention, and management of : near drowning, DCS, AGE, CO₂ poisoning, squeezes, O₂ toxicity, nitrogen narcosis, exhaustion and panic, respiratory fatigue, motion sickness, hypothermia, hypoxia/anoxia, and diving hazards; and
 - d. Emergency Oxygen Administration

3. Dive Rescue;
4. Function, care, use, and maintenance of diving equipment;
5. High pressure cylinder and compressor safety;
6. Decompression theory, application, and planning;
7. Altitude and freshwater diving considerations;
8. Scientific dive planning;
9. SIO/UCSD scientific diving regulations and history;
10. Oceanographic and environmental conditions;
11. Night and limited visibility diving;
12. Hazardous marine life;
13. Scientific methods and data gathering techniques as appropriate; and
14. Diving from small boats and research vessels.

Suggested topics include specialized environments, conditions, gasses, and equipment as described in Volume 2.

3.32 Confined Water Training

At the completion of confined water training, the trainee must satisfactorily demonstrate to the DSO, or designated representative:

1. Water entry with full equipment;
2. Ability to alternate snorkel and scuba while swimming;
3. Ability to clear face mask and regulator while submerged;
4. Ability to remove and replace scuba equipment while submerged;
5. Understanding of underwater signs and signals;
6. Ability to achieve and maintain neutral buoyancy while submerged;
7. A simulated emergency swimming ascent;
8. Proficiency in air sharing, both "buddy breathing" and use of alternate air source, as both donor and recipient, with and without a mask;
9. Techniques of self-rescue;
10. Diver rescue and transport of a passive simulated victim of an accident;
11. Simulate in-water, mouth-to-mouth resuscitation; and
12. Overall watermanship ability.

3.33 Ocean or Open Water Training

Practical training must include a checkout dive with the DSO or qualified designee, followed by at least 11 ocean or open water dives in a variety of dive sites and conditions, for a cumulative bottom time of 6 hours. In addition to the skin and scuba skills listed in Section 3.25 and 3.32, the trainee must satisfactorily demonstrate:

1. Planning and execution of a dive with a buddy;
2. Entry and exit of open water, surf, and a diving vessel, while wearing SCUBA gear;
3. Kicking on the surface (400 yards) while wearing scuba equipment, without breathing from the SCUBA unit;
4. Ability to maneuver efficiently in the environment, at and below the surface;
5. Underwater navigation;
6. Ability to ascend at a rate not to exceed 30 fsw/min; and
7. Judgment consistent with safe diving.

3.34 Examinations

1. SIO/UCSD Scientific Diver written examination based on theoretical and practical training described in this section.
2. Examination and approval of SCUBA equipment as described in Section 5.00.

SECTION 4.00 SCIENTIFIC DIVER CERTIFICATION

4.10 TYPES OF CERTIFICATION

Only a person diving under SIO/UCSD auspices is eligible for Scientific Diver certification from the Scripps Institution of Oceanography at the University of California, San Diego.

4.11 Diver-in-Training Authorization

This permit signifies the diver has completed a nationally recognized sport diving course and has successfully completed a minimum of 40 hours of training and a minimum of 24 open water dives since completion of training. This diver participates in a supervised training program and shall log 12 additional training dives with an approved certified buddy under normal working conditions.

4.12 Scientific Diver Certification

This is a permit to dive, issued by the DSO upon recommendation of the DCB, usable only while it is current and for the purpose intended.

4.13 Temporary Diver Authorization

This authorization is issued only following a demonstration of the required proficiency in diving and if the person in question can contribute measurably to a planned dive. It is granted by the DSO and is valid only for a specified time. Temporary diver authorizations shall be restricted to the planned diving operation under SIO/UCSD auspices and shall comply with all other policies, regulations, and standards of this manual, including medical requirements.

4.14 Scientific Diving Reciprocity Authorization

This authorization is issued by the DSO for a certified Scientific Diver from an organization that operates, at a minimum, under scientific diving regulations that meet or exceed AAUS scientific diving regulations. The visiting diver must, at a minimum, adhere to SIO/UCSD Manual for Diving Safety. Prior to arrival, a Scientific Diving Reciprocity form signed by the DSO or Chairman of the home organization's DCB must be submitted to the SIO/UCSD's DSO for approval. The visiting diver may be asked to demonstrate their knowledge and skills for the planned dive.

4.20 DENIAL OF CERTIFICATION

Any applicant who does not appear to possess the judgment necessary, under diving conditions, for the safety of the diver and his/her partner may be denied certification.

4.30 WAIVER OF REQUIREMENTS

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

4.40 DEPTH CERTIFICATION

The SIO/UCSD Scientific Diver certification will authorize the holder to dive to the depth indicated in his/her records. A diver shall not exceed his/her depth certification, unless accompanied by a diver certified to a greater depth. Under these circumstances, the diver may not exceed his/her depth limit by more than one step.

4.41 Certification to 30 Foot Depth

This is the initial certification, approved upon successful completion of training listed in Section 3.00.

4.42 Certification to 60 Foot Depth

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

4.43 Certification to 100 and 130 Foot Depth

A diver holding a 60 foot certification may be certified to depths of 100 and 130 feet, respectively, by logging 6 dives near the maximum planned depth. These qualification dives shall be validated by the signature of two authorized individuals who are SIO/UCSD Scientific Diver certified to at least that depth.

4.44 Certification to Depths Over 130 Feet

A diver may be certified to depths of 150 and 190 feet, respectively, provided there is a scientific need, by logging 4 dives near each depth, and successful completion of a check-out dive approved by the DSO. Dives shall be planned and executed under close supervision of a SIO/UCSD Scientific Diver certified to this depth. The diver must also demonstrate knowledge of the special problems of deep diving, and of special safety requirements.

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

4.50 MAINTENANCE OF CERTIFICATION

4.51 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 3 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.

4.52 Re-qualification of Depth Certification

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

4.53 Medical Examination

All SIO/UCSD Scientific Divers shall pass a medical examination as specified in Section 6.00. After each major illness or injury, as described in Section 6.15, the individual shall receive clearance to return to diving from a physician before resuming diving activities.

4.54 Diver First Aid Training

1. Cardiopulmonary Resuscitation (CPR) - current within 24 months
2. Emergency Oxygen Administration - current within 24 months
3. Basic First Aid for diving accidents - current within 24 months

4.60 REVOCATION OF CERTIFICATION

A diving certification may be revoked or restricted for cause, such as violation of regulations set forth in this manual, by the DSO or DCB. The DSO shall inform the diver in writing of the reason(s) for revocation. The diver will be given an opportunity to present his/her case in writing to the DCB 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.

4.70 RECERTIFICATION

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

SECTION 5.00 DIVING EQUIPMENT

5.10 GENERAL POLICY

All equipment shall meet standards as determined by the DSO and DCB. Equipment that is subjected to exceptional use under adverse conditions should require more frequent testing and maintenance.

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

5.20 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:

1. Regulators & alternate air source;
2. Submersible pressure gauges;
3. Depth gauges;
4. SCUBA cylinders;
5. Cylinder valves;
6. Diving helmets;
7. Full-face masks;
8. Compressors;
9. Gas control panels;
10. Air storage cylinders;
11. Air filtration systems;
12. Analytical instruments;
13. Buoyancy control devices;
14. Dry suits; and
15. Dive computers.

5.30 EQUIPMENT

5.31 Regulators

1. Only those makes and models of regulators specifically approved by the DCB shall be used.
2. SCUBA regulators shall be inspected and tested before first use and every 12 months thereafter by a technician approved by the DCB.
3. Regulators will consist of a primary second stage and an alternate air source (such as an octopus second stage or redundant air supply).

5.32 Breathing Masks and Helmets

Breathing masks and helmets shall have:

1. A non-return valve at the attachment point between helmet or mask hose, which shall close readily and positively;
2. An exhaust valve;
3. A minimum ventilation rate capable of maintaining the diver at the depth to which he/she is diving.

5.33 SCUBA Cylinders

1. SCUBA cylinders shall be designed, constructed, and maintained in accordance with the applicable provisions of the Unfired Pressure Vessel Safety Orders.
2. SCUBA cylinders must be hydrostatically tested in accordance with DOT standards.
3. SCUBA cylinders must have an internal inspection at intervals not to exceed 12 months. Any tank that is emptied shall be visually inspected before refilling.
4. SCUBA cylinder valves shall be functionally tested at intervals not to exceed 12 months.

5.34 Flotation Devices

1. Each diver shall have the capacity of achieving and maintaining positive buoyancy.
2. Personal flotation systems, buoyancy compensators, dry suits, or other variable volume buoyancy devices shall be equipped with an exhaust valve.
3. These devices shall be functionally inspected and tested at intervals not to exceed 12 months.

5.35 Backpacks and Weight Systems

All backpacks and weight systems worn by the diver shall be equipped with quick release devices designed to permit jettisoning with a single motion from either hand.

5.36 Gauges

1. Submersible pressure and depth gauges shall be inspected and tested before first use and every 12 months thereafter.
2. Both members of the buddy team must have an underwater timing device, an approved depth indicator, and a submersible pressure gauge.

5.37 Determination of Decompression Status: Dive Tables, Dive Computers

1. A set of diving tables, approved by the DCB, must be available at the dive location.
2. Dive computers may be utilized in place of diving tables, and must be approved by the DCB. SIO/UCSD Dive Computer Policy can be found in Appendix 7.

5.38 Auxiliary Equipment

1. Hand-held underwater power tools:
Electrical tools and equipment used underwater shall be specifically approved for this purpose. Electrical tools and equipment supplied with power from the surface shall be de-energized before being placed into or retrieved from the water. Hand-held power tools shall not be supplied with power from the dive location until requested by the diver.
2. First aid supplies:
A first aid kit and adequate emergency breathing oxygen shall be available at each location where diving is undertaken under SIO/UCSD auspices.

5.40 AIR QUALITY STANDARDS

Breathing air for scuba use shall meet the following specifications as set forth by the Compressed Gas Association (CGA Pamphlet G-7.1):

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

For breathing air used in conjunction with self-contained breathing apparatus in extreme cold where moisture can condense and freeze, causing the breathing apparatus to malfunction, a dew point not to exceed -50°F (63 pm v/v) or 10 degrees lower than the coldest temperature expected in the area is required.

5.50 COMPRESSOR SYSTEMS - SIO/UCSD CONTROLLED

5.51 Design and Location of Compressor

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

5.52 Compressor Operation and Air Test Records

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

**SECTION 6.00
MEDICAL STANDARDS**

6.10 MEDICAL REQUIREMENTS

6.11 General

1. The 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 as may be limited or restricted in the medical evaluation report.
2. All medical evaluations required by this standard shall be performed by, or under the direction of, a licensed physician of the applicant-diver's choice, preferably one trained in diving/undersea medicine.
3. The diver should be free of any chronic disabling disease and be free of any conditions contained in the list of conditions (Appendix 2) for which restrictions from diving are generally recommended.

6.12 Frequency of Medical Evaluations

Medical evaluation shall be completed:

1. Before a diver may begin diving, unless an equivalent initial medical evaluation has been given within the preceding 5 years (3 years if over the age of 40, 2 years if over the age of 60), the DSO has obtained the results of that examination, and those results have been reviewed and found satisfactory by the DSO and/or the DCB.
2. Thereafter, at 5 year intervals up to age 40, every 3 years after the age of 40, and every 2 years after the age of 60.
3. Clearance to return to diving must be obtained from a physician following any major injury or illness, or any condition requiring hospital care. If the injury or illness is pressure related, then the clearance to return to diving must come from a physician trained in diving medicine.

6.13 Information Provided Examining Physician

The DSO shall make available a copy of the medical evaluation requirements of this standard to the examining physician. (Appendices 2, 3, and 4).

6.14 Content of Medical Evaluations

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

1. Applicant agreement for release of medical information to the DSO and the DCB (Appendix 3).
2. Medical history (Appendix 4).
3. Diving physical examination (Required tests listed below and in Appendix 3).

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

1. Abnormalities of the tympanic membrane, such as perforation, presence of a monomeric membrane, or inability to auto inflate the middle ears;
2. Hearing loss; 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, 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;

14. Hematologic disorders including coagulopathies;
15. Risk factors or evidence of 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. Hypertension;
22. History of pneumothorax;
23. Asthma;
24. Chronic pulmonary disease, including radiographic evidence of pulmonary blebs, bullae or cysts;
25. Diabetes mellitus; and/or
26. Pregnancy.

6.16 Laboratory Requirements for Diving Medical Evaluation and Intervals.

1. **Initial examination under age 40:**
 - a. Medical History.
 - b. Complete Physical Exam, emphasis on neurological and otological components.
 - c. Urinalysis.
 - d. Any further tests deemed necessary by the physician.
2. **Periodic re-examination under age 40 (every 5 years):**
 - a. Medical History.
 - b. Complete Physical Exam, emphasis on neurological and otological components.
 - c. Urinalysis.
 - d. Any further tests deemed necessary by the physician.
3. **First exam over age 40:**
 - a. Medical History
 - b. Complete Physical Exam, emphasis on neurological and otological components
 - c. Detailed assessment of coronary artery disease risk factors using Multiple-Risk-Factor Assessment^{1,2} (age, family history, lipid profile, blood pressure, diabetic screening, smoking history). Further cardiac screening may be indicated based on risk factor assessment.
 - d. Resting EKG.
 - e. Chest X-ray.
 - f. Urinalysis.
 - g. Any further tests deemed necessary by the physician.
4. **Periodic re-examination over age 40 (every 3 years); over age 60 (every 2 years):**
 - a. Medical History
 - b. Complete Physical Exam, emphasis on neurological and otological components
 - c. Detailed assessment of coronary artery disease risk factors using Multiple-Risk-Factor Assessment^{1,2} (age, family history, lipid profile, blood pressure, diabetic screening, smoking history). Further cardiac screening may be indicated based on risk factor assessment.
 - d. Resting EKG
 - e. Urinalysis
 - f. Any further tests deemed necessary by the physician
5. **Physician's Written Report**
 - a. After any medical examination relating to the individual's fitness to dive, the DSO shall obtain a written report prepared by the examining physician, that shall contain the examining physician's opinion of the individual's fitness to dive, including any recommended restrictions or limitations. This may be reviewed by the DCB.
 - b. The DSO shall make a copy of the physician's written report available to the individual.

¹ Grundy, R.J. et. al. 1999. Assessment of Cardiovascular Risk by Use of Multiple-Risk-Factor Assessment Equations. AHA/ACC Scientific Statement. <http://www.acc.org/clinical/consensus/risk/risk1999.pdf>

² Bove, A.A. 2011. The cardiovascular system and diving risk. *Undersea and Hyperbaric Medicine* 38(4): 261-269.

VOLUME 2: SPECIALIZED DIVING TECHNIQUES

Scientific Diving Certification does not entitle a diver to exceed his/her level of training. It is necessary, in some instances, to request further training and permission from the DCB before undertaking a more complicated project that requires more specialized equipment or diving procedures. Under no circumstances, is a diver to undertake a project utilizing equipment or procedures found in this Volume (Sections 7.00 - 11.00) without prior training and approval from the DCB.

SECTION 7.00 NITROX DIVING GUIDELINES

Definition : Nitrox is defined as breathing mixtures composed predominantly of nitrogen and oxygen, produced by the addition of oxygen or the removal of nitrogen from air.

7.10 PREREQUISITES

7.11 Eligibility

Only a certified Scientific Diver or Scientific Diver-in-Training (Section 3.00 and 4.00) diving under the auspices of SIO/UCSD is eligible for authorization to use nitrox.

7.12 Application and Documentation

Application and documentation for authorization to use nitrox should be submitted in writing to the DSO.

7.20 NITROX TRAINING GUIDELINES

Submission of documents and participation in aptitude examinations does not automatically result in authorization to use nitrox. The applicant must convince the DSO and members of the DCB that he/she is sufficiently skilled and proficient.

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

7.21 Theoretical and Practical Training

Required topics should include, but are not limited to:

1. Function, care, use, and maintenance of equipment cleaned for nitrox use;
2. Physical and physiological considerations of nitrox diving (ex.: O₂ and CO₂ toxicity);
3. Diving regulations and procedures as related to nitrox diving, either SCUBA or surface supplied (depending on intended mode);
4. Given the proper information, calculation of:
 - a. Equivalent air depth (EAD) for a given fO₂ and actual depth;
 - b. PO₂ exposure for a given fO₂ and depth;
 - c. Optimal nitrox mixture for a given PO₂ exposure limit and planned depth;
 - d. Maximum operational depth (MOD) for a given mix and PO₂ exposure limit;
 - e. For nitrox production purposes, percentages/psi of oxygen present in a given mixture, and psi of each gas required to produce a fO₂ by partial pressure mixing.
5. Decompression table and dive computer selection and use;
6. Nitrox production methods and considerations;
7. Oxygen analysis; and
8. Nitrox operational guidelines, dive planning, and dive station components.

7.22 Open Water Training

A minimum of two supervised openwater dives using nitrox is required for authorization. The mode used in the dives should correspond to the intended application (i.e., SCUBA or surface supplied).

7.23 Written Examination

Before authorization, the trainee should successfully pass a written nitrox diving examination.

7.30 SCIENTIFIC NITROX DIVING REGULATIONS

7.31 Dive Personnel Requirements

Lead Diver - On any dive during which nitrox will be used by any team member, the Lead Diver should be authorized to use nitrox, and hold appropriate authorizations required for the dive. Lead Diver authorization for nitrox dives by the DSO and/or DCB should occur as part of the dive plan approval process. In addition to responsibilities listed in Section 2.31, the Lead Diver should:

1. Verify that all divers using nitrox are properly qualified and authorized; and
2. Verify nitrox mixtures, maximum operational depths (MOD), and establish maximum depth and time limits for all team divers.

7.32 Dive Parameters

1. Oxygen Exposure Limits
 - a. The maximum PO_2 experienced at depth should not exceed 1.6 ata.
 - b. Maximum oxygen time/dose allowances for single and daily oxygen exposures should comply with the current *NOAA Diving Manual* "Oxygen Exposure Limits"
 - c. The maximum allowable exposure limit should be reduced in cases where cold or strenuous dive conditions, or extended exposure times are expected.
 - d. If using the equivalent air depth (EAD) method the maximum depth of a dive should be based on the oxygen partial pressure for the specific nitrox breathing mix to be used.
2. Bottom Time Limits
 - a. Maximum bottom time should be based on the depth of the dive and the nitrox mixture being used.
 - b. Bottom time for a single dive should not exceed the NOAA maximum allowable "Single Exposure Limit" for a given oxygen partial pressure, as listed in the current *NOAA Diving Manual*.
3. Decompression Tables and Gases
 - a. A set of DCB approved nitrox decompression tables should be available at the dive site.
 - b. When using the equivalent air depth (EAD) method, dives should be conducted using air decompression tables at least as conservative as the US Navy air tables.
 - c. If nitrox is used to increase the safety margin of air-based dive tables, the MOD and oxygen exposure and time limits for the nitrox mixture being dived should not be exceeded.
 - d. Breathing mixtures used while performing in-water decompression, or for bail-out purposes, should contain the same or greater oxygen content as that being used during the dive.
4. Nitrox Dive Computers
 - a. Dive Computers may be used to compute decompression status during nitrox dives according to manufacturers' guidelines and operations instructions and should comply with the SIO/UCSD dive computer policy (Appendix 7).
 - b. If nitrox is used to increase the safety margin of an air-based dive computer, the MOD and oxygen exposure and time limits for the nitrox mixture being dived should not be exceeded.
 - c. Dive computers capable of PO_2 limit and fO_2 adjustment should be checked by the diver prior to the start each dive to assure compatibility with the mix being used.
5. Repetitive Diving
 - a. Repetitive dives using nitrox mixtures should be performed in compliance with procedures required of the specific dive tables used.
 - b. Residual nitrogen time should be based on the EAD for the specific nitrox mixture to be used on the repetitive dive, and not that of the previous dive.
 - c. The total cumulative exposure (bottom time) to a PO_2 in a given 24 hour period should not exceed the current *NOAA Diving Manual* "Oxygen Exposure Limits."

7.33 Oxygen Parameters

Purity

1. Oxygen used for mixing nitrox breathing gas should meet the purity levels for “Medical Grade” (U.S.P.) or “Aviator Grade” standards.
2. In addition to the AAUS Air Purity Guidelines (Section 5.40), the following standard should be met for breathing air that is either
 - a. Placed in contact with oxygen concentrations greater than 40%, or
 - b. Used in nitrox production by the partial pressure mixing method with gas mixtures containing greater than 40% oxygen as the enriching agent:

| | |
|--|---------------------------------------|
| Air Purity: CGA Grade E (Section 5.40) | |
| Condensed Hydrocarbons | 5mg/m ³ |
| Hydrocarbon Contaminants | No greater than 0.1 mg/m ³ |

7.34 Gas Mixing and Analysis

1. Personnel Requirements
 - a. Individuals responsible for producing and/or analyzing nitrox mixtures should be knowledgeable and experienced in all aspects of the technique.
 - b. Only those individuals approved by the DSO and/or DCB should be responsible for mixing and/or analyzing nitrox mixtures.
2. Production Methods - It is the responsibility of the DCB to approve the specific nitrox production method used.
3. Analysis Verification by User
 - a. It is the responsibility of each diver to analyze prior to the dive the oxygen content of his/her scuba cylinder and acknowledge in writing the following information for each cylinder: fO₂, MOD, cylinder pressure, date of analysis, and user's name.
 - b. Individual dive log reporting forms should report fO₂ of nitrox used, if different than 21%.

7.35 Minimum Activity to Maintain Authorization

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

7.40 NITROX DIVING EQUIPMENT

Equipment standards (Section 5.00) apply to nitrox diving operations. Additional minimal equipment necessary for nitrox diving operations includes:

1. Labeled SCUBA Cylinders
2. Oxygen Analyzers

7.41 Oxygen Cleaning and Maintenance Requirements

1. Requirement for Oxygen Service
 - a. All equipment which during the dive or cylinder filling process is exposed to concentrations greater than 40% oxygen at pressures above 150 psi should be cleaned and maintained for oxygen service.
 - b. Equipment used with oxygen or mixtures containing over forty percent (40%) by volume oxygen shall be designed and maintained for oxygen service. Oxygen systems over 125 psig shall have slow-opening shut-off valves. This should include the following equipment: SCUBA cylinders, cylinder valves, SCUBA and other regulators, cylinder pressure gauges, hoses, diver support equipment, compressors, and fill station components and plumbing.

7.42 SCUBA Cylinder Identification Marking

SCUBA cylinders to be used with nitrox mixtures should have the following identification Documentation affixed to the cylinder.

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

2. Nitrox identification color coding should include a 4-inch wide green band around the cylinder, starting immediately below the shoulder curvature. If the cylinder is not yellow, the green band should be bordered above and below by a 1-inch yellow band.
3. The alternate marking of a yellow cylinder by painting the cylinder crown green and printing the word "NITROX" parallel to the length of the cylinder in green print is acceptable.
4. Other markings which identify the cylinder as containing gas mixes other than air may be used at the approval of the DCB.
5. A contents label should be affixed, to include the current fO_2 , date of analysis, and MOD.
6. The cylinder should be labeled to indicate whether the cylinder is prepared for oxygen or nitrox mixtures containing greater than 40% oxygen.

7.43 Regulators

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

7.44 Other Support Equipment

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

7.45 Compressor and Fill Station

1. Compressor system
 - a. The compressor/filtration system MUST produce oil-free air.
 - b. An oil-lubricated compressor placed in service for a nitrox system should be checked for oil and hydrocarbon contamination at least quarterly.
2. Fill Station Components - All components of a nitrox fill station that will contact nitrox mixtures containing greater than 40% oxygen should be cleaned and maintained for oxygen service. This includes cylinders, whips, gauges, valves, and connecting lines.

SECTION 8.00 AQUARIUM DIVING OPERATIONS

Definition : A scientific aquarium diver is a scientific diver 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 SIO/UCSD and is used for the purposes of specimen exhibit, education, husbandry, or research.

8.10 GENERAL POLICY

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 SIO/UCSD's DCB 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 5.36 of this manual is modified to read as follows:

In an aquarium of a known maximum obtainable depth:

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

8.40 SCIENTIFIC AQUARIUM DIVER CERTIFICATION

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 Section 3.00 of this manual shall apply, except that Section 3.33 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 1 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.

1. Scientific aquarium divers using the surface supplied mode shall be equipped with a diver carried independent reserve breathing gas supply except when using conventional scuba masks, full-face masks or non-lockdown type helmets provided:
 - a. There are no overhead obstructions or entanglements;

- b. The diver is proficient in performing a Controlled Emergency Swimming Ascent from at least as deep as the maximum depth of the aquarium; and
 - c. The diver is proficient in performing out of air emergency drills, including ascent and mask/helmet removal.
2. 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.
 3. 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.
 4. 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.
 5. 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.
 6. 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 STAGED DECOMPRESSION DIVING

Definition : Staged Decompression diving is defined as any diving during which the diver cannot perform a direct return to the surface without performing a mandatory decompression stop to allow the release of inert gas from the diver's body. The following procedures shall be observed when conducting dives requiring planned decompression stops.

9.10 MINIMUM EXPERIENCE AND TRAINING REQUIREMENTS

9.11 Prerequisites

1. Scientific Diver qualification according to Section 3.00.
2. Minimum of 100 logged dives.
3. Demonstration of the ability to safely plan and conduct dives deeper than 100 feet.
4. Nitrox certification/authorization according to Section 7.00 is recommended.

9.12 Training

Training shall be appropriate for the conditions in which dive operations are to be conducted and shall, at a minimum, include:

1. A minimum of 6 hours of classroom training to include, at a minimum:
 - a. Physics and physiology of decompression;
 - b. Decompression planning and procedures;
 - c. Gas management;
 - d. Equipment configurations;
 - e. Decompression method; and
 - f. Emergency procedures.
2. It is recommended that at least one training session be conducted in a pool or sheltered water setting to cover equipment handling and familiarization, swimming and buoyancy control, gas consumption rates, and to practice emergency procedures.
3. At least 6 open-water training dives simulating/requiring decompression shall be conducted, emphasizing planning and execution of required decompression dives, and including practice of emergency procedures.
4. Progression to greater depths shall be by dive increments and depth intervals as specified in Section 4.40.
5. No training dives requiring decompression shall be conducted until the diver has demonstrated acceptable skills under simulated conditions.
6. The following are the minimum skills the diver must demonstrate proficiently during dives simulating and requiring decompression:
 - a. Buoyancy control;
 - b. Proper ascent rate;
 - c. Proper depth control;
 - d. Equipment manipulation;
 - e. Stage/decompression bottle use as pertinent to planned diving operation;
 - f. Buddy skills;
 - g. Gas management;
 - h. Time management;
 - i. Task loading; and
 - j. Emergency skills.
7. Divers shall demonstrate to the satisfaction of the DSO or the DSO's designee, proficiency in planning and executing required decompression dives appropriate to the conditions in which diving operations are to be conducted.
8. Upon completion of training, the diver shall be authorized to conduct required decompression dives with DSO approval.

9.20 MINIMUM EQUIPMENT REQUIREMENTS

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

9.30 MINIMUM OPERATIONAL REQUIREMENTS

1. Approval of dive plan applications to conduct required decompression dives shall be on a case-by-case basis.
2. The maximum PO₂ to be used for planning required decompression dives is 1.6 ata. It is recommended that a PO₂ of less than 1.6 ata be used during bottom exposure.
3. Divers gas supplies shall be adequate to meet planned operational requirements and foreseeable emergency situations.
4. Decompression dives may be planned using dive tables, dive computers, and/or PC software approved by the DSO/DCB.
5. Breathing gases used while performing in-water decompression shall contain the same or greater oxygen content as that used during the bottom phase of the dive.
6. The dive team prior to each dive shall review emergency procedures appropriate for the planned dive.
7. If breathing gas mixtures other than air are used for required decompression, their use shall be in accordance with those regulations set forth in the appropriate sections of this standard.
8. The maximum depth for required decompression using air as the bottom gas shall be 190 feet.
9. Use of additional nitrox and/or high-oxygen fraction decompression mixtures as travel and decompression gases to decrease decompression obligations is encouraged.
10. Use of alternate inert gas mixtures to limit narcosis is encouraged for depths greater than 150 feet.
11. If a period of more than 6 months has elapsed since the last mixed gas dive, a series of progressive workup dives to return the diver(s) to proficiency status prior to the start of project diving operations are required.
12. Mission specific workup dives are required.

SECTION 10.00 MIXED GAS DIVING

Definition : 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.

10.10 MINIMUM EXPERIENCE AND TRAINING REQUIREMENTS

10.11 Prerequisites

1. Nitrox certification and authorization (Section 7.00)
2. If the intended use entails required decompression stops, divers will be previously certified and authorized in decompression diving (Section 9.00).
3. Divers shall demonstrate to the DCB's satisfaction skills, knowledge, and attitude appropriate for training in the safe use of mixed gases.

10.12 Theoretical Training

1. Review of topics and issues previously outlined in nitrox and required decompression diving training as pertinent to the planned operations;
2. The use of helium or other inert gases, and the use of multiple decompression gases;
3. Equipment configurations;
4. Mixed gas decompression planning;
5. Gas management planning;
6. Thermal considerations;
7. END determination;
8. Mission planning and logistics;
9. Emergency procedures;
10. Mixed gas production methods;
11. Methods of gas handling and cylinder filling;
12. Oxygen exposure management;
13. Gas analysis; and
14. Mixed gas physics and physiology.

10.13 Practical Training

1. Confined water session(s) in which divers demonstrate proficiency in required skills and techniques for proposed diving operations.
2. A minimum of 6 open water training dives.
3. At least one initial dive shall be in 130 feet or less to practice equipment handling and emergency procedures.
4. Subsequent dives will gradually increase in depth, with a majority of the training dives being conducted between 130 feet and the planned operational depth.
5. Planned operational depth for initial training dives shall not exceed 260 feet.
6. Diving operations beyond 260 feet requires additional training dives.

10.20 EQUIPMENT AND GAS REQUIREMENTS

1. Equipment requirements shall be developed and approved by the DCB, and met by divers, prior to engaging in mixed-gas diving. Equipment shall meet other pertinent requirements set forth elsewhere in this standard.
2. The quality of inert gases used to produce breathing mixtures shall be of an acceptable grade for human consumption.

10.30 MINIMUM OPERATIONAL REQUIREMENTS

1. Approval of dive plan applications to conduct mixed gas dives shall be on a case-by-case basis.
2. All applicable operational requirements for nitrox and decompression diving shall be met.
3. The maximum PO₂ to be used for planning required decompression dives is 1.6 ata. It is recommended that a PO₂ of less than 1.6 ata be used during bottom exposure.
4. Maximum planned Oxygen Toxicity Units (OTU) will be considered based on mission duration.

5. Divers decompressing on high-oxygen concentration mixtures shall closely monitor one another for signs of acute oxygen toxicity.
6. If a period of more than 6 months has elapsed since the last mixed gas dive, a series of progressive workup dives to return the diver(s) to proficiency status prior to the start of project diving operations are required.

SECTION 11.00 REBREATHERS

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

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

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

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

11.10 GENERAL INFORMATION

Application of this standard is in addition to pertinent requirements of all other sections of the SIO Manual for Diving Safety, Volumes 1 and 2.

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

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

11.20 TRAINING

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).

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

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

11.21 Prerequisites

1. Active scientific diver status, with depth qualification sufficient for the type, make, and model of rebreather, and planned application.
2. Completion of a minimum of 50 open-water dives on SCUBA.
3. 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.

4. 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.

11.22 Theoretical Training

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

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

1. Hyperoxia (CNS and Pulmonary Oxygen Toxicity);
2. Middle Ear Oxygen Absorption Syndrome (oxygen ear);
3. Hyperoxia-induced myopia;
4. Hypoxia;
5. Hypercapnia;
6. Inert gas narcosis; and
7. Decompression sickness.

Rebreather-specific system design and operational information required for the safe and effective operation, including:

8. Counterlung(s);
9. CO₂ scrubber;
10. CO₂ absorbent material types, activity characteristics, storage, handling and disposal;
11. Oxygen control system design, automatic and manual;
12. Diluent control system, automatic and manual (if any);
13. Pre-dive set-up and testing;
14. Post-dive break-down and maintenance;
15. Oxygen exposure management;
16. Decompression management and applicable decompression tracking methods;
17. Dive operations planning;
18. Problem recognition and management, including system failures leading to hypoxia, hyperoxia, hypercapnia, flooded loop, and caustic cocktail; and
19. Emergency protocols and bailout procedures.

11.23 Practical Training

A minimum number of hours of underwater time.

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

* 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.

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

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

11.24 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:

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

11.25 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.

11.26 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.

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

11.27 Proficiency Development

Prior to planned scientific diving operations, divers should complete an additional 15 rebreather dives targeting 50 hours of underwater time on the rebreather system to be used.

1. Dives at this level may be targeted to activities associated with the planned science diving application.
2. Modification of these targets may be considered by the DCB on a case-by-case basis.

11.28 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.

1. As a prerequisite for training in staged decompression using rebreathers, the diver shall have logged a minimum of 50 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.
2. 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 75 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.
3. 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.

11.29 Maintenance of Proficiency

1. 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.
2. 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.

11.30 EQUIPMENT REQUIREMENTS

11.31 General Requirements

1. Only those models of rebreathers specifically approved by DCB shall be used.
2. 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.
3. Unit performance specifications should be within acceptable levels as defined by standards of a recognized authority (CE, US Navy, Royal Navy, NOAA, etc...).
4. 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.
5. The following documentation for each rebreather model to be used should be available as a set of manufacturer's specifications. These should include:
 - a. Operational depth range;
 - b. Operational temperature range;
 - c. Breathing gas mixtures that may be used;
 - d. Maximum exercise level which can be supported as a function of breathing gas and depth;
 - e. Breathing gas supply durations as a function of exercise level and depth;
 - f. CO₂ absorbent durations, as a function of depth, exercise level, breathing gas,

- g. and water temperature;
 - g. Method, range and precision of inspired PPO₂ control, as a function of depth, exercise level, breathing gas, and temperature;
 - h. Likely failure modes and backup or redundant systems designed to protect the diver if such failures occur;
 - i. Accuracy and precision of all readouts and sensors;
 - j. Battery duration as a function of depth and temperature; and
 - k. Mean time between failures of each subsystem and method of determination
6. A complete instruction manual is required, fully describing the operation of all rebreather components and subsystems as well as maintenance procedures.
 7. A maintenance log is required. The unit maintenance shall be up-to-date based upon manufacturer's recommendations.

11.32 Minimum Equipment

1. General Requirements
 - 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.
2. Oxygen Rebreathers
 - a. Oxygen rebreathers shall be equipped with manual and automatic gas addition valves.
3. Semi-Closed Circuit Rebreathers.
 - a. 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.
4. 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.

11.40 OPERATIONAL REQUIREMENTS

11.41 General Requirements

1. All dives involving rebreathers must comply with applicable operational requirements for open-circuit SCUBA dives to equivalent depths.
2. No rebreather system should be used in situations beyond the manufacturer's stated design limits (dive depth, duration, water temperature, etc).
3. Modifications to rebreather systems shall be in compliance with manufacturer's recommendations.
4. 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.
5. Dive Plan. In addition to standard dive plan components stipulated in Section 2.41, all dive plans that include the use of rebreathers must include, at minimum, the following

details:

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

11.42 Buddy Qualifications

1. 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.
2. 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.

11.43 Oxygen Exposures

1. Planned oxygen partial pressure in the breathing gas shall not exceed 1.4 atmospheres at depths greater than 30 feet.
2. Planned oxygen partial pressure set point for CCR should not exceed 1.3 atm. Set point at depth should be reduced to manage oxygen toxicity according to the NOAA Oxygen Exposure Limits.
3. Oxygen exposures should not exceed the NOAA oxygen single and daily exposure limits. Both CNS and pulmonary (whole-body) oxygen exposure indices should be tracked for each diver.

11.44 Decompression Management

1. DCB shall review and approve the method of decompression management selected for a given diving application and project.
2. 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:
 - a. Oxygen rebreathers: Not applicable.
 - b. SCR (presumed constant FO₂):
 - i. Use of any method approved for open-circuit scuba diving breathing air, above the maximum operational depth of the supply gas.
 - ii. 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.
 - iii. 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.
 - c. CCR (constant PPO₂):
 - i. Integrated constant PPO₂ dive computer.
 - ii. Non-integrated constant PPO₂ dive computer.
 - iii. Constant PPO₂ dive tables.
 - iv. Open-circuit (constant FO₂) nitrox dive computer, set to inspired FO₂ predicted using PPO₂ set point at the maximum planned dive depth.
 - v. 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.
 - vi. Air dive computer, or air dive tables used above the maximum operating depth (MOD) of air for the PPO₂ setpoint selected.

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

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

1. Gas supply cylinders full;
2. Composition of all supply and bail-out gases analyzed and documented;
3. Oxygen sensors calibrated;
4. Carbon Dioxide canister properly packed;
5. Remaining duration of canister life verified;
6. Breathing loop assembled;
7. Positive and negative pressure leak checks;
8. Automatic volume addition system working;
9. Automatic oxygen addition systems working;
10. 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);
11. Other procedures specific to the model of rebreather used;
12. Documentation of ALL components assembled;
13. Complete pre-dive system check performed; and
14. Final operational verification immediately prior to entering the water:
 - a. PO₂ in the rebreather is not hypoxic;
 - b. Oxygen addition system is functioning;
 - c. Volumetric addition is functioning; and
 - d. Bail-out life support is functioning.

11.46 Alternate Life Support System

The diver shall have reliable access to an alternate life support system designed to safely return to 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:

1. Open-circuit bailout cylinders or sets of cylinders, either carried or pre-positioned;
2. Redundant rebreather; and
3. Pre-positioned life support equipment with topside support.

11.47 CO₂ Absorbent Material

1. CO₂ absorption canister shall be filled in accordance with the manufacturer's specifications.
2. CO₂ absorbent material shall be used in accordance with the manufacturer's specifications for expected duration.
3. 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.
4. 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.

11.48 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.

11.49 Unit Disinfections

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

11.50 OXYGEN REBREATHERS

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

2. 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.
3. Breathing loop shall be flushed with fresh oxygen prior to ascending to avoid hypoxia due to inert gas in the loop.

11.60 SEMI-CLOSED CIRCUIT REBREATHERS

1. 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.
2. 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 FO_2 .
3. The intermediate pressure of supply gas delivery in active-addition SCR shall be checked periodically, in compliance with manufacturer's recommendations.
4. Maximum operating depth shall be based upon the FO_2 in the active supply cylinder.
5. 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.

11.70 CLOSED CIRCUIT REBREATHERS

1. The FO_2 of each diluent gas supply used shall be chosen so that, if breathed directly while in the depth range for which its use is intended, it will produce an inspired PPO_2 greater than 0.20 atm but no greater than 1.4 atm.
2. Maximum operating depth shall be based on the FO_2 of the diluent in use during each phase of the dive, so as not to exceed a PO_2 limit of 1.4 atm.
3. 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).
4. The PPO_2 set point shall not be lower than 0.4 atm or higher than 1.4 atm.

SECTION 12.00 OTHER DIVING TECHNOLOGY

12.10 BLUE WATER DIVING

Blue water diving is defined as diving in open water where the bottom is generally greater than 200 feet deep. It requires special training and the use of multiple-tethered diving techniques. Specific guidelines that should be followed are outlined in "Scientific Blue Water Diving" (California Sea Grant Publ. No. T-057).

12.20 ICE AND POLAR DIVING

Divers planning to dive under ice or in polar conditions should consult the following: "Standards for Conduct of Scientific Diving," Office of Polar Programs, National Science Foundation, 2012. Operational standards will be considered by the DCB on a case-by-case basis.

12.30 OVERHEAD ENVIRONMENTS

Where an enclosed or confined space is not large enough for two divers, a diver shall be stationed at the underwater point of entry and an orientation line shall be used. Operational standards will be considered by the DCB on a case-by-case basis.

12.40 SATURATION DIVING

If using open circuit compressed air scuba in saturation diving operations, divers shall comply with the saturation diving guidelines of the supporting organization.

12.50 SURFACE SUPPLIED DIVING

Defined as 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.

Surface supplied divers shall comply with all SCUBA diving procedures in this manual (except Section 2.21).

Surface supplied diving shall not be conducted at depths greater than 190 fsw (58 msw).

1. Divers using the surface supplied mode shall be equipped with a diver-carried independent reserve breathing gas supply.
2. Each surface supplied diver shall be hose tended by a separate dive team member while in the water.
3. Divers using the surface supplied mode shall maintain voice communication with the surface tender.
4. 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.
5. 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.

12.60 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. The diver is responsible for the monitoring his/her own depth, time, and diving profile.

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

3. 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.

APPENDIX 1 : Glossary of Terms

Air sharing - Sharing of an air supply between divers.

ATA(s) - “Atmospheres Absolute”, Total pressure exerted on an object, by a gas or mixture of gases, at a specific depth or elevation, including normal atmospheric pressure.

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

Buddy Breathing - Sharing of a single air source between divers.

Buddy Diver - Second member of the dive team.

Buddy System -Two comparably equipped SCUBA divers in the water in constant communication.

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

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

Certified Diver - A diver who holds a recognized valid certification from an organizational member or internationally recognized certifying agency.

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

Cylinder - A pressure vessel for the storage of gases.

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

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

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

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

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

Dive Site - Physical location of a diver during a dive.

Dive Table - A profile or set of profiles of depth-time relationships for ascent rates and breathing mixtures to be followed after a specific depth-time exposure or exposures.

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

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

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

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

Diving Control Board (DCB) - Group of individuals who act as the official representative of the membership organization in matters concerning the Scientific Diving Program.

Diving Safety Officer (DSO) - Individual responsible for the safe conduct of the Scientific Diving Program of the membership organization.

EAD - Equivalent Air Depth (see below).

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

Enriched Air (EANx) - A name for a breathing mixture of air and oxygen when the percent of oxygen exceeds 21%. This term is considered synonymous with the term “nitrox.”

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

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

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

FFW – Feet or freshwater, or equivalent static head.

FSW - Feet of seawater, or equivalent static head.

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

Hyperbaric Chamber - See decompression chamber.

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

Lead Diver - Certified Scientific Diver with experience and training to conduct the diving operation.

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

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

Mixed Gas - A breathing medium consisting of oxygen and one or more inert gases, synthetically mixed.

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

MOD - Maximum Operating Depth, usually determined as the depth at which the PO₂ for a given gas mixture reaches a predetermined maximum.

MSW - Meters of seawater or equivalent static head.

Nitrox - Any gas mixture comprised predominately of nitrogen and oxygen, most frequently containing between 21% and 40% oxygen. Also referred to as Enriched Air Nitrox, abbreviated EAN.

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

Normal Ascent - An ascent made with an adequate air supply at a rate of 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 are compatible with oxygen at a stated pressure and temperature.

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

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

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

Pressure Vessel - See cylinder.

PN₂ - Inspired partial pressure of nitrogen, usually expressed in units of atmospheres absolute.

PO₂ - Inspired partial pressure of oxygen, usually expressed in units of atmospheres absolute.

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

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

Recompression Chamber - see decompression chamber.

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

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

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

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

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

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

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

APPENDIX 2 : Diving Medical Exam Overview for the Examining Physician

DIVING MEDICAL EXAM OVERVIEW FOR THE EXAMINING PHYSICIAN

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

Christian McDonald
SIO Diving Safety Officer
Ph. (858) 534-2002 Fx. (858) 534-5306
cmcdonald@ucsd.edu

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

CONDITIONS WHICH MAY DISQUALIFY CANDIDATES FROM DIVING

1. Abnormalities of the tympanic membrane, such as perforation, presence of a monomeric membrane, or inability to autoinflate the middle ears. [5, 7, 8, 9]
2. Vertigo, including Meniere's Disease. [13]
3. Stapedectomy or middle ear reconstructive surgery. [11]
4. Recent ocular surgery. [15, 18, 19]
5. Psychiatric disorders including claustrophobia, suicidal ideation, psychosis, anxiety states, untreated depression. [20 - 23]
6. Substance abuse, including alcohol. [24 - 25]
7. Episodic loss of consciousness. [1, 26, 27]
8. History of seizure. [27, 28]
9. History of stroke or a fixed neurological deficit. [29, 30]
10. Recurring neurologic disorders, including transient ischemic attacks. [29, 30]
11. History of intracranial aneurysm, other vascular malformation or intracranial hemorrhage. [31]
12. History of neurological decompression illness with residual deficit. [29, 30]
13. Head injury with sequelae. [26, 27]
14. Hematologic disorders including coagulopathies. [41, 42]
15. Evidence of coronary artery disease or high risk for coronary artery disease. [33 - 35]
16. Atrial septal defects. [39]
17. Significant valvular heart disease - isolated mitral valve prolapse is not disqualifying. [38]
18. Significant cardiac rhythm or conduction abnormalities. [36 - 37]
19. Implanted cardiac pacemakers and cardiac defibrillators (ICD). [39, 40]
20. Inadequate exercise tolerance. [34]
21. Severe hypertension. [35]
22. History of spontaneous or traumatic pneumothorax. [45]
23. Asthma. [42 - 44]
24. Chronic pulmonary disease, including radiographic evidence of pulmonary blebs, bullae, or cysts. [45,46]
25. Diabetes mellitus. [46 - 47]
26. Pregnancy. [56]

SELECTED REFERENCES IN DIVING MEDICINE

Available from Best Publishing Company, P.O. Box 30100, Flagstaff, AZ 86003-0100, the Divers Alert Network (DAN) or the Undersea and Hyperbaric Medical Society (UHMS), Durham, NC

- Elliott, D.H. ed. 1996. *Are Asthmatics Fit to Dive?* Kensington, MD: Undersea and Hyperbaric Medical Society.
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- Douglas, P.S. 2011. Cardiovascular screening in asymptomatic adults: Lessons for the diving world. *Undersea and Hyperbaric Medicine* 38(4): 279-287.
- Mitchell, S.J., and A.A. Bove. 2011. Medical screening of recreational divers for cardiovascular disease: Consensus discussion at the Divers Alert Network Fatality Workshop. *Undersea and Hyperbaric Medicine* 38(4): 289-296.
- Grundy, S.M., Pasternak, R., Greenland, P., Smith, S., and Fuster, V. 1999. Assessment of Cardiovascular Risk by Use of Multiple-Risk-Factor Assessment Equations. AHA/ACC Scientific Statement. *Journal of the American College of Cardiology*, 34: 1348-1359. <http://content.onlinejacc.org/cgi/content/short/34/4/1348>
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- Edmonds, C., Lowry, C., Pennefather, J. and Walker, R. 2002. DIVING AND SUBAQUATIC MEDICINE, Fourth Edition. London: Hodder Arnold Publishers.
- Bove, A.A. ed. 1998. MEDICAL EXAMINATION OF SPORT SCUBA DIVERS, San Antonio, TX: Medical Seminars, Inc.
- NOAA DIVING MANUAL, NOAA. Superintendent of Documents. Washington, DC: U.S. Government Printing Office.
- U.S. NAVY DIVING MANUAL. Superintendent of Documents, Washington, DC: U.S. Government Printing Office, Washington, D.C.

DIVING MEDICINE CONTACT

UCSD Occupational & Environmental Medicine

- health.ucsd.edu/specialties/occ/Pages/divemedicine.aspx
- 619-471-9210

Undersea & Hyperbaric Medical Society

- membership.uhms.org
- uhms@uhms.org
- 919-490-5140/877-533-8467

Divers Alert Network

- www.diversalertnetwork.org
- 919-684-9111 (Emergency)
- 800-466-2671/919-684-2948 (Non-emergency)

APPENDIX 3 : SIO/UCSD Medical Evaluation of Fitness for SCUBA Diving Report

SIO/UCSD MEDICAL EVALUATION OF FITNESS FOR SCUBA DIVING REPORT

Name of Applicant (Print or Type)

Date of Medical Evaluation (Month/Day/Year)

To The Examining Physician: Scientific divers require periodic scuba diving medical examinations to assess their fitness to engage in diving with self-contained underwater breathing apparatus (scuba). Their answers on the Diving Medical History Form may indicate potential health or safety risks as noted. Scuba diving is an activity that puts unusual stress on the individual in several ways. Your evaluation is requested on this Medical Evaluation form. Your opinion on the applicant's medical fitness is requested. Scuba diving requires heavy exertion. The diver must be free of cardiovascular and respiratory disease (see references, following page). An absolute requirement is the ability of the lungs, middle ears and sinuses to equalize pressure. Any condition that risks the loss of consciousness should disqualify the applicant. Please proceed in accordance with the AAUS Medical Standards (Sec. 6.00). If you have questions about diving medicine, please consult with the Undersea Hyperbaric Medical Society or Divers Alert Network.

TESTS: THE FOLLOWING TESTS ARE REQUIRED:

URING ALL INITIAL AND PERIODIC RE-EXAMS (UNDER AGE 40):

- Medical history
- Complete physical exam, with emphasis on neurological and otological components
- Urinalysis
- Any further tests deemed necessary by the physician

DDITIONAL TESTS DURING FIRST EXAM OVER AGE 40 AND PERIODIC RE-EXAMS (OVER AGE 40):

- Chest x-ray (Required only during first exam over age 40)
- Resting EKG
- Assessment of coronary artery disease using Multiple-Risk-Factor Assessment¹ (age, lipid profile, blood pressure, diabetic screening, smoking)
- Note: Exercise stress testing may be indicated based on Multiple-Risk-Factor Assessment²

PHYSICIAN'S STATEMENT:

___ 01 Diver **IS** medically qualified to dive for: _____ 2 years (over age 60)
_____ 3 years (age 40-59)
_____ 5 years (under age 40)

___ 02 Diver **IS NOT** medically qualified to dive: _____ Permanently _____ Temporarily.

I have evaluated the abovementioned individual according to the American Academy of Underwater Sciences medical standards and required tests for scientific diving (Sec. 6.00 and Appendix 1) and, in my opinion, find no medical conditions that may be disqualifying for participation in scuba diving. I have discussed with the patient any medical condition(s) that would not disqualify him/her from diving but which may seriously compromise subsequent health. The patient understands the nature of the hazards and the risks involved in diving with these conditions.

Signature MD or DO _____
Date

Name (Print or Type)

Address

Telephone Number E-Mail Address

My familiarity with applicant is: ___ This exam only ___ Regular physician for ___ years

My familiarity with diving medicine is: _____

APPENDIX 3b : SIO/UCSD Medical Evaluation of Fitness for SCUBA Diving Report

APPLICANT'S RELEASE OF MEDICAL INFORMATION FORM

Name of Applicant (Print or Type) _____

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

Signature of Applicant _____ Date _____

REFERENCES

¹ Grundy, S.M., Pasternak, R., Greenland, P., Smith, S., and Fuster, V. 1999. Assessment of Cardiovascular Risk by Use of Multiple-Risk-Factor Assessment Equations. AHA/ACC Scientific Statement. *Journal of the American College of Cardiology*, 34: 1348-1359. <http://content.onlinejacc.org/cgi/content/short/34/4/1348>

APPENDIX 4 : Diving Medical History Form

DIVING MEDICAL HISTORY FORM

(To Be Completed By Applicant-Diver)

Name: _____ Sex: _____ Age: _____ Wt.: _____ Ht.: _____

Sponsor: _____ Date: ____/____/____
 (Dept./Project/Program/School, etc.) (Mo/Day/Yr)

TO THE APPLICANT:

SCUBA diving makes considerable demands on you, both physically and mentally. Diving with certain medical conditions may be asking for trouble not only for yourself, but also to anyone coming to your aid if you get into difficulty in the water. Therefore, it is prudent to meet certain medical and physical requirements before beginning a diving or training program.

Your answers to these questions are as important in determining your fitness as your physical examination. Obviously, you should give accurate information or the medical screening procedure becomes useless.

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

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

| | Yes | No | Please indicate whether or not the following apply to you | Comments |
|----|-----|----|---|----------|
| 1 | | | Convulsions, seizures, or epilepsy | |
| 2 | | | Fainting spells or dizziness | |
| 3 | | | Been addicted to drugs | |
| 4 | | | Diabetes | |
| 5 | | | Motion sickness or sea/air sickness | |
| 6 | | | Claustrophobia | |
| 7 | | | Mental disorder or nervous breakdown | |
| 8 | | | Are you pregnant? | |
| 9 | | | Do you suffer from menstrual problems? | |
| 10 | | | Anxiety spells or hyperventilation | |
| 11 | | | Frequent sour stomachs, nervous stomachs or vomiting spells | |
| 12 | | | Had a major operation | |
| 13 | | | Presently being treated by a physician | |
| 14 | | | Taking any medication regularly (even non-prescription) | |
| 15 | | | Been rejected or restricted from sports | |
| 16 | | | Headaches (frequent and severe) | |
| 17 | | | Wear dental plates | |

| | Yes | No | Please indicate whether or not the following apply to you | Comments |
|----|-----|----|--|----------|
| 18 | | | Wear glasses or contact lenses | |
| 19 | | | Bleeding disorders | |
| 20 | | | Alcoholism | |
| 21 | | | Any problems related to diving | |
| 22 | | | Nervous tension or emotional problems | |
| 23 | | | Take tranquilizers | |
| 24 | | | Perforated ear drums | |
| 25 | | | Hay fever | |
| 26 | | | Frequent sinus trouble, frequent drainage from the nose, post-nasal drip, or stuffy nose | |
| 27 | | | Frequent earaches | |
| 28 | | | Drainage from the ears | |
| 29 | | | Difficulty with your ears in airplanes or on mountains | |
| 30 | | | Ear surgery | |
| 31 | | | Ringing in your ears | |
| 32 | | | Frequent dizzy spells | |
| 33 | | | Hearing problems | |
| 34 | | | Trouble equalizing pressure in your ears | |
| 35 | | | Asthma | |
| 36 | | | Wheezing attacks | |
| 37 | | | Cough (chronic or recurrent) | |
| 38 | | | Frequently raise sputum | |
| 39 | | | Pleurisy | |
| 40 | | | Collapsed lung (pneumothorax) | |
| 41 | | | Lung cysts | |
| 42 | | | Pneumonia | |
| 43 | | | Tuberculosis | |

| | Yes | No | Please indicate whether or not the following apply to you | Comments |
|----|-----|----|---|----------|
| 44 | | | Shortness of breath | |
| 45 | | | Lung problem or abnormality | |
| 46 | | | Spit blood | |
| 47 | | | Breathing difficulty after eating particular foods, after exposure to particular pollens or animals | |
| 48 | | | Are you subject to bronchitis | |
| 49 | | | Subcutaneous emphysema (air under the skin) | |
| 50 | | | Air embolism after diving | |
| 51 | | | Decompression sickness | |
| 52 | | | Rheumatic fever | |
| 53 | | | Scarlet fever | |
| 54 | | | Heart murmur | |
| 55 | | | Large heart | |
| 56 | | | High blood pressure | |
| 57 | | | Angina (heart pains or pressure in the chest) | |
| 58 | | | Heart attack | |
| 59 | | | Low blood pressure | |
| 60 | | | Recurrent or persistent swelling of the legs | |
| 61 | | | Pounding, rapid heartbeat or palpitations | |
| 62 | | | Easily fatigued or short of breath | |
| 63 | | | Abnormal EKG | |
| 64 | | | Joint problems, dislocations or arthritis | |
| 65 | | | Back trouble or back injuries | |
| 66 | | | Ruptured or slipped disk | |
| 67 | | | Limiting physical handicaps | |
| 68 | | | Muscle cramps | |
| 69 | | | Varicose veins | |

| | Yes | No | Please indicate whether or not the following apply to you | Comments |
|----|-----|----|--|----------|
| 70 | | | Amputations | |
| 71 | | | Head injury causing unconsciousness | |
| 72 | | | Paralysis | |
| 73 | | | Have you ever had an adverse reaction to medication? | |
| 74 | | | Do you smoke? | |
| 75 | | | Have you ever had any other medical problems not listed? If so, please list or describe below; | |
| 76 | | | Is there a family history of high cholesterol? | |
| 77 | | | Is there a family history of heart disease or stroke? | |
| 78 | | | Is there a family history of diabetes? | |
| 79 | | | Is there a family history of asthma? | |
| 80 | | | Date of last tetanus shot? Vaccination dates? | |

Please explain any "yes" answers to the above questions.

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

Signature

Date

APPENDIX 5 : Diving Emergency Management Procedures

**FOR ALL DIVING EMERGENCIES
CALL 911**

Introduction

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

General Procedures

Depending on and according to the nature of the diving accident, 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. Call appropriate Diving Accident Coordinator for contact with diving physician and recompression chamber. etc.**
- 6. Notify DSO or designee according to the Emergency Action Plan.**
- 7. Complete and submit Incident Report Form(Appendix 9) to the DCB of the organization and the AAUS**

List of Emergency Contact Numbers Appropriate For Dive Location:

APPENDIX 6 : AAUS Ascent Recommendations

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

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

1. Buoyancy compensation is a significant problem in the control of ascents.
2. Training in, and understanding of, proper ascent techniques is fundamental to safe diving practice.
3. Before certification, the diver is to demonstrate proper buoyancy, weighting and a controlled ascent, including a "hovering" stop.
4. Diver shall periodically review proper ascent techniques to maintain proficiency.
5. Ascent rates shall not exceed 30 fsw per minute.
6. A stop at 15 fsw for 3-5 minutes is recommended on every dive.
7. When using a dive computer or tables, non-emergency ascents are to be at the rate specified for the system being used.
8. Each diver shall have instrumentation to monitor ascent rates.
9. Divers using dry suits shall have training in their use.
10. Dry suits shall have a hands-free exhaust valve.
11. Bouyancy Compensator's (BC), shall have a reliable rapid exhaust valve which can be operated in a horizontal swimming position.
12. A BC is required with dry suit use for ascent control and emergency flotation.
13. Breathing 100% oxygen above water is preferred to in-water air procedures for omitted decompression.

APPENDIX 7 : SIO Dive Computer Policy

DIVE COMPUTERS POLICY

1. No specific make or model dive computer is recommended by the Diving Control Board provided they are used according to manufacturer guidelines and the guidelines adopted by AAUS and SIO.
2. Any diver desiring the approval to use a dive computer as a means of determining decompression status must apply to the Diving Control Board, demonstrate appropriate practical knowledge, and pass a written exam.
3. Each diver relying on a dive computer to plan dives and indicate or determine decompression status must have his/her own unit.
4. On any given dive all divers in a buddy team must follow the most conservative dive computer.
5. If the dive computer fails at any time during the dive, the dive must be terminated and appropriate surfacing procedures should be initiated immediately.
6. A diver should not dive for 18 hours before activating a dive computer to use it to control his/her diving.
7. Once a dive computer is in use, it must not be switched off until it indicates complete offgassing has occurred or 18 hours have elapsed, whichever comes first.
8. When using a dive computer, non-emergency ascents are to be conducted at the rate specified for the make and model of dive computer used and shall be controlled at no faster than 30'/min from 60'.
9. Whenever practical, on dives deeper than 50', divers using a dive computer should make a safety stop at 15' for 3-5 minutes.
10. Only 1 dive on the dive computer in which the No-Decompression Limit (NDL) of the computer has been exceeded may be made in any 18 hour period.
11. Repetitive and multi-level diving procedures should start the dive, or series of dives, at the maximum planned depth, followed by subsequent dives of shallower exposure.
12. Multiple deep dives and/or decompression dives require special consideration.

Adapted from SIO Manual for Diving Safety
10th Revision, Nov. 2002

It is recommended that the use of a dive computer not replace the use of a back-up depth gauge and timing device.

Recommended Features:

- Ascent rate monitor, 30'/min. Is it variable? Does it display a warning if too fast?
- Dive log function to review previous dives: depth, time, surface interval, etc.
- NO on/off switch which could result in data loss
- Display depth, time, max. depth, remaining No-Deco time, tissue loading
- Clear "Violation Mode" displays and function
- Low battery indicator
- "Time to Fly" mode, computer tracks time after last dive for 12-24 hours

APPENDIX 8 : Waiver of Liability, Assumption of Risk, and Indemnity Agreement

Participant's name _____

Please Print

UNIVERSITY OF CALIFORNIA, SAN DIEGO

Name of Class or Activity:

Waiver of Liability, Assumption of Risk, and Indemnity Agreement

Waiver: In consideration of being permitted to participate in any way in:

_____ on _____
hereinafter called "The Activity", I, for myself, my heirs, personal representatives or assigns, **do hereby release, waive, discharge, and covenant not to sue** The Regents of the University of California, its officers, employees, and agents from liability **from any and all claims including the negligence of The Regents of the University of California, its officers, employees and agents**, resulting in personal injury, accidents or illnesses (including death), and property loss arising from, but not limited to, participation in The Activity.

Signature of Participant

Date

Signature of Parent/Guardian of Minor

Date

Assumption of Risks: Participation in The Activity carries with it certain inherent risks that cannot be eliminated regardless of the care taken to avoid injuries. The specific risks vary from one activity to another, but the risks range from 1) minor injuries such as scratches, bruises, and sprains 2) major injuries such as eye injury or loss of sight, joint or back injuries, heart attacks, and concussions to 3) catastrophic injuries including paralysis and death.

I have read the previous paragraphs and I know, understand, and appreciate these and other risks that are inherent in The Activity. I hereby **assert that my participation is voluntary and that I knowingly assume all such risks.**

Indemnification and Hold Harmless: I also agree to INDEMNIFY AND HOLD The Regents of the University of California HARMLESS from any and all claims, actions, suits, procedures, costs, expenses, damages and liabilities, including attorney's fees brought as a result of my involvement in The Activity and to reimburse them for any such expenses incurred.

Severability: The undersigned further expressly agrees that the foregoing waiver and assumption of risks agreement is intended to be as broad and inclusive as is permitted by the law of the State of California and that if any portion thereof is held invalid, it is agreed that the balance shall, notwithstanding, continue in full legal force and effect.

Acknowledgment of Understanding: I have read this waiver of liability, assumption of risk, and indemnity agreement, fully understand its terms, and **understand that I am giving up substantial rights, including my right to sue.** I acknowledge that I am signing the agreement freely and voluntarily, and **intend by my signature to be a complete and unconditional release of all liability** to the greatest extent allowed by law.

Signature of Participant

Date

Signature of Parent/Guardian of Minor

Date

Participant's Age (if minor) _____