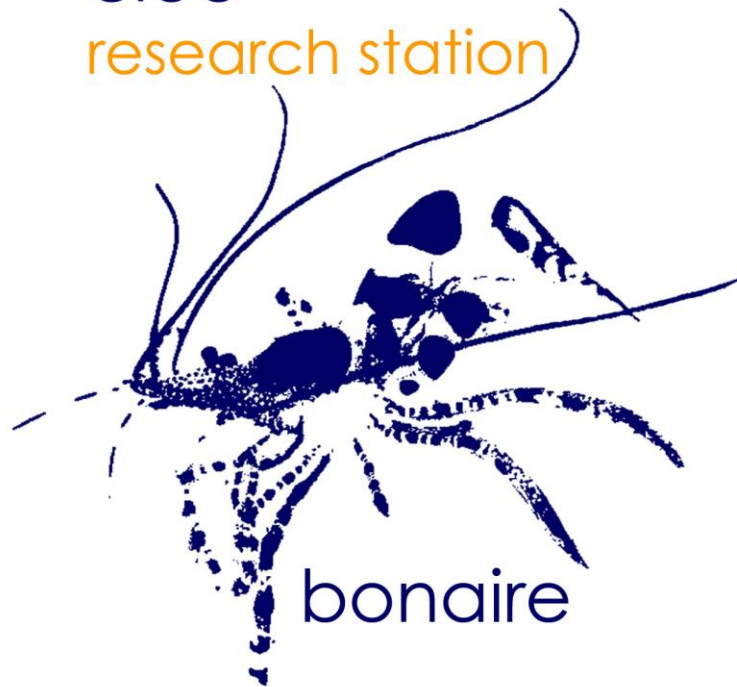


# Diving Safety Manual For

cíee  
research station



**October 2008**

## **FOREWORD**

Since 1951 the scientific diving community has endeavored to promote safe, effective diving through self-imposed diver training and education programs. Over the years, manuals for diving safety have been circulated between organizations, revised and modified for local implementation, and have resulted in an enviable safety record.

This document represents the minimal safety standards for scientific diving at the present day. As diving science progresses so shall this standard, and it is the responsibility of every member of the Academy to see that it always reflects state of the art, safe diving practice.

## **ACKNOWLEDGEMENTS**

CIEE Research Station Bonaire thanks AAUS and the numerous dedicated individual and organizational members for their contributions and editorial comments in the production of these standards. The majority of the text in this manual comes directly from The American Academy of Underwater Sciences Standards for Scientific Diving manual (2005 revision).

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**Volume 1**  
**Sections 1.00 through 6.00**  
**Required For All Organizational Members**

## SECTION 1.00 GENERAL POLICY

### 1.10 Scientific Diving Standards

#### Purpose

The purpose of these Scientific Diving Standards is to ensure that all scientific diving is conducted in a manner that will maximize protection of scientific divers from accidental injury and/or illness, and to set forth standards for training and certification that will allow a working reciprocity between organizational members. Fulfillment of the purposes shall be consistent with the furtherance of research and safety.

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

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

In 1982, OSHA exempted scientific diving from commercial diving regulations (29CFR1910, Subpart T) under certain conditions that are outlined below. The final guidelines for the exemption became effective in 1985 (Federal Register, Vol. 50, No.6, p.1046). AAUS is recognized by OSHA as the scientific diving standard setting organization.

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

#### Scientific Diving Definition

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

#### Scientific Diving Exemption

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

- a) The Diving Control Board consists of a majority of active scientific divers and has autonomous and absolute authority over the scientific diving program's operation.
- b) The purpose of the project using scientific diving is the advancement of science; therefore, information and data resulting from the project are non-proprietary.
- c) The tasks of a scientific diver are those of an observer and data gatherer. Construction and trouble-shooting tasks traditionally associated with commercial diving are not included within scientific diving.
- d) Scientific divers, based on the nature of their activities, must use scientific expertise in studying the underwater environment and therefore, are scientists or scientists-in-training.

- e) In addition, the scientific diving program shall contain at least the following elements (29CFR1910.401):
1. Diving safety manual which includes at a minimum: Procedures covering all diving operations specific to the program; including procedures for emergency care, recompression and evacuation, and the criteria for diver training and certification.
  2. Diving control (safety) board, with the majority of its members being active scientific divers, which shall at a minimum have the authority to: approve and monitor diving projects, review and revise the diving safety manual, assure compliance with the manual, certify the depths to which a diver has been trained, take disciplinary action for unsafe practices, and assure adherence to the buddy system (a diver is accompanied by and is in continuous contact with another diver in the water) for scuba diving.

#### Review of Standards

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

### **1.20 Operational Control**

#### Organizational Member Auspices Defined

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

It is the organizational member's responsibility to adhere to the AAUS Standards for Scientific Diving Certification and Operation of Scientific Diving Programs. The administration of the local diving program will reside with the organizational member's Diving Control Board (DCB).

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

#### Organizational Member's Scientific Diving Standards and Safety Manual

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

- a) AAUS standards may be used as a set of minimal guidelines for the development of an organizational member's scientific diving safety manual. Volume 1, Sections 1.00 through 6.00 and the Appendices are required for all manuals. Volume 2, Sections 7.00 through 9.00 are required only when the organizational member conducts that diving activity. Organizational member specific sections are placed in Volume 2.
- b) Emergency evacuation and medical treatment procedures.
- c) Criteria for diver training and certification.

- d) Standards written or adopted by reference for each diving mode utilized which include the following:
  - 1. Safety procedures for the diving operation.
  - 2. Responsibilities of the dive team members.
  - 3. Equipment use and maintenance procedures.
  - 4. Emergency procedures.

#### Diving Safety Officer

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

##### a) Qualifications

- 1. Shall be appointed by the responsible administrative officer or designee, with the advice and counsel of the Diving Control Board.
- 2. Shall be trained as a scientific diver.
- 3. Shall be a full member as defined by AAUS.
- 4. Shall be an active underwater instructor from a internationally recognized certifying agency.

##### b) Duties and Responsibilities

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

## Diving Control Board

- a) The Diving Control Board (DCB) shall consist of a majority of active scientific divers. Voting members shall include the Diving Safety Officer, the responsible administrative officer, or designee, and should include other representatives of the diving program such as qualified divers and members selected by procedures established by each organizational member. A chairperson and a secretary may be chosen from the membership of the board according to local procedure.
- b) Has autonomous and absolute authority over the scientific diving program's operation.
- c) Shall approve and monitor diving projects.
- d) Shall review and revise the diving safety manual.
- e) Shall assure compliance with the diving safety manual.
- f) Shall certify the depths to which a diver has been trained.
- g) Shall take disciplinary action for unsafe practices.
- h) Shall assure adherence to the buddy system for scuba diving.
- i) Shall act as the official representative of the membership organization in matters concerning the scientific diving program.
- j) Shall act as a board of appeal to consider diver-related problems.
- k) Shall recommend the issue, reissue, or the revocation of diving certifications.
- l) Shall recommend changes in policy and amendments to AAUS and CIEE Research Station Bonaire's (CIEE RSB) diving safety manual as the need arises.
- m) Shall establish and/or approve training programs through which the applicants for certification can satisfy the requirements of CIEE RSB's diving safety manual.
- n) Shall suspend diving programs that are considered to be unsafe or unwise.
- o) Shall establish criteria for equipment selection and use.
- p) Shall recommend new equipment or techniques.
- q) Shall establish and/or approve facilities for the inspection and maintenance of diving and associated equipment.
- r) Shall ensure that CIEE RSB's air station(s) meet air quality standards as described in Section 3.60.
- s) Shall periodically review the Diving Safety Officer's performance and program.
- t) Shall sit as a board of investigation to inquire into the nature and cause of diving accidents or violations of the organizational member's diving safety manual.

## Instructional Personnel

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

## Lead Diver

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

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

## Reciprocity and Visiting Scientific Diver

- a) Two or more AAUS Organizational Members engaged jointly in diving activities, or engaged jointly in the use of diving resources, shall designate one of the participating Diving Control Boards to govern the joint dive project.
- b) A Scientific Diver from one Organizational Member shall apply for permission to dive under the auspices of another Organizational Member by submitting to the Diving Safety Officer of the host Organizational Member a document containing all the information described in Appendix 6, signed by the Diving Safety Officer or Chairperson of the home Diving Control Board.
- c) A visiting Scientific Diver may be asked to demonstrate their knowledge and skills for the planned dive.
- d) If a host Organizational Member denies a visiting Scientific Diver permission to dive, the host Diving Control Board shall notify the visiting Scientific Diver and their Diving Control Board with an explanation of all reasons for the denial.

## Waiver of Requirements

CIEE RSB's Diving Control Board may grant a waiver for specific requirements of training, examinations, depth certification, and minimum activity to maintain certification.

## CIEE RSB Diving Control Board

Dr. Rita Peachey – CIEE Research Station Bonaire Resident Director  
Caren Eckrich – CIEE RSB Assistant Resident Director & Diving Safety Officer  
Dr. Lisa Kellogg – University of Maryland, Department of Biology

### **1.30 Consequence of Violation of Regulations by Scientific Divers**

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

### **1.40 Consequences of Violation of Regulations by Organizational Members**

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

### **1.50 Record Maintenance**

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

#### **Availability of Records:**

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

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

### **2.10 Introduction**

No person shall engage in scientific diving operations under the auspices of CIEE Research Station Bonaire's (CIEE RSB) scientific diving program unless they hold a current certification issued pursuant to the provisions of this standard.

### **2.20 Pre-Dive Procedures**

#### **Dive Plans**

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

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

#### **Pre-dive Safety Checks**

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

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

## **2.30 Diving Procedures**

### **Solo Diving Prohibition**

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

### **Supervision**

Until all scientific divers-in-training have been trained in advanced open water, rescue diving, primary and secondary care and oxygen first aid for scuba diving emergencies, two trained staff members will supervise students during all CIEE RSB dives. The only exception to this is if a student misses a dive and must dive outside of normal class hours. In this case, one staff member will accompany the student.

### **Refusal to Dive**

- a) The decision to dive is that of the diver. A diver may refuse to dive, without fear of penalty, whenever they feel it is unsafe for them to make the dive.
- b) Safety - The ultimate responsibility for safety rests with the individual diver. It is the diver's responsibility and duty to refuse to dive if, in their judgment, conditions are unsafe or unfavorable, or if they would be violating the precepts of their training or the regulations in this standard.

### **Termination of the Dive**

- a) It is the responsibility of the diver to terminate the dive, without fear of penalty, whenever they feel it is unsafe to continue the dive, unless it compromises the safety of another diver already in the water.
- b) The dive shall be terminated while there is still sufficient cylinder pressure to permit the diver to safely reach the surface, including decompression time, or to safely reach an additional air source at the decompression station.

### **Emergencies and Deviations from Regulations**

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

## **2.40 Post-Dive Procedures**

### **Post-Dive Safety Checks**

- a) After the completion of a dive, each diver shall report any physical problems, symptoms of decompression sickness, or equipment malfunctions.
- b) When diving outside the no-decompression limits, the divers should remain awake for at

least 1 hour after diving, and in the company of a dive team member who is prepared to transport them to a decompression chamber if necessary.

### **2.50 Emergency Procedures**

CIEE Research Station Bonaire has developed emergency procedures which follow the standards of care of the community and include procedures for emergency care, recompression and evacuation for each dive location (Volume 3, Section 8 and Appendix 8).

## **2.60 Flying After Diving**

- i) Following a Single No-Decompression Dive: Divers should have a minimum preflight surface interval of 12 hours.
- ii) Following Multiple Dives per Day or Multiple Days of Diving: Divers should have a minimum preflight surface interval of 18 hours.
- iii) Following Dives Requiring Decompression Stops: Divers should have a minimum preflight surface interval of 36 hours.
- iv) Before ascending to Altitude above 1000 feet by Land Transport: Divers should follow the appropriate guideline for preflight surface intervals unless the decompression procedure used has accounted for the increase in elevation.

## **2.70 Record Keeping Requirements**

### **Personal Diving Log**

Each certified scientific diver and diver-in-training shall log every dive made under the auspices of CIEE RSB, and is encouraged to log all other dives. Standard forms will be provided. Log sheets shall be submitted to the Diving Safety Officer to be placed in the diver's permanent file. Details of the submission procedures are left to the discretion of the Diving Safety Officer. The diving log shall be in a form specified by the CIEE RSB and shall include at least the following:

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

### **Required Incident Reporting**

All diving incidents requiring recompression treatment, or resulting in moderate or serious injury, or death shall be reported to CIEE RSB's Diving Control Board and the AAUS. CIEE RSB's regular procedures for incident reporting, including those required by the AAUS, shall be followed. The report will specify the circumstances of the incident and the extent of any injuries or illnesses.

Additional information must meet the following reporting requirements:

- a) CIEE RSB shall record and report occupational injuries and illnesses in accordance with requirements of the appropriate Labor Code section.
- b) If pressure-related injuries are suspected, or if symptoms are evident, the following additional information shall be recorded and retained by CIEE RSB, with the record of the dive, for a period of 5 years:

1. Complete AAUS Incident Report (Appendix 9).
  2. Written descriptive report to include:
    - Name, address, phone numbers of the principal parties involved.
    - Summary of experience of divers involved.
    - Location, description of dive site, and description of conditions that led up to incident.
    - Description of symptoms, including depth and time of onset.
    - Description and results of treatment.
    - Disposition of case.
    - Recommendations to avoid repetition of incident.
- c) CIEE RSB shall investigate and document any incident of pressure-related injury and prepare a report that is to be forwarded to AAUS during the annual reporting cycle. This report must first be reviewed and released by CIEE RSB's Diving Control Board.

## SECTION 3.00 DIVING EQUIPMENT

### 3.10 General Policy

All equipment shall meet standards as determined by the Diving Safety Officer and the Diving Control Board. Equipment that is subjected to extreme usage under adverse conditions should require more frequent testing and maintenance.

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

### 3.20 Equipment

#### Regulators

- a) Scuba regulators shall be inspected and tested prior to first use and every 12 months thereafter.
- b) Regulators will consist of a primary second stage and an alternate air source (such as an octopus second stage or redundant air supply).

#### Breathing Masks and Helmets

Breathing masks and helmets shall have:

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

#### Scuba Cylinders

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

#### Backpacks

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

#### Gauges

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

#### Flotation Devices

- a) Each diver shall have the capability of achieving and maintaining positive buoyancy.
- b) Personal flotation systems, buoyancy compensators, dry suits, or other variable volume buoyancy compensation devices shall be equipped with an exhaust valve.
- c) These devices shall be functionally inspected and tested at intervals not to exceed 12 months.

## Timing Devices, Depth, and Pressure Gauges

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

## Determination of Decompression Status: Dive Tables, Dive Computers

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

### **3.30 Auxiliary Equipment**

Hand held underwater power tools. Electrical tools and equipment used underwater shall be specifically approved for this purpose. Electrical tools and equipment supplied with power from the surface shall be de-energized before being placed into or retrieved from the water. Hand held power tools shall not be supplied with power from the dive location until requested by the diver.

### **3.40 Support Equipment**

#### First aid supplies

A first aid kit and emergency oxygen shall be available.

#### Diver's Flag

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

#### Oxygen System

A DAN oxygen kit will be available on-site during all dive activities.

#### Cellular Phone

A cellular phone will be available on-site during all dive activities.

#### Fire Extinguisher

A fire extinguisher will be available on site during all dive activities.

#### Compressor Systems

CIEE Research Station Bonaire will fill tanks at dive shops where compressor systems have the following:

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

### **3.50 Equipment Maintenance**

#### Record Keeping

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

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

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

**Compressor Operation and Air Test Records**

- a) Gas analyses and air tests shall be performed on breathing air compressors used to fill CIEE RSB dive tanks every 6 months. The results of these tests shall be entered in a formal log and be maintained.
- b) A log shall be maintained showing operation, repair, overhaul, filter maintenance, and temperature adjustment for each compressor.

**3.60 Air Quality Standards**

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

<b>CGA Grade E</b>	
<b>Component</b>	<b>Maximum</b>
Oxygen	20 - 22%/v
Carbon Monoxide	10 PPM/v
Carbon Dioxide	1000 PPM/v
Condensed Hydrocarbons	5 mg/m <sup>3</sup>
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.

## **SECTION 4.00 ENTRY-LEVEL TRAINING REQUIREMENTS**

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

### **4.10 Evaluation**

#### Medical Examination

The applicant for training shall be certified by a licensed physician to be medically qualified for diving before proceeding with the training as designated in Section 4.20 (Section 6.00 and Appendices 1 through 4).

#### Swimming Evaluation

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

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

### **4.20 Scuba Training**

#### Practical Training

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

- a) Enter water with full equipment.
- b) Clear face mask.
- c) Demonstrate air sharing, including both buddy breathing and the use of alternate air source, as both donor and recipient, with and without a face mask.
- d) Demonstrate ability to alternate between snorkel and scuba while kicking.
- e) Demonstrate understanding of underwater signs and signals.
- f) Demonstrate simulated in-water mouth-to-mouth resuscitation.
- g) Rescue and transport, as a diver, a passive simulated victim of an accident.
- h) Demonstrate ability to remove and replace equipment while submerged.
- i) Demonstrate watermanship ability, which is acceptable to the instructor.

## Written Examination

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

- a) Function, care, use, and maintenance of diving equipment.
- b) Physics and physiology of diving.
- c) Diving regulations and precautions.
- d) Near-shore currents and waves.
- e) Dangerous marine animals.
- f) Emergency procedures, including buoyant ascent and ascent by air sharing.
- g) Currently accepted decompression procedures.
- h) Demonstrate the proper use of dive tables.
- i) Underwater communications.
- j) Aspects of freshwater and altitude diving.
- k) Hazards of breath-hold diving and ascents.
- l) Planning and supervision of diving operations.
- m) Diving hazards.
- n) Cause, symptoms, treatment, and prevention of the following: near drowning, air embolism, carbon dioxide excess, squeezes, oxygen poisoning, nitrogen narcosis, exhaustion and panic, respiratory fatigue, motion sickness, decompression sickness, hypothermia, and hypoxia/anoxia.

## Open Water Evaluation

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

- a) Surface dive to a depth of 10 feet in open water without scuba.
- b) Demonstrate proficiency in air sharing as both donor and receiver.
- c) Enter and leave open water or surf, or leave and board a diving vessel, while wearing scuba gear.
- d) Kick on the surface 400 yards while wearing scuba gear, but not breathing from the scuba unit.
- e) Demonstrate judgment adequate for safe diving.
- f) Demonstrate, where appropriate, the ability to maneuver efficiently in the environment, at and below the surface.
- g) Complete a simulated emergency swimming ascent.
- h) Demonstrate clearing of mask and regulator while submerged.
- i) Demonstrate ability to achieve and maintain neutral buoyancy while submerged.
- j) Demonstrate techniques of self-rescue and buddy rescue.
- k) Navigate underwater.
- l) Plan and execute a dive.
- m) Successfully complete 5 open water dives for a minimum total time of 3 hours, of which 1-1/2 hours cumulative bottom time must be on scuba. No more than 3 training dives shall be made in any 1 day.

### **4.30 Diver-In-Training Permit Level**

Diver-in-Training Permit will be granted to divers that meet the medical examination requirements and swimming requirements as stipulated in section 4.10.

## **SECTION 5.00 SCIENTIFIC DIVER CERTIFICATION**

### **5.10 Certification Types**

#### Scientific Diver Certification

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

#### Temporary Diver Permit

This permit constitutes a waiver of the requirements of Section 5.00 and is issued only following a demonstration of the required proficiency in diving. It is valid only for a limited time, as determined by the Diving Safety Officer. This permit is not to be construed as a mechanism to circumvent existing standards set forth in this standard.

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

#### Scientific Diver-In-Training Permit

Permit granted to those eligible (See below). This permit is granted to divers training to become scientific divers.

- a) Eligibility

Must meet the medical examination and scuba training requirements as stipulated in Section 4.10 and 4.20 of this manual.

- b) Application

Must complete the CIEE RSB Scientific Diver-In-Training application form.

- c) Medical Examination

Must complete and pass the medical examination as specified in Section 4.10.

### **5.20 General Policy**

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

### **5.30 Requirements For Scientific Diver Certification**

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

#### Prerequisites

- a) Application - Application for certification shall be made to the Diving Safety Officer on

the form prescribed by CIEE RSB.

- b) Medical approval. Each applicant for diver certification shall submit a statement from a licensed physician, based on an approved medical examination, attesting to the applicant's fitness for diving (Section 6.00 and Appendices 1 through 4).
- c) Scientific Diver-In-Training Permit - This permit signifies that a diver has completed and been certified as at least an open water diver through an internationally recognized certifying agency or scientific diving program, and has the knowledge skills and experience equivalent to that gained by successful completion of training as specified in Section 4.00.

### Theoretical and Practical Training

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

- a) Required Topics (include, but not limited to):
  1. Diving Emergency Care Training
    - Cardiopulmonary Resuscitation (CPR)
    - Standard or Basic First Aid
    - Recognition of DCS and AGE
    - Accident Management
    - Field Neurological Exam
    - Oxygen Administration
  2. Dive Rescue
  3. Dive Physics
  4. Dive Physiology
  5. Dive Environments
  6. Decompression Theory and its Application
  7. AAUS Scientific Diving Regulations and History
    - Scientific Dive Planning
    - Coordination with other Agencies
    - Appropriate Governmental Regulations
  8. Scientific Method
  9. Data Gathering Techniques (Only items specific to area of study are required)
    - Quadrating
    - Transecting
    - Mapping
    - Coring
    - Photography
    - Tagging
    - Collecting

- Animal Handling
- Archaeology
- Common Biota
- Organism Identification
- Behavior
- Ecology
- Site Selection, Location, and Re-location
- Specialized Equipment for data gathering
- HazMat Training
- HP Cylinders
- Chemical Hygiene, Laboratory Safety (Use Of Chemicals)

b) Suggested Topics (include, but not limited to):

1. Specific Dive Modes (methods of gas delivery)
  - Open Circuit
  - Hooka
  - Surface Supplied diving
2. Small Boat Operation
3. Rebreathers
  - Closed
  - Semi-closed
4. Specialized Breathing Gas
  - Nitrox
  - Mixed Gas
5. Specialized Environments and Conditions
  - Blue Water Diving,
  - Ice and Polar Diving (Cold Water Diving)
  - Zero Visibility Diving
  - Polluted Water Diving,
  - Saturation Diving
  - Decompression Diving
  - Overhead Environments
  - Aquarium Diving
  - Night Diving
  - Kelp Diving
  - Strong Current Diving (Live-boating)
  - Potential Entanglement
6. Specialized Diving Equipment
  - Full face mask
  - Dry Suit
  - Communications

c) Practical training must include a checkout dive, with evaluation of the skills listed in

Section 4.20 (Open Water Evaluation), with the DSO or qualified delegate followed by at least 11 ocean or open water dives in a variety of dive sites and diving conditions, for a cumulative bottom time of 6 hours. Dives following the checkout dive must be supervised by a certified Scientific Diver with experience in the type of diving planned, with the knowledge and permission of the DSO.

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

## 5.40 Depth Certifications

### Depth Certifications and Progression to Next Depth Level

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

- a) Certification to 30 Foot Depth - Initial permit level, approved upon the successful completion of training listed in Section 4.00 and 5.30.
- b) Certification to 60 Foot Depth - A diver holding a 30 foot certificate may be certified to a depth of 60 feet after successfully completing, under supervision, 12 logged training dives to depths between 31 and 60 feet, for a minimum total time of 4 hours.
- c) Certification to 100 Foot Depth - A diver holding a 60 foot certificate may be certified to a depth of 100 feet after successfully completing, 4 dives to depths between 61 and 100 feet. The diver shall also demonstrate proficiency in the use of the appropriate Dive Tables.
- d) Certification to 130 Foot Depth - A diver holding a 100 foot certificate may be certified to a depth of 130 feet after successfully completing, 4 dives to depths between 100 and 130 feet. The diver shall also demonstrate proficiency in the use of the appropriate Dive Tables.
- e) Certification to 150 Foot Depth - A diver holding a 130 foot certificate may be certified to a depth of 150 feet after successfully completing, 4 dives to depths between 130 and 150 feet. The diver must also demonstrate knowledge of the special problems of deep diving, and of special safety requirements.
- f) Certification to 190 Foot Depth - A diver holding a 150 foot certificate may be certified to a depth of 190 feet after successfully completing, 4 dives to depths between 150 and 190 feet. The diver must also demonstrate knowledge of the special problems of deep diving, and of special safety requirements.

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

## **5.50 Continuation of Certificate**

### **Minimum Activity to Maintain Certification**

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

### **Re-qualification of Depth Certificate**

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

### **Medical Examination**

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

### **Emergency Care Training.**

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

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

## **5.60 Revocation of Certification**

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

## **5.70 Recertification**

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

## SECTION 6.00 MEDICAL STANDARDS

### 6.10 Medical Requirements

#### General

- a) CIEE RSB shall determine that divers have passed a current diving physical examination and have been declared by the examining physician to be fit to engage in diving activities as may be limited or restricted in the medical evaluation report.
- b) All medical evaluations required by this standard shall be performed by, or under the direction of, a licensed physician of the applicant-diver's choice, preferably one trained in diving/undersea medicine.
- c) The diver should be free of any chronic disabling disease and be free of any conditions contained in the list of conditions for which restrictions from diving are generally recommended. (Appendix 1)

#### Frequency of Medical Evaluations

Medical evaluation shall be completed:

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

#### Information Provided Examining Physician

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

#### Content of Medical Evaluations

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

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

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

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

## Laboratory Requirements for Diving Medical Evaluation and Intervals.

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

- c) Initial exam over age 40:
- \* Medical History
  - \* Complete Physical Exam, emphasis on neurological and otological components
  - \* Assessment of coronary artery disease using Multiple-Risk-Factor Assessment<sup>1</sup> (age, lipid profile, blood pressure, diabetic screening, smoker)
  - \* Resting EKG
  - \* Chest X-ray
  - \* Spirometry
  - \* Urinalysis
  - \* Hematocrit or Hemoglobin
  - \* Any further tests deemed necessary by the physician
  - \* Exercise stress testing may be indicated based on risk factor assessment.<sup>2</sup>
- d) Periodic re-examination over age 40 (every 3 years); over age 60 (every 2 years):
- \* Medical History
  - \* Complete Physical Exam, emphasis on neurological and otological components
  - \* Assessment of coronary artery disease using Multiple-Risk-Factor Assessment<sup>1</sup> (age, lipid profile, blood pressure, diabetic screening, smoker)
  - \* Resting EKG
  - \* Urinalysis
  - \* Hematocrit or Hemoglobin
  - \* Any further tests deemed necessary by the physician
  - \* Exercise stress testing may be indicated based on risk factor assessment.<sup>2</sup>
- e) Physician's Written Report
1. After any medical examination relating to the individual's fitness to dive, the organizational member shall obtain a written report prepared by the examining physician, that shall contain the examining physician's opinion of the individual's fitness to dive, including any recommended restrictions or limitations. This will be reviewed by the DCB.
  2. The organizational member shall make a copy of the physician's written report available to the individual.

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

<sup>2</sup> Gibbons RJ, et al. ACC/AHA Guidelines for Exercise Testing. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Exercise Testing). Journal of the American College of Cardiology. 30:260-311, 1997. <http://www.acc.org/clinical/guidelines/exercise/exercise.pdf>

# Volume 2

## SECTION 7.00 NITROX DIVING GUIDELINES

The following guidelines address the use of nitrox by scientific divers under the auspices of CIEE RSB. Nitrox is defined for these guidelines as breathing mixtures composed predominately of nitrogen and oxygen, most commonly produced by the addition of oxygen or the removal of nitrogen from air.

### 7.10 Prerequisites

#### Eligibility

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

#### Application and Documentation

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

### 7.20 Requirements for Authorization to Use Nitrox

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

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

#### Training

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

#### Examinations

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

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

## Minimum Activity to Maintain Authorization

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

### 7.30 Nitrox Training Guidelines

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

#### Classroom Instruction

- d) Topics should include, but are not limited to: review of previous training; physical gas laws pertaining to nitrox; partial pressure calculations and limits; equivalent air depth (EAD) concept and calculations; oxygen physiology and oxygen toxicity; calculation of oxygen exposure and maximum safe operating depth (MOD); determination of decompression schedules (both by EAD method using approved air dive tables, and using approved nitrox dive tables); dive planning and emergency procedures; mixing procedures and calculations; gas analysis; personnel requirements; equipment marking and maintenance requirements; dive station requirements.
- e) DCB may choose to limit standard nitrox diver training to procedures applicable to diving, and subsequently reserve training such as nitrox production methods, oxygen cleaning, and dive station topics to divers requiring specialized authorization in these areas.

#### Practical Training

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

- a) Oxygen analysis of nitrox mixtures.
- b) Determination of MOD, oxygen partial pressure exposure, and oxygen toxicity time limits, for various nitrox mixtures at various depths.
- c) Determination of nitrogen-based dive limits status by EAD method using air dive tables, and/or using nitrox dive tables, as approved by the DCB.
- d) Nitrox dive computer use may be included, as approved by the DCB.

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

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

- a) Function, care, use, and maintenance of equipment cleaned for nitrox use.
- b) Physical and physiological considerations of nitrox diving (ex.: O<sub>2</sub> and CO<sub>2</sub> toxicity).
- c) Diving regulations and procedures as related to nitrox diving, either scuba or surface-supplied (depending on intended mode).
- d) Given the proper information, calculation of:

1. Equivalent air depth (EAD) for a given  $fO_2$  and actual depth;
  2.  $pO_2$  exposure for a given  $fO_2$  and depth;
  3. Optimal nitrox mixture for a given  $pO_2$  exposure limit and planned depth;
  4. Maximum operational depth (MOD) for a given mix and  $pO_2$  exposure limit;
  5. For nitrox production purposes, percentages/psi of oxygen present in a given mixture, and psi of each gas required to produce a  $fO_2$  by partial pressure mixing.
- e) Dive table and dive computer selection and usage;
  - f) Nitrox production methods and considerations.
  - g) Oxygen analysis.
  - h) Nitrox operational guidelines (Section 7.40), dive planning, and dive station components.

### Openwater Dives

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

### Surface-Supplied Training

All training as applied to surface-supplied diving (practical, classroom, and openwater) will follow the member organization's surface-supplied diving standards, including additions listed in Section 11.60.

## 7.40 Scientific Nitrox Diving Regulations

### Dive Personnel Requirements

- a) Nitrox Diver In Training - A Diver In Training, who has completed the requirements of Section 4.00 and the training and authorization sections of these guidelines, may be authorized by the DSO to use nitrox under the direct supervision a Scientific Diver who also holds nitrox authorization. Dive depths should be restricted to those specified in the diver's authorization.
- b) Scientific Diver - A Scientific Diver who has completed the requirements of Section 5.00 and the training and authorization sections of these guidelines, may be authorized by the DSO to use nitrox. Depth authorization to use nitrox should be the same as those specified in the diver's authorization, as described in Section. 5.40.
- c) Lead Diver - On any dive during which nitrox will be used by any team member, the Lead Diver should be authorized to use nitrox, and hold appropriate authorizations required for the dive, as specified in AAUS Standards. Lead Diver authorization for nitrox dives by the DSO and/or DCB should occur as part of the dive plan approval process.

In addition to responsibilities listed in Section 1.20, the Lead Diver should:

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

#### Dive Parameters

##### a) Oxygen Exposure Limits

1. The inspired oxygen partial pressure experienced at depth should not exceed 1.6 ATA. All dives performed using nitrox breathing mixtures should comply with the current *NOAA Diving Manual* "Oxygen Partial Pressure Limits for 'Normal' Exposures"
2. The maximum allowable exposure limit should be reduced in cases where cold or strenuous dive conditions, or extended exposure times are expected. The DCB should consider this in the review of any dive plan application, which proposes to use nitrox. The Lead Diver should also review on-site conditions and reduce the allowable pO<sub>2</sub> exposure limits if conditions indicate.
3. If using the equivalent air depth (EAD) method the maximum depth of a dive should be based on the oxygen partial pressure for the specific nitrox breathing mix to be used.

##### b) Bottom Time Limits

1. Maximum bottom time should be based on the depth of the dive and the nitrox mixture being used.
2. Bottom time for a single dive should not exceed the NOAA maximum allowable "Single Exposure Limit" for a given oxygen partial pressure, as listed in the current NOAA Diving Manual.

##### c) Dive Tables and Gases

1. A set of DCB approved nitrox dive tables should be available at the dive site.
2. When using the equivalent air depth (EAD) method, dives should be conducted using air dive tables approved by the DCB.
3. If nitrox is used to increase the safety margin of air-based dive tables, the MOD and oxygen exposure and time limits for the nitrox mixture being dived should not be exceeded
4. Breathing mixtures used while performing in-water decompression, or for bail-out purposes, should contain the same or greater oxygen content as that being used during the dive, within the confines of depth limitations and oxygen partial pressure limits set forth in Section 7.40 Dive Parameters.

##### d) Nitrox Dive Computers

1. Dive computers may be used to compute decompression status during nitrox dives. Manufacturers' guidelines and operations instructions should be followed.
2. Use of Nitrox dive computers should comply with dive computer guidelines included in the AAUS Standards.
3. Nitrox dive computer users should demonstrate a clear understanding of the display, operations, and manipulation of the unit being used for nitrox diving prior to using the computer, to the satisfaction of the DSO or designee.
4. If nitrox is used to increase the safety margin of an air-based dive computer, the MOD and oxygen exposure and time limits for the nitrox mixture being dived should not be exceeded.
5. Dive computers capable of pO<sub>2</sub> limit and fO<sub>2</sub> adjustment should be checked by the diver prior to the start each dive to assure compatibility with the mix being used.

e) Repetitive Diving

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

f) Oxygen Parameters

1. Authorized Mixtures - Mixtures meeting the criteria outlined in Section 7.40 may be used for nitrox diving operations, upon approval of the DCB.
2. Purity - Oxygen used for mixing nitrox-breathing gas should meet the purity levels for "Medical Grade" (U.S.P.) or "Aviator Grade" standards.

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

- a. Placed in contact with oxygen concentrations greater than 40%.
- b. Used in nitrox production by the partial pressure mixing method with gas mixtures containing greater than 40% oxygen as the enriching agent.

Air Purity: CGA Grade E (Section 3.60)	
Condensed Hydrocarbons	5mg/m <sup>3</sup>
Hydrocarbon Contaminants	No greater than 0.1 mg/m <sup>3</sup>

g) Gas Mixing and Analysis for Organizational Members

1. Personnel Requirements
  - a. Individuals responsible for producing and/or analyzing nitrox mixtures should be knowledgeable and experienced in all aspects of the technique.
  - b. Only those individuals approved by the DSO and/or DCB should be responsible for mixing and/or analyzing nitrox mixtures.
2. Production Methods - It is the responsibility of the DCB to approve the specific nitrox production method used.
3. Analysis Verification by User
  - a. It is the responsibility of each diver to analyze prior to the dive the oxygen content of his/her scuba cylinder and acknowledge in writing the following information for each cylinder:  $fO_2$ , MOD, cylinder pressure, date of analysis, and user's name.
  - b. Individual dive log reporting forms should report  $fO_2$  of nitrox used, if different than 21%.

### **7.50 Nitrox Diving Equipment**

All of the designated equipment and stated requirements regarding scuba equipment required in the AAUS Standards should apply to nitrox scuba operations. Additional minimal equipment necessary for nitrox diving operations includes:

- Labeled SCUBA Cylinders
- Oxygen Analyzers

#### **Oxygen Cleaning and Maintenance Requirements**

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

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

1. Cylinders should be marked “NITROX”, or “EANx”, or “Enriched Air”.
  2. Nitrox identification color-coding should include a 4-inch wide green band around the cylinder, starting immediately below the shoulder curvature. If the cylinder is not yellow, the green band should be bordered above and below by a 1-inch yellow band.
  3. The alternate marking of a yellow cylinder by painting the cylinder crown green and printing the word “NITROX” parallel to the length of the cylinder in green print is acceptable.
  4. Other markings, which identify the cylinder as containing gas mixes other than Air, may be used as the approval of the DCB.
  5. A contents label should be affixed, to include the current  $fO_2$ , date of analysis, and MOD.
  6. The cylinder should be labeled to indicate whether the cylinder is prepared for oxygen or nitrox mixtures containing greater than 40% oxygen.
- c) Regulators - Regulators to be used with nitrox mixtures containing greater than 40% oxygen should be cleaned and maintained for oxygen service, and marked in an identifying manner.
- d) Other Support Equipment
1. An oxygen analyzer is required which is capable of determining the oxygen content in the scuba cylinder. Two analyzers are recommended to reduce the likelihood of errors due to a faulty analyzer. The analyzer should be capable of reading a scale of 0 to 100% oxygen, within 1% accuracy.
  2. All diver and support equipment should be suitable for the  $fO_2$  being used.
- e) Compressor system
1. Compressor/filtration system must produce oil-free air.
  2. An oil-lubricated compressor placed in service for a nitrox system should be checked for oil and hydrocarbon contamination at least quarterly.
- f) Fill Station Components - All components of a nitrox fill station that will contact nitrox mixtures containing greater than 40% oxygen should be cleaned and maintained for oxygen service. This includes cylinders, whips, gauges, valves, and connecting lines.

# Volume 3

## Section 8.00 CIEE RSB DIVING EMERGENCY PLAN

This plan is designed to be an outline of the emergency procedures that CIEE Research Station Bonaire has implemented in order to protect our staff, students, and other program participants. In the event of an emergency, this Emergency Procedure Plan describes the initial responsibilities and actions to be taken to protect all employees until the appropriate responders take over. 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.

### 8.10 Responsibility

It is a requirement that CIEE RSB review with each employee upon their initial assignment, and each student upon arrival in Bonaire, those parts of the plan that the employee or student must know to protect her/himself in the event of an emergency. In addition, the written plan shall be made available for employees and students to review and prepare for their duties.

### 8.20 General Procedures

It is impossible to provide specific information for all situations. Therefore, this plan is a guide for employees and students to familiarize themselves with basic emergency planning, response and evaluation. Begin by reviewing Diving Emergency Management Procedure (Appendix 8).

### 8.30 Prerequisites for Instructors and Staff:

Instructors must be certified as professional members of the recreational dive industry (Divemaster, Assistant Instructor, Open Water Instructor or above), and instructors and staff must be certified in CPR and first aid, as well as knowledgeable in boat safety, swimming, communications, and local weather conditions

### 8.40 First Aid Equipment and Location

The following items will be on location for open water activities:

- CIEE RSB Emergency Procedures
- First Aid Kit
- Emergency Oxygen
- Cellular Phone
- Fire extinguisher

### 8.50 Emergency Personnel

Caren Eckrich, Dive Safety Officer  
(599) 717-4140 - CIEE  
(599) 701-7394 - Mobile  
(599) 717-5322 - Home

Rita Peachey, Resident Director  
(599) 717-4140; 786-7394

PADI Open Water Instructor, EFR  
Instructor, DAN oxygen first aid for  
scuba diving injuries instructor

PADI Divemaster, First Aid, CPR and  
Oxygen administration certified

CIEE RSB Intern – Amy Milman  
(599) 717-4140 – CIEE  
(599) 785-3147 – Mobile

CIEE RSB Intern – Kelsey Burns  
(599) 717-4140 – CIEE  
(599) 788-3966 – Mobile

CIEE RSB Tropical Marine Cons. Instructor  
(599) 717-4140 – CIEE  
(599)785-3150 - Mobile

PADI Divemaster, First Aid, CPR and  
Oxygen administration certified

PADI Rescue Diver, First Aid, CPR and  
Oxygen administration certified

PADI Open Water Diver, First Aid, CPR  
and Oxygen administration certified

## **8.60 Emergency Communication**

Fixed telephone line at the CIEE Research Station Bonaire (599) 717-4140

Cellular phone at location (599) 701-7394, (599) 786-7394, or (599) 785-3150

## **8.70 Roles of First Responders**

1. Immediate care of the injured or ill - establish (A)irway, (B)reathing, (C)irculation and stabilize the victim.
2. Emergency equipment retrieval from the vehicle/boat – administer 100% oxygen if appropriate (in cases of Decompression Illness or Near Drowning)
3. Activation of emergency medical system (EMS)
  - Call 911
  - Provide your name  
CIEE Research Station Bonaire  
Kaya Gobernador Debrot 21
  - Telephone number: Cell phones: 701-7394; 786-7394; 785-3150 CIEE Office 717-4140
  - Number of individuals injured:
  - Condition of injured:
  - First aid treatment:
4. Direction of EMS to scene
  - State the dive site name (Directions to dive sites follow this section)
  - Designate individual to "flag down" EMS and direct to scene
  - Scene control: limit scene to first aid providers and move bystanders away from area
5. Transport of victim to hospital

**IF EMS IS DELAYED AND YOU CAN CONTINUE TREATING THE PATIENT WHILE TRANSPORTING HIM/HER TO THE HOSPITAL:**

- Call the hospital 717-8900 and tell them to make sure a doctor is waiting to meet you at the hyperbaric chamber.  
Dr. Van der Vaart office: 717-7140; 717-7141;  
Dr. Miranda cellular: 785-7080; office: 717-8316

- **If you have no confirmation that a doctor is waiting at the hyperbaric chamber, go directly to the hospital:** Pass Cultimara and continue about 200m. The entrance is on the right-hand side of the street (A map of Kralendijk is at the end of this section).
- **If you are told to meet the doctor at the hyperbaric chamber, directions to hyperbaric chamber are:** Pass Cultimara, take a right on the first small road after the yellow building opposite Cultimara. Immediately park on the left and the hyperbaric chamber is in a small building forward and to the left of your vehicle. It is not marked and looks run-down. It is just before the entrance to the hospital (A map of Kralendijk is at the end of this section).
- Contact CIEE RSB Dive Safety Officer, Caren Eckrich – cell 701-7394, work 717-4140, home 717-5322
- Record current complaint of injured diver(s):
- Record significant past medical history (medications, allergies, previous injuries, etc.):
- Record dive profile information of the injured diver(s) and, if possible, bring dive computer along with the diver to the hospital.

Dive Profile	Depth	Time	Surface Interval
Dive #1			
Dive #2			
Dive #3			
Dive #4			
Exit Water Time:		Breathing Gas:	

- Emergency contact information for each diver:

**Name of Diver    Emergency Relationship    Emergency Contact Information**

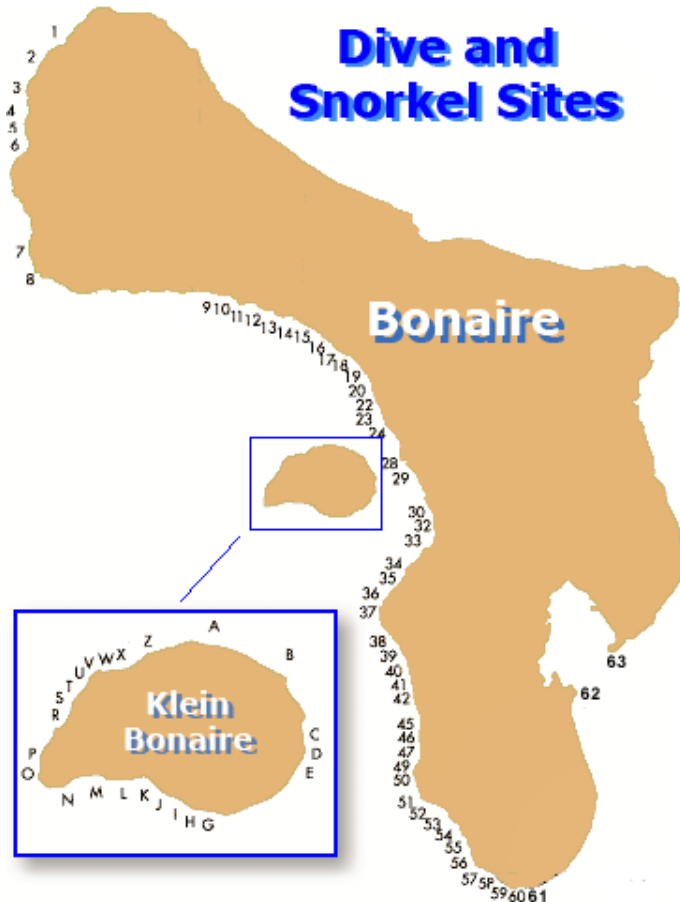
**Contact**

Diver 1	Emergency Contact	Relationship	Emergency Contact Info	Medical Allergies
Diver 2				
Diver 3				
Diver 4				
Diver 5				
Diver 6				
Diver 7				

- Complete and submit Incident Report Form ([www.aaus.org](http://www.aaus.org)) to the CIEE RSB DCB and the AAUS (Section 2.70 Required Incident Reporting).

## 8.80 Directions to Dive Sites, Kralendijk

**Yellow Submarine Dive Site** is on the north end of the seaside boulevard, Kaya Playa Lechi. Other sites are indicated on the following page:



- |                       |                            |                         |                      |
|-----------------------|----------------------------|-------------------------|----------------------|
| 1. Boca Bartol        | 23. Andrea I               | 45. Alice in Wonderland | D. Just a Nice Dive  |
| 2. Playa Bengi        | 24. Petries Pillar         | 46. Aquarius            | E. Nearest Point     |
| 3. Playa Funchi       | 25. Small Wall             | 47. Larry's Lair        | G. Bonadventure      |
| 4. Bise Morto         | 26. Cliff                  | 48. Jeannie's Glory     | H. Monte's Divi      |
| 5. Wayaca             | 27. La Machaca(Habitat)    | 49. Salt Pier           | I. Rock Pile         |
| 6. Boca Slagbaai      | 28. Reef Scientifico       | 50. Salt City           | J. Joanne's Sunchi   |
| 7. Nukove             | 29. Buddy's Reef           | 51. Invisibles          | K. Capt. Don's Reef  |
| 8. Carel's Vision     | 30. Bari Reef (SandDollar) | 52. Tori's Reef         | L. South Bay         |
| 9. Karpata            | 31. Front Porch (EdenB)    | 53. Pink Beach          | M. Hands Off         |
| 10. La Dania's Leap   | 32. Something Special      | 54. White Slave         | N. Forest            |
| 11. Rappel            | 33. Town Pier              | 55. Margate Bay         | O. Southwest Corner  |
| 12. Bloodlet          | 34. Calabas Reef           | 56. Red Beryl           | P. Munk's Haven      |
| 13. Ol' Blue          | 35. Eighteen Palm (Plaza)  | 57. Atlantis            | R. Sharon's Serenity |
| 14. Country Garden    | 36. Windsock               | 58. Vista Blue          | T. Mi Dushi          |
| 15. Bon Bini Cas      | 37. North Belnem           | 59. Sweet Dreams        | U. Yellowman's Reef  |
| 16. 1000 Steps        | 38. Bachelor's Beach       | 60. Red Slave           | V. Carl's Hill       |
| 17. Weberjoy/WitchHut | 39. Chez Hines             | 61. Willemst.Lighthouse | W. Ebo's Special     |
| 18. Jeff Davis        | 40. Lighthouse Point       | 62. Blue Hole           | X. Leonora's Reef    |
| 19. Kalli's Reef      | 41. Punt Vierkant          | 63. Lac Cai             | Y. Knife             |
| 20. Oil Slick Leap    | 42. The Lake               | A. No Name              | Z. Sampler           |
| 21. Barcadera         | 43. Hilma Hooker           | B. Ebo's Reef           |                      |
| 22. Andrea II         | 44. Angel City             | C. Jerry's Reef         |                      |

Map of Kralendijk

Airport

NORTH



Bonaire Warehouse Supermarket X

Lisa Gas X

Plaza Resort X

DIVI FLAMINGO RESORT

STADIUM X

Ocean

KAYA GRANDI

Kralendijk

Ocean

Church X

X

X MCB BANK  
Cultimara Supermarket

Hyperbaric Chamber & Hospital X X

SEASIDE PROMENADE

Kaya Gobernador Debrot

CIEE

Marlis Sail & Canvas

Pasa Bon Pizza X

YELLOW SUBMARINE

HARBOR VILLAGE MARINA X

SAND DOLLAR

1 mile

## 8.90 Scuba Emergency Support Information

Diver's Alert Network (DAN) +1-919-684-4326\* or +1-919-684-8111

DAN TravelAssist +1-215-245-2461\* or 1-800-DAN EVAC (326-3822)

\*These numbers may be called collect in an emergency.

## 8.91 First Aid for Marine Life Injuries

*\*necessity of hospitalization is dependent on size of wound, allergic reaction, or animal in question  
(extracted from DAN Travel and Dive Medical Guide, 2006)*

### Puncture Wounds

Large objects should not be removed, but stabilized in place with bandaging

Small objects should be removed as soon as possible

### Venomous Bites

Apply extreme heat as soon as possible (heat pack, hot shower)

### Contact Wounds (closed)

**Sponges/Bristle Worms** – skin should be gently dried, spicules removed with adhesive tape followed by a vinegar soak.

**Jellies** - *using seawater and gloves*, remove tentacles from skin (\*use of freshwater or alcohol will cause unfired nematocysts to discharge). To treat pain apply vinegar to disable nematocysts. Immerse the area in hot water/shower for 30-90 minutes. DO NOT RUB.

**Stingrays** – irrigate the wound to remove surface venom and attempt to extract the spine and integument (spine membrane). Immerse in hot water 30-90 minutes, monitor pulse and respiration, providing resuscitation if needed. Hospitalize if severe.

**Fish Lacerations/Stings** – elevate affected area, apply local, adrenaline-free anesthetic for pain relief, immerse wound in hot water for 30-90 minutes. Remove foreign body (including integument), hospitalize if needed.

# Appendices

**Appendix 1 through 9  
Required For All Organizational Members**

**APPENDIX 1**  
**DIVING MEDICAL EXAM OVERVIEW FOR THE EXAMINING PHYSICIAN**

TO THE EXAMINING PHYSICIAN:

This person, \_\_\_\_\_, requires a medical examination to assess their fitness for certification as a Scientific Diver for the \_\_\_\_\_.

Organizational Member

Diving Medical History Form (attached) may indicate potential health or safety risks as noted. Your evaluation is requested on the attached scuba Diving Fitness Medical Evaluation Report. If you have questions about diving medicine, you may wish to consult one of the references on the attached list or contact one of the physicians with expertise in diving medicine whose names and phone numbers appear on an attached list. Please contact the undersigned Diving Safety Officer if you have any questions or concerns about diving medicine or the \_\_\_\_\_ standards. Thank you for your assistance.

Organizational Member

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

\_\_\_\_\_  
Date

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Phone Number

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

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

**CONDITIONS WHICH MAY DISQUALIFY CANDIDATES FROM DIVING**

1. Abnormalities of the tympanic membrane, such as perforation, presence of a monomeric membrane, or inability to autoinflate the middle ears. [5 ,7, 8, 9]
2. Vertigo including Meniere’s Disease. [13]
3. Stapedectomy or middle ear reconstructive surgery. [11]
4. Recent ocular surgery. [15, 18, 19]
5. Psychiatric disorders including claustrophobia, suicidal ideation, psychosis, anxiety states, untreated depression. [20 - 23]
6. Substance abuse, including alcohol. [24 - 25]
7. Episodic loss of consciousness. [1, 26, 27]
8. History of seizure. [27, 28]
9. History of stroke or a fixed neurological deficit. [29, 30]
10. Recurring neurologic disorders, including transient ischemic attacks. [29, 30]
11. History of intracranial aneurysm, other vascular malformation or intracranial hemorrhage. [31]
12. History of neurological decompression illness with residual deficit. [29, 30]
13. Head injury with sequelae. [26, 27]
14. Hematologic disorders including coagulopathies. [41, 42]
15. Evidence of coronary artery disease or high risk for coronary artery disease<sup>3</sup>. [33 - 35]

<sup>3</sup> “Assessment of Cardiovascular Risk by Use of Multiple-Risk-Factor Assessment Equations.” Grundy et. al. 1999. AHA/ACC Scientific Statement. <http://www.acc.org/clinical/consensus/risk/risk1999.pdf>

16. Atrial septal defects. [39]
17. Significant valvular heart disease - isolated mitral valve prolapse is not disqualifying. [38]
18. Significant cardiac rhythm or conduction abnormalities. [36 - 37]
19. Implanted cardiac pacemakers and cardiac defibrillators (ICD). [39, 40]
20. Inadequate exercise tolerance. [34]
21. Severe hypertension. [35]
22. History of spontaneous or traumatic pneumothorax. [45]
23. Asthma<sup>4</sup>. [42 - 44]
24. Chronic pulmonary disease, including radiographic evidence of pulmonary blebs, bullae, or cysts. [45,46]
25. Diabetes mellitus. [46 - 47]
26. Pregnancy. [56]

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### SELECTED REFERENCES IN DIVING MEDICINE

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

- ACC/AHA Guidelines for Exercise Testing. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Exercise Testing). Gibbons RJ, et al. 1997. Journal of the American College of Cardiology. 30:260-311. <http://www.acc.org/clinical/guidelines/exercise/exercise.pdf>
- Alert Diver Magazine; Articles on diving medicine <http://www.diversalertnetwork.org/medical/articles/index.asp>
- “Are Asthmatics Fit to Dive? “ Elliott DH, ed. 1996 Undersea and Hyperbaric Medical Society, Kensington, MD.
- “Assessment of Cardiovascular Risk by Use of Multiple-Risk-Factor Assessment Equations.” Grundy et. al. 1999. AHA/ACC Scientific Statement. <http://www.acc.org/clinical/consensus/risk/risk1999.pdf>
- DIVING MEDICINE, Third Edition, 1997. A. Bove and J. Davis. W.B. Saunders Company, Philadelphia
- DIVING AND SUBAQUATIC MEDICINE, Third Edition, 1994. C. Edmonds, C. Lowery and J. Pennefather. Butterworth-Heinemann Ltd. Oxford
- MEDICAL EXAMINATION OF SPORT SCUBA DIVERS, 1998. Alfred Bove, M.D., Ph.D. (ed.). Medical Seminars, Inc. San Antonio, TX
- NOAA DIVING MANUAL, NOAA. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.
- U.S. NAVY DIVING MANUAL. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.

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

**APPENDIX 2**  
**MEDICAL EVALUATION OF FITNESS FOR SCUBA DIVING REPORT**

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

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

To The PHYSICIAN:

This person is an applicant for training or is presently certified to engage in diving with self-contained underwater breathing apparatus (scuba). This is an activity that puts unusual stress on the individual in several ways. Your opinion on the applicant's medical fitness is requested. Scuba diving requires heavy exertion. The diver must be free of cardiovascular and respiratory disease. An absolute requirement is the ability of the lungs, middle ear and sinuses to equalize pressure. Any condition that risks the loss of consciousness should disqualify the applicant.

**TESTS:** Please initial that the following tests were completed.

**[ ] Initial Examination**

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

**Additional testing for first over age 40**

- \_\_\_\_\_ Resting EKG
- \_\_\_\_\_ Assessment of coronary artery disease using Multiple-Risk-Factor Assessment<sup>5</sup>  
(age, lipid profile, blood pressure, diabetic screening, smoker) Note: Exercise stress testing may be indicated based on risk factor assessment<sup>6</sup>

**[ ] Re-examination**

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

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

**Additional testing for over age 40**

- \_\_\_\_\_ Resting EKG
- \_\_\_\_\_ Assessment of coronary artery disease using Multiple-Risk-Factor Assessment<sup>5</sup>  
(age, lipid profile, blood pressure, diabetic screening, smoker) Note: Exercise stress testing may be indicated based on risk factor assessment<sup>6</sup>

**RECOMMENDATION:**

- [ ] APPROVAL. I find no medical condition(s) that I consider incompatible with diving.
- [ ] RESTRICTED ACTIVITY APPROVAL. The applicant may dive in certain circumstances as described in REMARKS.
- [ ] FURTHER TESTING REQUIRED. I have encountered a potential contraindication to diving. Additional medical tests must be performed before a final assessment can be made. See REMARKS.
- [ ] REJECT. This applicant has medical condition(s), which, in my opinion, clearly would constitute unacceptable hazards to health and safety in diving

<sup>5</sup> "Assessment of Cardiovascular Risk by Use of Multiple-Risk-Factor Assessment Equations." Grundy et. al. 1999. AHA/ACC Scientific Statement. <http://www.acc.org/clinical/consensus/risk/risk1999.pdf>

<sup>6</sup> Gibbons RJ, et al. ACC/AHA Guidelines for Exercise Testing. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Exercise Testing). Journal of the American College of Cardiology. 30:260-311, 1997. <http://www.acc.org/clinical/guidelines/exercise/exercise.pdf>

**REMARKS:**

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**PHYSICIAN’S STATEMENT:**

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

\_\_\_\_\_ M.D.

Date    Signature

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Name (Print or Type)

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Address

---

Telephone Number

My familiarity with applicant is:

\_\_\_\_\_ With this exam only

\_\_\_\_\_ Regular Physician for \_\_\_\_\_ years

\_\_\_\_\_ Other (describe) \_\_\_\_\_

---

My familiarity with diving medicine is:

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**APPLICANT’S RELEASE OF MEDICAL INFORMATION FORM**

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

Signature of Applicant \_\_\_\_\_

**APPENDIX 3  
DIVING MEDICAL HISTORY FORM**

(To Be Completed By Applicant-Diver)

Name \_\_\_\_\_ Sex \_\_\_\_ Age \_\_\_\_ Wt. \_\_\_\_ Ht. \_\_\_\_

Sponsor \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
(Dept./Project/Program/School, etc.) (Mo/Day/Yr)

**TO THE APPLICANT:**

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

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

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

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

	<b>Have you ever had or do you presently have any of the following?</b>	<b>Yes</b>	<b>No</b>	<b>Comments</b>
1.	Trouble with your ears, including ruptured eardrum, difficulty clearing your ears, or surgery.			
2.	Trouble with dizziness.			
3.	Eye surgery.			
4.	Depression, anxiety, claustrophobia, etc.			
5.	Substance abuse, including alcohol.			
6.	Loss of consciousness.			
7.	Epilepsy or other seizures, convulsions, or fits.			
8.	Stroke or a fixed neurological deficit.			
9.	Recurring neurologic disorders, including transient ischemic attacks.			
10.	Aneurysms or bleeding in the brain.			
11.	Decompression sickness or embolism.			
12.	Head injury.			
13.	Disorders of the blood, or easy bleeding.			
14.	Heart disease, diabetes, high cholesterol.			
15.	Anatomical heart abnormalities including patent foramen ovale, valve problems, etc.			
16.	Heart rhythm problems.			
17.	Need for a pacemaker.			
18.	Difficulty with exercise.			

19.	High blood pressure.			
20.	Collapsed lung.			
21.	Asthma.			
22.	Other lung disease.			
23.	Diabetes mellitus.			
24.	Pregnancy.			
25.	Surgery If yes explain below.			
26.	Hospitalizations. If yes explain below.			
27.	Do you take any medications? If yes list below.			
28.	Do you have any allergies to medications, foods, and environmental? If yes explain below.			
29.	Do you smoke?			
30.	Do you drink alcoholic beverages?			
31.	Is there a family history of high cholesterol?			
32.	Is there a family history of heart disease or stroke?			
33.	Is there a family history of diabetes?			
34.	Is there a family history of asthma?			

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

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

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Signature

Date

**APPENDIX 4**  
**RECOMMENDED PHYSICIANS WITH EXPERTISE IN DIVING MEDICINE**

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

1. Name: Dr. Van der Vaart  
Address: Centro Medico Central, Kaya Soeur Bartola 7, Kralendijk, Bonaire, Netherlands Antilles  
Telephone: office:717-7140, 717- 7141
  
2. Name: Dr. Schraeder  
Address: Fundashon Mariadal, Kaya Soeur Bartola 2, Kralendijk, Bonaire, Netherlands Antilles  
  
Telephone:office 717-7151, cellular 567-0810
  
3. Name: Dr. Miranda  
Address: Fundashon Mariadal, Kaya Soeur Bartola 2, Kralendijk, Bonaire, Netherlands Antilles  
Telephone: office: 717-8316; cellular: 785-7080
  
4. Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
Telephone: \_\_\_\_\_
  
5. Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
Telephone: \_\_\_\_\_

## **APPENDIX 5**

### **DEFINITION OF TERMS**

Air sharing - Sharing of an air supply between divers.

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

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

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

Buddy Diver - Second member of the dive team.

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

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

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

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

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

Cylinder - A pressure vessel for the storage of gases.

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

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

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

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

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

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

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

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

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

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

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

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

Diving Safety Officer (DSO) - Individual responsible for the safe conduct of the scientific diving program of the membership organization (Section 1.20).

EAD - Equivalent Air Depth (see below).

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

Enriched Air (EAN<sub>x</sub>) - A name for a breathing mixture of air and oxygen when the percent of oxygen exceeds 21%. This term is considered synonymous with the term “nitrox” (Section 7.00).

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

fN<sub>2</sub> - Fraction of nitrogen in a gas mixture, expressed as either a decimal or percentage, by volume.

fO<sub>2</sub> - Fraction of oxygen in a gas mixture, expressed as either a decimal or percentage, by volume.

FFW – Feet of freshwater, or equivalent static head.

FSW - Feet of seawater, or equivalent static head.

Hookah - 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.

Hyperbaric Chamber - See decompression chamber.

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

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

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

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

Mixed Gas - MG

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

MOD - Maximum Operating Depth, usually determined as the depth at which the pO<sub>2</sub> for a given gas mixture reaches a predetermined maximum.

MSW - Meters of seawater or equivalent static head.

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

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

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

Normal Ascent - An ascent made with an adequate air supply at a rate of 60 feet per minute or less.

Oxygen Clean - All combustible contaminants have been removed.

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

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

Oxygen Toxicity Unit - OTU

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

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

Pressure Vessel - See cylinder.

pN<sub>2</sub> - Inspired partial pressure of nitrogen, usually expressed in units of atmospheres absolute.

pO<sub>2</sub> - Inspired partial pressure of oxygen, usually expressed in units of atmospheres absolute.

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

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

Recompression Chamber - see decompression chamber.

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

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

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

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

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

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

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

**APPENDIX 6**  
**CIEE RSB SCIENTIFIC DIVER-IN-TRAINING APPLICATION FORM**

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

Certification Level: \_\_\_\_\_

Certifying Agency: \_\_\_\_\_

First Aid and CPR expiration date (if applicable): \_\_\_\_\_

Certifying Agency: \_\_\_\_\_

Oxygen First Aid for Scuba Diving Emergencies expiration date (if applicable): \_\_\_\_\_

Certifying Agency: \_\_\_\_\_

DAN member number: \_\_\_\_\_

Emergency Information: (To notify in an emergency)

Name: \_\_\_\_\_ Relationship: \_\_\_\_\_

Telephone: (work) \_\_\_\_\_ (home) \_\_\_\_\_

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

Doctor's Name: \_\_\_\_\_

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

Allergies: \_\_\_\_\_

**APPENDIX 7**  
**AAUS REQUEST FOR DIVING RECIPROCITY FORM**  
**VERIFICATION OF DIVER TRAINING AND EXPERIENCE**

A scientific diver that is currently certified under the auspices of an organizational member institution of the American Academy of Underwater Sciences (AAUS) shall be recognized by any other organizational member of AAUS and may apply for reciprocity in order to dive with the host organization. Organizational members that are in good standing with AAUS operate, at a minimum, under the AAUS Standards for Scientific Diving Certification and Operation of Scientific Diving Programs (2003 edition). The visiting diver will comply with the diving regulations of the host organization's Diving Safety Manual unless previously arranged by both organization's Diving Control Boards.

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

(Date)

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

Number of dives completed within previous 12 months? \_\_\_\_\_

Depth certification \_\_\_\_\_

Any restrictions? (Y/N) \_\_\_\_\_ if yes, explain:

Please check any pertinent specialty certifications:

- |                      |                                |                  |
|----------------------|--------------------------------|------------------|
| _____ Dry Suit       | _____ Rescue                   | _____ Blue water |
| _____ Dive Computer  | _____ Divemaster               | _____ Altitude   |
| _____ Nitrox         | _____ Instructor               | _____ Ice/Polar  |
| _____ Mixed gas      | _____ EMT                      | _____ Cave       |
| _____ Closed Circuit | _____ Dive Accident Management | _____ Night      |
| _____ Saturation     | _____ Chamber Operator         | Other _____      |
| _____ Decompression  | _____ Lifesaving               | _____            |

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

Emergency Information: (To notify in an emergency)

Name: \_\_\_\_\_ Relationship: \_\_\_\_\_

Telephone: (work) \_\_\_\_\_ (home) \_\_\_\_\_

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

This is to verify that the above individual is currently a certified scientific diver at:

\_\_\_\_\_  
 (Name of AAUS Organizational Member)

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

(Signature)

(Date)

(Print)

(Telephone, FAX, e-mail)

## APPENDIX 8

### AAUS CHECKOUT DIVE AND TRAINING EVALUATION

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

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

**APPENDIX 9**  
**AAUS DIVING INJURY INCIDENT REPORT FORM**

Required Incident Reporting: All diving incidents requiring recompression treatment, or resulting in moderate or serious injury, or death shall be reported the AAUS Statistics Committee. The report will specify the circumstances of the incident and the extent of any injuries or illnesses. This form is confidential and for statistics purposes only. The Organizational Member's Diving Control Board must review and release this report before it is submitted to the AAUS Statistics Committee

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

- Simple Illness
- Referred to Physician
- Serious injury
- Barotrauma
- Hyperbaric Treatment
- Near Drowning
- Hyperoxic
- Hypercapnea
- Fatality
- Other

Workers' Compensation Claim Yes  No

Descriptive Report (use additional sheets if necessary)

Date of Incident:        /        /        (Month/Day/Year)

Circumstances and the extent of the injuries or illnesses:

Treatment provided and results:

Recommendations to avoid repetition of incident:

Organizational Member Name:

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

Signature Date:

Mailing Address:

Telephone/FAX e-mail:

**APPENDIX 10  
CIEE RESEARCH STATION BONAIRE  
DIVE PLAN FORM**

Date of proposed dive(s):

Lead diver:

Lead diver is responsible for:

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

Other divers (include level of certification):

Estimated time of departure:

Estimated time of return:

Location, estimated start time, maximum depth, and duration of dive one:

Location, estimated start time, maximum depth, and duration of dive two (if applicable):

Proposed work and equipment (be specific in how it relates to your research):

Signature of Diving Safety Officer:

\_\_\_\_\_  
Caren Eckrich, CIEE Research Station Bonaire DSO  
Or Rita Peachey CIEE RSB Resident Director

## APPENDIX 11

### CIEE RESEARCH STATION BONAIRE

### DIVE ACCIDENT INSURANCE FORM

#### CIEE Research Station Bonaire

#### Dive Accident Insurance

As of January 2008 all CIEE RSB divers are required to have some type of medical insurance to cover their expenses in the event of a scuba diving accident requiring Recompression/Hyperbaric Oxygen Therapy, (recompression chamber treatment).

To determine if your present major medical insurance will cover these expenses inquire to the claims department of your insurance company and be sure to specify "SCUBA diving accidents requiring a recompression chamber".

#### **THIS POLICY MUST COVER HYPERBARIC OXYGEN THERAPY IN A RECOMPRESSION CHAMBER.**

If you have no policy meeting this requirement you can purchase one from the Diver's Alert Network (DAN). You can contact DAN on the web at [www.DiversAlertNetwork.org](http://www.DiversAlertNetwork.org). See the Diving Safety Officer for details of this policy and application forms. Complete the following and return to the Diving Safety Office at CIEE RSB.

Name:

Insurance Company:

Policy Number:

Expiration Date:

I certify this insurance policy covers Hyperbaric Oxygen Therapy in a recompression chamber for SCUBA diving accidents.

\_\_\_\_\_  
(Diver's Signature)

\_\_\_\_\_  
(Date)

**APPENDIX 12**  
**DIVE COMPUTER GUIDELINES**

1. Any diver desiring the approval to use a dive computer as a means of determining decompression status must apply to the Diving Control Board, complete an appropriate practical training session and pass a written examination.
2. Each diver relying on a dive computer to plan dives and indicate or determine decompression status must have his/her own unit.
3. On any given dive, both divers in the buddy pair must follow the most conservative dive computer.
4. If the dive computer fails at any time during the dive, the dive must be terminated and appropriate surfacing procedures should be initiated immediately.
5. A diver should not dive for 18 hours before activating a dive computer to use it to control their diving.
6. Once the dive computer is in use, it must not be switched off until it indicates complete out gassing has occurred or 18 hours have elapsed, whichever comes first.
7. When using a dive computer, non emergency ascents are to be at a rate specified for the make and model of dive computer being used.
8. Whenever practical, divers using a dive computer should make a stop between 10 and 30 feet for 5 minutes, especially for dives below 60 fsw.
9. Multiple deep dives require special consideration.

**APPENDIX 13**  
**SAFE ASCENT RECOMMENDATIONS**  
**From: AAUS BIOMECHANICS OF SAFE ASCENTS WORKSHOP.1990 , Lang**  
**and Egstrom (Eds.)**

It has long been the position of the American Academy of Underwater Sciences that the ultimate responsibility for safety rests with the individual diver. The time has come to encourage divers to slow their ascents.

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 60 fsw per minute.
6. A stop in the 10-30 fsw zone for 3-5 min 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. BCs shall have a reliable rapid exhaust valve which can be operated in a horizontal swimming position.
12. A buoyancy compensator 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 14**

### **REPETITIVE DIVING WORKSHOP**

Michael A. Lang and Richard D. Vann, Co-Chairs

March 18-19, 1991

Duke University Medical Center, NC

Co-Sponsors:

American Academy of Underwater Sciences

Divers Alert Network and Duke University Medical Center

NOAA

DEMA

Association of Diving Contractors

#### **Repetitive Diving Recommendations**

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

#### **Recreational Diving, Peter B. Bennett, Moderator.**

1. Scientific diving programs provide continuous training, re-certification and dive site supervision, which helps maintain established safe diving protocols. Recreational divers, who may lack such direct supervision, need to be aware of their need to stay within established protocols, especially when making repetitive dives over multiple days, in which the risk of DCS may be higher.
2. It is recommended that attention of divers be directed with emphasis on the ancillary factors to decompression risk such as fitness to dive, adequate rest, hydration, body weight, age and especially rate of ascent which should not be more than 60 feet per minute.
3. Divers are encouraged to learn and remember the signs and symptoms of decompression illness and report them promptly so as to receive effective treatment as rapidly as possible to prevent residual injury.
4. The use of oxygen breathing on the surface, whenever possible via a demand regulator mask system, to insure the highest percentage of oxygen to the patient, is recommended while awaiting treatment if decompression illness is thought to be present. The use of 100% oxygen in the water while awaiting treatment is not recommended for recreational diving.
5. There is a strong need for more controlled data on the relationship of decompression illness to multi-level, multi-day diving, especially with the provision of baseline data. Such a study could be made from information gathered from closed groups such as certain island areas and liveaboard fleets where heavy recreational dive activities occur.
6. To help obtain information, dive computer manufacturers are encouraged to provide data loggers to computers so that a permanent record is available of dive depth, dive time, rate of ascent, etc. as close as every minute. This should be coupled with detailed accident reporting forms (e.g. DAN form) in the case of an accident.

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

1. The position of recommending slower ascent rates seems to have gained support.
2. Increasing knowledge regarding the incidence of DCS indicates that our ability to predict the onset of DCS on multi-level, multi-day diving is even less sensitive than our ability to predict DCS on single square dives.

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

**Commercial Diving, Gary L. Beyerstein, Moderator.**

1. Repetitive diving, multi-level and multi-day diving modes are considered normal, routine and essential practices in the commercial diving industry. They are performed safely and efficiently.
2. The use of surface decompression using oxygen is also essential to the safe and efficient conduct of commercial diving operations. Alternate methods to date have shown increased risk to the diver and have not reduced the incidence of DCS.
3. The quality of decompression (i.e. the effectiveness of the decompression table in controlling decompression stress) is much more important than the mode used when considering DCS risk.
4. A zero bends incidence rate is desirable but not thought to be achievable in all types of commercial diving. Given the commercial situation, with the ability to treat immediately and effectively, an incidence of 1 type I case of DCS per 1,000 to 2,000 dives is considered currently tolerable.
5. Current commercial practices and tables were developed from need and have been modified for safety. We feel they are currently tolerable. We look forward to a new generation of safer tables that will also increase our operational efficiency. Such tables will have longer bottom times at deeper depths without higher levels of risk. Such tables will need field validation. This will be greatly assisted by advanced dive profilers, field Doppler units, and an industry data base. We look forward to industry standard tables and therapy procedures.

**Dive Computers, John E. Lewis, Moderator.**

1. No data were presented that warrant revision of the recommendations of the 1988 AAUS Dive Computer Workshop.
2. Data presented indicate that limiting dives to the no-stop (No-D) range, plus training and

experience adds up to a one-hundred fold decrease in the incidence of DCS.

3. Multi-level diving is a commonly accepted practice, and it appears to be less stressful than square wave profile diving.
4. Repetitive NoD (no-stop) diving with dive computers within the tested envelope is a valid practice. Deep repetitive dives with short surface intervals should be given special consideration.
5. No data were presented that indicate multi-day diving requires any special rules.
6. To assist in the analysis of decompression illness, dive computer manufacturers should consider working with the Divers Alert Network to provide an indication of inert gas loading by profile recovery, group letter, or other simple technique.

#### **Dive Recorders, Karl E. Huggins, Moderator.**

1. Because of limited analysis of the existing profile database, no conclusions have been reached regarding repetitive diving limits.
2. Paper databases are too cumbersome, it is considered essential that future profile recorders have the ability to download dive profile information directly to personal computer (through standard I/O ports).
3. The following desirable dive recorder features were identified:
  - a. ascent/descent rate record;
  - b. long storage capacity (commercial diver suggested one month);
  - c. for data points collected in large time intervals (i.e. 2,5-3 minutes), the average depth during the interval as well as the maximum depth attained during the interval should be recorded;
  - d. depth resolution should be at least .3 msw (1 fsw);
  - e. "low" tech recorder (inexpensive, requiring daily dumps);
  - f. date/time stamps on each dive; and,
  - g. diver/recorder information.
4. Possible dive recorder enhancements:
  - a. two-way communication with personal computer (i.e. allows adjustment in sampling, initialization of program variables, setting of recorder's internal clock, etc.); and,
  - b. data compression techniques (i.e. store rate of depth change instead of depth) for both the recorder and final computer storage.
5. A standardization of information and file formats would be advantageous, with PENNDEC or CANDID databases as possible starting points.
6. There is a need to obtain a list, from end users, of the minimal "header" information required. Suggested were:
  - a. DAN incident form information; and,
  - b. time of incident to time of resolution.

#### **Physiology, Medicine and Environment, Richard D. Vann, Moderator.**

1. Investigate the arterialization of gas emboli (VGE) as a potential mechanism for spinal and cerebral DCS,
2. Investigate the ability of reduced ascent rate and short decompression stops to reduce the incidence of VGE.
3. Dose-response curves for direct decompression are of fundamental importance to the development of decompression procedures.
4. Classification of decompression illness should be by specific sign/symptoms to guide therapy and prognosis and provide improved data for analysis.
5. There is a potential risk of bone necrosis for long shallow dives followed by inadequate

decompression.

6. Multiple decompressions per day for multiple days can be potentially hazardous. The number of dives per day and the number of consecutive days during which diving can be conducted with reasonable safety is uncertain at present and depends upon the decompression procedures that are used.

**Data Analysis and Procedure Calculation, R.W. Bill Hamilton, Moderator.**

1. Maximum likelihood and other statistical techniques are useful for evaluation and assessment of new procedures based on past experience.
2. Predictive models are sensitive to the data set used to determine the parameter estimates of the model.
3. Field data can be useful and data exchange should be encouraged.

**Decompression Trials, Ronald Y. Nishi, Moderator.**

1. After all these years we still do not know much about DCS. None of the table or dive computer developers really have decompression “models”. What they actually have are decompression calculation methods as stated by Brian Hills in his book “Decompression Sickness”.
2. There are two primary methods for developing decompression tables and designing decompression trials. The first is the traditional approach, where tables are developed from some model and selected profiles are dived to test whether or not DCS occurs. A variation on this approach is to include risk analysis. Dives are tested, either by following printed tables or by following dive computers. It is necessary to use other tools such as Doppler and complement analysis to determine decompression stress.
3. The second approach to designing trials is the probabilistic method. In this case, a large amount of carefully documented (well-calibrated) dive data is required to estimate the risk of DCS, compute optimum profiles and test with appropriate criteria for rejecting or accepting profiles. With the proper design of sequential tests, the total decompression time can be minimized and the number of trials and cases of DCS can also be minimized. The probabilistic method appears to be the way of the future but still needs further development. To make it work, accurate dive data and DCS information are required, which the military, scientific, commercial and recreational diving community must supply.
4. What does this all mean for the scientific, recreational and commercial diving communities? Although designers and testers of decompression trials may talk about incidences or risks of DCS which are much higher than the different communities are willing to accept, the eventual tables will probably be more effective than those commonly in use now. It must be kept in mind that DCS is a probabilistic event.

**APPENDIX 15**  
**REVERSE DIVE PROFILES WORKSHOP**

Michael A. Lang and Charles E. Lehner

Co-Chairs

Smithsonian Institution

October 29-30, 1999

Co-Sponsors:

Smithsonian Institution

Divers Alert Network

American Academy of Underwater Sciences

Diving Equipment and Marketing Association

Dive Training Magazine

**WORKSHOP FINDINGS**

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

**Workshop Conclusion**

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

## APPENDIX 16

### AAUS STATISTICS COLLECTION CRITERIA AND DEFINITIONS

#### **COLLECTION CRITERIA:**

The "Dive Time in Minutes", "The Number of Dives Logged", and the "Number of Divers Logging Dives" will be collected for the following categories.

- Dive Classification
- Breathing Gas
- Diving Mode
- Decompression Planning and Calculation Method
- Depth Ranges
- Specialized Environments
- Incident Types

Dive Time in Minutes is defined as the surface to surface time including any safety or required decompression stops.

A Dive is defined as a descent into water, an underwater diving activity utilizing compressed gas, an ascent/return to the surface, and a surface interval of greater than 10 minutes.

Dives will not be differentiated as openwater or confined water dives. But openwater and confined water dives will be logged and submitted for AAUS statistics classified as either scientific or training/proficiency.

A "Diver Logging a Dive" is defined as a person who is diving under the auspices of your scientific diving organization. Dives logged by divers from another AAUS Organization will be reported with the divers home organization. Only a diver who has actually logged a dive during the reporting period is counted under this category.

Incident(s) occurring during the collection cycle. Only incidents occurring during, or resulting from, a dive where the diver is breathing a compressed gas will be submitted to AAUS.

#### **DEFINITIONS:**

##### Dive Classification:

- **Scientific Dives:** Dives that meet the scientific diving exemption as defined in 29 CFR 1910.402. Diving tasks traditionally associated with a specific scientific discipline are considered a scientific dive. Construction and trouble-shooting tasks traditionally associated with commercial diving are not considered a scientific dive.
- **Training and Proficiency Dives:** Dives performed as part of a scientific diver training program, or dives performed in maintenance of a scientific diving certification/authorization.

##### Breathing Gas:

- **Air:** Dives where the bottom gas used for the dive is air.
- **Nitrox:** Dives where the bottom gas used for the dive is a combination of nitrogen and oxygen other than air.

- Mixed Gas: Dives where the bottom gas used for the dive is a combination of oxygen, nitrogen, and helium (or other "exotic" gas), or any other breathing gas combination not classified as air or nitrox.

#### Diving Mode:

- Open Circuit Scuba: Dives where the breathing gas is inhaled from a self contained underwater breathing apparatus and all of the exhaled gas leaves the breathing loop.
- Surface Supplied: Dives where the breathing gas is supplied from the surface by means of a pressurized umbilical hose. The umbilical generally consists of a gas supply hose, strength member, pneumofathometer hose, and communication line. The umbilical supplies a helmet or full-face mask. The diver may rely on the tender at the surface to keep up with the divers' depth, time and diving profile.
- 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.
- Rebreathers: Dives where the breathing gas is repeatedly recycled in the breathing loop. The breathing loop may be fully closed or semi-closed. Note: A rebreather dive ending in an open circuit bailout is still logged as a rebreather dive.

#### Decompression Planning and Calculation Method:

- Dive Tables
- Dive Computer
- PC Based Decompression Software

#### Depth Ranges:

Depth ranges for sorting logged dives are 0-30, 31-60, 61-100, 101-130, 131-150, 151-190, and 191->. Depths are in feet seawater. A dive is logged to the maximum depth reached during the dive. Note: Only "The Number of Dives Logged" and "The Number of Divers Logging Dives" will be collected for this category.

#### Specialized Environments:

- Required Decompression: Any dive where the diver exceeds the no-decompression limit of the decompression planning method being employed.
- Overhead Environments: Any dive where the diver does not have direct access to the surface due to a physical obstruction.
- Blue Water Diving: Openwater diving where the bottom is generally greater than 200 feet deep and requiring the use of multiple-tethered diving techniques.
- Ice and Polar Diving: Any dive conducted under ice or in polar conditions. Note: An Ice Dive would also be classified as an Overhead Environment dive.

- Saturation Diving: Excursion dives conducted as part of a saturation mission are to be logged by "classification", "mode", "gas", etc. The "surface" for these excursions is defined as leaving and surfacing within the Habitat. Time spent within the Habitat or chamber shall not be logged by AAUS.
- Aquarium: An aquarium is a shallow, confined body of water, which is operated by or under the control of an institution and is used for the purposes of specimen exhibit, education, husbandry, or research. (Not a swimming pool)

#### Incident Types:

- Hyperbaric: Decompression Sickness, AGE, or other barotrauma requiring recompression therapy.
- Barotrauma: Barotrauma requiring medical attention from a physician or medical facility, but not requiring recompression therapy.
- Injury: Any non-barotrauma injury occurring during a dive that requires medical attention from a physician or medical facility.
- Illness: Any illness requiring medical attention that can be attributed to diving.
- Near Drowning/ Hypoxia: An incident where a person asphyxiates to the minimum point of unconsciousness during a dive involving a compressed gas. But the person recovers.
- Hyperoxic/Oxygen Toxicity: An incident that can be attributed to the diver being exposed to too high a partial pressure of oxygen.
- Hypercapnea: An incident that can be attributed to the diver being exposed to an excess of carbon dioxide.
- Fatality: Any death accruing during a dive or resulting from the diving exposure.
- Other: An incident that does not fit one of the listed incident types

#### Incident Classification Rating Scale:

- Minor: Injuries that the OM considers being minor in nature. Examples of this classification of incident would include, but not be limited to:
  - Mask squeeze that produced discoloration of the eyes.
  - Lacerations requiring medical attention but not involving moderate or severe bleeding.
  - Other injuries that would not be expected to produce long term adverse effects on the diver's health or diving status.
- Moderate: Injuries that the OM considers being moderate in nature. Examples of this classification would include, but not be limited to:
  - DCS symptoms that resolved with the administration of oxygen, hyperbaric treatment given as a precaution.
  - DCS symptoms resolved with the first hyperbaric treatment.
  - Broken bones.
  - Torn ligaments or cartilage.
  - Concussion.
  - Ear barotrauma requiring surgical repair.
- Serious: Injuries that the OM considers being serious in nature. Examples of this classification would include, but not be limited to:
  - Arterial Gas Embolism.
  - DCS symptoms requiring multiple hyperbaric treatment.
  - Near drowning.
  - Oxygen Toxicity.

- Hypercapnea.
- Spinal injuries.
- Heart attack.
- Fatality.