The American Academy of Underwater Sciences
STANDARDS FOR SCIENTIFIC DIVING

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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.

American Academy of Underwater Sciences

ACKNOWLEDGEMENTS

The Academy thanks the numerous dedicated individual and organizational members 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

Volume 1

Sections 1.00 through 6.00
Required For All Organizational Members

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

1. Diving safety manual which includes at a minimum: Procedures covering all

Diving Control Board

a) The Diving Control Board (DCB) shall consist of a majority of active scientific divers. Voting members shall include the Diving Safety Officer, the responsible administrative officer, or designee, and should include other representatives of the diving program such as qualified divers and members selected by procedures established by each organizational member. A chairperson and a secretary may be chosen from the membership of the board according to local procedure.

b) Has autonomous and absolute authority over the scientific diving program's operation.

c) Shall approve and monitor diving projects.

d) Shall review and revise the diving safety manual.

e) Shall assure compliance with the diving safety manual.

f) Shall certify the depths to which a diver has been trained.

g) Shall take disciplinary action for unsafe practices.

h) Shall assure adherence to the buddy system for scuba diving.

i) Shall act as the official representative of the membership organization in matters concerning the scientific diving program.

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

k) Shall recommend the issue, reissue, or the revocation of diving certifications.

l) Shall recommend changes in policy and amendments to AAUS and the membership organization's diving safety manual as the need arises.

m) Shall establish and/or approve training programs through which the applicants for certification can satisfy the requirements of the organizational member's diving safety manual.

n) Shall suspend diving programs that are considered to be unsafe or unwise.

o) Shall establish criteria for equipment selection and use.

p) Shall recommend new equipment or techniques.

q) Shall establish and/or approve facilities for the inspection and maintenance of diving and associated equipment.

r) Shall ensure that the organizational member's air station(s) meet air quality standards as described in Section 3.60.

s) Shall periodically review the Diving Safety Officer's performance 15(s)-1.63761(h)-3.718-6.99717(n

Lead Diver

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

a)

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 organizational member Diving Control Board, and other pertinent information deemed necessary.

Availability of Records:

a) Medical records shall be available to the attending physician of a diver or former diver when released in writing by the diver.

b) Records and documents required by this standard shall be retained by the organizational member 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.

b) Equipment Evaluations

1. Divers shall ensure that their equipment is in proper working order and that the equipment is suitable for the type of diving operation.

2. Each diver shall have the capability of achieving and maintaining positive buoyancy.

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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.

c) Organizational member 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 organizational member's Diving Control Board.

Flotation Devices

a) Each diver shall have the capability of achieving and maintaining positive buoyancy.

b) Personal flotation systems, buoyancy compensators, dry suits, or other variable volume buoyancy compensation devices shall be equipped with an exhaust valve.

c) These devices shall be functionally inspected and tested at intervals not to exceed 12 months.

Timing Devices, Depth, and Pressure Gauges

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

Determination of Decompression Status: Dive Tables, Dive Computers

a) A set of diving tables, approved by the Diving Control Board, must be available at the dive location.

b) Dive computers may be utilized in place of diving t

3.50 Equipment Maintenance

Record Keeping

SECTION 5.00 SCIENTIFIC DIVER CERTIFICATION

5.10 Certification Types

Scientific Diver Certification

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

Temporary Diver Permit

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

a) Requirements of this section may be waived by t

Theoretical and Practical Training

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

a) Required Topics (include, but not limited to):

1. Diving Emergency Care Training

- Cardiopulmonary Resuscitation (CPR)
- Standard or Basic First Aid
-

- Common Biota
    - Organism Identification
    - Behavior
    - Ecology
-

cumulative bottom time of 6 hours. Dives following the checkout dive must be

5.50 Continuation of Certificate

Minimum Activity to Maintain Certification

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

Re-qualification of Depth Certificate

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

Medical Examination

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

Emergency Care Training.

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

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

5.60 Revocation of Certification

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

SECTION 6.00 MEDICAL STANDARDS

6.10 Medical Requirements

General

g) The organizational member 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.

h) 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.

i) 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)

Frequency of Medical Evaluations

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

p) Abnormalities of the tympanic membrane, such as perforation, presence of a monomeric membrane, or inability to auto inflate the middle ears.
q) Hearing loss; Vertigo including Meniere's Disease.
r) Stapedectomy or middle ear reconstructive surgery.
s) Recent ocular surgery.
t) Psychiatric disorders including claustrophobia, suicidal ideation, psychosis, anxiety states, depression.
u) Substance abuse, including alcohol.
v) Episodic loss of consciousness.
w) History of seizure.
x) History of stroke or a fixed neurological deficit.
y) Recurring neurologic disorders, including transient ischemic attacks.
z) History of intracranial aneurysm, other vascular malformation or intracranial hemorrhage.
aa) History of neurological decompression illness with residual deficit.
bb) Head injury.
cc) Hematologic disorders including coagulopathies.
dd) Risk factors or evidence of coronary artery disease.
ee) Atrial septal defects.
ff) Significant valvular heart disease - isolated mitral valve prolapse is not disqualifying.
gg) Significant cardiac rhythm or conduction abnormalities.
hh) Implanted cardiac pacemakers and cardiac defibrillators (ICD).
ii) Inadequate exercise tolerance.
jj) Hypertension.
kk) History of pneumothorax.
ll) Asthma.
mm) Chronic pulmonary disease, including radiographic evidence of pulmonary blebs, bullae or cysts.
nn) Diabetes mellitus.
oo) Pregnancy.

Laboratory Requirements for Diving Medical Evaluation and Intervals.

pp) Initial examination under age 40:

* Medical History
* Compl 19.5711 0 Td [(P)0.884686(r)4.F91.96388(d)6.56299(i)-9.83821(1715(n)-13.9969(g)27.122

* Complete Physical Exam, emphasis on neurological and otological components
* 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

Volume 2

Sections 7.00 through 12.00
Required Only When Conducting Described Diving Activities
and

7.30 Nitrox Training Guidelines

Training in these guidelines should be in addition

Dive Parameters

a) Oxygen Exposure Limits

1.

d) Nitrox Dive Computers

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

e) Repetitive Diving

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

f) Oxygen Parameters

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

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

   a. Placed in contact with oxygen concentrations greater than 40%.

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

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

g) Gas Mixing and Analysis for Organizational Members

1. Personnel Requirements

a. Individuals responsible for producing and/or analyzing nitrox mixtures should be knowledgeable and experienced in all aspects of the technique.

b. Only those individuals approved by the DSO and/or DCB should be responsible for mixing and/or analyzing nitrox mixtures.

2. Production Methods - It is the responsibility of the DCB to approve the specific nitrox production method used.

SECTION 8.00 AQUARIUM DIVING OPERATIONS

8.10 General Policy

SECTION 9.00 STAGED DECOMPRESSION DIVING

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

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

7. Divers shall demonstrate to the satisfaction of the DSO or the DSO's designee proficiency in planning and executing required decompression dives appropriate to the conditions in which diving operations are to be conducted.

8. Upon completion of training, the diver shall be authorized to conduct required decompression dives with DSO approval.

9.20 Minimum Equipment Requirements

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

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

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

d) Minimum dive equipment shall include:

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

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

   3. Compass

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

   1. Decompression Schedules

   2. Dive Timing Devices

   3. Depth gauges

   4. Buoyancy Control Devices

   5. Cutting devices

   6. Lift bags and line reels

9.30 Minimum Operational Requirements

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

b) The maximum pO_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 mixed gas dive, a series of progressive workup dives to return the diver(s) to proficiency status prior to the start of project diving operations are recommended.

l) Mission specific workup dives are recommended.

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

a) Prerequisites:

1. Nitrox certification and authorization (Section 7.00)

c) Practical Training:

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

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 12.0 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

Training

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

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

b) Classroom training shall include:

1.

Practical Training (with model of rebreather to be used)

a) A minimum number of hours of underwater time.

Type	Pool/Confined Water	O/W Training	O/W Supervised
Oxygen Rebreather	1 dive, 90 min	4 dives, 120 min.*	2 dives, 60 min

Written Evaluation

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

Minimum Equipment

a) A surface/dive valve in the mouthpiece assembly, al

Decompression Management

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

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

1. Oxygen rebreathers: Not applicable.

2. SCR (presumed constant FO_2):

- Use of any method approved for open-circuit scuba diving breathing air, above the maximum operational depth of the supply gas.
- Use of open-circuit nitrox dive tables based upon expected inspired FO_2. In this case, contingency air dive tables may be necessary for active-addition SCR's in the event that exertion level is higher than expected.
- Equivalent air depth correction to open-circuit air dive tables, based upon expected inspired FO_2 for planned exertion level, gas supply rate, and gas composition. In this case, contingency air dive tables may be necessary for active-addition SCR's in the event that exertion level is higher than expected.

3.

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

Logs and checklists will be developed for the rebre

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

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

Unit Disinfections

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

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 breathi

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

b) Cave Diver

1. Prerequisites

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

2. Cave Training

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

   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.

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

13.5 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.

a) Cavern Diver Procedures

- Cavern diving shall not be conducted at depths greater than 100 feet.
- Dive teams shall perform a safety drill prior to each cave or cavern penetration that includes equipment check, gas management, and dive objectives.
- 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.
- Gas management must be appropriate for the planned dive with special considerations made for; DPV's, siphon diving, rebreathers, etc.
- The entire dive team is to immediately terminate the dive whenever any dive team member feels an unsafe condition is present.

b) Cave Diving Procedures

Appendices

Appendix 1 through 9
Required For All Organizational Members

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/ACCtaaAaiific -11.16 Tdd [(s)-1942 9.6942 Tf 4.44250.1012(F)-1.357i-7.81668

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 y/Year qu

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

APPLICANT'S RELEASE OF MEDICAL INFORMATION FORM

_____

Name of Applicant (Print or Type)

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

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

Yes	No	Please indicate whether or not the following apply to you	Comments

	Yes	No	Please indicate whether or not the following apply to you	Comments
70			Amputations	

APPENDIX 4
RECOMMENDED PHYSICIANS WITH EXPERTISE IN DIVING MEDICINE

APPENDIX 5
DEFINITION OF TERM

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

(Scientific Diver / Diver in Training)

(Organizational Member)
_____)

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

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 Emergen

APPENDIX 8
DIVE COMPUTER GUIDELINES

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 n

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.