The University of Mississippi

SCIENTIFIC DIVING SAFETY MANUAL

OFFICE OF RESEARCH AND SPONSORED PROGRAMS

RESEARCH INTEGRITY AND COMPLIANCE

UNIVERSITY OF MISSISSIPPI

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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

The University of Mississippi thanks the numerous dedicated individual and organizational members of the AAUS for their contributions and editorial comments in the production of these standards.

Revision History

April, 1987	
October, 1990	
May, 1994	
January, 1996	
March 1999	Added Sec 7.6.1 Nitrox Diving Guidelines. Revised Appendix 7 and 11.
January 2001	Revised Section 1.23.1 DSO Qualifications. Revised Section 5.31.4 Emergency Care Training. Revised Section 6 Medical Standards. Made Sec 7.6.1 Nitrox Diving Guidelines into Section 7. Added Section 8.0 Scientific Aquarium Diving. Moved Section 7.0 to Section 9.0 Other Diving Technologies.
April 2002	Removed Appendix 7 AAUS Checkout Dive and Training Evaluation. Revised Section 5.33.3. Revised Section 4.23.2.
August 2003	Section 1.27.3 Delete reference to Appendix 9 (checkout dive). Section 1.4 Remove word "waiver". Section 2.21 Change "supervisor" to "lead diver". Section 2.72.2.1 Remove reference to Appendix 13, and remove Appendix 13. Replace with "at www.aaus.org" after Incident Report. Section 3.28.3 Remove Appendix 10 (dive computers). Section 5.32 Training and 100-hour requirement, eliminate "beyond the DIT level". Section 5.32.1 Eliminate paragraph "Suggested topics include" and replace it with a list of topics for inclusion in the 100 hours. Some of these topics would be designated "R" (required). Section 4.0 Remove lead sentence "This section describes for diving". Alter the lead sentence read as follows: "This section describes training for the non-diver applicant, previously not certified for diving, and equivalency for the certified diver."

	Section 4.3 Delete this section. Section 9 Update Required Decompression (9.10) and Mixed Gas Diving (9.60) to individual sections. Appendices 9, 10, 11,and 12 Remove these and make available online as historic documents in the Virtual Office. Formatted document for consistency. Separated manual into two volumes. Volume 1 and the appendices are required for all manual and Volume 2 sections only apply when the referenced diving activity is being conducted. Volume 2 is where organizational specific information is contained.
October 2005	Section 11.70 Deleted section for rebreathers. Section 12.00 Added new section for rebreathers.
March 2006	Section 13.00 Added new section for cave and cavern diving. Section 11.5 and 11.6, revised definitions for Hookah and surfaced supplied diving.
April 2006	Section 5.30 Deleted emergency care training prerequisite. Section 5.50 Added emergency care training requirements to Continuation of Certificate.
November 2006	Section 2.60 flying after diving rules updated to meet current DAN standards. Section 3.20 dive computers reference changed to "appendix 8". Section 3.60 air quality guidelines updated to meet current CGA standards. Section 5.30 – added words "Transect Sampling "to item #9. Appendix 1 – Updated one medical web link. Appendix 2 - Added the abbreviation "DO" to the MD signature line. Appendix 6 – new LOR template. Updated and added Appendix 8 dive computer recommendations Added Appendix 9 (criteria for entering diving statistics).
December 2009	Appendix 2 – Revised
December 2011	Section 6 – Revised after Medical Review Panel review Appendix 1 - Revised
May 2013	Section 3.10- added "and serviced according to manufacturers' recommendations" Section 9.1(c) (1)- added "omitted decompression" Section 9.1(c) (7)- added "qualified" to DSO's designee Section 9.30 (k)- replaced "mixed gas" with "decompression" Section 4.0- removed specific requirements for Entry-Level Training. Adopted WRSTC/ISO standards by reference. Section 5.0- merged requirements for Entry-Level Diver Training with Scientific Diver Training Formatted document for consistency
August 2016	Section 12 – Revised.

CONTENTS

Volume 1

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 the University of Mississippi and AAUS 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, the federal government 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 the federal government as the scientific diving standard setting organization.

Additional standards that extend this document may be adopted by the University of Mississippi, 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

The federal government 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.

In addition, the scientific diving program shall contain at least the following elements (29CFR1910.401):

a) 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.

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

Review of Standards

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

1.20 Operational Control

University of Mississippi Auspices Defined

For the purposes of these standards the auspices of the University of Mississippi includes any scientific diving operation in which the University of Mississippi 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 University of Mississippi 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 University of Mississippi or are diving as members of an AAUS organizational member.

It is the University of Mississippi'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 University of Mississippi's Diving Control Board (DCB).

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

The University of Mississippi's Scientific Diving Standards and Safety Manual

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

1. AAUS standards may be used as a set of minimal guidelines for the development of the University of Mississippi'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 University of Mississippi conducts that diving activity. The University of Mississippi specific sections are placed in Volume 2.
2. Emergency evacuation and medical treatment procedures.

3. Criteria for diver training and certification.
4. Standards written or adopted by reference for each diving mode utilized which include the following:
    a. Safety procedures for the diving operation.
    b. Responsibilities of the dive team members.
    c. Equipment use and maintenance procedures.
    d. 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.

Qualifications:

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

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

- 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.
- Has autonomous and absolute authority over the scientific diving program's operation.
- Shall approve and monitor diving projects.

- Shall review and revise the diving safety manual.
- Shall assure compliance with the diving safety manual.
- Shall certify the depths to which a diver has been trained.
- Shall take disciplinary action for unsafe practices.
- Shall assure adherence to the buddy system for scuba diving.
- Shall act as the official representative of the membership organization in matters concerning the scientific diving program.
- Shall act as a board of appeal to consider diver-related problems.
- Shall recommend the issue, reissue, or the revocation of diving certifications.
- Shall recommend changes in policy and amendments to AAUS and the University of Mississippi's diving safety manual as the need arises.
- Shall establish and/or approve training programs through which the applicants for certification can satisfy the requirements of the organizational member's diving safety manual.
- Shall suspend diving programs that are considered to be unsafe or unwise.
- Shall establish criteria for equipment selection and use.
- Shall recommend new equipment or techniques.
- Shall establish and/or approve facilities for the inspection and maintenance of diving and associated equipment.
- Shall ensure that the University of Mississippi's air station(s) meet air quality standards as described in Section 3.60.
- Shall periodically review the Diving Safety Officer's performance and program.
- 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

Qualifications

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

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:

- Coordination with other known activities in the vicinity that are likely to interfere with diving operations.

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

Reciprocity and Visiting Scientific Diver

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.

A Scientific Diver from one Organizational Member shall apply for permission to dive under the auspices of the University of Mississippi by submitting to the Diving Safety Officer of the University of Mississippi a document containing all the information described in Appendix 6, signed by the Diving Safety Officer or Chairperson of the home Diving Control Board.

A visiting Scientific Diver may be asked to demonstrate their knowledge and skills for the planned dive.

If University of Mississippi 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

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

1.30 Consequence of Violation of Regulations by Scientific Divers

Failure to comply with the regulations of the University of Mississipi's diving safety manual may be cause for the revocation or restriction of the diver's scientific diving certificate by action of the University of Mississippi'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 the organizational member'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 the University of Mississippi Diving Control Board, and other pertinent information deemed necessary.

Availability of Records:

- Medical records shall be available to the attending physician of a diver or former diver when released in writing by the diver.
    - Records and documents required by this standard shall be retained by the University of Mississippi 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 the University of Mississippi's 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 of the University of Mississippi, the lead diver for a proposed operation must formulate a dive plan that should include the following:

- Divers' qualifications, and the type of certificate or certification held by each diver.
- 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.
- Approximate number of proposed dives.
- Location(s) of proposed dives.
- Estimated depth(s) and bottom time(s) anticipated.
- Decompression status and repetitive dive plans, if required.
- Proposed work, equipment, and boats to be employed.
- Any hazardous conditions anticipated.

Pre-dive Safety Checks

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 University of Mississippi'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.

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.

Site Evaluation

1. 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.

Refusal to Dive

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.

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

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.

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

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

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

The University of Mississippi will develop emergency procedures which follow the standards of care of the community and must include procedures for emergency care, recompression and evacuation for each dive location (Appendix 7).

2.60 Flying After Diving or Ascending to Altitude (Over 1000 feet)

Following a Single No-Decompression Dive: Divers should have a minimum preflight surface interval of 12 hours.

Following Multiple Dives per Day or Multiple Days of Diving: Divers should have a minimum preflight surface interval of 18 hours.

Following Dives Requiring Decompression Stops: Divers should have a minimum preflight surface interval of 24 hours.

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 shall log every dive made under the auspices of the University of Mississippi's program, and is encouraged to log all other dives. Standard forms will be provided by the University of Mississippi. 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 organization and shall include at least the following:

- Name of diver, buddy, and Lead Diver.
- Date, time, and location.
- Diving modes used.
- General nature of diving activities.

- Approximate surface and underwater conditions.
- Maximum depths, bottom time, and surface interval time.
- Diving tables or computers used.
- Detailed report of any near or actual incidents.

Required Incident Reporting

All diving incidents requiring recompression treatment, or resulting in moderate or serious injury, or death shall be reported to the University of Mississippi's Diving Control Board and the AAUS. The University of Mississippi'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:

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

    1. Complete AAUS Incident Report at http://www.aaus.org.
    2. Written descriptive report to include:

        - 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.

    The University of Mississippi 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 the University of Mississippi'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. All equipment shall be regularly examined by the person using them and serviced according to manufacturer recommendations. Equipment that is subjected to extreme usage under adverse conditions should require more frequent testing and maintenance.

3.20 Equipment

Regulators

- Only those makes and models specifically approved by the Diving Safety Officer and the Diving Control Board shall be used.
- Scuba regulators shall be inspected and tested prior to first use and every 12 months thereafter.
- 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 non-return valve at the attachment point between helmet or mask and hose, which shall close readily and positively.
- An exhaust valve.
- A minimum ventilation rate capable of maintaining the diver at the depth to which they are diving.

Scuba Cylinders

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

- Each diver shall have the capability of achieving and maintaining positive buoyancy.
- Personal flotation systems, buoyancy compensators, dry suits, or other variable volume buoyancy compensation devices shall be equipped with an exhaust valve.
- These devices shall be functionally inspected and tested at intervals not to exceed 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 set of diving tables, approved by the Diving Control Board, must be available at the dive location.
- 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 located in Appendix 8.

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.

Compressor Systems – University of Mississippi Controlled

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

- Low-pressure compressors used to supply air to the diver if equipped with a volume tank shall have a check valve on the inlet side, a relief valve, and a drain valve.
- Compressed air systems over 500 psig shall have slow-opening shut-off valves.
- 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:

- Regulators
- Submersible pressure gauges
- Depth gauges
- Scuba cylinders
- Cylinder valves
- Diving helmets
- Submersible breathing masks
- Compressors
- Gas control panels
- Air storage cylinders
- Air filtration systems
- Analytical instruments
- Buoyancy control devices
- Dry suits

Compressor Operation and Air Test Records

Gas analyses and air tests shall be performed on each organizational member-controlled breathing air compressor at regular intervals of no more than 100 hours of operation or 6 months, whichever occurs first. The results of these tests shall be entered in a formal log and be maintained.

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

3.60 Air Quality Standards

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

CGA Grade E	
Component	**Maximum**
Oxygen	20 - 22%/v
Carbon Monoxide	10 PPM/v
Carbon Dioxide	1000 PPM/v
Condensed Hydrocarbons	5 mg/m3
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

4.10 General Policy

Training and certification as an entry-level diver is a prerequisite to University of Mississippi Scientific Diver Training. In lieu of writing/promulgating UM specific standards for entry-level divers, UM references here, the standards for entry-level diver training as defined by the WRSTC and/or ISO. AAUS programs who wish to train entry-level divers may do so using one of the following options:

a) under the auspices and standards of an internationally recognized diver training agency.

b) under the auspices of UM using the minimum guidelines presented by the most current version of the RSTC/WRSTC and/or ISO entry-level diver standards.

4.20 References

"Minimum Course Content for Open Water Diver Certification"- World Recreational Scuba Training Council (WRSTC), www.wrstc.com.

"Safety related minimum requirements for the training of recreational scuba divers -- Part 2: Level 2 -- Autonomous diver". ISO 24801-2:2007- International Organization for Standardization (ISO)- www.iso.org.

SECTION 5.00 SCIENTIFIC DIVER CERTIFICATION

This section describes the training and performance standards for AAUS Scientific Divers. These standards represent the minimum required level of knowledge and skills presented in a generalized format. Individual diving programs are encouraged to expand upon and augment these requirements, develop or utilize appropriate educational materials, and optimize instructional programs to suit and reflect their specific needs.

5.10 Prerequisites

Administrative

The applicant/candidate must complete all administrative and legal documentation required by the University of Mississippi.

Diver Certification

The applicant/ candidate must, at minimum, show documented proof of entry-level diver certification from an internationally recognized training agency. As an alternative, AAUS OMs who wish to train and certify entry-level divers under AAUS auspices may do so under the guidelines presented in Section 4.0.

Medical Examination

The applicant/candidate must be medically qualified for diving as described in Section 6.0 of the AAUS Standards for Scientific Diving.

Swimming/Watermanship Evaluation

The applicant/candidate must demonstrate the following in the presence of the Diving Safety Officer, instructor, or other approved examiner. All tests are to be performed without swim aids, however,

where exposure protection is needed, the applicant must be appropriately weighted to provide for neutral buoyancy.

a) Swim underwater for a distance of 25 yards/meters without surfacing.

b) Swim 400 yards/meters in less than 12 minutes.

c) Tread water for 10 minutes, or 2 minutes without the use of hands.

d) Transport a passive person of equal size a distance of 25 yards/meters in the water.

5.20 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.

Theoretical Training/ Knowledge Development

Required Topics:

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 required)
   - Transect Sampling (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)

Suggested Topics:

10. Specific Dive Modes (methods of gas delivery)
    - Open Circuit
    - Hooka
    - Surface Supplied diving
11. Small Boat Operation
12. Rebreathers
    - Closed
    - Semi-closed
13. Specialized Breathing Gas
    - Nitrox
    - Mixed Gas
14. 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
15. Specialized Diving Equipment
    - Full face mask
    - Dry Suit
    - Communications

Practical Training/ Skill Development

Confined Water Evaluation

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.

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.

Checkout Dive/ Additional Experience

Practical training must include an Open Water checkout dive(s), with evaluation of the skills listed in 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.

5.30 Examinations

Written Exams

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

1. Function, care, use, and maintenance of diving equipment.
2. Physics and physiology of diving.
3. Diving regulations and precautions.
4. Near-shore currents and waves.
5. Dangerous marine animals.
6. Emergency procedures, including buoyant ascent and ascent by air sharing.
7. Currently accepted decompression procedures.
8. Demonstrate the proper use of dive tables.
9. Underwater communications.
10. Aspects of freshwater and altitude diving.
11. Hazards of breath-hold diving and ascents.
12. Planning and supervision of diving operations.
13. Diving hazards.
14. Cause, symptoms, treatment, and prevention of the following: near drowning, air embolism, carbon dioxide excess, squeezes, oxygen poisoning, nitrogen narcosis, exhaustion and panic, respiratory fatigue, motion sickness, decompression sickness, hypothermia, and hypoxia/anoxia.
15. Suggested topics (from Sec. 5.20) at the DSO's discretion.

Equipment

The trainee will be subject to examination/review of:

1. Personal diving equipment
2. Task specific equipment

5.40 Diver Permits/ Certifications

AAUS requires that no person shall engage in scientific diving unless that person is authorized by the University of Mississippi pursuant to the provisions of this standard. Only a person diving under the

auspices of the University of Mississippi that subscribes to the practices of AAUS is eligible for a scientific diver certification.

Scientific Diver-In-Training Permit

This is a permit to dive, usable only while it is current and for the purpose intended. This permit signifies that a diver has completed and been certified as at least an entry level diver through an internationally recognized certifying agency or scientific diving program, and has the knowledge skills and experience necessary to continue training as a scientific diver under supervision, as approved by the DSO.

Scientific Diver Certification

This permit signifies a diver has completed all requirements in Section 5.0 and is authorized by the AAUS OM to engage in scientific diving without supervision, as approved by the DSO. 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 organizational member scientific diving privileges.

5.50 Depth Certifications

Depth Certifications and Progression to Next Depth Level

A certified diver diving under the auspices of the University of Mississippi 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 5.00.

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.

5.60 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 5.00 are met, divers whose depth certification has lapsed due to lack of activity may be re-qualified by procedures adopted by the organization's DCB.

Medical Examination

All certified scientific divers shall pass a medical examination at the intervals specified in Section 6.0. After each major illness or injury, as described in Section 6.0, 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)

5.70 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.

5.80 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.

5.90 Waiver of Requirements/Temporary Diver

A temporary diver permit constitutes a waiver of the requirements of Section 5.0 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.

Requirements of Section 5.0 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.

SECTION 6.00 MEDICAL STANDARDS

6.10 Medical Requirements

General

- The University of Mississippi 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.
- 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.
- The diver should be free of any chronic disabling disease and any conditions contained in the list of conditions for which restrictions from diving are generally recommended. (Appendix 1)

6.20 Frequency of Medical Evaluations

Medical evaluation shall be completed:

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

6.30 Information Provided Examining Physician

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

6.40 Content of Medical Evaluations

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

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

6.50 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) Hearing loss; 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, 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.
n) Hematologic disorders including coagulopathies.
o) Risk factors or evidence of 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) Hypertension.
v) History of pneumothorax.
w) Asthma.
x) Chronic pulmonary disease, including radiographic evidence of pulmonary blebs, bullae or cysts.
y) Diabetes mellitus.
z) Pregnancy.

6.60 Laboratory Requirements for Diving Medical Evaluation and Intervals

Initial examination under age 40:

1. Medical History
2. Complete Physical Exam, emphasis on neurological and otological components
3. Urinalysis
4. Any further tests deemed necessary by the physician.

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

1. Medical History
2. Complete Physical Exam, emphasis on neurological and otological components
3. Urinalysis
4. Any further tests deemed necessary by the physician

First exam over age 40:

1. Medical History
2. Complete Physical Exam, emphasis on neurological and otological components
3. Detailed assessment of coronary artery disease risk factors using Multiple-Risk-Factor Assessment[1,2] (age, family history, lipid profile, blood pressure, diabetic screening, smoking history). Further cardiac screening may be indicated based on risk factor assessment.
4. Resting EKG
5. Chest X-ray
6. Urinalysis
7. Any further tests deemed necessary by the physician

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

1. Medical History
2. Complete Physical Exam, emphasis on neurological and otological components
3. Detailed assessment of coronary artery disease risk factors using Multiple-Risk-Factor Assessment[1] (age, family history, lipid profile, blood pressure, diabetic screening, smoking history). Further cardiac screening may be indicated based on risk factor assessment.
4. Resting EKG
5. Urinalysis
6. Any further tests deemed necessary by the physician

6.70 Physician's Written Report

After any medical examination relating to the individual's fitness to dive, the University of Mississippi 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 report will be reviewed by the DCB.

The University of Mississippi shall make a copy of the physician's written report available to the individual.

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

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

Volume 2

SECTION 7.00 NITROX DIVING GUIDELINES

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

7.10 Prerequisites

Eligibility

Only a certified Scientific Diver or Scientific Diver In Training (Sections 4.00 and 5.00) diving under the auspices of a member organization is eligible for authorization to use nitrox. After completion, review and acceptance of application materials, training and qualification, an applicant will be authorized to use nitrox within their depth authorization, as specified in Section 5.50.

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:

1. 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).

2. Examinations

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

   - Written examinations covering the information presented in the classroom training session(s) (i.e., gas theory, oxygen toxicity, partial pressure determination, etc.)
   - Practical examinations covering the information presented in the practical training session(s) (i.e., gas analysis, documentation procedures, etc.)
   - 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 5.00).

Classroom Instruction

Topics should include, but are not limited to: review of previous training; physical gas laws pertaining to nitrox; partial pressure calculations and limits; equivalent air depth (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.

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 5.00), with additional training as follows:

- Oxygen analysis of nitrox mixtures.
- Determination of MOD, oxygen partial pressure exposure, and oxygen toxicity time limits, for various nitrox mixtures at various depths.
- 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.
- 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:

- Function, care, use, and maintenance of equipment cleaned for nitrox use.
- Physical and physiological considerations of nitrox diving (ex.: O_2 and CO_2 toxicity).
- Diving regulations and procedures as related to nitrox diving, either scuba or surface-supplied (depending on intended mode).
- Given the proper information, calculation of:

3. Equivalent air depth (EAD) for a given fO_2 and actual depth;
4. pO_2 exposure for a given fO_2 and depth;
5. Optimal nitrox mixture for a given pO_2 exposure limit and planned depth;
6. Maximum operational depth (MOD) for a given mix and pO_2 exposure limit;
7. 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.

- Dive table and dive computer selection and usage.
- Nitrox production methods and considerations.
- Oxygen analysis.
- Nitrox operational guidelines (Section 7.40), dive planning, and dive station components.

Open water 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

- 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.
- 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. 5.50.
- Lead Diver - On any dive during which nitrox will be used by any team member, the Lead Diver should be authorized to use nitrox, and hold appropriate authorizations required for the dive, as specified in AAUS Standards. Lead Diver authorization for nitrox dives by the DSO and/or DCB should occur as part of the dive plan approval process.

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

  1. As part of the dive planning process, verify that all divers using nitrox on a dive are properly qualified and authorized;
  2. As part of the pre-dive procedures, confirm with each diver the nitrox mixture the diver is using, and establish dive team maximum depth and time limits, according to the shortest time limit or shallowest depth limit among the team members.

3. The Lead Diver should also reduce the maximum allowable pO_2 exposure limit for the dive team if on-site conditions so indicate (see Sec. 7.42).

Dive Parameters

Oxygen Exposure Limits

- 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".
- The maximum allowable exposure limit should be reduced in cases where cold or strenuous dive conditions, or extended exposure times are expected. The DCB should consider this in the review of any dive plan application, which proposes to use nitrox. The Lead Diver should also review on-site conditions and reduce the allowable pO_2 exposure limits if conditions indicate.
- 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.

Bottom Time Limits

- Maximum bottom time should be based on the depth of the dive and the nitrox mixture being used.
- 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.

Dive Tables and Gases

- A set of DCB approved nitrox dive tables should be available at the dive site.
- When using the equivalent air depth (EAD) method, dives should be conducted using air dive tables approved by the DCB.
- 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.
- 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.

Nitrox Dive Computers

- Dive computers may be used to compute decompression status during nitrox dives. Manufacturers' guidelines and operations instructions should be followed.
- Use of Nitrox dive computers should comply with dive computer guidelines included in the AAUS Standards.
- 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.
- If nitrox is used to increase the safety margin of an air-based dive computer, the MOD and oxygen exposure and time limits for the nitrox mixture being dived shall not be exceeded.

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

Repetitive Diving

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

Oxygen Parameters

- Authorized Mixtures - Mixtures meeting the criteria outlined in Section 7.40 may be used for nitrox diving operations, upon approval of the DCB.
- Purity - Oxygen used for mixing nitrox-breathing gas should meet the purity levels for "Medical Grade" (U.S.P.) or "Aviator Grade" standards.
- In addition to the AAUS Air Purity Guidelines (Section 3.60), the following standard should be met for breathing air that is either:
    a) Placed in contact with oxygen concentrations greater than 40%.
    b) Used in nitrox production by the partial pressure mixing method with gas mixtures containing greater than 40% oxygen as the enriching agent.

Air Purity: CGA Grade E (Section 3.60)	
Condensed Hydrocarbons	$5mg/m^3$
Hydrocarbon Contaminants	No greater than $0.1\ mg/m^3$

Gas Mixing and Analysis for Organizational Members

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.

Production Methods

It is the responsibility of the DCB to approve the specific nitrox production method used.

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

Requirement for Oxygen Service

a) All equipment, which during the dive or cylinder filling process is exposed to concentrations greater than 40% oxygen at pressures above 150 psi, should be cleaned and maintained for oxygen service.

b) Equipment used with oxygen or mixtures containing over 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.

Scuba Cylinder Identification Marking

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

a) Cylinders should be marked "NITROX", or "EANx", or "Enriched Air".

b) 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.

c) 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.

d) Other markings, which identify the cylinder as containing gas mixes other than Air, may be used as the approval of the DCB.A contents label should be affixed, to include the current fO_2, date of analysis, and MOD.

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

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.

Other Support Equipment

a) 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.

b) All diver and support equipment should be suitable for the fO_2 being used.

Compressor system

a) Compressor/filtration system must produce oil-free air.

b) An oil-lubricated compressor placed in service for a nitrox system should be checked for oil and hydrocarbon contamination at least quarterly.

Fill Station Components

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

SECTION 8.00 AQUARIUM DIVING OPERATIONS

8.10 General Policy

Section 8.00 applies to scientific aquarium divers only.

Definition - A scientific aquarium diver is a scientific diver who is diving solely within an aquarium. An aquarium is a shallow, confined body of water, which is operated by or under the control of an institution and is used for the purposes of specimen exhibit, education, husbandry, or research.

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

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

8.20 The Buddy System In Scientific Aquarium Diving

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

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

8.30 Diving Equipment

Section 3.20 is modified to read as follows:

In an aquarium of a known maximum obtainable depth:

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

8.40 Scientific Aquarium Diver Certification

A Scientific Aquarium Diver is a certification enabling the qualified diver to participate in scientific diving in accordance with Section 8.00 as provided below.

All of the standards set forth in sections 4.0 and 5.0 of this standard shall apply, except that Section 5.30 of this standard is modified to read as follows:

- Practical training shall include at least 12 supervised aquarium dives for a cumulative bottom time of 6 hours. No more than 3 of these dives shall be made in 1 day.

8.50 Scientific Aquarium Diving Using Other Diving Technology

Surface Supplied Scientific Aquarium Diving

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

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

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

   - There are no overhead obstructions or entanglements.
   - The diver is proficient in performing a Controlled Emergency Swimming Ascent from at least as deep as the maximum depth of the aquarium.
   - The diver is proficient in performing out of air emergency drills, including ascent and mask/helmet removal.
   - Each surface supplied diver shall be hose-tended by a separate dive team member while in the water. Scientific aquarium divers are exempt from this standard, provided the tender is monitoring only one air source, there is mutual assistance between divers and there are no overhead obstructions or entanglements.

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

c) During surface supplied diving operations when only one diver is in the water, there must be a standby diver in attendance at the dive location. Scientific aquarium divers are exempt from this standard, provided the tender is equipped, ready and able to conduct a prompt and effective in-water retrieval of the diver at all times during the dive."

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

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

SECTION 9.00 STAGED DECOMPRESSION DIVING

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

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

9.10 Minimum Experience and Training Requirements

Prerequisites

1) Scientific Diver qualification according to Section 5.00.
2) Minimum of 100 logged dives.
3) Demonstration of the ability to safely plan and conduct dives deeper than 100 feet.
4) Nitrox certification/authorization according to AAUS Section 7.00 recommended.

Training

Training shall be appropriate for the conditions in which dive operations are to be conducted. Minimum Training shall include the following:

1) A minimum of 6 hours of classroom training to ensure theoretical knowledge to include: physics and physiology of decompression; decompression planning and procedures; gas management; equipment configurations; decompression method, emergency procedures, and omitted decompression.
2) It is recommended that at least one training session be conducted in a pool or sheltered water setting, to cover equipment handling and familiarization, swimming and buoyancy control, to estimate gas consumption rates, and to practice emergency procedures.
3) At least 6 open-water training dives simulating/requiring decompression shall be conducted, emphasizing planning and execution of required decompression dives, and including practice of emergency procedures.
4) Progression to greater depths shall be by 4-dive increments at depth intervals as specified in Section 5.50.
5) No training dives requiring decompression shall be conducted until the diver has demonstrated acceptable skills under simulated conditions.

6) The following are the minimum skills the diver must demonstrate proficiently during dives simulating and requiring decompression:

- Buoyancy control
- Proper ascent rate
- Proper depth control
- Equipment manipulation
- Stage/decompression bottle use as pertinent to planned diving operation
- Buddy skills
- Gas management
- Time management
- Task loading
- Emergency skills

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

9.20 Minimum Equipment Requirements

a) Valve and regulator systems for primary (bottom) gas supplies shall be configured in a redundant manner that allows continuous breathing gas delivery in the event of failure of any one component of the regulator/valve system.

b) Cylinders with volume and configuration adequate for planned diving operations

c) One of the second stages on the primary gas supply shall be configured with a hose of adequate length to facilitate effective emergency gas sharing in the intended environment.

d) Minimum dive equipment shall include:

1) Snorkel is optional at the DCB's discretion, as determined by the conditions and environment.

2) Diver location devices adequate for the planned diving operations and environment.

3) Compass

e) Redundancy in the following components is desirable or required at the discretion of the DCB or DSO:

1) Decompression Schedules

2) Dive Timing Devices

3) Depth gauges

4) Buoyancy Control Devices

5) Cutting devices

6) Lift bags and line reels

9.30 Minimum Operational Requirements

a) Approval of dive plan applications to conduct required decompression dives shall be on a case-by-case basis.

b) The maximum pO_2 to be used for planning required decompression dives is 1.6. It is recommended that a pO_2 of less than 1.6 be used during bottom exposure.

c) Diver's gas supplies shall be adequate to meet planned operational requirements and foreseeable emergency situations.

d) Decompression dives may be planned using dive tables, dive computers, and/or PC software approved by the DSO/DCB.

e) Breathing gases used while performing in-water decompression shall contain the same or greater oxygen content as that used during the bottom phase of the dive.

f) The dive team prior to each dive shall review emergency procedures appropriate for the planned dive.

g) If breathing gas mixtures other than air are used for required decompression, their use shall be in accordance with those regulations set forth in the appropriate sections of this standard.

h) The maximum depth for required decompression using air as the bottom gas shall be 190 feet.

i) Use of additional nitrox and/or high-oxygen fraction decompression mixtures as travel and decompression gases to decrease decompression obligations is encouraged.

j) Use of alternate inert gas mixtures to limit narcosis is encouraged for depths greater than 150 feet.

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

l) Mission specific workup dives are recommended.

SECTION 10.00 MIXED GAS DIVING

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

10.10 Minimum Experience and Training Requirements

Prerequisites

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

Classroom training including

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

Practical Training

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

10.20 Equipment and Gas Quality Requirements

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

b) The quality of inert gases used to produce breathing mixtures shall be of an acceptable grade for human consumption.

10.30 Minimum Operational Requirements

a) Approval of dive plan applications to conduct mixed gas dives shall be on a case-by-case basis.

b) All applicable operational requirements for nitrox and decompression diving shall be met.

c) The maximum pO_2 to be used for planning required decompression dives is 1.6. It is recommended that a pO_2 of less than 1.6 be used during bottom exposure.

d) Maximum planned Oxygen Toxicity Units (OTU) will be considered based on mission duration.

e) Divers decompressing on high-oxygen concentration mixtures shall closely monitor one another for signs of acute oxygen toxicity.

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

SECTION 11.00 OTHER DIVING TECHNOLOGY

Certain types of diving, some of which are listed below, require equipment or procedures that require training. Supplementary guidelines for these technologies are in development by the AAUS. Organizational member's using these, must have guidelines established by their Diving Control Board. Divers shall comply with all scuba diving procedures in this standard unless specified.

11.10 Blue Water Diving

Blue water diving is defined as diving in open water where the bottom is generally greater than 200 feet deep. It requires special training and the use of multiple-tethered diving techniques. Specific guidelines that should be followed are outlined in "Blue Water Diving Guidelines" (California Sea Grant Publ. No. T-CSGCP-014).

11.20 Ice And Polar Diving

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

11.30 Overhead Environments

Where an enclosed or confined space is not large enough for two divers, a diver shall be stationed at the underwater point of entry and an orientation line shall be used.

11.40 Saturation Diving

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

11.50 Hookah

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

11.60 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.

SECTION 12.00 REBREATHERS

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

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

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

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

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

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

12.10 Definition

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

B. There are three classes of rebreathers:

1. Oxygen Rebreathers: Oxygen rebreathers recycle breathing gas, consisting of pure oxygen, replenishing the oxygen metabolized by the diver. Oxygen rebreathers are generally the least complicated design but are limited in depth of use due to the physiological limits associated with oxygen toxicity

2. Semi-Closed Circuit Rebreathers: Semi-closed circuit rebreathers (SCR) recycle the majority of exhaled breathing gas, venting a portion into the water and replenishing it with a constant or variable amount of a single oxygen-enriched gas mixture. Gas addition and venting is balanced against diver metabolism to maintain safe oxygen levels

3. Closed-Circuit Rebreathers: Closed-circuit mixed gas rebreathers (CCR) recycle all of the exhaled gas. Electronically controlled CCRs (eCCR) replace metabolized oxygen via an electronically controlled valve, governed by oxygen sensors. Manually

controlled CCR (mCCR) rely on mechanical oxygen addition and diver monitoring to control oxygen partial pressure (ppO_2). Depending on the design, manual oxygen addition may be available on eCCR units as a diver override, in case of electronic system failure. Systems are equipped with two cylinders; one with oxygen, the other with a diluent gas source used to make up gas volume with depth increase and to dilute oxygen levels. CCR systems operate to maintain a constant ppO_2 during the dive, regardless of depth

12.20. Prerequisites for use of any rebreather.

A. Active scientific diver status, with depth qualification sufficient for the type, make, and model of rebreather, and planned application.

B. Completion of a minimum of 25 open-water dives on open circuit SCUBA. The DCB may require increased dive experience depending upon the intended use of the rebreather system for scientific diving.

C. For SCR or CCR, a minimum 60-fsw-depth qualification is generally recommended, to ensure the diver is sufficiently conversant with the complications of deeper diving. If the sole expected application for use of rebreathers is shallower than this, a lesser depth qualification may be allowed with the approval of the DCB.

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

12.30. Training

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

B. Successful completion of training does not in itself authorize the diver to use rebreathers. The diver must demonstrate to the DCB or its designee that the diver possesses the proper attitude, judgment, and discipline to safely conduct rebreather diving in the context of planned operations.

C. Post training supervised dives are required before the Scientific rebreather diver is authorized to use rebreather for research dives. (see training section for details).

II. Individual Equipment Requirements

Individual Equipment Requirements			
Key: X = include, IA = If Applicable			
	O2	SCR	CCR
DCB approved rebreather make and model	X	X	X
Bottom timer, and depth gauge	X	X	X
Dive computer (separate from rebreather unit)		X	X
Approved dive tables		IA	IA
SMB (surface marker buoy) and line reel or spool with sufficient line to deploy an SMB from the bottom in the training environment	IA	IA	IA
Access to an oxygen analyzer	X	X	X
Cutting implement	X	X	X
BCD capable of floating a diver with a flooded loop and/or dry suit at the Surface	X	X	X
Bailout gas supply of sufficient volume for planned diving activities	X	X	X
Approved CO2 absorbent and other consumables	X	X	X

12.40. Equipment Requirements

A. General

1. Only those models of rebreathers specifically approved by DCB shall be used
2. Rebreathers should meet the quality control/quality assurance protocols of the International Organization for Standardization (ISO) requirements: ISO 9004: 2009 or the most current version, AND successful completion of CE (Conformité Européenne) or DCB approved third party testing
3. Rebreather modifications (including consumables and operational limits) that deviate from or are not covered by manufacturer documentation should be discussed with the manufacturer and approved by the DCB prior to implementation

B. Equipment Maintenance Requirements

1. The DCB or their designee will establish policies for the maintenance of rebreathers and related equipment under their auspices. Rebreathers should be maintained in accordance with manufacturer servicing recommendations
2. Field repairs and replacement of components covered in rebreather diver training is not annual maintenance and may be performed by the rebreather diver in accordance with DCB policy
3. A maintenance log will be kept and will minimally include:
    a) Dates of service
    b) Service performed
    c) Individuals or company performing the service

12.50.Operational Requirements

A. Dive Plan

1. In addition to standard dive plan components, at a minimum all dive plans that include the use of rebreathers must include:
    a) Information about the specific rebreather model(s) to be used

b) Type of CO_2 absorbent material

c) Composition and volume(s) of supply gasses

d) Bailout procedures

e) Other specific details as required by the DCB

f) Particular attention should be paid to using rebreathers under conditions where vibration or pulsating water movement could affect electronics or control switches and systems

g) Particular attention should be paid to using rebreathers under conditions where heavy physical exertion is anticipated

B. Ideally, respired gas densities should be less than 5 $g \cdot L^{-1}$, and should not exceed 6 $g \cdot L^{-1}$ under normal circumstances.

C. User replaceable consumable rebreather components should be replaced per manufacture recommendations or as defined by the DCB

D. If performed, periodic field validation of oxygen cells should be conducted per DCB designated procedure

E. Diver carried off-board bailout is not required under conditions where the onboard reserves are adequate to return the diver to the surface while meeting proper ascent rate and stop requirements, and the system is configured to allow access to onboard gas. These calculations must take into consideration mixed mode operations where an open circuit diver could require assistance in an out of gas situation

F. Use and reuse of CO_2 scrubber media should be per manufacture recommendations or as defined by the DCB

G. Planned oxygen partial pressure in the breathing gas shall not exceed 1.4 atmospheres at depths greater than 30 feet, or 1.6 at depths less than 30feet

H. Both CNS and Oxygen Tolerance Units (OTUs) should be tracked for each diver. Exposure limits should be established by the DCB

I. The DCB or their designee will:

1. Establish policies for the use of checklists related to rebreather operations

2. Establish policies for pre and post dive equipment checks to be conducted by their divers

3. Establish policies for disinfection of rebreathers to be used by their divers

4. Establish policies for pre-breathing of rebreathers used by their divers

5. Establish policies for the use of mixed mode and mixed rebreather platform dive teams under their auspices.

    a) Mixed mode and/or mixed platform dive teams are permitted.

    b) At minimum, divers must be cross briefed on basic system operations for establishing positive buoyancy, closing a rebreather diver's breathing loop, and procedures for gas sharing

6. Establish policies for the maximum depth of dives conducted using a particular class of rebreather within the auspices of their diving operations

7. Establish policies for depth progression/depth certification/depth certification maintenance for divers using rebreathers

8. Establish policies for implementing workup dives within program

    a) Pre-operation workup dives, including review and practice of emergency recognition and response skills, and management of task loading are required for operations defined by the DCB as beyond the scope of normal operating conditions.

9. Establish policies for the minimum use of rebreathers to maintain proficiency.

    a) The minimum Annual rebreather diving activity should be 12 rebreather dives, with a minimum of 12 h underwater time.

    b) To count, dives should be no less than 30 min in duration. A required element of maintaining proficiency is the periodic performance and reevaluation of skills related to in-water problem recognition and emergency procedures

J. Establish policies for reauthorization for the use of rebreathers if minimum proficiency requirements are not met

1. Reestablishment of authorization to use rebreathers must require more than just performing a dive on a particular make or model of rebreather

2. At minimum demonstrated skills included in the required training elements for the level of rebreather operation must be performed and reevaluated.

12.60 REBREATHER TRAINING SECTION

A. Entry Level Training

1. The training area for O2 Rebreather should not exceed 20 fsw in depth
2. Entry level CCR and SCR training is limited in depth of 130fsw and shallower
3. Entry level CCR and SCR training is limited to nitrogen/oxygen breathing media
4. Divers at the CCR and SCR entry level may not log dives that require a single decompression stop longer than 10 minutes
5. Who may teach: Individuals authorized as a CCR, SCR, or O2 Rebreather Instructor by the DCB; in all cases, the individual authorized must have operational experience on the rebreather platform being taught, and where applicable the individual being authorized should be authorized as an instructor by the respective rebreather manufacturer or their designee.
6. Maximum Student/Instructor Ratio: 4 to 1. This ratio is to be reduced as required by environmental conditions or operational constraints
7. Upon completion of practical training, the diver must demonstrate proficiency in pre-dive, dive, and post-dive operational procedures for the particular model of rebreather to be used
8. Supervised dives target activities associated with the planned science diving application. Supervisor for these dives is the DSO or designee, experienced with the make/model rebreather being used

Rebreather Entry Level Training Requirements			
Key: X = include, IA = If Applicable, ISE = If So Equipped			
	O2	SCR	CCR
Required Training Topic			
Academic			
History of technology	X	X	X
Medical & physiological aspects of:			
Oxygen toxicity	X	X	X
chemical burns & caustic cocktail	X	X	X

Hypoxia – insufficient O_2	X	X	X
Hypercapnia – excessive CO_2	X	X	X
Arterial gas embolism	X	X	X
Middle Ear Oxygen Absorption Syndrome (oxygen ear)	X	X	X
Hygienic concerns	X	X	X
Nitrogen absorption & decompression sickness		X	X
CO_2 retention	X	X	X
Hyperoxia-induced myopia	X	X	X
System design, assembly, and operation, including:			
Layout and design	X	X	X
Oxygen control systems	X	X	X
Diluent control systems		ISE	ISE
Use of checklists	X	X	X
Complete assembly and disassembly of the unit	X	X	X
Canister design & proper packing and handling of chemical absorbent	X	X	X
Decompression management and applicable tracking methods		ISE	X
Oxygen and high pressure gas handling and safety	X	X	X
Fire triangle	X	X	X
Filling of cylinders	X	X	X
Pre-dive testing & trouble shooting	X	X	X
Post-dive break-down and maintenance	X	X	X
Trouble shooting and manufacturer authorized field repairs	X	X	X
Required maintenance and intervals	X	X	X
Manufacturer supported additional items (ADV, temp stick, CO_2 monitor, etc.)	ISE	ISE	ISE
Dive planning:			
Operational planning	X	X	X
Gas requirements	X	X	X
Oxygen exposure and management	X	X	X
Gas density calculations		X	X
Oxygen metabolizing calculations	X	X	X
Scrubber limitations	X	X	X
Mixed mode diving (buddies using different dive modes)	X	X	X
Mixed platform diving (buddies using different rebreather platforms)	X	X	X
Problem Recognition & Emergency Procedures:			
Applicable open circuit emergency procedures for common gear elements	X	X	X
Loss of electronics	ISE	ISE	X
Partially flooded loop	X	X	X
Fully flooded loop	X	X	X
Cell warnings		ISE	X
Battery warnings	ISE	ISE	X
High O_2 warning	ISE	ISE	X
Low O_2 warning	ISE	ISE	X
High CO_2 warning	ISE	ISE	ISE
Recognizing issues as indicated by onboard scrubber monitors	ISE	ISE	ISE
Recognizing hypercapnia signs and symptoms in self or others	X	X	X

Excluded O2 cell(s)	ISE	ISE	ISE
Loss of Heads Up Display (HUD)	ISE	ISE	ISE
Loss of buoyancy	X	X	X
Diluent manual add button not functioning		ISE	ISE
O2 manual add button not functioning	ISE	ISE	ISE
Exhausted oxygen supply	X	X	X
Exhausted diluent supply		ISE	ISE
Lost or exhausted bailout	ISE	ISE	ISE
Handset not functioning	ISE	ISE	ISE
Solenoid stuck open	ISE	ISE	ISE
Solenoid stuck closed	ISE	ISE	ISE
ADV stuck open	ISE	ISE	ISE
ADV stuck closed	ISE	ISE	ISE
Isolator valve(s) not functioning	ISE	ISE	ISE
Oxygen sensor validation	ISE	ISE	X
CO_2 sensor validation	IA	IA	IA
Gas sharing	X	X	X
Diver assist and diver rescue	X	X	X
Other problem recognition and emergency procedures specific to the particular unit, environment, or diving conditions	X	X	X
Practical Training and Evaluations			
Demonstrated skills shall include, at a minimum:			
Use of checklists	X	X	X
Carbon dioxide absorbent canister packing	X	X	X
Supply gas cylinder analysis and pressure check	X	X	X
Test of one-way valves	X	X	X
System assembly and breathing loop leak testing	X	X	X
Oxygen control system calibration	ISE	ISE	X
Proper pre-breathe procedure	X	X	X
In-water bubble check	X	X	X
Proper buoyancy control during descent, dive operations, and ascent	X	X	X
System monitoring & control during descent, dive operations, and ascent	X	X	X
Proper interpretation and operation of system instrumentation	X	X	X
Proper buddy contact and communication	X	X	X
Use of a line reel or spool to deploy an SMB from planned dive depth and while controlling buoyancy in the water column	X	X	X
Proper management of line reel or spool, and SMB during ascents and safety or required stops	X	X	X
Unit removal and replacement on the surface	X	X	X
Bailout and emergency procedures for self and buddy, including:			
System malfunction recognition and solution	X	X	X
Manual system control	ISE	ISE	ISE
Flooded breathing loop recovery	IA	IA	IA
Absorbent canister failure	X	X	X
Alternate bailout options	X	X	X
Manipulation of onboard and offboard cylinder valves	X	X	X

Manipulation of bailout cylinders (removal, replacement, passing and receiving while maintaining buoyancy control)	ISE	ISE	ISE
Manipulation of quick disconnects, isolator valves, and manual controls specific to the unit and gear configuration	ISE	ISE	ISE
Proper system maintenance, including:			
Breathing loop disassembly and disinfection	X	X	X
Oxygen sensor replacement	ISE	ISE	ISE
Battery removal and replacement or recharging	ISE	ISE	ISE
Other tasks as required by specific rebreather models	X	X	X
Written Evaluation	X	X	X
Supervised Rebreather Dives	X	X	X

Entry Level Training – Minimum Underwater Requirements			
	Pool/Confined Water	**Openwater**	**Supervised Dives**
O2	1 Dive, 90 – 120 minutes	4 dives, 120 minute cumulative	2 Dives, 120 minute cumulative
SCR	1 Dive, 90 – 120 minutes	4 dives, 120 minute cumulative	4 dives, 120 minute cumulative
CCR	1 Dive, 90 – 120 minutes	8 dives, 380 minute cumulative	4 dives, 240 minute cumulative

B. Rebreather Required Decompression, Mixed Gas, and Hypoxic Mix Training

9. Required Decompression and Mixed Gas Training may be taught separately or combined. If combined, open water and supervised dive requirements are added together to equal the total of the courses if taught separately

10. Prerequisites:

    a) Required Decompression 25 rebreather dives for a minimum cumulative dive time of 25 hours

    b) Mixed Gas:

        (1) Non-hypoxic Mixes – 25 rebreather dives for a minimum cumulative dive time of 25 hours

        (2) Hypoxic Mixes – Rebreather Required Decompression Certification and Mixed Gas Certification and 25 dives for a minimum cumulative dive time of 40 hours on dives requiring decompression

11. Who may teach: Individuals authorized as a CCR/SRC required decompression and/or Mixed Gas and/or Hypoxic Mix instructor by the DCB or their designee (this is in addition to the original authorization from section A #5)

12. Maximum Student/Instructor Ratio: 2 to 1. This ratio is to be reduced as required by environmental conditions or operational constraints

13. Upon completion of practical training, the diver must demonstrate proficiency in pre-dive, dive, and post-dive operational procedures for the particular model of rebreather to be used

14. Supervised dives target activities associated with the planned science diving application. Supervisor for these dives is the DSO or designee, experienced with the make/model rebreather being used

Rebreather Required Decompression, Mixed Gas & Hypoxic Mix Training Requirements			
Key: X = include, IA = If Applicable, ISE = If So Equipped			
	Deco	Mixed Gas	Hypoxic Mixes
Required Training Topic			
Academic			
Review of applicable subject matter from previous training	X	X	X
Medical & physiological aspects of:			
Hypercapnia, hypoxia, hyperoxia	X	X	X
Oxygen limitations	X	X	X
Nitrogen limitations	X	X	X
Helium absorption and elimination		X	X
High Pressure Nervous Syndrome (HPNS)			X
System design, assembly, and operation, including:			
Gear considerations and rigging	X	X	X
Gas switching	X	X	X
Dive planning:			
Decompression calculation	X	X	X
Gradient Factors	X	X	X
Scrubber duration and the effects of depth on scrubber function	X	X	X
Gas requirements including bailout scenarios	X	X	X
Bailout gas management – individual vs team bailout	X	X	X
Gas density calculations	X	X	X
Operational Planning	X	X	X
Equivalent narcosis depth theory		X	X
Gas selection, gas mixing and gas formulas		X	X
Problem Recognition & Emergency Procedures:			
Applicable open circuit emergency procedures for common gear elements	X	X	X
Flooded loop	X	X	X
Cell warnings	X	X	X
Battery warnings	X	X	X
Hypercapnia, hypoxia, hyperoxia	X	X	X
Practical Training and Evaluations			
Demonstrated skills shall include, at a minimum:			
Proper demonstration of applicable skills from previous training	X	X	X
Proper manipulation of DSV and/or BOV	X	X	X

Proper descent and bubble check procedures	X	X	X
Proper monitoring of setpoint switching and pO2 levels	X	X	X
Proper interpretation and operation of system instrumentation	X	X	X
System monitoring & control during descent, dive operations, and ascent	X	X	X
Demonstrate the ability to manually change setpoint and electronics settings during the dive	ISE	ISE	ISE
Demonstrate buoyancy control; ability to hover at fixed position in water column without moving hands or feet	X	X	X
Onboard and offboard valve manipulation for proper use, and reduction of gas loss	X	X	X
Diagnosis of and proper reactions for a flooded absorbent canister	X	X	X
Diagnosis of and proper reactions for CO_2 breakthrough	X	X	X
Diagnosis of and proper response to Cell Errors	X	X	X
Diagnosis of and proper reactions for Low oxygen drills	X	X	X
Diagnosis of and proper reactions for Flooded Loop	X	X	X
Diagnosis of and proper reactions for High Oxygen Drills	X	X	X
Diagnosis of and proper reactions for electronics and battery failure	X	X	X
Operation in semi-closed mode	X	X	X
Properly execute the ascent procedures for an incapacitated dive buddy	X	X	X
Demonstrate controlled ascent with an incapacitated diver including surface tow at least 30 metres / 100 feet with equipment removal on surface, in water too deep to stand	X	X	X
Proper buddy contact and communication	X	X	X
Use of a line reel or spool to deploy an SMB from planned dive depth and while controlling buoyancy in the water column	X	X	X
Proper management of line reel or spool, and SMB during ascents and safety or required stops	X	X	X
Demonstrate the ability to maintain minimum loop volume	X	X	X
Demonstrate comfort swimming on surface and at depth carrying a single bailout/decompression cylinder/bailout rebreather	X		
Demonstrate ability to pass and retrieve a single bailout/decompression cylinder or bailout rebreather while maintaining position in the water column	X		
Demonstrate ability to pass and retrieve multiple bailout/decompression cylinders or bailout rebreather while maintaining position in the water column	IA	X	X
Demonstration of the ability to perform simulated decompression stops at pre-determined depths for scheduled times	X	X	X
Demonstration of the ability to perform decompression stops at pre-determined depths for scheduled times	X	X	X
Demonstrate competence managing multiple bailout cylinders, including drop and recovery while maintaining position in the water column	IA	X	X
Demonstrate appropriate reaction to simulated free-flowing deco regulator	X	X	X
Gas share of deco gas for at least 1 minute	X	X	X
Demonstrate oxygen rebreather mode at appropriate stop depth		X	X
Complete bailout scenarios from depth to include	X	X	X

decompression obligation on open circuit			
Written Evaluation	X	X	X
Supervised Rebreather Dives	X	X	X

Minimum Underwater Requirements			
	Pool/Confined Water	**Openwater**	**Supervised Dives****
Deco	1 Dive / 60 min	7 Dives / 420 min*	4 Dives / 240 min.*
Mixed Gas	1 Dive / 60 min	7 Dives / 420 min*	4 Dives / 240 min.*
Hypoxic Mixes		7 Dives / 420 min	4 Dives / 240 min.

*If Deco and Mixed Gas training are done concurrently, a minimum of three mixed gas dives for a minimum cumulative time of 180 minutes must be conducted; a minimum of 4 supervised dives is required

**A minimum of three supervised dives should comply with certification parameters

B. Rebreather Crossover Training

1. Crossover training to a new rebreather platform requires a minimum of 4 training dives for a minimum cumulative dive time of 240 min.

2. Advanced level certification on a new rebreather platform may be awarded upon successful demonstration of required skills using the new platform

SECTION 13.00 SCIENTIFIC CAVE AND CAVERN DIVING STANDARD

This standard helps to ensure all scientific diving in overhead environments is conducted in a manner which will maximize the protection of scientific divers from accidental injury and/or illness and provide the basis allowing the working reciprocity between AAUS organizational members.

If a conflict exists between this standard and other standards in this manual, the information set forth in this standard only takes precedence when the scientific diving being conducted takes place wholly or partly within an underwater cave or cavern environment.

A dive team shall be considered to be cave or cavern diving if at any time during the dive they find themselves in a position where they cannot complete a direct, unobstructed ascent to the surface because of rock formations.

The member organization requires that no person shall engage in scientific cave or cavern diving unless that person holds a recognized certificate/authorization issued pursuant to the provisions of this manual.

The diver must demonstrate to the DCB or its designee that the diver possesses the proper attitude, judgment, and discipline to safety conduct cave and cavern diving in the context of planned operations.

Operational requirements for cave and cavern diving have been established through accident analysis of previous cave diving accidents.

13.10 Definitions

Alternate Gas Supply - Fully redundant system capable of providing a gas source to the diver should their primary gas supply fail.

Bubble Check - Visual examination by the dive team of their diving systems, looking for o-ring leaks or other air leaks conducted in the water prior to entering a cave. Usually included in the "S" Drill.

Cave – A dive shall be considered a cave dive if any one or more of the environmental limits specified in the definition of cavern are exceeded or otherwise not followed. Linear penetrations limits shall not exceed the limits of each diver's training.

Cave Dive - A dive, which takes place partially or wholly underground, in which one or more of the environmental parameters defining a cavern dive are exceeded.

Cavern - An entrance and first chamber to a cave where:

- Sunlight from the entrance is visible to all dive team members at all times during the dive.
- Members of the dive team do not pass through any restrictions that don't allow the divers to swim side by side during the dive, nor are there any restrictions between the divers and the most expeditious exit to the surface.
- Maximum depth achieved shall not exceed the depth ratings of dive team.

Cavern Dive - A dive which takes place partially or wholly underground, in which the following environmental parameters are met:

- Natural sunlight is continuously visible from the entrance.
- Environmental conditions will be evaluated by the DSO or designee and appropriate limits incorporated into the dive plan.

Dual Valve Manifold with Isolator Valve - A manifold joining two diving cylinders, that allows the use of two completely independent regulators. If either regulator fails, it may be shut off, allowing the remaining regulator access to the gas in both of the diving cylinders.

Gas Management - Gas planning rule which is used in cave diving environments in which the diver reserves a portion of their available breathing gas for anticipated emergencies (See Rule of Thirds, Sixths).

Guideline - Continuous line used as a navigational reference during a dive leading from the team position to a point where a direct vertical ascent may be made to the surface.

Jump/Gap Reel -Spool or reel used to connect one guide line to another thus ensuring a continuous line to the exit.

Knife/Line Cutter - Small, sharp blade capable of easily cutting a guideline and that is accessible to the diver.

Lava Tube - Type of cave or cavern formed by the surface hardening of a stream of flowing molten rock, which may later become flooded due to static sea level changes.

Line Marker - Any one of several types of markers attached to a guideline, which provides additional navigational information to the dive team, most commonly the direction out to the nearest surface.

Mine Diving - Diving in the flooded portions of a man-made mine. Necessitates use of techniques detailed for cave diving.

Penetration Distance - Linear distance from the entrance intended or reached by a dive team during a dive at a dive site.

Primary Reel - Initial guideline used by the dive team from open water to maximum penetration or a permanently installed guideline.

Restriction - Any passage through which two divers cannot easily pass side by side while sharing air.

Rule of Thirds - Gas planning rule which is used in cave diving environments in which the diver reserves 2/3's of their breathing gas supply for exiting the cave or cavern.

Rule of Sixths - Air planning rule which is used in cave or other confined diving environments in which the diver reserves 5/6's of their breathing gas supply (for DPV use, siphon diving, etc.) for exiting the cave or cavern.

Safety Drill - ("S" Drill) - Short gas sharing, equipment evaluation, dive plan, and communication exercise carried out prior to entering a cave or cavern dive by the dive team.

Safety Reel - Secondary reel used as a backup to the primary reel, usually containing 150 feet of guideline that is used in an emergency.

Scientific Cave or Cavern Diver In Training - Authorized to dive in the cave or cavern environment under the direct supervision of qualified instructional personnel for training purposes only.

Scientific Cavern Diver - Authorization to dive in an overhead environment as defined in cavern.

Scientific Cave Diver - Authorization to dive in an overhead environment as defined in cave.

Sidemount Diving - A diving mode utilizing two independent SCUBA systems carried along the sides of the diver's body; either of which always has sufficient air to allow the diver to reach the surface unassisted.

Siphon - Cave into which water flows with a generally continuous in-current.

Solution Cave - Cave formed in carbonate or carbonate-cemented bedrock, formed by the dissolution of the rock by groundwater.

Spring - Cave with water flowing with a generally continuous outflow.

Sump - An area in a dry cave that can no longer be negotiated without the use of diving equipment.

Well - A vertical or nearly vertical shaft, usually manmade, through which a diver can access a dive site.

13.20 Cave and Cavern Environment Hazards

Current/Flow - Underwater caves have currents that vary in strength and direction. Of particular note is a condition known as siphoning. Siphoning caves have flow or current directed into the cave. This can cause poor visibility as a result of mud and silt being drawn into the cave entrance.

Silt - The presences of silt, sand, mud, clay, etc. on the cave floor can cause visibility to be reduced to nothing in a very short time.

Restrictions - Any passage through which two divers cannot easily pass side by side while sharing air make air sharing difficult.

Cave-ins - Cave-ins are a normal part of cave evolution; however experiencing a cave-in during diving operations is extremely unlikely.

13.30 Minimum Experience and Training Requirements

Cavern Diver

Prerequisites

The applicant for training shall have met the requirements in Section 5.00 of the AAUS *Standards for Scientific Diving Certification and Operation of Scientific Diving Programs,* fourth edition (2003), and hold as a minimum a scientific diver permit.

Cavern Training

The applicant is to participate in the following areas of training, or their equivalent:

1. Classroom Lecture and Critique—The applicant shall participate in classroom discussion or equivalent type activities covering these topics: Policy for cavern diving, cavern environment and environmental hazards, accident analysis, psychological considerations, equipment, body control, communications, cavern diving techniques, navigation and guidelines, dive planning, cave geology, cave hydrology, cave biology, and emergency procedures.
2. Land Drills—The applicant shall participate in drills above water using the guideline and reel. Drills are to emphasize proper use of the reel, techniques and considerations for laying a guideline, guideline following, buddy communication, and emergency procedures.
3. Cavern Dives—A minimum of four (4) cavern dives, preferably to be conducted in a minimum of two (2) different caverns. Skills the applicant should demonstrate include: Safety drill (S-drill), gear matching, bubble check prior to entering the cavern on each dive, proper buoyancy compensator use, proper trim and body positioning, hovering and buoyancy with hand tasks, specialized propulsion techniques (modified flutter kick, modified frog kick, pull and glide, ceiling walk or shuffle), proper guideline and reel use, ability to follow the guideline with no visibility, sharing air while following a guideline, and sharing air while following the guideline

with no visibility light and hand signal use, and ability to comfortably work in a cavern without assistance.

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

Cave Diver

Prerequisites

The applicant for training shall hold as a minimum a cavern diver permit.

Cave Training

The applicant is to participate in the following areas of training, or their equivalent:

1. Classroom Lecture and Critique—The applicant shall participate in classroom discussion or equivalent type activities covering these topics: Review of the topics listed in cavern diver training and differing techniques and procedures used in cave diving, additional equipment procedures used in cave diving, cave diving equipment configurations, procedures for conducting diving operations involving complex navigation and use of line markers, advanced gas management and a thorough review of dive tables, decompression tables, and decompression theory.
2. Land Drills—The applicant shall participate in drills above water included in cavern training. Drills are to emphasize proper use of the reel in lost diver procedures, as well as line placements and station location as required for surveying.
3. Cave Dives—A minimum of twelve (12) cave dives, to be conducted in a minimum of four (4) different cave sites with differing conditions recommended. Skills the applicant should demonstrate include: Review of skills listed in cavern training, and special techniques in buoyancy control, referencing and back-up navigation, air sharing in a minor restriction using a single file method, special propulsion techniques in heavy outflow, anti-silting techniques, line jumping techniques and protocols, surveying, and ability to critique their dives. Emergency procedures training shall include proficiency in lost line, lost diver, gas sharing, light failure, valve manipulation, and no/low visibility situations.
4. Written Examination - A written evaluation approved by the DCB with a predetermined passing score, covering concepts of both classroom and practical training is required.

13.40 Equipment Requirements

Equipment

Equipment used for SCUBA in cave or cavern diving is based on the concept of redundancy. Redundant SCUBA equipment shall be carried whenever the planned penetration distances are such that an emergency swimming ascent is not theoretically possible.

Cavern Diving Equipment

The following equipment shall be required, in excess of that detailed for open water SCUBA diving in Volume 1, Section 3.00. Each member of the dive team shall have:

- At minimum, a single tank equipped with an "H" valve or an alternate air supply.
- A BCD capable of being inflated from the tank.
- Slate and pencil.

- Two battery powered secondary lights of an approved type.
- Knife or line cutter.
- One primary reel of at least 350 feet for each team.
- Snorkel—No snorkel shall be worn while inside underwater cave or cavern.

Cave Diving Equipment

The following equipment shall be required, in excess of that detailed for cavern diving: Each member of the dive team shall have:

- Cylinders with dual orifice isolation valve manifold or independent SCUBA systems each capable of maintaining enough gas for the diver during exit and ascent to the surface.
- Two completely independent regulators, at least one of each having submersible tank pressure gauge, a five foot or longer second stage hose, low pressure inflator for the BCD.
- A primary light with sufficient burn time for the planned dive.
- Safety reel with at least 150 feet of line.
- Appropriate submersible dive tables and/or dive computer (computers w/ backup tables).
- Line markers.
- Snorkel—No snorkel shall be worn while inside underwater cave or cavern.

13.50 Operational Requirements and Safety Protocols

All members of the dive team must have met the applicable all sections of Volume One and applicable sections of Volume Two of the AAUS manual and be authorized for that type of diving by the DCB before conducting scientific cave dives.

Cavern Diver Procedures

1. Cavern diving shall not be conducted at depths greater than 100 feet.
2. Dive teams shall perform a safety drill prior to each cave or cavern penetration that includes equipment check, gas management, and dive objectives.
3. Each team within the cavern zone must utilize a continuous guideline appropriate for the environment leading to a point from which an uninterrupted ascent to the surface may be made.
4. Gas management must be appropriate for the planned dive with special considerations made for; DPV's, siphon diving, rebreathers, etc.
5. The entire dive team is to immediately terminate the dive whenever any dive team member feels an unsafe condition is present.

Cave Diving Procedures

1. Dive teams shall perform a safety drill prior to each cave or cavern penetration that includes equipment check, gas management, and dive objectives.
2. Diver teams must run or follow a continuous guideline from the surface pool to maximum penetration.
3. Gas management must be appropriate for the planned dive with special considerations made for: DPV's, siphon diving, rebreathers, etc.
4. Each diver must carry one primary and two back up lights.
5. Divers utilizing side mount diving or other dual independent diving systems must have the approval of the Diving Safety Officer or his/her designee.
6. The entire dive team is to immediately terminate the dive whenever any dive team member feels an unsafe condition is present.

Appendices

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). Their answers on the Diving Medical History Form (attached) may indicate potential health or safety risks as noted. Your evaluation is requested on the attached scuba Diving Fitness Medical Evaluation Report. If you have questions about diving medicine, you may wish to consult one of the references on the attached list or contact one of the physicians with expertise in diving medicine whose names and phone numbers appear on an attached list, the Undersea Hyperbaric and Medical Society, or the Divers Alert Network. 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. Recent deaths in the scientific diving community have been attributed to cardiovascular disease. Please consult the following list of conditions that usually restrict candidates from diving.

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

CONDITIONS WHICH MAY DISQUALIFY CANDIDATES FROM DIVING

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

20. Inadequate exercise tolerance. [34]
21. Severe hypertension. [35]
22. History of spontaneous or traumatic pneumothorax. [45]
23. Asthma. [42 - 44]
24. Chronic pulmonary disease, including radiographic evidence of pulmonary blebs, bullae, or cysts. [45,46]
25. Diabetes mellitus. [46 - 47]
26. Pregnancy. [56]

SELECTED REFERENCES IN DIVING MEDICINE

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

- Elliott, D.H. ed. 1996. *Are Asthmatics Fit to Dive?* Kensington, MD: Undersea and Hyperbaric Medical Society.
- Bove, A.A. 2011. The cardiovascular system and diving risk. *Undersea and Hyperbaric Medicine* 38(4): 261-269.
- Thompson, P.D. 2011. The cardiovascular risks of diving. *Undersea and Hyperbaric Medicine* 38(4): 271-277.
- Douglas, P.S. 2011. Cardiovascular screening in asymptomatic adults: Lessons for the diving world. *Undersea and Hyperbaric Medicine* 38(4): 279-287.
- Mitchell, S.J., and A.A. Bove. 2011. Medical screening of recreational divers for cardiovascular disease: Consensus discussion at the Divers Alert Network Fatality Workshop. *Undersea and Hyperbaric Medicine* 38(4): 289-296.
- Grundy, S.M., Pasternak, R., Greenland, P., Smith, S., and Fuster, V. 1999. Assessment of Cardiovascular Risk by Use of Multiple-Risk-Factor Assessment Equations. AHA/ACC Scientific Statement. *Journal of the American College of Cardiology,* 34: 1348-1359. http://content.onlinejacc.org/cgi/content/short/34/4/1348
- Bove, A.A. and Davis, J. 2003. DIVING MEDICINE, Fourth Edition. Philadelphia: W.B. Saunders Company.
- Edmonds, C., Lowry, C., Pennefather, J. and Walker, R. 2002. DIVING AND SUBAQUATIC MEDICINE, Fourth Edition. London: Hodder Arnold Publishers.
- Bove, A.A. ed. 1998. MEDICAL EXAMINATION OF SPORT SCUBA DIVERS, San Antonio, TX: Medical Seminars, Inc.
- NOAA DIVING MANUAL, NOAA. Superintendent of Documents. Washington, DC: U.S. Government Printing Office.
- U.S. NAVY DIVING MANUAL. Superintendent of Documents, Washington, DC: U.S. Government Printing Office, Washington, D.C.

APPENDIX 2
AAUS MEDICAL EVALUATION OF FITNESS FOR SCUBA DIVING REPORT

_____ _____

Name of Applicant (Print or Type) Date of Medical Evaluation (Month/Day/Year)

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

TESTS: THE FOLLOWING TESTS ARE <u>REQUIRED</u>:

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

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

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

- Chest x-ray (Required only during first exam over age 40)
- Resting EKG
- Assessment of coronary artery disease using Multiple-Risk-Factor Assessment[1]
  (age, lipid profile, blood pressure, diabetic screening, smoking)
  Note: Exercise stress testing may be indicated based on Multiple-Risk-Factor Assessment[2]

PHYSICIAN'S STATEMENT:

_____ 01 Diver **IS** medically qualified to dive for: _____2 years (over age 60)
_____3 years (age 40-59)
_____5 years (under age 40)

_____ 02 Diver **IS NOT** medically qualified to dive:_____Permanently_____Temporarily.

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

_____ MD or DO _____
Signature Date

_____
Name (Print or Type)

_____
Address

_____ _____
Telephone Number E-Mail Address

My familiarity with applicant is: _____This exam only _____Regular physician for _____ years

My familiarity with diving medicine is: _____

APPENDIX 2b
AAUS MEDICAL EVALUATION OF FITNESS FOR SCUBA DIVING REPORT

APPLICANT'S RELEASE OF MEDICAL INFORMATION FORM

_____

Name of Applicant (Print or Type)

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

Signature of Applicant _____ Date_____

REFERENCES

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

APPENDIX 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 places considerable physical and mental demands on the diver. Certain medical and physical requirements must be met before beginning a diving or training program. Your accurate answers to the questions are more important, in many instances, in determining your fitness to dive than what the physician may see, hear or feel as part of the diving medical certification procedure.

This form shall be kept confidential by the examining physician. 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 who must then indicate, in writing, that you have done so and that no health hazard exists.

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

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

23			Take tranquilizers	
24			Perforated ear drums	
25			Hay fever	
26			Frequent sinus trouble, frequent drainage from the nose, post-nasal drip, or stuffy nose	
27			Frequent earaches	
28			Drainage from the ears	
29			Difficulty with your ears in airplanes or on mountains	
30			Ear surgery	
31			Ringing in your ears	
32			Frequent dizzy spells	
33			Hearing problems	
34			Trouble equalizing pressure in your ears	
35			Asthma	
36			Wheezing attacks	
37			Cough (chronic or recurrent)	
38			Frequently raise sputum	
39			Pleurisy	
40			Collapsed lung (pneumothorax)	
41			Lung cysts	
42			Pneumonia	
43			Tuberculosis	
44			Shortness of breath	
45			Lung problem or abnormality	
46			Spit blood	
47			Breathing difficulty after eating particular foods, after exposure to particular pollens or animals	
48			Are you subject to bronchitis	
49			Subcutaneous emphysema (air under the skin)	
50			Air embolism after diving	
51			Decompression sickness	
52			Rheumatic fever	
53			Scarlet fever	
54			Heart murmur	
55			Large heart	
56			High blood pressure	
57			Angina (heart pains or pressure in the chest)	
58			Heart attack	
	Yes	**No**	**Please indicate whether or not the following apply to you**	**Comments**
59			Low blood pressure	

60			Recurrent or persistent swelling of the legs	
61			Pounding, rapid heartbeat or palpitations	
62			Easily fatigued or short of breath	
63			Abnormal EKG	
64			Joint problems, dislocations or arthritis	
65			Back trouble or back injuries	
66			Ruptured or slipped disk	
67			Limiting physical handicaps	
68			Muscle cramps	
69			Varicose veins	
70			Amputations	
71			Head injury causing unconsciousness	
72			Paralysis	
73			Have you ever had an adverse reaction to medication?	
74			Do you smoke?	
75			Have you ever had any other medical problems not listed? If so, please list or describe below;	
76			Is there a family history of high cholesterol?	
77			Is there a family history of heart disease or stroke?	
78			Is there a family history of diabetes?	
79			Is there a family history of asthma?	
80			Date of last tetanus shot? Vaccination dates?	

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

_____
_____
_____
_____
_____
_____

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

Signature Date

APPENDIX 4
RECOMMENDED PHYSICIANS WITH EXPERTISE IN DIVING MEDICINE

List of local Medical Doctors that have training and expertise in diving or undersea medicine. Level I graduates of the Undersea Hyperbaric and Medical Society (UHMS) Fitness to Dive courses (approximately 250 physicians) are listed at http://membership.uhms.org/?page=DivingMedical (UHMS website, go to Resources, go to Library, go to Diving Medical Examiners)

1. Name: _____

   Address: _____

   _____

   Telephone: _____

2. Name: _____

   Address: _____

   _____

   Telephone: _____

3. Name: _____

   Address: _____

   _____

   Telephone: _____

4. Name: _____

   Address: _____

   _____

   Telephone: _____

5. Name: _____

   Address: _____

   _____

   Telephone: _____

APPENDIX 5
DEFINITION OF TERMS

Air sharing - Sharing of an air supply between divers.

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

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

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

Buddy Diver - Second member of the dive team.

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

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

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

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

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

Cylinder - A pressure vessel for the storage of gases.

Decompression Chamber - A pressure vessel for human occupancy. Also called a hyperbaric chamber 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 (EANx) - A name for a breathing mixture of air and oxygen when the percent of oxygen exceeds 21%. This term is considered synonymous with the term "nitrox" (Section 7.00).

Equivalent Air Depth (EAD) - Depth at which air will have the same nitrogen partial pressure as the nitrox mixture being used. This number, expressed in units of feet seawater or saltwater, will always be less than the actual depth for any enriched air mixture.
fN_2 - Fraction of nitrogen in a gas mixture, expressed as either a decimal or percentage, by volume.
fO_2 - Fraction of oxygen in a gas mixture, expressed as either a decimal or percentage, by volume.
FFW – Feet or 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_2 for a given gas mixture reaches a predetermined maximum.
MSW - Meters of seawater or equivalent static head.
Nitrox - Any gas mixture comprised predominately of nitrogen and oxygen, most frequently containing between 21% and 40% oxygen. Also 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_2 - Inspired partial pressure of nitrogen, usually expressed in units of atmospheres absolute.
pO_2 - Inspired partial pressure of oxygen, usually expressed in units of atmospheres absolute.
Psi - Unit of pressure, "pounds per square inch.

Psig - Unit of pressure, “pounds per square inch gauge.
Recompression Chamber - see decompression chamber.
Scientific Diving - Scientific diving is defined (29CFR1910.402) as diving performed solely as a necessary part of a scientific, research, or educational activity by employees whose sole purpose for diving is to perform scientific research tasks.
Scuba Diving - A diving mode independent of surface supply in which the diver uses open circuit self-contained underwater breathing apparatus.
Standby Diver - A diver at the dive location capable of rendering assistance to a diver in the water.
Surface Supplied Diving - 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

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

Diver:_____ Date:_____

This letter serves to verify that the above listed person has met the training and pre-requisites as indicated below, and has completed all requirements necessary to be certified as a *(Scientific Diver / Diver in Training)* as established by the *(Organizational Member)* Diving Safety Manual, and has demonstrated competency in the indicated areas. (Organizational Member) is an AAUS OM and meets or exceeds all AAUS training requirements.

The following is a brief summary of this diver's personnel file regarding dive status at

_____
(Date)

_____ Original diving authorization
_____ Written scientific diving examination
_____ Last diving medical examination Medical examination expiration date_____
_____ Most recent checkout dive
_____ Scuba regulator/equipment service/test
_____ CPR training (Agency) _____ CPR Exp. _____
_____ Oxygen administration (Agency) _____ 02 Exp. _____
_____ First aid for diving _____ F.A. Exp. _____
_____ Date of last dive _____ Depth
Number of dives completed within previous 12 months?_____ Depth Certification_____ fsw
Total number of career dives? _____

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

Please indicate any pertinent specialty certifications or training:

Emergency Information:

Name: Relationship:

Telephone: (work) (home)

Address:

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

Diving Safety Officer:

_____ _____

(Signature) (Date)

_____ _____

(Print)

APPENDIX 7
DIVING EMERGENCY MANAGEMENT PROCEDURES

Introduction

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

General Procedures

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

1. Make appropriate contact with victim or rescue as required.
2. Establish (A)irway, (B)reathing, (C)irculation as required.
3. Stabilize the victim
3. Administer 100% oxygen, if appropriate (in cases of Decompression Illness, or Near Drowning).
4. Call local Emergency Medical System (EMS) for transport to nearest medical treatment facility. Explain the circumstances of the dive incident to the evacuation teams, medics and physicians.
   Do not assume that they understand why 100% oxygen may be required for the diving accident victim or that recompression treatment may be necessary.
5. Call appropriate Diving Accident Coordinator for contact with diving physician and decompression chamber. etc.
6. Notify DSO or designee according to the Emergency Action Plan of the organizational member.
7. Complete and submit Incident Report Form (www.aaus.org) to the DCB of the organization and the AAUS (Section 2.70 Required Incident Reporting).

List of Emergency Contact Numbers Appropriate For Dive Location

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Available Procedures

- Emergency care
- Recompression
- Evacuation

Emergency Plan Content

- Name, telephone number, and relationship of person to be contacted for each diver in the event of an emergency.
- Nearest operational decompression chamber.
- Nearest accessible hospital.
- Available means of transport.

APPENDIX 8
DIVE COMPUTER GUIDELINES

1. Only those makes and models of dive computers specifically approved by the Diving Control Board may be used.

2. Any diver desiring the approval to use a dive computer as a means of determining decompression status must apply to the Diving Control Board, complete an appropriate practical training session and pass a written examination.

3. Each diver relying on a dive computer to plan dives and indicate or determine decompression status must have his/her own unit.

4. On any given dive, both divers in the buddy pair must follow the most conservative dive computer.

5. If the dive computer fails at any time during the dive, the dive must be terminated and appropriate surfacing procedures should be initiated immediately.

6. A diver should not dive for 18 hours before activating a dive computer to use it to control their diving.

7. 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.

8. 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.

10. Whenever practical, divers using a dive computer should make a stop between 10 and 30 feet for 5 minutes, especially for dives below 60 fsw.

11. Multiple deep dives require special consideration.

APPENDIX 9
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.

Appendix 10: University of Mississippi Dive Plan

University of Mississippi /AAUS
Scientific Diving Program

Project Proposal and Dive Plan

Project Leader

Divemaster for the Project

It is the responsibility of the Divemaster to ensure that all divers, and equipment used, are approved. A copy of the dive-plan should accompany the field team.

Name and Description of Project

Project Location and Duration

Estimated maximum depths and bottom times anticipated

Estimated number of dives required to complete project

List any special equipment, diving conditions, or boats to be used

Divers (and affiliation, if other than UM) involved with the project:	
Name	Certification Depth

Faculty Advisor Approval	Date
Diving Officer Approval	Date

For each diver, please provide the information requested in the blanks [copy additional pages as necessary]:

Diver: _____ Age: _____

Emergency Contact [relationship]/phone number: _____

_____

DAN Insurance #: _____; valid until: _____

Diver: _____ Age: _____

Emergency Contact [relationship]/phone number: _____

_____

DAN Insurance #: _____; valid until: _____

Diver: _____ Age: _____

Emergency Contact [relationship]/phone number: _____

_____

DAN Insurance #: _____; valid until: _____

In the space below [and on back, as needed], list your emergency plan for this dive location(s).

Onsite. [victim stabilization; transit; hand-held emergency channels; use of O2; etc]

Shore. [contact- EMS, DAN, chamber; victim support; etc]

- Local EMS #: _____
- DAN: 1-919-648-9111
- Nearest Chamber #: _____

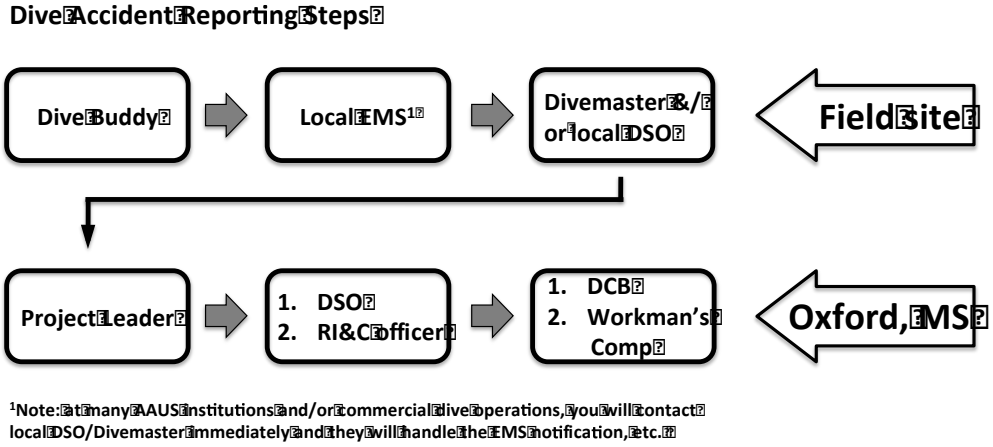
Dive Incident Protocol.

Assess situation [i.e., injuries/treatment, evacuation, etc], contact local EMS- transport as directed, control victim's gear.

- Remember your ABCs [Airway, Breathing, Circulation].
- O2 should be provided whenever there is a suspected case of DCS.

Following stabilization of the victim, the following steps should be undertaken:

1. Assist local EMS with treatment/relevant information [i.e., victim's dive profile, symptoms, DAN insurance number, etc]. Call DAN as necessary: 1-919-648-9111
2. Inform University of Mississippi. Important numbers:
   - Marc Slattery, Diving Safety Officer. 662-915-7026 [office]; 662-281-0313 [home]; 662-801-9840 [cell]; slattery@olemiss.edu
   - Gene Hines, Director of Research Integrity and Compliance. 662-915-5458 [office]; ghines@olemiss.edu



If the victim requires evacuation, a member of the dive team should accompany the individual to the chamber/clinic. ASAP the respondents should detail the dive incident/response timeline, and provide a narrative of important information.

A dive incident report should include the following information, at a minimum:
1. Divers, and their roles, as well as their dive training/history
2. Dive location and conditions, purpose of dive
3. Dive profile, and log of all prior dives during this expedition
4. Description of symptoms, including timeline of onset
5. Description and results of treatment
6. Other possible risk factors that led to incident, problems (e.g., loss of radio contact)
7. Disposition of the incident (i.e., response & timing)

The first draft of this Incident Report must be filed with the DSO within a week of the incident.