SCIENTIFIC DIVING MANUAL

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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 must 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

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Volume 1

Sections 1.00 through 5.00
Required For All Organizational Members

Section 1.00 GENERAL POLICY

1.10 Scientific Diving Standards

Purpose

The purpose of these Scientific Diving Standards is to ensure scientific diving is conducted in a manner that will maximize the protection of scientific divers from accidental injury and/or illness, and to set forth standards for training and certification that will allow a working reciprocity between Organizational Members (OMs or OM), and to give the OM Diving Control Boards a framework to effectively administer their OM scientific diving safety program Fulfillment of these purposes shall be consistent with the furtherance of research and safety, and facilitation of collaborative opportunities between AAUS OMs. Examples of AAUS OMs include, but are not limited to, academic institutions within and outside of the United States, state and federal agencies, zoo and aquariums, non-profits, citizen science groups, and consulting firms. Examples of scientific diving include, but are not limited to, biology, zoology, archaeology, chemistry, educational outreach, oceanography, ecology, medical, and human performance. The type of organization or the scientific discipline does not determine eligibility to apply the scientific diving exemption or to be Organizational Members of AAUS; rather, current membership in AAUS is recognized by the Federal OSHA as meeting all requirements for conducting scientific diving training and operations in the workplace.

By maintaining compliance with this consensual AAUS Standards for Scientific Diving Manual, OMs will avail themselves of the scientific diving exemption set forth in CFR 1910 Subpart T. This does not preclude OMs from employing the outlined Code of Federal Regulations and other state sponsored Occupational Safety and Health program's standards if the diving tasks falls outside of the scientific diving exemption and the guidelines provided therein. OMs that conduct both exempt and non-exempt dive operations must have clear delineations outlined by the OM Diving Control Board.

This *Manual* sets minimum standards for the establishment of 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 OMs that adhere to these minimum standards. AAUS considers divers to be scientists or scientists-in-training during or after successful completion of the AAUS-compliant Scientific Diver Course, as they have been trained to the task of data collection and effective methods of observation.

Historical Perspective

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

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

In 2022, AAUS was recognized by OSHA as the scientific diving standard setting organization. AAUS Organizational Members activities represent the current scope of scientific diving programs.

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 does not include performing any tasks usually associated with commercial diving such as: Placing or removing heavy objects underwater; inspection of pipelines and similar objects; construction; demolition; cutting or welding; or the use of explosives."

Scientific Diving Exemption

The two elements that a diving program must contain as defined by OSHA in 29 CFR 1910 Subpart T 1910.401(a)(2)(iv) are:

a) Diving safety manual which includes at a minimum: Procedures covering all diving operations specific to the program; procedures for emergency care, including recompression and evacuation; and criteria for diver training and certification.
b) Diving control (safety) board, with the majority of its members being active divers, which must 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.

OSHA has granted an exemption for scientific diving from commercial diving regulations under the following guidelines (Appendix B to 29 CFR 1910 Subpart T):

- 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.
- The purpose of the project using scientific diving is the advancement of science; therefore, information and data resulting from the project are non-proprietary.
- 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.
- 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.

Recommendations for Changes to AAUS Manual

As part of each OMs annual report, recommendations for modifications of this *Manual* must be submitted to AAUS for consideration.

1.20 Operational Control

Organizational Member Auspices and Responsibilities

OM auspices include any scientific diving operation in which an OM is connected because of ownership of life support equipment used, locations selected, or relationship with the

individual(s) concerned. This includes all cases involving the operations of authorized individuals of the OM or auxiliary organizations, where such individuals are acting within the scope of their authorization.

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

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

University of Rhode Island (URI) Diving Safety Manual

Meeting AAUS minimum standards is a requirement for organizational membership in the Academy. URI must develop and maintain a diving safety manual that includes wording on how the university defines specific policies and procedures required for the proper function of a scientific diving program. The URI manual must address environmental and working conditions unique to the program's operations. The URI diving manual must meet or exceed the AAUS standards.

AAUS standards must be the foundation for the development of an OM's scientific diving safety manual. The order and formatting of the OM manual does not have to conform to the AAUS template. The information contained in Volume 1, Sections 1.00 through 5.00 and the Appendices are required for all manuals. Volume 2, Sections 6.00 through 12.00 are required only when the OM conducts the specifically referenced diving mode or activity. Deviations or significant changes to AAUS minimum standards may require justification before approval is granted by the AAUS Standards Committee.

Diving Control Board

- The Diving Control Board (DCB) must consist of a majority of active scientific divers. Voting members include the Diving Safety Officer (DSO), and other representatives of the diving program such as qualified divers and members selected by procedures established by URI. 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.
- The DCB must:
    - Establish additional standards, protocols, and operational procedures beyond the AAUS minimums to address URI's specific needs and concerns.
    - Approve and monitor diving projects.
    - Review and revise the diving safety manual.
    - Ensure compliance with the diving safety manual.
    - Approve the depth to which a diver has been authorized to dive.
    - Take disciplinary action for unsafe practices.
    - Ensure adherence to the buddy system for scientific diving.
    - Act as the official representative of URI in matters concerning the scientific diving program.
    - Act as a board of appeal to consider diver-related problems.
    - Recommend the issue, reissue, or the revocation of diving authorizations.
    - Recommend changes in policy and amendments to AAUS and URI's diving safety manual as the need arises.
    - Establish and/or approve training protocols or standards through which the applicants for

authorization can satisfy the requirements of URI's diving safety manual.
    - Suspend diving operations considered to be unsafe or unwise.
    - Establish criteria for equipment selection and use.
    - Recommend new equipment or techniques.
    - Establish and/or approve facilities for the inspection and maintenance of diving and associated equipment.
    - Ensure that URI's air station(s) meet air quality standards as described in Section 3.60.
    - Periodically review the DSO's performance and program.
    - Investigate diving incidents within URI's diving program or violations of URI's diving safety manual.
- The DCB may delegate operational oversight for portions of the program to the DSO; however, the DCB may not abdicate responsibility for the safe conduct of the diving program.

Diving Safety Officer

The Diving Safety Officer (DSO) serves as a voting member of the DCB, and should be designated one of URI's Representatives to AAUS. This person should have broad technical expertise and experience in research related diving.

Qualifications:

1. Must be an active scuba instructor from an internationally recognized certifying agency.
2. Must be appointed by the responsible administrative officer or designee, with the advice and counsel of the DCB.
3. Must qualify as a Full Voting Member of AAUS as defined by AAUS Bylaws:

   "(a) Holds a diving certification from a recognized national certifying agency or equivalent, and
   (b) Has engaged in sustained or successive scientific diving activities during the past two years, or
   (c) Has completed a course in scientific diving that meets the requirements as specified by the most current edition of the AAUS Standards for Scientific Diving."
4. Must attend an AAUS DSO Orientation within one year of accepting a position at an AAUS approved OM, unless he/she has served as a DSO for another current AAUS OM within the last year.

Duties and Responsibilities

1. Answers, through the DCB, to the appropriate administrative officer or designee, for the conduct of the scientific diving program of URI.
2. If delegated by the DCB, the routine operational authority for this program rests with the DSO. This oversight includes, but is not limited to: training, diver authorizations, approval of dive plans, maintenance of diving records, and ensuring compliance with this Manual.
3. May permit some duties and responsibilities to be carried out by a qualified delegate, with the approval of the DCB.
4. Must be guided in the performance of the required duties by the advice of the DCB, but operational responsibility for the conduct of the scientific diving program will be

retained by the DSO.

5. Must suspend diving operations determined to be unsafe or unwise.

Instructional Personnel Qualifications

All personnel involved in diving instruction under the auspices of URI must be reviewed and authorized by the DCB.

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:

- Ensuring dives are conducted in accordance with Section 2.0.
- Ensuring all dive team members possess current authorization and are qualified for the type of diving operation.
- Coordination with other known activities in the vicinity that are likely to interfere with diving operations.
- Ensuring safety and emergency equipment is in working order and at the dive site.
- Suspending diving operations if in their opinion conditions are not safe.
- Reporting to the DCB, through the DSO, any physical problems or adverse physiological effects including symptoms of pressure-related injuries.

Reciprocity and Visiting Scientific Diver

- Two or more AAUS OMs engaged jointly in diving activities, or engaged jointly in the use of diving resources, must designate one of the participating DCBs to govern the joint dive project. However, responsibility for individual divers ultimately resides with the home OM.
- A Scientific Diver from one OM must apply for permission to dive under the auspices of another OM by submitting to the DSO of the host OM a document containing all the information listed in Appendix 6, signed by the DSO or designee of the home DCB.
- A visiting Scientific Diver may be asked to demonstrate their knowledge and skills for the planned dive.
- If a host OM denies a visiting Scientific Diver permission to dive, the host DCB must notify the visiting Scientific Diver and their DCB with an explanation of all reasons for the denial.

Waiver of Requirements

The URI DCB may grant a waiver for specific requirements of training, examinations, depth authorizations, and minimum activity to maintain authorizations. AAUS medical standards may not be waived.

1.30 Consequence of Violation of Regulations by Scientific Divers

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

1.40 Consequences of Violation of Regulations by Organizational Members

Failure to comply with the regulations of this *Manual* may be cause for the restriction or revocation of URI's recognition by AAUS.

1.50 Record Maintenance

URI must maintain consistent records for its diving program and for each participant. These

records include but are not limited to: diving safety manual; equipment inspection, testing, and maintenance records; dive plans (project and/or individual); records of dive (project and/or individual); medical approval to dive; diver training records; diver authorization(s); individual dive log; dive incident reports; reports of disciplinary actions by the DCB; and other pertinent information deemed necessary by URI.

Availability of Records:

- Medical records must be available to an attending physician of a diver or former diver when released in writing by the diver.
- Records and documents required by this Manual must be retained by URI for the following period:

    1. Diving safety manual – Current document only.
    2. Equipment inspection, testing, and maintenance records – Minimum current entry or tag.
    3. Records of Dive – minimum of 1 year, except 5 years where there has been an incident of pressure-related injury.
    4. Medical approval to dive – Minimum of 1 year past the expiration of the current document except 5 years where there has been an incident of pressure-related injury.
    5. Diver training records – Minimum of 1 year beyond the life of the diver's program participation.
    6. Diver authorization(s) – Minimum of 1 year beyond the life of the diver's program participation.
    7. Pressure-related injury assessment - 5 years.
    8. Reports of disciplinary actions by the DCB – Minimum of 1 year beyond the life of the diver's program participation.

SECTION 2.00 DIVING REGULATIONS

2.10 Introduction

No person shall engage in scientific diving operations under the auspices of URI's scientific diving program unless they are authorized pursuant to the provisions of this *Manual*.

2.20 Pre-Dive Procedures

Dive Plans

Before conducting any diving operations under the auspices of URI, a dive plan for the proposed project or dive must be formulated and submitted for approval by the DCB or designee. Dives should be planned around the competency of the least experienced diver. The dive plan (project or individual) should include the following:

- Diving Mode(s) and Gas(es)
- Divers' authorizations
- 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
- Emergency Action Plan (Appendix 7)
- In water details of the dive plan should include:
    - Dive Buddy assignments and tasks
    - Goals and objectives
    - Maximum depth(s) and bottom time
    - Gas management plan
    - Entry, exit, descent and ascent procedures
    - Perceived environmental and operational hazards and mitigations
    - Emergency and diver recall procedures

Diver Responsibility and Refusal to Dive

The decision to dive is that of the diver. The ultimate responsibility for safety rests with the individual diver. It is the diver's responsibility and duty to refuse to dive, without fear of penalty, if in his/her judgment, conditions are unsafe or unfavorable, or if he/she would be violating the precepts of regulations in this *Manual*.

No dive team member will be required to be exposed to hyperbaric conditions against his/her will.

No dive team member may dive for the duration of any known condition, which is likely to adversely affect the safety and health of the diver or other dive team members.

Pre-dive Safety Checks

- Prior to commencing the dive, the team must assure that every team member is healthy, fit, and trained for the type of dive that is being attempted.
- Scientific divers must conduct a functional check of their diving equipment in the presence of the dive buddy or tender. They must ensure the equipment is functioning properly and

suitable for the type of diving operation being conducted.
- Each diver must have the capability of achieving and maintaining positive buoyancy at the surface.
- Environmental conditions at the site will be evaluated prior to entering the water.

Pre-dive Briefings

Before conducting any diving operations under the auspices of URI, the dive team members must be briefed on:
- Dive Buddy assignments and tasks
- Dive objectives.
- Maximum depth(s) and bottom time
- Turn around pressure and required surfacing pressure
- Entry, exit, descent and ascent procedures
- Perceived environmental and operational hazards and mitigations
- Emergency and diver recall procedures

2.30 Diving Procedures

Solo Diving Prohibition

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

Decompression Management

- On any given dive, both divers in the buddy pair must follow the most conservative dive profile
- A safety stop performed during the ascent phase of the dive should be conducted on any dive that exceeds 30 feet (9.14m).

Termination of the Dive

Any dive must 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.

It is the responsibility of the diver to terminate the dive that he/she considers unsafe, without fear of reprisal, in a way that does not compromise the safety of another diver already in the water.

Emergencies and Deviations from Regulations

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

2.40 Post-Dive Procedures

Post-Dive Safety Checks

After the completion of a dive, each diver must report any physical problems, symptoms of decompression sickness, or equipment malfunctions to the Lead Diver, DSO, and/or DCB.

2.50 Emergency Procedures

URI will develop emergency procedures which follow the standards of care of the community

and must include procedures and implementation criteria for emergency care, recompression, evacuation, and incident reporting.

2.60 Flying After Diving or Ascending to Altitude (Over 1000 feet/304 meters)

- 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 (304 meters): 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 authorized scientific diver must log every dive made under the auspices of URI's program and is encouraged to log all other dives. URI may allow dives to be logged in any format of URI's choosing. Logs must be submitted per local protocol and must remain in the divers' file. The dive log must include at least the following:

- Name of diver and buddy
- Date, time, and location
- Diving modes used
- General nature of diving activities
- Maximum depth and dive 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 must be reported to the OM's DCB and AAUS in a timely manner. OMs must record and report occupational injuries and illnesses in accordance with requirements of the appropriate Labor Code section. OMs must 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.

If pressure-related injuries are suspected, or if symptoms are evident, the following additional information must be recorded and retained by the OM, with the record of the dive, for a period of 5 years.

Written descriptive report shall 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 the incident.
- The circumstances of the incident and the extent of any injuries or illnesses.

- Description of symptoms, including depth and time of onset.
- Description and results of treatment.
- Disposition of case.
- Recommendations to avoid repetition of incident.

In addition to requirements specific to the OM, all diving incidents will be reported to the AAUS. This report must first be reviewed and released by the OM's DCB and at a minimum contain:

- Complete AAUS Incident Report.
- Summary of experience of divers involved.
- Description of dive site, and description of conditions that led up to incident.
- The circumstances of the incident and the extent of any injuries or illnesses.
- Description of symptoms, including depth and time of onset.
- Description and results of treatment.
- Disposition of case.
- Recommendations to avoid repetition of incident.

Recommended Near-Miss Reporting

It is also recommended that near-misses be reported to the AAUS in a timely manner, utilizing the Near-Miss Reporting Form that can be found on the AAUS website.

Near-Misses may be reported by any Scientific Diver. It is recommended that Near-Miss reports be generated by the OM DSO and/or DCB. AAUS reserves the right to contact the reporting OM DSO/DCB regardless of who reports the near-miss.

See definitions and the incident rating scale in Appendix 8.

SECTION 3.00 DIVING EQUIPMENT

3.10 General Policy

All equipment must meet standards as determined by the DSO and the DCB. All equipment must be regularly examined by the person using it 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

The URI DCB must establish the minimum equipment configuration for all dives.

Regulators and Gauges

- Scuba regulators and gauges must be inspected and tested prior to each use and serviced, at a minimum, according to manufacturer's recommendations
- Standard open circuit (OC) regulator configuration is:
    - A first stage
    - Primary 2nd stage
    - Back up 2nd stage
    - Submersible Pressure Gauge (SPG)
    - Inflator hose for a Buoyancy Compensator Device
- A Full-Face Mask may be used in place of the primary 2nd stage according to manufacturer's recommendations

Equipment for Determination of Decompression Status

- Each member of the buddy team must have an underwater timing device and depth indicator, or dive computer
- If dive tables are being used a set must be available at the dive location
- If a dive computer is used the diver must use the same computer used on repetitive dives.
- In an aquarium or other manmade structure of a known maximum obtainable depth:
    - A depth indicator is not required, except when a diver's decompression status must be taken into consideration on repetitive dives.
    - Only one buddy must be equipped with a timing device.
    - The maximum obtainable depth of the aquarium must be used as the diving depth.

Scuba Cylinders

- Scuba cylinders must 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 must be functionally tested at intervals not to exceed 12 months.

Buoyancy Compensation Devices (BCD)

- Each diver must have the capability of achieving and maintaining neutral buoyancy underwater and positive buoyancy at the surface.
- BCDs, dry suits, or other variable volume buoyancy compensation devices must be equipped with an exhaust valve.
- These devices must be functionally inspected and tested at intervals not to exceed 12 months.

- BCDs, dry suits, or other variable volume buoyancy compensation devices must not be used as a lifting device in lieu of lift bags.

3.30 Auxiliary Equipment

The below outlined Auxiliary Equipment are examples of equipment and tools utilized by the scientific diver. These equipment and tools require DCB approval along with theoretical and practical training and evaluation by the DSO or their designee on proper and safe use prior to being deployed by a scientific diver for underwater research purposes.

- Sampling Equipment
- Organism & Tissue Collection Tools - Spearguns & Polespears
- Cameras - Still & Video
- Small Hand Tools
- Handheld Underwater Power Tools
- Line Reels & Spools
- Surface Maker Buoys
- Lift Bags
- Full Face Masks
- Diver Propulsion Vehicles (DPVs)

***See App. 10 for Equipment Descriptions, Examples of Use and Pertinent Safety Considerations.*

3.40 Support Equipment

First Aid Supplies

- A first aid kit and emergency oxygen appropriate for the diving being conducted must be available at the dive site.

Diver's Flag

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

Compressor Systems - Organizational Member 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 must have a check valve on the inlet side, a relief valve, and a drain valve.
- Compressed air systems over 500 psig must have slow-opening shut-off valves.
- All air compressor intakes must 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 must be logged, including the date and nature of work performed, serial number of the item (if applicable), and the name of the person performing the work for the following equipment:

- Regulators
- Gauges (SPG, Depth Gauges, Timers, and Dive Computers)
- BCDs

- Dry suits
- Scuba cylinders and valves
- Full Face Masks
- Compressors, air filtration systems, gas control panels, and storage banks
- Surface supplied equipment
- Rebreather systems
- Additional equipment categories as determined by the DCB

Compressor Operation and Air Test Records

Gas analyses and air tests must be performed on each URI-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 must be entered in a formal log and be maintained.

3.60 Air Quality Standards

Breathing Gas

Breathing gas must meet the following specifications as set forth by the Compressed Gas Association (CGA Pamphlet G-7.1; see table below).

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.

Remote Operations

For remote site operations using gas sources not controlled by URI, every effort should be made to verify breathing gas meets the requirements of this standard. If CGA Grade E gas is not verifiable, the DCB must develop a protocol to mitigate risk to the diver.

SECTION 4.00 SCIENTIFIC DIVER CERTIFICATION AND AUTHORIZATIONS

This section describes the training and performance standards for AAUS Scientific Divers and 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.

4.10 Prerequisites

Administrative

The candidate must complete all administrative and legal documentation required by URI.

Entry Level Diver Certification

The candidate must, at minimum, show documented proof of Diver Certification or equivalent from an internationally recognized training agency. OMs who wish to train and certify entry level divers may do so under the standards of the most current version of the RSTC/WRSTC and/or ISO entry-level diver standards. Entry level diver training is a prerequisite to scientific diver training and therefore no part of entry level training may be counted in any way toward scientific diver training.

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

[2] "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.

Medical Examination

The candidate must be medically qualified for diving as described in Section 5.0 and Appendices 1-4 of this Manual. AAUS medical standards may not be waived.

Swimming/Watermanship Evaluation

The candidate must demonstrate the following in the presence of the DSO or designee. All tests are to be performed without swim aids. However, where exposure protection is needed, the candidate must be appropriately weighted to provide for neutral buoyancy.

a) Swim underwater for a distance of 25 yards (23 meters) without surfacing.
b) Swim 400 yards (366 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 (23 meters) in the water.

4.20 Training

The candidate must successfully complete prerequisites, theoretical aspects, practical training, and examinations for a minimum cumulative time of 100 hours and a minimum of 12 open water dives. Theoretical aspects must include principles and activities appropriate to the intended area of scientific study. Formats for meeting the 100 hour training requirement include OM developed formalized training course, or a combination of formalized and on the job training.

When a diver's resume provides clear evidence of significant scientific diving experience, the diver can be given credit for meeting portions of the 100 hour course requirements. The DCB will identify specific overlap between on-the-job training, previous scientific diving training/experience and course requirements, and then determine how potential deficiencies will be resolved. However, OMs cannot "test-out" divers, regardless of experience, when they have no previous experience in scientific diving.

Any candidate who does not convince the DCB, through the DSO, that they possess the necessary judgment, under diving conditions, for the safety of the diver and his/her buddy, may be denied URI scientific diving privileges.

Theoretical Training / Knowledge Development	
Required Topics:	**Suggested Topics:**
Diving Emergency Care Training • Cardiopulmonary Resuscitation (CPR) • AED • Standard or Basic First Aid • Recognition of DCS and AGE • Accident Management • Field Neurological Exam • Oxygen Administration	Specific Dive Modes (methods of gas delivery) • Open Circuit • Hookah • Surface Supplied diving • Rebreathers (closed and/or semi-closed)
Dive Rescue • To include procedures relevant to OM specific protocols. (See water skills below)	Specialized Breathing Gas • Nitrox • Mixed Gas
Scientific Method	Small Boat Operation
Data Gathering Techniques (Only items specific to area of study required) • Transects and Quadrats • Mapping • Coring • Photography • Tagging • Collecting • Animal Handling • Archaeology • Common Biota • Organism Identification • Behavior • Ecology • Site Selection, Location, and Re-	Specialized Environments and Conditions • Blue Water Diving • Altitude • 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 • Potential Entanglement/Entrapment

location • Specialized Data Gathering Equipment	• Live boating
Required Topics:	**Suggested Topics:**
Navigation	HazMat Training • Chemical Hygiene, Laboratory Safety (Use of Chemicals)
HazMat Training • HP Cylinders	
Decompression Management Tools • Dive Tables • Dive Computers • PC Based Software	Specialized Diving Equipment • Full face mask • Dry Suit • Communications • Dive Propulsion Vehicle (DPV) • SMBs/Lift Bags • Line Reels
AAUS Scientific Diving Regulations and History • Scientific Dive Planning • Coordination with other Agencies • Appropriate Governmental Regulations	
Hazards of breath-hold diving and ascents	
Dive Physics (Beyond entry level scuba)	Other Topics and Techniques as Determined by the DCB
Dive Physiology (Beyond entry level scuba)	
Dive Environments	
Decompression Theory and its Application	

Practical Training / Skill Development	
Confined Water	At the completion of training, the trainee must satisfy the DSO or DCB-approved designee of their ability to perform the following, as a minimum, in a pool or in sheltered water: • Enter water fully equipped for diving • Clear fully flooded face mask • Demonstrate air sharing and ascent using an alternate air source, as both donor and recipient, with and without a face mask • Demonstrate buddy breathing as both donor and recipient, with and without a face mask • Demonstrate understanding of underwater signs and signals • Demonstrate ability to remove and replace equipment while submerged • Demonstrate acceptable watermanship skills for anticipated scientific diving conditions
Open Water Skills	The trainee must satisfy the DSO, or DCB-approved designee, of their ability to perform at least the following in open water: • Surface dive to a depth of 10 feet (3 meters) without scuba* • Enter and exit water while wearing scuba gear* ^^ • Kick on the surface 400 yards (366 meters) while wearing scuba gear, but not breathing from the scuba unit* • Demonstrate proficiency in air sharing ascent as both donor and receiver* • Demonstrate the ability to maneuver efficiently in the environment, at and below the surface* ^^ • Complete a simulated emergency swimming ascent*

	• Demonstrate clearing of mask and regulator while submerged* • Underwater communications^^ • Demonstrate ability to achieve and maintain neutral buoyancy while submerged* • Demonstrate techniques of self-rescue and buddy rescue* • Navigate underwater ^ • Plan and execute a dive^ • Demonstrate judgment adequate for safe scientific diving* ^^
	Rescue Skills: • Rescue from depth and transport 25 yards (23 meters), as a diver, a passive simulated victim of an accident: surface diver, establish buoyancy, stabilize victim • Demonstrate simulated in-water mouth-to-mouth resuscitation • Removal of victim from water to shore or boat • Stressed and panicked diver scenarios • Recommendations For Rescue Of A Submerged Unresponsive Compressed-Gas Diver – Appendix 9
	Successfully complete a minimum of one checkout dive and at least eleven additional open water dives in a variety of dive sites, for a cumulative surface to surface time of 6 hours. Dives following the checkout dive(s) may be supervised by an active Scientific Diver holding the necessary depth authorization experienced in the type of diving planned, and with the knowledge and permission of the DSO
	The eleven dives (minimum) following the initial checkout dive may be conducted over a variety of depth ranges as specified by the URI DCB. Depth progression must proceed shallower to deeper after acceptable skills and judgement have been demonstrated, and are not to exceed 100 feet (30 m) during the initial 12 dive cycle
	* Checkout dive element ^^ Evaluated on all dives ^ Evaluated at some point during the training cycle

Examinations	
Equipment	The trainee will be subject to examination/review of: • Personal diving equipment • Task specific equipment • Function and manipulation of decompression computer to be employed by the diver (if applicable)
Written Exams	The trainee must pass a written examination reviewed and approved by the URI DCB that demonstrates knowledge of at least the following: • Function, care, use, and maintenance of diving equipment • Advanced physics and physiology of diving • Diving regulations • Applicable diving environments • Emergency procedures for URI-specific dive mode(s) and environments, including buoyant ascent and ascent by air sharing • Currently accepted decompression theory and procedures • Proper use of dive tables • Hazards of breath-hold diving and ascents

	• Planning and supervision of diving operations • Navigation • Diving hazards & mitigations • Cause, symptoms, treatment, and prevention of the following: near drowning, air embolism, hypercapnia, squeezes, oxygen toxicity, nitrogen narcosis, exhaustion and panic, respiratory fatigue, motion sickness, decompression sickness, hypothermia, and hypoxia/anoxia • Applicable theoretical training and knowledge development from the Required and Suggested Topics (above)

4.30 Diver Certification and Authorizations

Only a person diving under the auspices of URI that subscribes to the practices of the AAUS is eligible for a scientific diver certification.

Diver-In-Training (DIT) Authorization

This is an authorization to dive, usable only while it is current and for the purpose intended. This authorization signifies that a diver has completed and been certified as at least an entry level diver through an internationally recognized certifying agency and has the knowledge skills and experience necessary to commence and continue training as a scientific diver under supervision, as approved by the DCB. DIT status must only be used when the diver is on his/her way to becoming certified as a scientific diver. While it is recommended for DIT's to have hands-on scientific diver experience during their training, the DIT status is intended to be a temporary authorization, not a substitute for Scientific Diver Certification.

Scientific Diver Certification

Signifies a diver has completed all requirements in Section 4.20 and is certified by the AAUS OM to engage in scientific diving without supervision, as approved by the DCB through the DSO. Submission of documents and participation in aptitude examinations does not automatically result in certification. To be certified, the applicant must demonstrate to the DCB, through the DSO, that s/he is sufficiently skilled and proficient, and possess the necessary judgement for their safety and/or that of the dive team. Scientific Diver Certification is only active when required authorizations are in place and current.

Scientific Aquarium Diver Certification

Scientific Aquarium Diver is a certification authorizing the diver to participate in scientific diving solely in the aquarium environment.

All requirements set forth for Scientific Diver certification must apply, except follows:

- Practical training must include at least 12 supervised aquarium dives for a cumulative bottom time of 6 hours.
- Training requirements for navigation and 400-yard (366-meter) surface swim in scuba gear may be waived at the discretion of the DCB.

Temporary Diver Authorization

Only a diver not under the auspices of an AAUS OM may be granted a Temporary Diver Authorization. The individual in question must demonstrate proficiency in diving and can contribute measurably to a planned dive. A Temporary Diver Authorization constitutes a waiver of selected requirements of Section 4.0 and is valid only for a limited time, as approved by the DCB. A Temporary Diver Authorization must be restricted to the planned diving operation and must comply with all other policies, regulations,

and standards of this Manual, including medical requirements. This authorization is not to be utilized as a repeated mechanism to circumvent existing standards set forth in this Manual.

4.40 Depth Authorizations

Depth Ratings and Progression to Next Depth Level

Indicates the maximum depth in which a diver can conduct science and may supervise other divers holding a lesser depth authorization. A scientific diver requires a valid depth authorization to be considered active.

A diver may be authorized to the next depth level after successfully completing the requirements for that level. A diver may exceed his/her depth authorization when accompanied and supervised by a dive buddy holding a depth authorization greater or equal to the intended depth. Dives must be planned and executed with the permission of the DCB or designee.

In the event a diver within URI does not hold an authorization at the desired next level, the DCB may authorize a required progression or procedure for a diver to attain a deeper authorization. If local conditions do not conform to traditional AAUS depth progressions, the DCB may devise a reasonable accommodation. However, the total number of dives to obtain a given depth authorization must follow the cumulative number of dives listed below.

a) Authorization to 30 Foot Depth - Initial science diver depth authorization, approved upon the successful completion of training listed in Section 4.00. Cumulative minimum supervised dives: 12.
b) Authorization to 60 Foot Depth - A diver holding a 30-foot authorization may be authorized to a depth of 60 feet after successfully completing and logging 12 supervised dives to depths between 31 and 60 feet under supervision of a diver authorized by the DCB, for a minimum total time of 4 hours. Cumulative minimum supervised dives: 24.
c) Authorization to 100 Foot Depth - A diver holding a 60-foot authorization may be authorized to a depth of 100 feet after successfully completing and logging 6 supervised dives to depths between 61 and 100 feet under supervision of a dive buddy authorized by the DCB. The diver must also demonstrate proficiency in the use of the appropriate decompression profiling method. Cumulative minimum supervised dives: 30.
d) Authorization to 130 Foot Depth - A diver holding a 100-foot authorization may be authorized to a depth of 130 feet after successfully completing and logging 6 supervised dives to depths between 100 and 130 feet under supervision of a dive buddy authorized by the DCB. The diver must also demonstrate proficiency in the use of the appropriate decompression profiling method. Cumulative minimum supervised dives: 36.
e) Authorization to 150 Foot Depth - A diver holding a 130-foot authorization may be authorized to a depth of 150 feet after successfully completing and logging 6 supervised dives to depths between 130 and 150 feet under supervision of a dive buddy authorized by the DCB. The diver must also demonstrate knowledge of the special problems of deep diving and of special safety requirements. Cumulative minimum supervised dives: 42.
f) Authorization to 190 Foot Depth - A diver holding a 150-foot authorization may be authorized to a depth of 190 feet after successfully completing and logging 6 dives to depths between 150 and 190 feet under supervision of a dive buddy authorized by the DCB. The diver must also demonstrate knowledge of the special problems of deep diving and of special safety requirements. Cumulative minimum supervised dives: 48.

Diving on air is not permitted beyond a depth of 190 feet. Dives beyond 190 feet require the use of mixed gas.

g) Authorization to 250 Foot Depth - A diver holding a 190-foot authorization may be authorized to a depth of 250 feet after successfully completing and logging 6 supervised dives to depths between 190 and 250 feet under supervision of a dive buddy authorized by the DCB. The diver must also demonstrate knowledge of the special problems of deep diving and of special safety requirements.
h) Authorization to 300 Foot Depth - A diver holding a 250-foot authorization may be authorized to a depth of 300 feet after successfully completing and logging 6 supervised dives to depths between 200 and 250 feet under supervision of dive buddy authorized by the DCB. The diver must also demonstrate knowledge of the special problems of deep diving and of special safety requirements.
i) Authorizations deeper than 300 Feet – Depth authorizations deeper than 300 feet progress in 50-foot depth/6 dive increments. A diver holding a 300 foot, or deeper authorization may be authorized to the next depth authorization increment after successfully completing and logging 6 supervised dives under supervision of dive buddy authorized by the DCB. The diver must also demonstrate knowledge of the special problems of deep diving and of special safety requirements.

4.50 Maintaining Active Status

Minimum Activity to Maintain Authorizations

During any 12-month period, each scientific diver must log a minimum of 12 scientific, scientific training, or proficiency dives. At least one dive must be logged near the maximum depth, as defined by the DCB, of the diver's authorization during each 6-month period. Divers authorized to 150 feet or deeper may satisfy these requirements with dives to 130 feet or deeper. Failure to meet these requirements will result in revocation or restriction of authorization by the DSO under procedures established by the DCB.

Requalification of Authorization

Once the initial requirements of Section 4.00 are met, divers whose depth authorization has lapsed due to lack of activity may be requalified by procedures adopted by the DCB.

Medical Examination

All scientific divers must pass a medical examination at the intervals specified in Section 5.0. A medically cleared diver experiencing any Conditions Which May Disqualify Candidates From Diving (Appendix 1) must receive clearance to return to diving from a physician before resuming diving activities. This medical examination requirement cannot be waived for any diver.

Emergency Care Training

The scientific diver must hold current training in the following:

- Adult CPR and AED
- Emergency oxygen administration
- First aid for diving accidents

4.60 Revocation of Authorization

An individual's scientific diver certification can be restricted or revoked for cause by the DCB. Authorizations associated with an individual's scientific diver certification may be restricted or suspended for cause by the DSO. Restrictions or suspensions issued by the DSO may be rescinded by the DSO; these issues will be reported to and reviewed by the DCB, and the outcomes or actions resulting from this review will be documented in the diver's OM record. Violations of regulations set forth in this Manual or other governmental subdivisions not in conflict with this Manual, or

demonstration of poor judgement, may be considered cause. The DCB or designee must inform the diver in writing of the reason(s) for revocation. The diver will be given the opportunity to present their case in writing to the DCB for reconsideration. Following revocation, the diver may be reauthorized after complying with conditions the DCB may impose. All such written statements and requests, as identified in this section, are formal documents, and therefore part of the diver's file.

SECTION 5.00 MEDICAL STANDARDS

5.10 Medical Requirements

General

- All medical evaluations required by this *Manual* must 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)
- URI must verify that divers have been declared by the examining medical authority to be fit to engage in diving activities.

5.20 Frequency of Medical Evaluations

Medical evaluation must be completed:		
Before Age 40	After age 40 Before Age 60	After Age 60
Before a diver may begin diving, unless an equivalent initial medical evaluation has been given within the preceding 5 years	Before a diver may begin diving, unless an equivalent initial medical evaluation has been given within the preceding 3 years	Before a diver may begin diving, unless an equivalent initial medical evaluation has been given within the preceding 2 years
At 5-year intervals	At 3-year intervals	At 2-year intervals
Clearance to return to diving must be obtained from a healthcare provider following a medically cleared diver experiencing any Conditions Which May Disqualify Candidates From Diving (Appendix 1), or following any major injury or illness, or any condition requiring chronic medication. If the condition is pressure related, the clearance to return to diving must come from a physician trained in diving medicine.		

5.30 Information Provided Examining Physician

URI must provide a copy of the medical evaluation requirements of this *Manual* to the examining physician. (Appendices 1, 2, and 3).

5.40 Content of Medical Evaluations

Medical examinations conducted initially and at the intervals specified in Section 5.20 must consist of the following:

1. Diving physical examination (Appendix 2). Modifications or omissions of required tests are not permitted
2. Applicant agreement for release of medical information to the Diving Safety Officer and the DCB (Appendix 2b)
3. Medical history (Appendix 3)

5.50 Physician's Written Report

- A Medical Evaluation of Fitness For Scuba Diving Report (or URI's equivalent) signed by the examining physician stating the individual's fitness to dive, including any recommended restrictions or limitations will be submitted to URI for the diver's record after the examination is completed.

- The Medical Evaluation of Fitness For Scuba Diving Report will be reviewed by the DCB or designee and the diver's record and authorizations will be updated accordingly.
- A copy of any physician's written reports will be made available to the individual.
- It is the diver's responsibility to provide to URI a written statement from the examining medical authority listing any restrictions, limitations, or clearances to dive resulting from medical examinations obtained by the individual outside of their normal diving medical examination cycle. These statements will be reviewed by the DCB or designee and the diver's record and authorizations will be updated accordingly.

Volume 2

Sections 6.00 through 12.00
Required Only When Conducting Described Diving Activities
and
Organizational Member Specific Sections

SECTION 6.00 NITROX DIVING

This section describes the requirements for authorization and use of nitrox for Scientific Diving.

6.10 Requirements for Nitrox Authorization

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

Prerequisites

Only a certified Scientific Diver or DIT diving under the auspices of URI is eligible for authorization to use nitrox.

Application for authorization to use nitrox must be made to the DCB. Submission of documents and participation in aptitude examinations does not automatically result in authorization to use nitrox. The applicant must convince the DCB through the DSO that they are sufficiently knowledgeable, skilled and proficient in the theory and use of nitrox for diving.

Training

In lieu of writing/promulgating AAUS specific training standards for Nitrox divers, AAUS references the standards for Nitrox diver training as defined by the WRSTC and/or ISO. AAUS programs who wish to train Nitrox 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 AAUS using the minimum guidelines presented by the most current version of the RSTC/WRSTC and/or ISO Nitrox diver training standards.

References:
"Minimum Course Content for Enriched Air Nitrox Certification" - World Recreational Scuba Training Council (WRSTC), www.wrstc.com.

"Recreational diving services- Requirements for training programs on enriches air nitrox (EAN) diving". ISO 11107:2009 - International Organization for Standardization (ISO), www.iso.org

Practical Evaluation

- 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.
- A minimum of two supervised open water dives using nitrox is required for authorization.

Written Evaluation

- Function, care, use, and maintenance of equipment cleaned for nitrox use.
- Physical and physiological considerations of nitrox diving (eg.: O_2 and CO_2 toxicity)
- Diving regulations, procedures/operations, and dive planning as related to nitrox diving
- Equipment marking and maintenance requirements
- Dive table and/or dive computer usage
- Calculation of: MOD, pO_2, and other aspects of Nitrox diving as required by the DCB

6.20 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.

6.30 Operational Requirements

Oxygen Exposure Limits

- The inspired oxygen partial pressure experienced at depth should not exceed 1.6 ATA.
- The maximum allowable exposure limit should be reduced in cases where cold or strenuous dive conditions, or extended exposure times are expected.

Calculation of Decompression Status

- A set of DCB approved nitrox dive tables should be available at the dive site.
- Dive computers may be used to compute decompression status during nitrox dives. Manufacturers' guidelines and operation instructions should be followed.
- Dive computers capable of pO_2 limit and fO_2 adjustment should be checked by the diver prior to the start each dive to ensure conformity with the mix being used.

Gas Mixture Requirements

- Only nitrox mixtures and mixing methods approved by the DCB may be used.
- URI personnel mixing nitrox must be qualified and approved by the DCB for the method(s) used.
- Oxygen used for mixing nitrox should meet the purity levels for "Medical Grade" (U.S.P.) or "Aviator Grade" standards.
- In addition to the AAUS Air Purity Guidelines outlined in Section 3.60, any air that may come in contact with oxygen concentrations greater than 40% (i.e.. during mixing), must also have a hydrocarbon contaminant no greater than .01 mg/m^3.
    - For remote site operations using compressors not controlled by the OM where this is not verifiable, the DCB must develop a protocol to mitigate risk to the diver.

Analysis Verification by User

- Prior to the dive, it is the responsibility of each diver to analyze 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.
- Individual dive log reporting forms should report fO_2 of nitrox used, if different than 21%.

6.40 Nitrox Diving Equipment

Required Equipment

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

- Labeled SCUBA Cylinders in Accordance with Industry Standards
- Oxygen Analyzers
- Oxygen compatible equipment as applicable

Requirement for Oxygen Service

- All equipment, which during the dive or cylinder filling process is exposed to concentrations greater than 40% oxygen, should be cleaned and maintained for oxygen service.
- Any equipment used with oxygen or mixtures containing over 40% by volume oxygen must be designed and maintained for oxygen service. Oxygen systems over 125 psig must have slow-opening shut-off valves.

Compressor system

- Compressor/filtration system must produce oil-free air, or
- An oil-lubricated compressor placed in service for a nitrox system should be checked for oil and hydrocarbon contamination at least quarterly.

SECTION 7.00 Surface Supplied Diving Technologies

Surface supplied diving technologies include any diving mode in which a diver at depth is supplied with breathing gas from the surface.

7.10 Surface Supplied Diving

Prerequisites

All surface supplied divers must be authorized scientific divers or divers-in-training and have successfully completed specific training in the use of this mode as authorized by the OM's DCB.

Definition

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. This mode has also been used to supply breathing gas from a diving bell, habitat, or submersible/submarine.

Staffing Requirements

The minimum number of personnel comprising a surface supplied dive team is three. They consist of: a Designated Person-In-Charge (DPIC), a Diver, and a Tender. Additional dive team members are required when a diving operation or dive site is considered complex, or when the task loading of a dive team member is deemed excessive.

It is the OM DCB's responsibility to define when the surface supplied dive team must be expanded beyond the minimum manning requirements.

Equipment Requirements

- Helmet, Bandmask, Full Face Mask equipment must have:
  - A non-return valve at the attachment point between the mask/helmet and hose which must close readily and positively;
  - A gas distribution block that allows for access to an independent reserve breathing gas supply;
  - An exhaust valve
  - Have a minimum ventilation rate capability of 4.5 actual cubic feet per minute (acfm) at any depth at which they are operated or the capability of maintaining the diver's inspired carbon dioxide partial pressure below 0.02 atmospheres absolute (ATA) when the diver is producing carbon dioxide at the rate of 1.6 standard liters per minute
  - Helmets or masks connected directly to the dry suit or other buoyancy-changing equipment must be equipped with an exhaust valve

- Safety Harness
  - The diver will wear a positive buckling device on the safety harness to which the umbilical hose will be secured. The attachment must be of sufficient strength to prevent any strain on the helmet/full face mask hose connections and equipment must be configured to allow retrieval of the diver by the surface tender without risk of interrupting breathing gas supply to the

diver.

- Independent Reserve Breathing Gas Supply
  - Each diver must be equipped with a diver-carried independent reserve breathing gas supply containing sufficient volume to complete the ascent to the surface, including all required decompression and safety stops.

- Umbilical
  - The umbilical generally consists of a gas supply hose, strength member, pneumofathometer hose, and communication line. The umbilical supplies a helmet, bandmask full-face mask.

- Breathing Gas
  - Gas supplied to the diver must meet the air quality standards outlined in section 3.60 regardless of equipment used and its configuration.

Operational Requirements

- Each diver must be continuously tended while in the water.
  - When diving is conducted in enclosed, overhead, physically confined spaces or other conditions deemed an increased risk by the OM's DCB, an additional surface supplied diver should be stationed outside of the hazard area(s) in order to initiate an emergency response.
- Each diving operation must have a primary breathing gas supply sufficient to support divers for the duration of the planned dive including decompression.
- For dives deeper than 100 feet (30 meters) or outside of the no-decompression limits:
  - A separate dive team member must tend each in-water diver;
  - A standby diver must be available while the diver is in the water.
- A diver using surface supply as defined above, i.e. pneumofathometer present in umbilical, may rely on surface personnel to keep the diver's depth, time and diving profile,
- Surface supplied air diving must not be conducted at depths of deeper than 190 feet (57.9 meters).
- The OM DCB is responsible for developing additional operational procedures and requirements based upon risk assessments completed prior to each operation.

Surface Supplied in Aquariums or Confined Water Environments

- In an aquarium habitat where the maximum depth is known, a pneumofathometer is not required.
- The maximum obtainable depth of the aquarium may be used as the diving depth
- The OM DCB is responsible for developing additional operational standards for surface supplied diving specific to the aquarium or other confined water environment. Based upon outcomes of conducted risk assessments during the dive planning process.

7.20 Hookah Diving

Prerequisites

All hookah divers must be authorized scientific diver or diver-in-training and have successfully completed specific training in the use of this mode as authorized by the OM's DCB.

Definition

Dives where 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 monitoring their own depth, time, and diving profile.

Staffing Requirements

The minimum number of personnel comprising a hookah dive team is three. They consist of: a Designated Person-In-Charge (DPIC), a Diver, and a Tender. Additional dive team members are required when a diving operation or dive site is considered complex, or when the task loading of a dive team member is deemed excessive. It is the OM DCB's responsibility to define when the surface supplied dive team must be expanded beyond the minimum staffing requirements.

Equipment Requirements

- Second Stage SCUBA Regulator and Full Face Mask::
    - Must have a non-return valve shall be connected to the second stage of the SCUBA regulator or Full Face Mask.
    - Be designed to deliver adequate breathing gas, within manufacturer specifications at the diver's working depth.
        - The OM DCB must ensure that the depth to which the hookah diving equipment is being utilized can meet this requirement.
- Safety Harness must include:
    - A positive buckling device.
    - An attachment for the primary gas hose to distribute the pull force of the breathing gas hose and to prevent strain on the second stage SCUBA regulator or Full Face Masks.
- Independent Reserve Breathing Gas Supply
    - Each diver must be equipped with a diver-carried independent reserve breathing gas supply or other immediately accessible breathing gas supply containing sufficient volume to complete the ascent to the surface, including all required decompression and safety stops.
- Breathing Gas Hose
    - Be configured with an attachment point to a safety harness to prevent strain on the second stage of a SCUBA regulator mouthpiece or Full Face Mask.
    - Be rated for a working pressure adequate for supplying all divers with sufficient gas at their working depths.
- Breathing Gas
    - Gas supplied to the diver must meet the air quality standards outlined in section 3.60 regardless of equipment used and its configuration.

Operational Requirements

- The hookah breathing gas supply shall be sufficient to support all hookah divers in the water for the duration of the planned dive, including decompression.
- Hookah divers must be planned to ensure divers have access to personnel support

throughout the operation, consistent with the minimum staffing requirements.
● Procedures for communication to topside and/or underwater support shall be developed.
● The OM DCB is responsible for developing additional operational procedures and requirements based upon risk assessments completed prior to each operation.

Hookah Diving in Aquariums or Confined Water Environments

● In an aquarium habitat or confined water environment where the maximum depth is known and planned for, a depth gauge is not required.
● The maximum obtainable depth of the aquarium may be used as the maximum diving depth.
● The OM DCB is responsible for developing additional operational standards for hookah diving specific to the aquarium or other confined water environment based on outcomes of conducted risk assessments during the dive planning process

SECTION 8.00 STAGED DECOMPRESSION DIVING

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

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

8.10 Minimum Experience and Training Requirements

Prerequisites

1) Scientific Diver qualification according to Section 4.00.
2) Minimum of 100 logged dives with experience in the depth range where decompression dives will be conducted.
3) Demonstration of the ability to safely plan and conduct dives deeper than 100 feet.
4) Nitrox certification/authorization according to AAUS Section 6.00 recommended.

Training

Training must be appropriate for the conditions in which dive operations are to be conducted. Minimum Training must 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 must be conducted, emphasizing planning and execution of required decompression dives, and including practice of emergency procedures.
4. Progression to greater depths must be by 6-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 must 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 must be authorized to conduct required decompression dives with DSO approval.

8.20 Minimum Equipment Requirements

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

8.30 Minimum Operational Requirements

1. The maximum pO_2 to be used for planning required decompression dives is 1.6 for open circuit. It is recommended that a pO_2 of less than 1.6 be used during bottom exposure.
2. Decompression dives may be planned using dive tables, dive computers, and/or PC software approved by the DCB.
3. Breathing gases used while performing in-water decompression must contain the same or greater oxygen content as that used during the bottom phase of the dive.
4. The dive team prior to each dive must review emergency decompression procedures appropriate for the planned dive.
5. If breathing gas mixtures other than air are used for required decompression, their use must be in accordance with those regulations set forth in the appropriate sections of this Manual.
6. Use of additional nitrox and/or high-oxygen fraction decompression mixtures as travel and decompression gases to decrease decompression obligations is recommended.
7. Use of alternate inert gas mixtures to limit narcosis is recommended for depths greater than

150 feet.

8. The maximum depth for required decompression using air as the bottom gas is 190 feet.
9. If a period of more than 6 months has elapsed since the last decompression dive, a series of progressive workup dives defined by the DCB to return the diver(s) to proficiency status prior to the start of project diving operations are required.
10. Mission specific workup dives are recommended.

SECTION 9.00 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.

9.10 Minimum Experience and Training Requirements

Prerequisites

1. Nitrox authorization (Section 6.00).
2. If the intended use entails required decompression stops, divers will be previously authorized in decompression diving (Section 8.00).
3. Divers must 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 must 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 must not exceed 260 feet.

6. Diving operations beyond 260 feet requires additional training dives.

9.20 Equipment and Gas Quality Requirements

1. Equipment requirements must be developed and approved by the DCB. Equipment must meet other pertinent requirements set forth elsewhere in this Manual.
2. The quality of inert gases used to produce breathing mixtures must be of an acceptable grade for human consumption.

9.30 Minimum Operational Requirements

3. All applicable operational requirements for nitrox and decompression diving must be met.
4. The maximum pO_2 to be used for planning required open circuit decompression dives is 1.6. It is recommended that a pO_2 of less than 1.6 be used during bottom exposure.
5. Divers decompressing on high-oxygen concentration mixtures must closely monitor one another for signs of acute oxygen toxicity.
6. If a period of more than 6 months has elapsed since the last decompression dive, a series of progressive workup dives defined by the DCB to return the diver(s) to proficiency status prior to the start of project diving operations are required.
7. Mission specific workup dives are recommended.

SECTION 10.00 SPECIALIZED DIVING ENVIRONMENTS

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. OM's using these, must have guidelines established by their Diving Control Board. Divers must comply with all scuba diving procedures in this *Manual* unless specified.

10.10 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).

10.20 Ice and Polar Diving

Divers planning to dive under ice or in polar conditions should use the following: "PESH-POL_2000.08 Standards for the Conduct of Scientific Diving", National Science Foundation, Division of Polar Programs, 2015.

10.30 Overhead Environments

Overhead environments include water filled Caverns, Caves, Flooded Mines and Ice diving, as well as portions of Sunken Shipwrecks and other manmade structures.

For the purposes of this *Manual*, Ice diving is a specialized overhead environment addressed in Section 10.20 and supplemented by requirements and protocols established by the URI's DCB.

Cavern, Cave, or Flooded Mine Diving see Section 12

It is the responsibility of the URI's DCB to establish the requirements and protocol under which diving will be safely conducted in overhead environment portions of sunken shipwrecks and other manmade structures.

10.40 Saturation Diving

If conducting saturation diving operations, divers must comply with the saturation diving guidelines of URI.

10.50 Aquarium Diving

An aquarium is an artificial, confined body of water, which is operated by or under the control of an institution and is used for the purposes of specimen exhibit, education, husbandry, or research.

It is recognized that within scientific aquarium diving there are environments and equipment that fall outside the scope of those addressed in this *Manual*. In those circumstances it is the responsibility of the URI's DCB to establish the requirements and protocol under which diving will be safely conducted.

SECTION 11.00 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 this *Manual*.

For rebreather dives that also involve staged decompression and/or mixed gas diving, all requirements for each of the relevant diving modes must be met. The DCB 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 must be qualified for the type of instruction to be provided. Training must be conducted by agencies or instructors approved by DSO and DCB.

11.10 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.

11.20 Prerequisites for use of any rebreather

A. Active scientific diver status, with depth authorization 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-feet-depth authorization 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 authorization 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.

11.30 Training

A. Specific training requirements for use of each rebreather model must be defined by DCB on a case-by-case basis. Training must 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).

Individual Equipment Requirements

Individual Equipment Requirements			
Key: X = include, IA = If Applicable			
	O_2	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	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

11.40 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

11.50 Operational Requirements

A. Dive Plan

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

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

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

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

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

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

G. 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.

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

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

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

K. 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 authorization and 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

L. 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.

11.60 REBREATHER TRAINING SECTION

A. Entry Level Training

1. The training area for O_2 Rebreather should not exceed 20 feet in depth.
2. Entry level CCR and SCR training is limited in depth of 130feet 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 O_2 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			
	O_2	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, CO2 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	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 buddy	X	X	X
Excluded O_2 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 must 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	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 off board 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	Open water	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, Normoxic, and Hypoxic Mix Training

1. Required Decompression and Normoxic Training may be taught separately or combined.
2. Prerequisites:
   a) Required Decompression 25 rebreather dives for a minimum cumulative dive time of 25 hours
   b) Mixed Gas:
      (1) Normoxic Mixes – 25 rebreather dives for a minimum cumulative dive time of 25 hours
      (2) Hypoxic Mixes – Rebreather Required Decompression Certification and Normoxic Certification and 25 decompression rebreather dives for a minimum cumulative dive time of 40 hours on dives requiring decompression
3. Who may teach: Individuals authorized as a CCR/SRC required decompression and/or Normoxic and/or Hypoxic Mix instructor by the DCB or their designee (this is in addition to the original authorization from section A #5)
4. Maximum Student/Instructor Ratio: 2 to 1. This ratio is to be reduced as required by environmental conditions or operational constraints
5. 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
6. 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, Normoxic & Hypoxic Mix Training Requirements			
Key: X = include, IA = If Applicable, ISE = If So Equipped			
	Deco	Normoxic	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	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 must 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
Demonstrate controlled ascent with an incapacitated diver including surface tow at least 30 meters / 100 feet with equipment removal on surface, in water too deep to stand	X	X	X
Onboard and off board 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 CO2 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	X	X	X
Operation in semi-closed mode	X	X	X
Properly execute the ascent procedures for an incapacitated	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 receive 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 decompression obligation on open circuit	X	X	X
Written Evaluation	X	X	X
Supervised Rebreather Dives	X	X	X

Minimum Underwater Requirements

	Pool/Confined	**Openwater**	**Supervised Dives****
Deco	1 Dive / 60 min	7 Dives / 420 min	4 Dives / 240 min.
Normoxic	1 Dive / 60 min	7 Dives / 420 min	4 Dives / 240 min.
Deco/Normoxic Combined	1 Dive / 60 min	7 Dives / 420 min 3 Normoxic Dives / 180 min	4 Dives / 240 min.
Hypoxic Mixes		7 Dives / 420 min	4 Dives / 240 min.

**A minimum of three supervised dives should comply with authorization 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 12.00 SCIENTIFIC CAVE AND CAVERN DIVING

This section defines specific considerations regarding the following issues for Scientific Cavern and Cave diving:

- 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 this *Manual*.

For cavern or cave dives that also involve staged decompression, rebreathers, and/or mixed gas diving, all requirements for each of the relevant diving techniques, modes, or gases must be met.

No diver must conduct planned operations in caverns, caves, or other overhead environments without prior review and approval of the DCB or designee. The diver must demonstrate that he/she possesses the proper attitude, judgment, and discipline to safety conduct cave and cavern diving in the context of planned operations.

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

12.10 Definition

A dive team must 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. In addition to blocking direct access to surfacing, underwater caves have additional environmental hazards including but not limited to:

- The absence of natural light.
- Current or flow 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.
- The presences of silt, sand, mud, clay, etc. that 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.

12.20 Prerequisites

Prerequisites	Cavern: OC or Rebreather	Cave	Rebreather Cave
Active scientific diver status, with depth qualification sufficient for proposed training location(s)	X	X	X
Completion of a minimum of 25 dives.	X		
Cavern Diver Authorization		X	X

12.30 Training

Training	Cavern: OC or Rebreather	Cave OC	Rebreather Cave
Key: X = include, R = Review, IA = If Applicable, OC = Open Circuit			
Trainers must be qualified for the type of instruction to be provided. Training must be conducted by agencies or instructors approved by the DCB or their designee	X	X	X
Academic			
Policy for diving overhead environments	X	X	X
Environment and environmental hazards	X	X	X
Accident analysis	X	X	X
Psychological considerations	X	X	X
Required equipment and equipment configuration			
Single cylinder with H or Y Valve	IA	IA	
Doubles with Isolation Manifold	IA	IA	
Side Mount		IA	IA
No Mount		IA	IA
Stage Cylinder(s)		IA	IA
Off-board Bailout	IA		X
Communications	X	X	X
Diving techniques			
Body control	X	X	X
Navigation and guidelines	X	X	X
Entry and Exit Protocols (Right of Way)	X	R	R
Use of line arrows and cookies	X	X	X
Line Systems Applicable to the Area and/or Cave System	X	R	R
Line Jumps		X	X
Circuits		X	X
Dive planning			
Rule of Sixths	X	R	R
Rule of Thirds	X	R	R
Gas Matching	IA	X	X
Decompression Theory	R	R	R
Dive Tables	R	R	R
Mixed Mode Diving	IA	IA	IA
Cave geology	X	R	R

Cave hydrology	X	R	R
Cave biology	X	X	X
Emergency procedures	X	X	X
Practical Training and Evaluation			
Land Drills			
Line Reel Use	X	R	R
Techniques and Considerations for Laying a Guideline	X	X	X
Guideline Following	X	R	R
Buddy Communication	X	R	R
Team Positioning for Normal Entry and Exit	X	X	X
Zero Visibility Drills			
Line Reel Use	X	R	R
Line and Line Arrow Identification and Following	X	R	R
Bump and Go (Skills description)		X	X
Emergency Procedures			
How Far Can You Go Out Of Gas?(Skills description)	X	X	X
Team Positioning for Emergency Situations	X	X	X
In-Water			
Demonstrated skills must include, at a minimum:			
A minimum of four (4) cavern dives, preferably to be conducted in a minimum of two (2) different caverns	X		
A minimum of twelve (12) cave dives, preferably to be conducted in a minimum of four (4) different cave sites with differing conditions		X	X
Safety drill (S-drill) – Performed on every dive			
Review of Dive Plan and Turn Pressures	X	X	X
Essential Gear Identification, Positioning, and Function Check	X	X	X
Proper Valve Position Check	X	X	X
Bubble Check	X	X	X
Proper Buoyancy Compensator Use	X	X	X
Proper Trim and Body Positioning	X	X	X
Hovering and Buoyancy With Hand Tasks	X	X	X
Specialized Propulsion Techniques and Anti-Silting Techniques (modified flutter kick, modified frog kick, pull and glide, ceiling walk or shuffle)	X	X	X
Proper Light and Hand Signal Use	X	R	R
Proper Reel and Guideline Use	X	X	X
Ability to Deploy a Primary Reel and Tie Into a Main Line Under Different Conditions (Flow, Visibility, Bottom/Silt, etc.)	X	X	X
Proper Line Placement and Etiquette	X	X	X
Proper Use of Safety Reel		X	X
Proper Use of Jump/Gap Reel(s)		X	X
Use of Drop/Stage Cylinders			
Proper Placement and Retrieval of Cylinder(s) With Minimal Disturbance of Environment and Visibility		IA	IA
Ability to Deploy and Retrieve Cylinders With Minimal Loss of Forward Progress		IA	IA

Surveying	IA	IA	IA
Ability to Properly Critique Their Dives and Performance	X	X	X
Zero Visibility Drills	IA	X	X
Line Reel Use	X	R	R
Buddy Communication	X		
Line and Line Arrow Identification and Following	X	R	R
Bump and Go (Skills Description)		X	X
Emergency Procedures			
Team Positioning for Emergency Situations	X	X	X
Lost Line (Skills Description)		X	X
Lost Buddy	X	X	X
Gas Sharing While Following Guideline (Conducted with and without visibility, As Donor and Receiver)	X	X	X
Gas Sharing in a Minor Restriction Using a Single File Method As Donor and Receiver		X	X
Valve Manipulation	X	X	X
Proper Attitude, Judgment, and Discipline To Safely Conduct Dives In An Overhead Environment	X	X	X
Written Examination			
A written evaluation approved by the DCB with a predetermined passing score, covering concepts of both classroom and practical training	X	X	X

12.40 Equipment Requirements

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

Minimum Equipment	Cavern OC	Rebreather Cavern	Cave OC	Rebreather Cave
Key: X = include, R = Review, IA = If Applicable, OC = Open Circuit				
At a minimum, a single cylinder with adequate volume and configured to allow divers to exit from farthest/deepest penetration while supporting self and dive buddy equipped with a “K” valve; standard OC regulator configuration (Section 3.20); and BCD	X			
At minimum, a single cylinder equipped with an “H” or “Y” valve Or an alternate gas supply with adequate volume and configured to allow divers to exit from farthest/deepest penetration while supporting self and dive buddy			IA	
Off-board/bailout gas supply of sufficient volume and configured to allow diver to exit from farthest/deepest penetration	IA	X		X
A BCD capable of being inflated from the cylinder	X	X	X	X
Slate and pencil	X	X	X	X
A functioning primary light with sufficient burn time for the planned dive			X	X

Two functioning battery powered secondary lights	X	X	X	X
Two cutting devices	X	X	X	X
One primary reel of at least 350 feet (106 m) for each team	X	X	X	X
Safety reel with at least 150 feet (45.6 m) of line			X	X
Directional Line Markers			X	X
Cylinders with dual orifice isolation valve manifold Or independent SCUBA systems* with enough volume for the planned dive plus required reserve			X	
Two completely independent regulators, at least one of each having submersible tank pressure gauge and a low pressure inflator for the BCD			X	
One regulator to be configured with a five foot or longer second stage hose			X	
Rebreather		X		X
Off-board Bailout of sufficient capacity for the diver to exit to the surface		X		X
*Independent SCUBA systems must be configured to allow for monitoring of gas pressures in each cylinder				

12.50 Operational Requirements and Safety Protocols

Operational Requirements and Safety Protocols	Cavern	Cave
Diving must not be conducted at penetration distance into the overhead environment greater than 200 feet (60 m) from the water's surface, with a depth limit of 100 feet (30 m)	X	
Dive teams must perform a safety drill prior to each dive that includes equipment check, gas management, and dive objectives	X	X
Each team within the overhead 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	X	X
Gas management must be appropriate for the planned dive with special considerations made for; DPV's, siphon diving, rebreathers, etc.	X	X
The entire dive team is to immediately terminate the dive whenever any dive team member calls (terminates) the dive	X	X

Appendices

Appendix 1 Through 8 Or Equivalent
Required For All Organizational Members

APPENDIX 1- URI & AAUS Medical Form

AAUS MEDICAL EVALUATION OF FITNESS FOR SCUBA DIVING REPORT

Applicant Name _____ Evaluation Date _____

Organizational Member _____

Diving Safety Officer _____ Phone Number _____

To The Examining or Supervising Physician: Scientific divers require periodic medical examinations to assess their fitness to engage in underwater diving. Their answers on the diving medical history form may indicate potential health or safety risks. Your evaluation is requested on this scuba diving fitness medical evaluation report. Please proceed in accordance with the AAUS medical standards (Sec. 5.00). If you have questions about diving medicine, please consult with the Undersea Hyperbaric Medical Society or Divers Alert Network. You can also contact the undersigned organizational Diving Safety Officer if you have any questions about the diving standards. Thank you for your assistance.

NOTE: Although portions of this exam may be conducted by other medical professionals (e.g., PA or NP), the final decision signature must come from a medical doctor (MD) or osteopath (DO).

THE FOLLOWING TESTS ARE <u>REQUIRED</u> FOR ALL EXAMS AND CANDIDATES:

- Medical history form
- Complete physical exam, with emphasis on cardiac, pulmonary, neurological and otological components
- Resting electrocardiogram (on initial exam only for candidates ≤40 years of age)
- Any further tests deemed necessary by the physician

ADDITIONAL TESTS FOR CANDIDATES >40 YEARS OF AGE:

- Assessment of coronary artery disease using the American College of Cardiology ASCVD risk estimator plus tool (https://tools.acc.org/ascvd-risk-estimator-plus/#!/calculate/estimate)
    - Evaluation to include age, blood pressure, smoking status, history of diabetes, resting electrocardiogram, and venous blood draw (for lipid panel and HbA1c)
    - Note to physician: If the 10-year ASCVD risk estimate is intermediate or high (>7.4%), further cardiac evaluation could include cardiology consultation and indicated testing
- Any further tests deemed necessary by the physician

FOR THE EXAMINING PHYSICIAN

Scuba and other modes of compressed-gas diving can be strenuous and hazardous. Diving is an activity that puts unusual stress on the individual in several ways. Immersion produces physiological strain and diving may add to this with heavy exertion (planned or unplanned). Divers should be in good health, with no conditions that may be made worse by diving. Divers must be able to equalize pressure in any air spaces during compression and decompression (e.g., lungs, middle ears, sinuses, mask). Any condition that risks the loss of consciousness should disqualify the applicant. Cardiovascular disease also represents high risk to divers. The following conditions require additional investigation and **may** restrict candidates from diving:

- Episodic loss of consciousness
- History of seizure (except single febrile seizure in childhood)
- History of stroke or a fixed neurological deficit
- Recurring neurologic disorders, including transient ischemic attacks
- History of intracranial aneurysm, other vascular malformation, or intracranial hemorrhage
- Vertigo (including Meniere's disease), lightheadedness, or dizziness
- Head injury with sequelae

- Abnormalities of the tympanic membrane, such as perforation, presence of a monomeric membrane, or inability to autoinflate the middle ears
- Stapedectomy or middle ear reconstructive surgery
- Recent ocular surgery

- High risk for coronary artery disease (cardiovascular disease to include chest pain [angina], and claudication [especially with activity])

- Atrial septal defects
- Significant valvular heart disease, including sclerotic valve disease (note: isolated mitral valve prolapse may not be disqualifying on its own)
- Significant cardiac rhythm or conduction abnormalities
- Inadequate exercise tolerance
- Severe hypertension

- History of spontaneous or traumatic pneumothorax
- Asthma, wheezing, or bronchospasm
- Chronic pulmonary disease, including radiographic evidence of pulmonary bullae or cysts

- Psychiatric disorders including claustrophobia, suicidal ideation, psychosis, anxiety states, untreated depression
- Substance abuse, including alcohol

- History of neurological decompression illness with residual deficit

- Hematologic disorders including coagulopathies
- Diabetes
- Pregnancy
- Certain medications, including psychotropics, anticoagulation and those that lower seizure threshold
- Implanted devices (e.g., cardiac pacemaker)

PHYSICIAN STATEMENT

I have evaluated the patient considering the guidance above and the medical information they have provided. I have discussed with them any medical condition(s) that could increase their risk in diving. The patient understands the nature of the hazards and the risks involved in diving with these conditions.

_____ I find no medical conditions that are disqualifying for participation in underwater diving.

If health status remains unchanged, the candidate **IS** medically qualified to dive for:

_____ 5 years (age <40 years)

_____ 3 years (age 40-59 years)

_____ 2 years (age >59 years)

_____ Interval recommended if less than above (specify) _____

_____ Applicant **IS NOT** medically qualified to dive: _____ Permanently _____ Temporarily

MD/DO signature _____ Date _____

MD/DO name (print) _____

Address _____

Telephone _____ E-mail _____

APPENDIX 2

UNIVERSITY OF RHODE ISLAND &
AAUS MEDICAL EVALUATION OF FITNESS FOR SCUBA DIVING REPORT

PHYSICAN'S STATEMENT (CONTINUED)

_____

Name of Applicant (Print or Type)

Your patient (the diving applicant listed above) is requesting approval to participate in research diving at the University of Rhode Island. The activity of scientific research diving is much more rigorous than traditional recreational scuba diving. In addition to typical dive equipment (weighing roughly 50-75 lbs), research divers routinely carry and use additional heavy research equipment (e.g. coring materials, biological survey materials, underwater cameras). The participant may be asked to perform multiple dives a day while on SCUBA, repeatedly lifting, carrying and maneuvering 50+ lbs of dive gear and equipment, while operating in potentially adverse conditions (e.g. wet and crowded boat decks, or during prolonged exposure to sun/wind/waves). Research divers also often work underwater in variable conditions (e.g. strong currents, poor visibility, or cold temperatures). Please note that by signing this form, you are validating that in your professional medical opinion, the diving applicant is in proper physical condition, including appropriate abilities and endurance to handle research scuba diving under strenuous and sometimes adverse underwater environmental conditions.

_____ MD or DO _____

Signature Date

_____

Name (Print or Type)

_____

Address

_____ _____

Telephone Number E-Mail Address

REFERENCES

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AAUS MEDICAL EVALUATION OF FITNESS FOR SCUBA DIVING REPORT
APPLICANT'S RELEASE OF MEDICAL INFORMATION FORM

Name of Applicant _____

I authorize the release of this information and all medical information subsequently acquired in association with my diving to the Diving Control Board or their designee of (organization/institution):

_____

Signature of Applicant _____

Date _____

APPENDIX 3

DIVING MEDICAL HISTORY FORM

Applicant Name _____

Date of Birth _____

Age _____ Weight _____ Height _____

Sponsor_____
(Department/Project/Program/School, etc.)

Date _____

TO THE APPLICANT:
Underwater diving places considerable physical and mental demands on the diver. Certain medical and physical requirements must be met before participating in diving activity. Your candid and complete answers are extremely important in determining your fitness to dive. Many of the below concerns may not result in your disqualification but are important for your long-term health and diving safety.

Should your answers indicate a condition which might make diving hazardous, you will be asked to review the matter with a physician, preferably one trained in diving medicine. Medical authorization is required for participation when concerns exist. If the physician evaluation determines that diving would involve undue risk for you, please remember that the concern is for your well-being and safety.

Yes	No	Please indicate whether or not the following apply to you (either current or past)
		NEUROLOGIC
		Convulsions, seizures, or epilepsy
		Concussion, traumatic brain injury, head injury with loss of consciousness
		Severe headaches, including migraines with any neurologic symptoms
		Balance, dizziness, lightheadedness, or vertigo problems
		Fainting or other loss of consciousness
		Stroke or other neurologic disease
		EAR, NOSE, THROAT, AND SINUSES
		Eye disease, injury, or recent surgery (within 6 months)
		Hearing loss
		Ear disease, injury, or surgery
		Perforated eardrum (tympanic membrane)
		Obstructive sleep apnea
		Dental or oral issues affecting ability to hold a mouthpiece in place
		Allergies
		CARDIAC/CARDIOVASCULAR
		Chest pain, heart disease, or heart attack
		Heart failure, pulmonary edema, heart murmur, or valvular heart disease
		Atrial septal defect or other congenital heart disease
		Abnormal heart rhythm (such as but not limited to long QT syndrome, Brugada, Wolff-Parkinson-White (WPW) syndrome, atrial fibrillation, blocks, supraventricular tachycardia, ventricular tachycardia, postural orthostatic tachycardia syndrome (POTS)
		Cardiac angiogram, echocardiogram, or other cardiac procedures
		High cholesterol (hyperlipidemia)
		High blood pressure (hypertension)
		Family history of early heart disease or sudden death (i.e., at <50 years of age)
		PULMONARY
		Asthma, reactive airway disease, chronic obstructive pulmonary disease/emphysema, or wheezing
		Tuberculosis, chronic lung conditions, or respiratory infection in last 2 months
		Shortness of breath or fatigue with mild exertion or exercise
		Pneumothorax (or collapsed lung)
		Lung disease or surgery (including history of bullae)
		Pulmonary embolism or deep vein thrombosis
		Severe respiratory disease or infection causing hospitalization or with persistent symptoms
		GASTROINTESTINAL, LIVER, AND KIDNEY
		Gastrointestinal bleeding, ulcers, liver disease, or hepatitis
		Crohn's disease or ulcerative colitis
		Hernia
		Kidney problems (including but not limited to impaired kidney function, kidney stones, blood in the urine)
		MUSCULOSKELETAL
		Back/Neck pain or injury, including herniated disc, spinal stenosis, or sciatica

		Joint injury causing restrictions in range of motion or activity
		History of osteonecrosis
		ENDOCRINE, HEMATOLOGIC, AND AUTOIMMUNE
		Diabetes
		Thyroid disease
		Autoimmune disease
		Anemia (sickle cell or other)
		Bleeding or clotting disorder
		History of or active cancer
		PSYCHIATRIC AND SUBSTANCE USE
		Mental illness, depression, anxiety, or panic
		Tobacco use (including vaping)
		Alcohol or substance abuse
		DIVING ILLNESSES
		Decompression sickness or arterial gas embolism
		Immersion pulmonary edema (including shortness of breath while diving/swimming, coughing up pink or frothy fluid)
		Any other problems related to diving
		MISCELLANEOUS
		Current pregnancy
		Implantable device (such as pacemaker, medication pump, nerve stimulator, automated implantable cardioverter defibrillator [AICD])

Additional comments on any “yes” answers above:

_____
_____
_____
_____
_____
_____
_____
_____

Any changes in your medical condition or exercise capacity since your last physical examination:

_____
_____

List of all surgeries or hospitalizations:

_____
_____
_____

_____

Summarize other medical history not addressed in the above list:

_____
_____
_____
_____
_____

List of all current medications (include dosages for both prescription and over-the-counter) and supplements:

_____
_____
_____
_____

List of all allergies:

_____
_____
_____
_____
_____

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

I am aware that a meaningful drop in exercise capacity or a new or worsening health condition requires a dive examination by a physician before participation in any diving activity.

Applicant signature _____ Date _____

APPENDIX 4- RECOMMENDED PHYSICIANS WITH EXPERTISE IN DIVING MEDICINE

A List of Medical Doctors that have training and expertise in diving or undersea medicine can be found through the Undersea and Hyperbaric Medical Society or Divers Alert Network. See links below
https://www.uhms.org/resources/diving-medical-examiners-list.html
https://www.diversalertnetwork.org/medical/physicians.asp

1. Dr. Christopher Nasin, MD
   URI Health Services
   6 Butterfield Road
   Kingston, RI 02881
   T: 401.872.2246

2. Name:_____
   Address:_____
   _____
   Telephone: _____

3. Name:_____
   Address:_____
   _____
   Telephone: _____

4. 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.

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

Authorization-The DCB authorizes divers to dive using specialized modes of diving, and the depth they may dive to.

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

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.

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

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

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

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 Dive **-** A dive which takes place partially or wholly underground, in which natural sunlight is continuously visible from the entrance.

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

(Scientific Diver) Certification- A diver who holds a recognized valid certification from an AAUS OM

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

Designated Person-In-Charge – Surface Supplied diving mode manning requirement. An individual designated by the OM DCB or designee with the experience or training necessary to direct, and oversee in the surface supplied diving operation being conducted.

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 – A person who stays underwater for long periods by having compressed gas supplied from the surface or by carrying a supply of compressed gas.

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.

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 (See Diving Control Board under Section 1.0).

Diving Safety Officer (DSO) - Individual responsible for the safe conduct of the scientific diving program of the membership organization (See Diving Safety Officer under Section 1.0).

DPIC – See Designated Person-In-Charge.

EAD - Equivalent Air Depth (see below).

Emergency Swimming Ascent - An ascent made under emergency conditions where the diver may exceed 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 6.00).

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.

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

fO_2 - Fraction of oxygen in a gas mixture, expressed as either a decimal or percentage, by volume.

FSW - Feet of seawater.

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).

Gas Matching – The technique of calculating breathing gas reserves and turn pressures for divers using different volume cylinders. Divers outfitted with the same volume cylinders may employ the Rule of Thirds for gas management purposes. Divers outfitted with different volume cylinders will not observe the same gauge readings when their cylinders contain the same gas volume, therefore the Rule of Thirds will not guarantee adequate reserve if both divers must breathe from a single gas volume at a Rule of Thirds turn pressure. Gas Matching is based on individual consumption rates in volume consumed per minute. It allows divers to calculate turn pressures based on combined consumption rates and to convert the required reserve to a gauge based turn pressure specific to each diver's cylinder configuration.

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.

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 Recompression chamber.

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

Independent 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.

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

Life Support Equipment – Underwater equipment necessary to sustain life.

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

Organizational Member (OM) - 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 Manual*.

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.

Mixed Gas - Breathing gas containing proportions of inert gas other than nitrogen greater than 1% by volume.

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.

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

Normal Ascent - An ascent made with an adequate air supply at a rate of 30 feet per minute or less.

OTU - Oxygen Toxicity Unit

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

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

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

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

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.

pO_2 - Inspired partial pressure of oxygen, usually expressed in units of atmospheres absolute.

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

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

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

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

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.

Safety Stop – A stop made between 15-20 feet (5-6 meters) for 3-5 minutes during the final ascent phase of a dive.

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.

Side Mount - 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.

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.

Tender - Used in Surface supplied and tethered diving. The tender comprises the topsides buddy for the in-water diver on the other end of the tether. The tender must have the experience or training to perform the assigned tasks in a safe and healthful manner.

Turn Pressure – The gauge reading of a diver’s open circuit scuba system designating the gas limit for terminating the dive and beginning the exit from the water.

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.

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 University of Rhode Island Diving Safety Manual, and has demonstrated competency in the indicated areas. The University of Rhode Island 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 Authorization_____ feet
Total number of career dives? _____

Any restrictions or Waivers of Requirements? (Y/N)_____ if yes, explain:

Please indicate any pertinent authorizations or training:

Emergency Information:

Name: Relationship:

Telephone: (work) (home)

Address:

This is to verify that the above information is complete and correct

Diving Safety Officer:

_____ _____
(Signature) (Date)

_____ _____
(Print)

APPENDIX 7
EMERGENCY ACTION PLAN

Introduction

A diving accident victim could be any person who has been breathing compressed gas 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 OM 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 or (C)irculation (A)irway (B)reathing as appropriate
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 recompression chamber, etc.
6. Notify DSO or designee according to the Emergency Action Plan of URI.
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

1. **Diver Alert Network**
   T: 919-684-9111

2. **Anya Hanson, Diving Safety Officer**
   Office: 401-874-6205, Cell: 203-258-4479

3. **USCG Castle Hill Station, Rhode Island**
   401-846-3675

4. **Kent Hospital**
   Wound Recovery & Hyperbaric Medicine
   401-736-4646

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 recompression chamber.
- Nearest accessible hospital.
- Available means of transport.

APPENDIX 8
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 underwater utilizing compressed gas and subsequent ascent/return to the surface with a minimum surface interval of 10 minutes.

Dives will not be differentiated as open water or confined water dives. But open water 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 diver's home organization. Only a diver who has actually logged a dive during the reporting period is counted under this category.

Incident(s) that occur during the collection cycle: Only incidents that occurred 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 percentages different from those of air.

- Mixed Gas: Dives where the bottom gas used for the dive is a combination of oxygen, nitrogen, and helium (or other inert 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 monitor 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 monitoring their own depth, time, and diving profile.
- Rebreathers: Dives where the breathing gas is repeatedly recycled in a 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, 191-250, 251-300, and 301->. Depths are in feet seawater (when measured in meters: 0-10, >10-30, >30-40, >40-45, >45-58, >58-76, >76-92, and >92->). 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: Open Water diving where the bottom is generally greater than 200 feet deep and requires the use of multiple-tethers 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 must 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 type

Incident Classification Rating Scale:

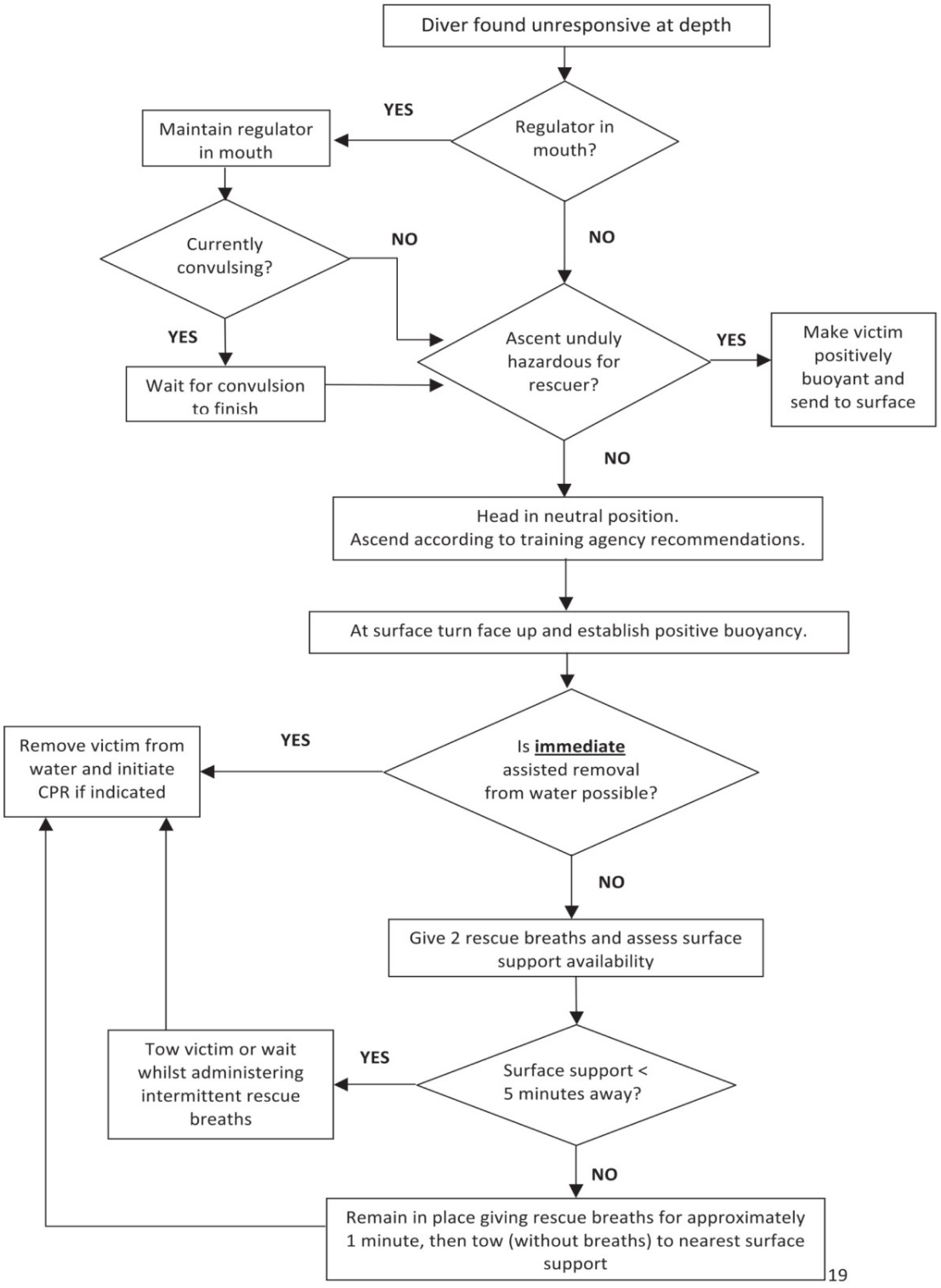
- Near-Miss: A near-miss is a potential hazard or incident in which no property was damaged and no personal injury was sustained, but where given a slight shift in time or position, damage or injury could easily have occurred. Near-misses also may be referred to as close calls, near accidents, or injury-free events.
- 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.
    - Hypercapnia.

- Spinal injuries.
- Heart attack.
- Fatality.

Appendix 9

Recommendations For Rescue Of A Submerged Unresponsive Compressed-Gas Diver

From: S.J. Mitchell et al., Undersea and Hyperbaric Medicine 2012, Vol. 39, No. 6, pages 1099-1108



APPENDIX 10

Auxiliary Equipment - Equipment Use, Example of Use, Pertinent Safety Considerations

Sampling Equipment

Equipment Description & Examples of Use

Sampling Equipment is a broad category of equipment used to collect many types of data while underwater. These items include but are not limited to:

- Transect Tapes
- Quadrats
- Slates and other writing instruments
- Hand nets
- Sample Collection Storage
- Coring/Vibra-Coring
- Diver controlled suction dredges and air-lifts
- Traps

Pertinent Safety Considerations

1. Many pieces of sampling equipment pose, either directly or indirectly, an entanglement hazard. A thorough assessment of the likelihood of entanglement for each piece of equipment along with the specific environmental conditions should be completed prior to the deployment of chosen sampling equipment. Cutting tools and diver communication in the event of entanglement must be discussed prior to the operation.
2. Sampling equipment should be fitted with a means of safely transporting the equipment both on the surface and underwater to the dive location, i.e. clips, lines, bags, etc.
3. When sampling equipment requires the use of surface support/personnel, a means of communication should be established between the diver(s) and topside personnel to ensure equipment can be energized/de-energized when needed.
4. A review of the hazards associated with the specific sampling equipment should be included in the pre-dive planning process and briefings

Organism & Tissue Collection Tools – Spearguns & Polespears

Equipment Description & Examples of Use

Spearguns and pole spears can range in size and length. Each tool consists of a spear tip end for capturing organisms with a mechanism for projecting the spear, either by way of trigger (speargun) or a simple rubber sling (polespear). These tools are constructed out of a wide variety of marine grade materials such as fiberglass, wood, plastics and steel.

Pertinent Safety Considerations

1. Slings and guns are not to be positioned in a tense, release mode unless the diver is actively targeting a specimen
2. Divers will only release/activate the polespear/speargun in the opposite direction of their dive buddy.
3. Collection gear type should be appropriate for the targeted specimens to prevent any injuries. For example, if collecting lionfish, divers should use a collection container that is designed to hold the lionfish and prevent being stung by spines.

4. Collecting roving animals may cause a diver to inadvertently swim away from their dive buddy, or exceed maximum operating depths. Divers must regularly assess that they are at an appropriate depth and distance to reach or assist their dive buddy in the case of an emergency.
5. All effort must be taken to avoid damaging live benthic fauna (e.g., coral, sponges). Divers should position their spears to target the animal in the water column or release their spear when the targeted animal is near sand or bare rocks.
6. Collections should be spread out across numerous and vast areas, when possible, to avoid the aggregation of large predatory animals in one location.
7. In the case of aggressive large animals, dive buddies should position themselves close to one another and keep eyes on aggressive animals as they return to shore or other diving platform. If divers need to ascend to their boat, divers are to position themselves back-to-back so that aggressive animals can always be monitored by one of the divers. Use of the pole spear can be used to keep distance between the buddy team and the animal if they become too close.
8. Divers should be cautious of entrapment hazards when fish attempt to hide in reef areas.

Cameras – Still & Video

Equipment Description & Examples of Use
Cameras, diver carried and remote, are effective tools for the scientific diver in aiding with capture of natural phenomena, mechanical apparatus movement/behavior, archeological sites etc. The advancements in camera technology over the past decade(s) has made these tools compact and relatively inexpensive, allowing for most scientific diving operations to employ the benefits of these tools.

Pertinent Safety Considerations
1. Avoid perceptual narrowing when using a camera for scientific work and reinforce dive safety concerns during pre-dive briefings, i.e. decompression and gas management, buddy awareness, etc.
2. If utilizing a large camera, ensure proper buoyancy can be maintained throughout the planned scientific dive operations.
3. Cameras should have an attachment point on the diver that is easily accessed so that (1) camera can be maintained if the diver releases the camera and (2) can be removed efficiently in the event of an emergency.

Small Hand Tools:

Equipment Description & Examples of Use
Small Hand Tools are any manually powered tool used for basic underwater tasks. Examples include, but are not limited to: dive knives & line cutters, screwdrivers, hammers, wrenches, pliers, prybars, hand saws, shears, clips, lines, zip ties etc.

Pertinent Safety Considerations
1. Divers should be familiar with the proper use and safe operation of the tools they will be utilizing
2. Tools should be carried in a bag or tethered to the diver to avoid dropping
3. Divers should not use tools as weighting
4. Divers should avoid carrying excessive amounts of tools that may affect buoyancy control
5. Divers should be aware of potential hazards utilizing the tool (impact injuries, sharp edges, etc.)
6. Divers should be aware of the impact of the use of the tools on the surrounding environment

Handheld Underwater Power Tools

Equipment Description & Examples of Use
Handheld underwater power tools are battery, pneumatically or hydraulically powered tools that enhance the scientific diver's abilities to complete tasks efficiently. Small handheld drills, impact hammers & wrenches and grinders are examples of handheld underwater power tools available to the scientific diver.

Handheld underwater power tools are lightweight and assist the scientific diver in tasks such as creating holes in substrate, removing and collecting organisms or fixed items from benthic environments and establishing secure locations for scientific apparatus like sensors, automated sampling equipment or grids.

Pertinent Safety Considerations
1. Tools supplied with power from the surface must be de-energized before being placed into or received from the water.
2. Tools must not be supplied with power from the dive location until requested by the diver.
3. Divers must receive detailed instructions and training in the operation, use and hazards of any underwater power tool prior to the operation.
4. Underwater power tools have the potential of generating high noise levels so care must be taken to protect the scientific diver from this hazard.
5. Battery powered tools, esp. those equipped with lithium ion batteries, shall follow the manufacturer's recommended charging procedures along with thorough inspection prior to and after the dive operation to ensure the integrity of the battery has been maintained.

Line Reels & Spools

Equipment Description & Examples of Use
Line reels and spools are designed to carry braided, nylon line on a drum and can be of varying sizes and line capacities. Reels tend to have a large capacity, have a guide for the line to aid the diver in paying out or loading the reel and are made of rugged materials specifically designed for underwater use. Spools are much simpler in design, are simply a drum of plastic, delrin or metal with braided and tend to carry less length of line than a reel. There are two general categories of use for line reels and spools: aid in navigation or searching and aid in surfacing when line is fixed to a surface marker.

Pertinent Safety Considerations
1. The line should be constructed of neutrally buoyant braided nylon so as to minimize the risk of the line causing any buoyancy challenges for the diver and becoming unweaved while deployed and/or not underload.
2. Reels should be inspected and functionally tested regularly to ensure the line can be deployed and retrieved without significant effort or interruption, esp. when being used as an aid in surfacing.
3. When using a reel or spool for surfacing a marker, ensure the reel/spool is configured with sufficient length of line to reach the surface from deployment depth.

Delayed Surface Marker Buoy (dSMB)

Equipment Description & Examples of Use
Delayed Surface Marker Buoys vary in length and volume and are equipped with a means of (1)

inflation while at depth (pneumatically or orally) and (2) venting gas to ensure the buoy does not experience rupture and lose buoyancy during ascent.

These types of buoys are generally used to indicate a diver or dive team's location during ascent in areas where operational hazards exist or challenging conditions are encountered, i.e. shipping/boating lanes, blue water ascents with currents. They also allow for points of reference during decompression, both recommended and mandatory stops.

They can also be utilized to mark locations of items on the bottom to ensure an efficient retrieval can be made or the location can be revisited easily. Generally, dSMBs are not permanent installations but instead a short term surface marker.

Pertinent Safety Considerations

1. Must be equipped with a reel/spool (1) containing sufficient line length to ensure effective surfacing of the buoy from the planned deployment depth (2) have a mechanism to lock the reel/spool to ensure the line cannot deploy unexpectedly.
    a. Line should be of braided composition as twisted line can become problematic and unravel during standard use.
2. Have a means of allowing gas to escape upon ascent, i.e. opened bottom, overpressurization valve.
3. Be of adequate size to achieve intended visibility in the environment and conditions being deployed.
4. If used as a lifting device, esp. for ascending an item, ensure proper planning of retrieval of load once at the surface.
5. Methods of gas delivery vary depending on dSMB design, with the most common being oral inflation and pneumatic inflation through a low pressure hose coming from a volume cylinder. Prior to the operation, each dive team member should be familiar with the means of inflation.

Lift Bags

Equipment Description & Examples of Use

Lift bags are available in many configurations, lift capacity and constructed out of a myriad of materials. Listed below are common characteristics of lift bags used in scientific diving operations:

1. Commercially available.
2. Constructed from heavy duty materials that can withstand the stresses of raising objects underwater.
3. Most have exhaust valves for controlling variable volumes of gas experienced during lifting operations.
4. Constructed with loops, slings and other convenient locations for rigging and securing an object.

Lift bags are used to move items to the surface, laterally to new locations or to suspend apparatus mid-water, due to their size, weight and/or shape.

Additionally, lifting operations employing lift bags can be conducted with divers in the water and remotely, dependent upon operational needs and configurations. In all instances, divers are required to complete the rigging of the lift bags to the object.

Pertinent Safety Considerations

1. Select properly sized with appropriate lift capacity based on the object to be lifted, based on

buoyancy needs of the object.
2. Select appropriate rigging materials based on the characteristics of the object, i.e. pre-stretched nylon rope and fastening knots for light loads; nylon straps, wire rope and/or chain with marine hardware for heavier loads.
3. Divers must be briefed on how to handle a lift that becomes uncontrolled, i.e. rapid ascent and descent.
4. Depth, water temperature, size of object and size/configuration of the lift bag along with complexity of the operation should all be factors to consider when determining if an independent gas source should be used for the lifting operation.
5. If divers are controlling the lift while in-water, attention must be paid to the volume of gas in the lift bag to ensure a controlled lift and/or avoid rapid descent due to loss of buoyancy of the object.

Full Face Masks

Equipment Description & Examples of Use

Full Face Masks are diving masks that have an integrated regulator. Full Face Masks (FFM) can allow for through water voice communication between divers and the surface, can decrease exposure in contaminated environments, can limit some cold water exposure, and may be used to protect a diver's airway if they are prone to seizure or other medical compromises. While diving a FFM can provide advantages divers should be aware that FFM may also cause greater air consumption, can pose more complex procedures for out of air emergencies, and may be a little more difficult to equalize air spaces.

Pertinent Safety Considerations

1. Proper donning and adjusting
2. Closing any ambient breathing valves
3. Ensuring noseblocks and one-way valves are in place.
4. Checking seal, oronasal mask, and strap integrity
5. Appropriate bail out procedures
6. Carrying a spare scuba mask
7. Easy retrieval of spare regulator for bail out
8. Easy deployment of regulator to out of air diver
9. Proper de-watering procedures
10. Equalization techniques and procedures
11. Readability of gauges and computers
12. Gas consumption may increase with FFM diving
13. Gas block utilization/selector valve procedures (if applicable)
14. Proper through water comms procedures
15. Secondary communication protocols in case of loss of primary comms

Diver Propulsion Vehicles (DPV's)

Equipment Description & Examples of Use

A diver propulsion vehicle (DPV), also known as a scooter, is an item of diving equipment used by divers to increase range underwater. Range and/or Time limits are restricted by the amount of breathing gas that can be carried, the rate at which that breathing gas is consumed, the battery power/duration of the DPV and any potential decompression requirements. DPV's are available in different sizes and

configurations.

Pertinent Safety Considerations

1. The DPV must not be used for ascents and descents.
2. DPV operation requires greater situational awareness to prevent buddy separation, maintain depth control, monitor breathing gas, and properly navigate.
3. Proper streamlining and equipment placement to prevent propeller entanglement.
4. If a DPV fails, floods or becomes unsafe to continue use, be prepared to leave it.
5. Regulator setup must allow for air sharing with a towed diver.
6. Observe an air rule that would allow you to swim back, towing DPV if necessary, from the most distant point of the dive
7. A diver shall only use those models of DPVs for which the diver has demonstrated proficiency, as described above

APPENDIX 11

DIVING FROM A LARGE RESEARCH VESSEL (>65 feet)

POLICY

Scientific diving is a normal operation from URI research vessels. All diving from is under the auspices of the University National Oceanographic Laboratory Systems (UNOLS) Research Vessel Safety Standards and the guidelines of the University of Rhode Island (URI) Research Diving Manual. All scientific diving conducted must be approved by the vessel's Master and URI's Diving Safety Officer (DSO). All diving must meet the minimum standards of the American Academy of Underwater Sciences (AAUS).

ADMINISTRATIVE PROCEDURES

In a multi-institutional diving cruise, a lead Diving Control Board (DCB) will be designated by agreement of all DCB's involved. The procedures, rules and regulations that govern diving operations for that particular cruise will be those of the designated lead DCB.

Cruise Planning

An onboard Diving Supervisor will be proposed by the Principal Investigator (PI) and approved by the lead institution's DCB. It is the responsible of the Diving Supervisor to assure that all scientific diving is conducted in accordance with all applicable regulations. The Principal Investigator (PI) or their designee will supply a detailed dive plan to their DCB, who will forward the dive plan, once approved, to the lead institution's DCB 90 days before cruise departure. The dive plan will include:

1. Diving credentials for all diving members of the scientific party, including Scientific Diver certification, current diving physicals, dive logs. Reciprocity exists for Scientific Divers in good standing between URI and other AAUS organizations (Appendix 6 URI Research Diving Manual).

2. An emergency plan including:
   a. accident management and emergency evacuation protocols;
   b. a list of medical supplies required;
   c. a specified quantity of medical grade oxygen with a positive pressure demand delivery system;
   e. request for diving support equipment (e.g., small boats).

3. Forward the approved dive plan to the Chief Scientist and Marine Superintendent.

Cruise Personnel

1. The Master has responsibility for the safety of all activities aboard the vessel, including diving (Section 14.4 UNOLS Research Vessel Safety Standards).
2. The PI of the diving project is responsible for the planning and coordination of the research diving operations.
3. The Diving Supervisor will be the main point of contact for scientists, technicians and crewmembers participating in research diving. The diving supervisor is responsible for the

execution of the research diving operations in accord with the dive plan. He or she has the authority to restrict or suspend diving operations and alter the cruise plan in consultation with the Master and the PI. The diving supervisor's responsibilities include:

a. Meeting with the Master and Chief Scientist to review the dive plan and emergency procedures prior to any diving activities.
b. Assure that a copy of the URI Research Diving Manual or the lead institution's Diving Manual is on board, and available to the scientists and crew. The Research Diving Manual and emergency plan should be filed on the bridge.
c. Act, at all times, as supervisor of diving operations. Before diving, divers should submit, in writing, or verbally, a detailed dive plan to the diving supervisor for approval. The dive supervisor will then communicate the plan to the bridge for final go ahead. No diving is to be undertaken without the knowledge of both the Diving Supervisor and the Master or Watch Officer. Failure to follow this procedure can result in revocation of diving privileges for the duration of the cruise.
d. Inspecting high-pressure SCUBA cylinders and breathing air compressors to assure that they meet URI's standards (Section 5.5 URI Research Diving Manual).

4. Scientific Divers must recognize their individual responsibility for their safety.

Small Boats

Diving from a larger research vessel will be supported from one of the small boats. Crewmembers or a member of the scientific party can operate small boats. The Master, or their designee, will decide the competency of all boat operators and approve the use of the scientific party members as small boat operators. Whenever divers are in the water, a small boat will be deployed to assist. All small boat operators will be versed in emergency procedures. Small boats will be equipped with a hand-held VHF marine radio and medical grade oxygen with a positive pressure demand delivery system.

DIVING EQUIPMENT

Diving from the Endeavor often reflects the regional and personal preferences of participants from multiple institutions and this is reflected in their equipment choices. Most of the variability in diving equipment does not present a problem, but sometimes this variation can be potentially hazardous. To avoid such incidents, it is the responsibility of the PI to advise URI's DSO of any significant equipment variations 60 days before cruise departure (Section 5.0 URI Research Diving Manual).

SCUBA Cylinders

Sixty days before cruise departure, certification of a current visual internal inspection (VIP) and hydrostatic testing, performed according to accepted methods, must be supplied by the SCUBA cylinder's owner, to the Diving Safety Officer. The diving supervisor, in consultation with the appropriate ship's personnel will secure all SCUBA cylinders aboard Endeavor in an appropriate manner.

Compressed Air

Diving-quality compressed air is available on board the Endeavor in the form of a diving support van. Certification of air quality for all compressors will be supplied to the lead DCB upon request. All compressors are operated in accordance with manufacturers' specifications and meet AAUS minimum standards.