Diving Safety Manual

University of Hawai'i System

Approved by

The University of Hawai'i Diving Control Board

University of Hawai'i

April 14, 2020

rev. 5/14/2020

Acknowledgements and Forward

This manual was revised from the 2016 University of Hawaii Diving Safety Manual, to include revisions and improvements embodied in the December 2018 AAUS Standards for Conduct of Scientific Diving Programs and Certification of Scientific Divers, and to extend the local standard of practice as per the needs of the University of Hawaii. The manual is also available online, at: **http://www.hawaii.edu/ehso/diving-safety**.

Intermediary revisions and the most recent versions of forms in the Appendices may be found there.

This document was authored and edited by the University of Hawaii Diving Control Board, as listed in Appendix 1.

April 2020 Revisions Summary

Global replace of “shall” with “must” (with grammatical corrections)

REVISED TO COMPLY WITH AAUS STANDARDS ver. December, 2018:

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5/14/2020 Corrected embedded URL.

Chapter 1. GENERAL POLICY

A. PURPOSE

1. The Scientific Diving Standards

The purpose of these scientific diving standards is to:

Ensure that all scientific diving under the jurisdiction of the University of Hawaii System (hereinafter referred to as the University), an Organizational Member of the **American Academy of Underwater Sciences** (hereinafter referred to as AAUS), is conducted in a manner that will maximize protection of scientific divers from accidental injury and/or illness, and

Set forth standards for diver training, evaluation, and authorization, which will allow a working reciprocity with other AAUS member organizations. All scientific diving conducted under the auspices of the University (Section 1.D.1) must comply with the standards set forth in this manual. Fulfillment of these purposes must be consistent with the furtherance of research and safety.

In 1982, the U.S. Occupational Safety and Health Administration (OSHA) exempted scientific diving from commercial diving regulations (29 CFR Part 1910, Subpart T) under certain conditions outlined below. The final guidelines for the exemption became effective in 1985 (Federal Register, Vol. 50, No. 6, p. 1046).

AAUS is recognized by OSHA as the organization setting scientific diving standards. This document incorporates the AAUS standards, and extends them based on local procedure and assent of the University of Hawaii Diving Control Board.

2. OSHA Scientific Diving Definition

In compliance with 29 CFR 1910.402, Scientific Diving is defined 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."*

3. OSHA Scientific Diving Exemption

OSHA granted a conditional exemption for scientific diving from commercial diving regulations. The two elements that a scientific 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."*
>
> *"[A] 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."*

Subsequent to U.S Federal litigation, the exemption for scientific diving from commercial diving regulations under was upheld with the following conditions and 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."

4. Liability

In adopting the policies set forth in this manual, the University assumes liability as defined in existing state law. Each person diving under University jurisdiction must complete an Application for Scientific Diving Authorization, and endorse an Assumption of Risk, Waiver and Release Form and a Medical Consent Form (Appendix 1). A diver may refuse to dive without fear of penalty at any time.

5. Compliance with AAUS

- A copy of these standards must be approved by and filed with AAUS.
- As an AAUS Organizational Member, it is the intent of the University that this manual comply with the most current AAUS Standards for Scientific Diving Manual (www.aaus.org), in addition to those of other training agencies or regulatory bodies under which UH divers are certified or operate.
- For each diving mode the following must be described in writing, adhering to the standards of this manual, and be approved by the University Diving Control Board:
  - Criteria for diver training and authorization;
  - Safety procedures for the diving operation;
  - Responsibilities of the dive team members;
  - Equipment use and maintenance procedures;
  - Emergency procedures for each diving location, including procedures for appropriate emergency medical treatment and expeditious recompression.
- An annual report and review of diving activities must be prepared and submitted to the AAUS. At this time recommendations for modifications to the standards may be submitted for consideration.

B. ADMINISTRATIVE ORGANIZATION

The University President, or his/her designee, will appoint a Diving Safety Officer (DSO), and members of a Diving Control Board (DCB) with the advice and consent of standing members of the Diving Control Board.

1. The Diving Safety Officer (DSO):

- Must serve as a voting member of the Diving Control Board.
- Must be appointed by the University President, with the advice and counsel of the Diving Control Board.
- Must be a currently active instructor, certified by AAUS or other recognized dive training organization.

- Must be trained as a scientific diver, as defined in this manual, and should have broad technical and scientific expertise in activities related to scientific diving.
- *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."
- *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.*
- Must be responsible, through the Diving Control Board, to the University President, or his/her designee, for the conduct of the scientific diving program of the University. The routine operational authority for this program, including the conduct of training and authorization, approval of dive plans, maintenance of diving records, and insuring compliance with this manual and all relevant regulations of the University--rests with the DSO.
- May permit portions of this program to be carried out by a qualified delegate with the approval of the DCB, although the DSO may not delegate responsibility for the safe conduct of the program.
- Must be guided in the performance of the required duties by the advice of the Diving Control Board, but operational responsibility for the conduct of the local diving program will be retained by the DSO. The DSO has the delegated authority to waive at his/her discretion any requirements herein except the medical standards.
- Must suspend diving operations which he/she considers to be unsafe or unwise.

2. The Diving Control Board (DCB):

- Must include as voting members: the DSO, at least six University faculty and staff from units representative of the University's scientific diving activities, and at least one graduate student utilizing scientific diving in his/her thesis/dissertation research. A majority of these individuals must be currently active scientific divers. The University President will designate an ex-officio member to provide the DCB with advice on liability and risk management. The Chair of the Diving Medical Advisormay serve as a voting member.
- Must be responsible to the University President or his/her designee, and must act as the official representative of the University in matters concerning the scientific diving program;
- Must schedule monthly meetings and meet more or less often than this, depending on the amount of business pending as determined by the DCB Chairman and DSO. A quorum must consist of a majority of voting members. Decisions will be approved by majority vote when at least a quorum is in attendance. A chairman will be elected by the DCB each September.
- Except the DSO, members must each serve a term of three years, at which time they may be reappointed or recommend a successor to the DCB. The DCB will then select a replacement. Terms may be staggered to provide continuity of experience. Members unable to attend a meeting may designate a proxy.
- Must have autonomous and absolute authority over the scientific diving program's operations, and must have the authority to:

- Review and revise the diving safety manual, and appropriately change policy and amend the diving manual as the need arises;
- Establish additional standards, protocols, and operational procedures beyond the AAUS minimums to address OM specific needs and concerns.
- Assure compliance with the manual, including adherence to the buddy system for SCUBA diving;
- Approve and monitor diving projects;
- Approve the depth to which a diver has been authorized; Recommend the issue, reissue, restriction and revocation of diving authorizations;
- Take disciplinary action for unsafe practices;
- Act as a Board of Appeal to consider diver-related problems;
- Establish and/or approve training programs through which applicants for authorization can satisfy the requirements of the University's diving manual;
- Suspend diving programs it considers to be unsafe or unwise.
- Establish criteria for equipment selection and use.
- Approve new equipment or techniques.
- Establish and/or approve facilities for the inspection and maintenance of diving and associated equipment, as recommended by the DSO.
- Ensure that the University's air stations meet air quality standards (Chapter 6), as monitored by the DSO.
- Periodically review the DSO's performance and program.
- Must sit as a Board of Investigation to inquire into the nature and cause of diving accidents or violations of the University diving manual.

- The DCB must receive each year from the DSO an annual report in order to review the previous year's diving activities and to prepare programs for the coming year. This will also be the basis of the annual report to the AAUS (Section 1.A.5).
- 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.

3. Diving Medical Advisor

Upon the recommendation of the DCB, the University President will appoint the Diving Medical Advisor (DMA). The term of appointment will be as mutually agreed-upon, and renewable by the agreement of the DCB and DMA. The DMA will be a voting member of the DCB, and may:

- Be a voting member of the DCB;
- Assist the DCB in identifying physicians in Hawaii with sufficient expertise in hyperbaric and diving medicine to conduct diving medical examinations for UH divers;
- Advise the DCB regarding the efficacy of UH diving medical exams, and the procedures for approval of individual divers whose initial exams indicate confounding relative contraindications to diving;
- Advise the DCB on medical and/or emergency management aspects of proposed dive plans or operations;
- Assemble and convene a Diving Medical Advisory Panel;
- Solicit on behalf of the DCB consensus opinions on diving medical issues from diving medical authorities as deemed necessary and report recommendations to the DCB. Issues may include, but are not limited to:
  - Contraindications to Diving;

- Medical concerns of diving protocols, especially those involving advanced technology or extended operational range;
- Diving emergency management considerations and feasibility of emergency treatment, especially for proposed remote, extended range, or advanced technology operations.

4. Diving Medical Advisory Panel

The DMA may at his/her discretion select qualified physicians for inclusion on an advisory panel (DMAP). The DMAP may be permanent, semi-permanent, or *ad hoc* at the discretion of the DMA. The DMAP will meet in a manner that the members see fit to address diving medical issues placed before the DCB, and referred to it for review.

5. Unit Diving Coordinator

Conditional upon approval by and consent of the DCB, units of the University system may appoint a Unit Diving Coordinator (UDC), to assume authorities and responsibilities as delegated by the DCB. This option is intended to enable large units of the University system (campus, institute, school or research unit) the ability to meet the operational and administrative needs of the unit in a timely fashion.

- The UDC must possess the following qualifications:
  - Permanent faculty or staff member in the unit;
  - Training as a SCUBA instructor (if the UDC is to conduct diver checkouts or training, this must be current and active);
  - Current active status as a UH Scientific Diver;
  - Broad experience in Scientific Diving methods, especially with those diving techniques and activities regularly employed within the unit, and with the sites regularly dived by unit divers.
- As delegated by the DCB on a case-by-case basis, and in coordination with the DSO, the UDC may:
  - Serve as unit representative to the DCB;
  - Maintain unit diver files on-site, and update diver qualification records in the UHDSP database, or facilitate record transfer to the DSO;
  - Maintain unit dive locker and equipment as per requirements of this manual;
  - Review and approve routine dive plans;
  - Conduct diver checkouts, depth authorization and proficiency dives;
  - Recommend to the DSO and DCB the depth to which unit divers should be authorized;
  - Coordinate or conduct unit scientific diver training.
- The UDC must:
  - Communicate the results of training, supervision and diving activity to UHDSP for main records;
  - Ensure compliance with requirements of this manual by unit divers and diving projects;
  - Ensure that unit diving activity is accurately logged with UHDSP by unit divers;
  - Suspend any unit diving activity that the UDC feels is unwise, unsafe, or in violation of provisions of this manual or State or Federal laws or regulations.
- The departmental privilege of utilizing a UDC may be revoked by the DCB, if the above responsibilities are not fulfilled in a prompt and timely manner, or the DCB finds the authority or privilege is being abused or misused.

C. PROGRAM RESPONSIBILITY

1. Ultimate Authority

The Diving Control Board has the ultimate authority for the scientific diving program and its related activities.

2.Policy

Policy relating to the diving program of the University must be reported to the University President or his/her designee. The development of these policies is the responsibility of the DCB.

3.Policy Administration

Administration of the University Diving Program will be the responsibility of the DCB. Daily executive control must be delegated to the DSO.

D. OPERATIONAL CONTROL

1. University Auspices Defined

All diving performed by individuals necessary to and part of a scientific, research, or educational activity in conjunction with a project or study under the jurisdiction of the University must be considered scientific diving. This must include operations which involve:

- University Personnel:
  - University employees or volunteers, where such persons are acting within their official capacity as a University affiliate, or are engaged otherwise in University scientific diving operations;
  - Individuals whose diving activities are in support of a research or educational project which has been approved by a University academic advisor or advisory committee, the results of which are intended to be credited towards completion of a University project, course or degree.
  - Individuals from auxiliary organizations who are engaged in scientific diving operations otherwise under University auspices, as defined in this section;
  - Visiting persons engaged in diving under University auspices, as defined in this section;
- University-owned, purchased, rented, chartered or otherwise provided facilities, equipment, or supplies. This includes diving equipment, vessels or motor vehicles used for diving operational support, compressors, compressed air, or other scientific supplies or equipment used to meet the diving objectives;
- University-owned or leased locations;
- Scientific diving activities supported in whole or part by University-administered funds.

All research and training proposals which include scientific diving operations must be reviewed and approved by the Diving Safety Officer and/or Diving Control Board Chair prior to approval by the University Office of Research Services (ORS) and/or Contracts and Grants Management Office (CGMO) (Appendix 1).

2. Diving Privileges

Certification as a UH Scientific Diver and authorization to dive under UH auspices is a privilege gained by compliance with training, qualification, and re-qualification provisions of this manual. Authorization to dive may be suspended or modified by the DSO or UDC, and restricted or revoked by the DCB, for non-compliance (Section. 1.I).

3. Authorization Types

No person is allowed to engage in scientific diving unless that person holds a recognized, valid authorization issued by the University pursuant to the provisions of this manual (Section 1.D.3, Chapter 3, Chapter 4, Chapter 7, Chapters 8 - 18). The following permit classifications will be recognized:

- Diver-In-Training Permit. This permit signifies that a diver has completed and been certified as at least an open water diver through a nationally or internationally recognized certifying agency, scientific diving program or its equivalent (Chapter 3).
- Active Scientific Diver Authorization. This is a permit to dive, usable only while it is current and for the purposes intended. Unless otherwise specified, it is restricted to non-blue water open water diving not requiring decompression stops, utilizing open circuit air SCUBA, and approved dive tables to control decompression status (Chapter 4).
- Temporary Diving Authorization. This permit constitutes a waiver of certain requirements of Chapter 4 and is issued only following a demonstration to the DSO of the required proficiency in diving. The Temporary Diving Authorization is valid only for a specified time and mode as determined by the Diving Safety Officer (Section 4.I).
- Restricted Scientific Diver Authorization. A UH Scientific Diver whose emergency response certifications (CPR, First Aid, or Oxygen Administration) have expired, or who has conducted fewer than the minimum required number of periodic dives for Active status, but who otherwise is currently qualified as a Scientific Diver according to the requirements of Chapter 4, may be granted an authorization to dive on a Restricted Diver status. It is intended in most cases that the Restricted Status be of temporary duration while the diver obtains recertification in the expired emergency response training (Appendix 13).
  - A UH Diver on Restricted status is eligible to dive on projects under UH jurisdiction, provided the diver is under the supervision of a fully authorized UH Scientific Diver. Diving must only be conducted within the Restricted Diver's depth authorization.
  - A UH Diver on Restricted status is ineligible to:
    - Serve as a Lead Diver or Lead Buddy on a dive under UH jurisdiction;
    - Be referred to other institutions under reciprocity agreements;
    - Dive on projects involving joint operations with other institutions.
- Inactive or Disqualified Diver Status. A diver placed on Inactive or Disqualified status must not dive under UH jurisdiction until the conditions for the designation are remedied (Section 4.F).
  - Inactive Diver Status. A UH Diver must be placed on Inactive Diver status if: his/her medical clearance to dive (Chapter 7) has expired, or the diver has logged no dives or otherwise not maintained current records in the past 12 months.
  - Disqualified Status: A UH Diver or Diver candidate must be placed on Disqualified status, if upon medical examination the diver fails to gain medical approval to dive, in accordance with Chapter 7.

4. Equipment

All diving equipment used by all classifications of divers, regardless of ownership, must conform to the standards set forth in this manual.

5. Records

The Diving Safety Officer must maintain permanent records on each diver (Chapter 3, Chapter 4, Chapter 7), including personal dive logs (Section 2.C.1), copies of all dive plans approved (Section 2.2.9), records of diving accidents (Section 2.C.2), and records of equipment modifications, tests, repairs, calibrations, and maintenance (Chapter 5).

6. Sites

The regulations herein must be observed at all locations where scientific diving is conducted. This includes all sea-going vessels owned, operated, and/or chartered by University projects. Operations involving UNOLS ships must also comply with UNOLS regulations (Appendix 10).

7. Visiting Scientific Divers and Reciprocity

Complete applications for visiting diver authorization must be submitted to the DSO in conjunction with the first UH dive plan on which the visiting diver will be working, and at least 14 days prior to the start of planned diving operations.

- UH Visiting Diver Application forms are required, including:
    - Diver contact information;
    - Waiver and release;
    - Medical consent;
    - Insurability, Employment Status and Indemnification;
    - Documentation of diver training, experience and proficiency;
- The most current versions of these forms are available on the UHDSP website or by request from the DSO. Additionally, a letter describing the diving operations planned under UH jurisdiction, and identifying a host member of the UH community who is a currently authorized UH Scientific Diver must be included.
- If, in the opinion of the UH DSO, the environment or equipment will be significantly different than the norm for a visiting scientific diver, the diver may be asked to demonstrate his/her knowledge and skills for the planned diving, as determined by the UH DSO.
- Reciprocity shall exist with other AAUS member organizations. A Scientific Diver currently authorized under the jurisdiction of another member organization in good standing may also be so recognized by the University of Hawaii Diving Safety Program. Divers granted reciprocity with the University of Hawaii are subject to and agree to abide by all University diving regulations applicable as outlined in this manual. The University reserves the right to require both skill and knowledge evaluations of any such divers, appropriate to the dive mode to be used, if is deemed advisable.
- A scientific diver from another AAUS Organizational Member must apply for permission to dive under University jurisdiction by submitting to the DSO a completed UH Visiting Diver Application and a document containing all information exemplified in Appendix 7 (Letter of Reciprocity), which will serve as documentation of diver training, experience and proficiency. The truth and accuracy of this information must be attested to by the home Organizational Member's DSO or DCB Chairperson.
- If a visiting diver from an AAUS Organizational Member is denied permission to dive, the UH DSO or a UH DCB designee must promptly submit to the visiting diver and his/her home DSO an explanation of all reasons for the denial.
- A scientific diver from an institution that is not an AAUS Organizational Member, but which has a Scientific Diving program as specified in Sections 1.A.2 and 1.A.3, may request reciprocity by submitting a completed UH Visiting Diver, a copy of the home institution's Diving Safety Manual, and letters of documentation from the home DSO demonstrating compliance with qualification standards substantially similar to those of the University, including medical examinations. Such requests will be reviewed and approved or disapproved by the DCB.
- A visiting diver not under the jurisdiction of an institutional diving safety program must apply for authorization as a Temporary Diver (Section 1.D.3, Section 4.I). Such requests must be reviewed and approved or disapproved by the DCB.

- A UH scientific diver diving at another host institution under a UH letter of reciprocity is governed by the requirements of this manual, and any placed upon them by the host institution's DCB.
- Unless otherwise arranged in advance between the UH DCB and the host institution, while visiting a host institution under reciprocity a UH scientific diver must dive within the limits of his/her UH authorization, as specified in the letter of reciprocity.

E. DIVING PERSONNEL

1. Instructional Personnel

- All personnel providing diving instruction under the jurisdiction of the University Scientific Diving Program must be qualified trainers for the type of instruction being given, as determined by the DCB.
- Instructional personnel will be selected by the DCB after preliminary screening of applicants by the DSO.

2. Lead Diver (Diving Supervisor, Person-in-charge)

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

- Ensuring dives are conducted in accordance with Chapter 2.
- Coordinating with other known activities in the vicinity which are likely to interfere with diving operations.
- Verifying all dive team members possess current authorization and are qualified for the type and mode required by the operation.
- Briefing dive team members (Section 2.B.13);
- Ensuring safety and emergency equipment is in working order and present at the dive site;
- Suspending diving operations if in his/her opinion conditions are not safe.

3. Authorized Diver

Each scientific diver must be trained, qualified, and authorized for the diving mode being used. For most scuba divers, training certified by a recognized national or international diving certification organization will be prerequisite to applying for University authorization. In most instances, certification from a commercial diving school, military diving school, or other appropriate training approved by the DCB will be required for some specialized diving modes (Chapter 8 through 18). Each dive team member must have training and experience as outlined in Chapter 3, Chapter 4, and, as applicable, Chapters 8 through 18.

F. DEPARTMENTAL CONTROL

University departments and programs may own and provide to UH Scientific Divers resources in support of scientific diving operations. Such resources may include diving equipment, compressors and compressed air, other diving supplies, boats or motor vehicles.

Prior to release, each department or program providing resources in support of diving must have in place measures to ensure the following:

- Departmental diving resources are serviced and maintained in compliance with pertinent sections of this manual;
- Use of departmental diving resources are limited to authorized personnel;
- Lead Divers obtain dive plan approval from the DSO or DCB for the dives to be conducted from unit auspices;

- Diving and departmental vessel operations are conducted in compliance with applicable government and University regulations.
- Appropriate departmental emergency response procedures are formulated, in place, and operational while diving is conducted.

  Departmental control measures must be implemented to the satisfaction of the DCB. The DSO must make a periodic review of departmental control measures. Results of the review must be reported to the DCB and Head of the department or program with recommendations regarding whether revisions in departmental procedures are needed.

G. MEDICAL EXAMINATION

All authorized divers must pass a medical examination (Chapter 7) and the expiration date of the examination will appear on the diver's status documentation. After any major illness or injury, or any condition requiring hospitalization for more than 24 hours, authorized divers must submit to a medical interview or examination appropriate to the nature and extent of the injury or illness, as determined by the examining physician, before receiving clearance to resume diving activities.

H. WAIVER OF REQUIREMENTS

The 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.

I. CONSEQUENCE OF VIOLATION OF REGULATIONS BY SCIENTIFIC DIVERS

Failure to comply with the regulations of the University's diving manual may be cause for the revocation or restriction of the diver's scientific diving authorization by action of the DCB. The DCB may direct the University to invoke additional sanctions (e.g. through withholding proposals, grants, or contracts by ORS and/or CGMO) against the responsible parties if the situation requires further action.

J. VIOLATION REVIEW AND DISCIPLINARY PROCESS.

A diving authorization may be revoked or restricted for cause by the DCB. Violations of regulations set forth in this manual, or of regulations of governmental subdivisions not in conflict with this manual, may be considered cause. The following process and disciplinary procedures must be followed.

- Violation Review Process. The DSO may restrict, modify or suspend a diver’s authorization for cause, pending review by the DCB.
  - In the case of violations resulting in a risk to personnel safety, severe equipment loss or damage, or major environmental damage, the DSO must immediately suspend the diver’s authorization, pending a review hearing by the DCB.
  - The DSO must make a written notice (hard copy or email) to the diver in question. A copy of the notice must be forwarded (or cc'd) to each DCB member.
  - The diver must be given the opportunity to present his/her case in writing for reconsideration and/or reauthorization. All such written statements and requests, as identified in this section, are formal documents that must become part of the diver's file maintained by the DSO.
  - The DCB Chair must convene a review hearing at the next scheduled DCB meeting, at which the diver must have the right to be present. If the violation requires expedited review, the DCB Chair may convene a review panel comprised of a subset of no fewer than 5 DCB members, which must include the DSO and DMAP Chair.

- The diver must not be permitted to dive under University jurisdiction during the period of review and appeal of a suspension or revocation of authorization.

- Disciplinary Action. Disciplinary actions available to the board must include the following, separately or in combination:
  - A written reprimand placed in the diver's file;
  - A probationary period of length to be determined by the DCB;
  - Restriction or reduction of depth authorization;
  - Restriction of dive activity;
  - Revocation of Lead Diver privileges;
  - Temporary revocation of diving authorization;
  - Permanent revocation of diving authorization.
- Violations of the regulations in this manual also violating University personnel regulations, State or Federal law, or expose the University to significant legal liability must also be reported by the DCB Chair to the appropriate authority for review.

K. RECORD MAINTENANCE

The DSO or his/her designee must maintain permanent records for each individual scientific diver authorized. The file must include evidence of certification level, log sheets, waiver, reports of disciplinary actions by the DCB, and other pertinent information deemed necessary. Such information must be made available to the AAUS upon request. The DSO will maintain and file all medical reports, the results of physical examinations, and diving medical history for each diver or applicant.

1. Records Retention

Records and documents required by this standard must be retained by the University for the following minimum periods:

- Manual for diving safety, current document;
- Physician's written reports of medical examinations for UH divers: Thirty years;
- Pressure-related injury assessment: thirty years;
- Records of hospitalization: thirty years.
- Diver training records – Minimum of 10 years beyond the life of the diver's program participation.
- Diver authorization(s) – Minimum of 10 years beyond the life of the diver's program participation.
- Records of dives - three years, except thirty years where there has been an incident of pressure-related injury;
- Reports of disciplinary actions by the DCB – Minimum of 10 years beyond the life of the diver's program participation.
- Equipment inspection, service, and testing records: For equipment listed in Section 5.B, most recently current service record.

2. Availability of Records

- Records in a diver's file are available to the diver and to the DCB and its agents. Records may be released to a third party with the signed agreement of the diver.
- Medical records must be available to the attending physician of a diver or former diver when released in writing by the diver or his/her survivors. "Blinded" medical data may be released at the discretion of the DSO, and DCB Chair.

CHAPTER 2. DIVING REGULATIONS

A. GENERAL POLICY

No person must engage in scientific diving operations under the auspices of the University's diving program unless he/she holds a current authorization issued pursuant to the provisions of this manual. Procedures must be established for emergency medical treatment of divers at a hyperbaric chamber, by in-water recompression using oxygen, or at other medical facilities as appropriate for any medical emergency.

B. DIVING PROCEDURES

1. Solo Diving Prohibition

All diving conducted under the auspices of the University must be planned and executed in such a manner as to insure that every diver involved in untethered diving operations maintains constant, effective communication with at least one other comparably equipped authorized scientific diver in the water. This buddy system is based upon mutual assistance, especially in the case of an emergency. Dives should be planned around the competency of the least experienced diver. If loss of effective communication occurs within a buddy team, divers must surface and re-establish contact.

2. Enclosed or Confined Spaces

No diver will enter confined or restricted overhead environments unless trained, and authorized by the DCB for work under such conditions. This includes any environment in which there is a physical barrier which blocks direct ascent to the surface. See Chapter 8 regarding diving in restricted overhead environments.

3. Diver's Flag

- A diver's flag (red background with white diagonal stripe) must be displayed prominently whenever diving is conducted under circumstances where a flag is required, or where traffic is probable, including dives conducted from shoreline access.
- When diving from a vessel, the International Code flag Alpha (blue and white) must be displayed when required for compliance with the current U.S. Coast Guard rules published in "Navigation Rules, International and Inland" (e.g. if the vessel is restricted in its ability to maneuver).
- University divers must comply with all site-specific local, state, federal, and international regulations regarding marking of diving activities.

4. Flotation Devices

- Under normal circumstances each open circuit scuba diver must on every dive possess the capability of establishing neutral buoyancy at the working depth, making a controlled neutrally buoyant ascent, and attaining and maintaining positive buoyancy at the surface with an approved buoyancy control device.

5. Timing Devices, Depth and Pressure Gauges

- Both members of each diving pair must have an appropriate underwater time-keeping device, an approved depth indicator and (when SCUBA is used) an approved submersible cylinder pressure gauge.

6. 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 m).

7. Diving Tables

When dive tables are used for decompression management, a set of approved diving tables must be available at the dive location. If the US Navy tables are not used, the tables must have no-decompression limits and residual nitrogen accounting at least as conservative as the United States Navy Diving Tables. Use of alternate dive tables, dive computers, or decompression software must be approved by the Diving Control Board.

8. Dive Computers

Use of dive computers is required for diving operations at depths greater than 60feet, or for any repetitive dives deeper than 40feet.

The following regulations for the use of Dive Computers (DC's) must be followed by Scientific Divers while diving under University auspices.

- Training Requirements:
  - The diver must complete a training session on Dive Computer (DC) use, of scope deemed appropriate by the DCB. The training must include the operational guidelines defined below and must include a DCB-approved written examination to demonstrate knowledge mastery of DC use.
  - The diver must demonstrate proficiency of DC use in a dive checkout with the DSO or his designated agent. The proficiency review must include:
    - Proper interpretation of the DC indicator system;
    - Adherence to the DC-prescribed rates of ascent and descent;
    - Demonstration of proper DC use protocols, as outlined below.
- Equipment Requirements:
  - The DCB has the authority to designate makes and models of DC's which are acceptable for use during University dives.
  - A diver must only use those models of DC for which the diver has demonstrated proficiency, as described above.
  - DC's should be tested for depth accuracy at 12 month intervals, or in accordance with manufacturer's recommendations.
- Operational Requirements:
  - A diver must not dive for 24 hours prior to activating a DC for use to control decompression status.
  - Each diver using a DC must have a specific and separate unit dedicated to their use for the duration of a dive series.
  - If either member of a buddy pair does not have a DC, the dive profile must be planned and executed using University-approved dive tables. In this situation, the diver having a DC may use it for dive time and depth recording.
  - When both members of a buddy pair are using DC's, both divers in a buddy pair must follow whichever diver's DC which requires the most conservative profile.
  - In the event of a DC inactivation at any time, diving should be terminated immediately, using appropriate ascent procedures.
  - If a DC fails before it indicates that complete outgassing has occurred, the diver must not dive for 24 hours from the end of the last dive unless all diving since the last 24 hour surface interval can be reconstructed using approved dive tables.

- Whenever practical, divers using DC's should make a safety decompression stop between 10 and 30 feet for 3 to 5 minutes, especially for dives exceeding 60 feet.
- Only one dive should be made in any 24 hour period in which a decompression ceiling is incurred.
- Multi-level diving procedures should start the dive or series of dives at the maximum planned depth, followed by subsequently shallower depth exposures. "Saw-tooth" and bounce profiles should be avoided if possible.
- Multiple deep repetitive dives or multiple days of diving without complete outgassing should be conducted in a conservative fashion.

9. Decompression Software

- Decompression software must provide schedules at least as conservative as those provided by the US Navy Tables (i.e., generate predicted shorter no-stop times, and/or longer/deeper decompression stops).
- If the software allows breathing gas compositions other than air to decrease stop time, the software must produce decompression profiles more conservative than the US Navy Air Tables when software gas parameters are defined as air.
- If the software provides schedules for helium-oxygen mixtures, the software must produce decompression profiles more conservative than the US Navy Heliox Tables.
- The Diving Control Board must reserve the right to designate versions of decompression software which are acceptable for use on University-affiliated dives.

10. Termination of Dive

- It is the right and responsibility of a diver to terminate the dive whenever he/she feels it is unsafe to continue the dive. This decision may be made at any time, without fear of penalty. Before electing to terminate a dive, the diver must ensure that such action does not compromise the safety of another diver already in the water.
- Under normal diving conditions, the dive must be terminated while there is still sufficient cylinder gas pressure remaining to permit the diver to safely reach the surface, including decompression time, or to safely reach an additional breathing gas source at a decompression station.

11. Refusal to Dive

- A diver may refuse to dive whenever he/she feels it is unsafe for him/her to make the dive (Section 1.A.3). This decision may be made at any time, without fear of penalty.
- Ultimate responsibility for safety rests with the individual diver. It is the diver's responsibility and duty to refuse to dive if, in his/her judgment, conditions are unsafe or unfavorable, or if he/she would be violating the precepts of his/her training or the regulations in this manual.

12. Dive Plans

Before conducting any diving operations under the auspices of the University, the Lead Diver for a proposed operation must formulate a dive plan, and submit it to the DSO for review.

The DSO must review and approve or disapprove the dive plan in a timely fashion. For complicated operations, the DSO must request the approval of the DCB. In such cases, review and approval should be completed within six weeks from the time of submission. Approval must be obtained prior to commencement of the diving (see Appendix 1, Application for Dive Plan Approval).

The Application for Dive Plan Approval must include the following information in an application to the DSO:

- The name, contact phone number, University affiliation, and the type and depth of diving authorization held for each participating diver.
- Approximate total number of proposed dives, and estimated dives per day.
- Locations of proposed dives.
- Diving Mode(s) and Gas(es) to be employed;
- Estimated maximum depths and bottom times anticipated.
- Diver decompression status and repetitive dive plans, if repetitive dives are to be conducted.
- Proposed work, equipment and boats to be employed.
- Source of breathing gas, boats, specialized equipment.
- 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
- Details of any hazardous conditions anticipated, and emergency procedures planned and provided for such conditions.
- Emergency Management Plan for each listed dive site, the procedures of which follow the standards of care of the community and include procedures and implementation criteria for emergency care, recompression, evacuation, and incident reporting. Elements must include the following information:
  - The name, address, telephone number, and relationship of a person to be contacted for each diver in the event of emergency;
  - Nearest operational recompression chamber, and means of contact and transport;
  - Nearest accessible hospital and means of contact and transport;
  - Available means of emergency transport and means of contact (Appendix 8).

13. Pre-Dive Procedures

- Diver's Responsibility
  - Each scientific diver must conduct a functional check of his/her diving equipment in the presence of the Diving Buddy or Tender. (See also Section 1.A.3).
  - It is the diver's responsibility and duty to refuse to dive if, in his/her judgment, conditions are unfavorable, or if he/she would be violating the precepts of his/her training, or of this manual (Section 1.A.3).
  - No dive team member is required to dive or be exposed to hyperbaric conditions against his/her will.
  - No dive team member will be allowed to to dive during the duration of any known condition likely to adversely affect the safety and health of the diver or other dive team members Chapter 7).
  - The diver must terminate a dive while there are sufficient breathing gas supplies remaining to permit the diver to safely reach the surface with planned reserves, and including decompression stop requirements.
- Equipment Requirements and 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.

- The environmental conditions at the site will be evaluated prior to commencement of operations. Operations will be terminated if the Lead Diver deems conditions unsafe (Section 1.E.2).
- Each diver must conduct a functional check of their diving equipment in the presence of the dive buddy or tender. The diver must ensure the equipment is functioning properly and suitable for the type of diving operation being conducted.
- Each diver must be equipped for the diving modes to be utilized, as defined in appropriate sections in this manual.
    - Each scuba diver must have a submersible pressure gauge for monitoring scuba cylinder pressure, capable of being monitored by the diver during the dive.
    - Each diver must have the capability of achieving and maintaining positive buoyancy on the surface.
    - Each diver must have the capability to execute a controlled neutrally buoyant ascent, through the use of an approved buoyancy control device.
- If gases other than air are used as the breathing medium, appropriate diving tables must be used. The applicable procedures of Chapter 6 and Chapters 10-14 regarding use of breathing mixtures other than air must be followed.
- Closed and semi-closed circuit scuba (rebreathers) must meet the requirements listed in Section 14.D.

- Diver Qualifications. Each diver must be trained, qualified, and authorized for the diving mode and specialized equipment being used, the diving activity to be performed, and the depths at which the diving is to be conducted (Chapters 3, 4, 8 through 18)
- Pre-Dive Briefings: Before conducting any diving operations under the auspices of the OM, 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

14. Post-Dive Safety Checks

After the completion of a dive, each diver must report any physical problems, injury, symptoms of decompression illness, or equipment malfunctions to the Lead Diver. The Lead Diver must file a written report of any such incident to the Diving Safety Officer as soon as practicable (Appendix 9).

When diving beyond no-decompression limits, the divers should remain awake for at least one hour after diving and in the company of a dive team member who is prepared to assist with arrangements for expeditious recompression if necessary.

15. Emergency Deviation from Regulations

Any diver may deviate from the requirements of this manual to the extent necessary to prevent or minimize a situation which is likely to cause death, serious physical harm, or major environmental damage. A written report of such actions must be submitted to the DSO by the Lead Diver explaining the circumstances and justifications for such action.

16. Flying and Altitude Exposure After Diving

UH Divers must not fly within 24 hours after a dive. Divers engaging in staged decompression diving are strongly advised to not fly for 48 hours after diving.

UH divers must wait an appropriate time interval before ascending to altitudes in excess of 1000 feet after diving. Specific times must be determined on a case-by-case basis, depending on the diving altitude exposures involved. In no case must divers ascend to altitude in excess of 2,800 feet prior to achieving a "D" repetitive group designator on the US Navy tables, or its equivalent on other approved decompression planning materials.

C. DIVE RECORD KEEPING REQUIREMENTS

1. Personal Dive Log

Authorized scientific divers must log every dive made under the auspices of the University and are encouraged to log all other dives. Log reports must be submitted to the DSO on a monthly basis, and in no case more than 30 days after completion of a dive under University auspices. The DSO will keep the log sheets as part of each diver's permanent file. The DSO will furnish standard forms, which include the following information (Appendix 5 Personal Dive Log Reporting Sheet; Appendix 6, Personal Dive Log Reporting Sheet Guidelines):

- Name and authorization information of Diver;
- Date, time, and dive location;
- Name of dive buddy;
- Maximum depth and bottom time, and decompression profiles;
- Name of Lead Diver, or dive plan identifier.
- General nature of diving activities;
- Types of diving mode, environment, platform, and life support technology used;
- Approximate underwater and surface conditions;
- Breathing gas composition (including decompression gases);
- Type and method of decompression management (dive tables, dive computer, decompression software, etc…);
- Detailed report of any accidents or potentially dangerous incidents (Section 2.C.2; Appendix 9);

If a diver conducts no dives under University auspices in a given month, he/she may notify the DSO via mail or electronic mail, instead of filing a dive log. This notification may be included in the diver's file in lieu of the monthly dive log.

2. Required Incident Reporting

All diving accidents requiring recompression or resulting in death or injury requiring medical attention must be reported to the DSO, and DCB using the form in Appendix 9. This information can be released (e.g. to AAUS, the Divers Alert Network, or the National Underwater Accident Data Center) only in blinded form unless with the diver's/survivor's permission in writing. The University's regular procedures for accident reporting must also be followed.

- The following information must be recorded and retained for a period of at least five years by the DSO with the record of the:
  - Name, addresses, and phone numbers of the principal parties involved;
  - Summary of experience of divers involved;
  - Location and description of dive site and description of conditions that led to the incident;
  - Description of symptoms--including depth and time of onset;

- Suspected causes and effects;
- Diagnosis, treatment, and outcome;
- Disposition of case;
- Recommendations to avoid repetition of incident.

- The DSO will investigate and document any incident or pressure-related injury and prepare a report for the University Diving Control Board and AAUS).
- Additional information deemed necessary may be required. In addition, the University must:
  - Record and report occupational injuries and illnesses in accordance with requirements of the appropriate UH Administrative Procedures;
  - Record the occurrence of any diving related injury or illness which requires any dive team member to be hospitalized for 24 hours or more, or after an episode of unconsciousness related to diving activity, or after treatment in a recompression chamber following a diving accident; specifying the circumstances of the incident and the extent of any injuries or illnesses.
- 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.

CHAPTER 3. DIVER-IN-TRAINING PERMIT

This section describes required entry-level training under University auspices of the non-diver applicant, and qualification evaluation criteria for the previously certified diver applicant.

A. ELIGIBILITY

The following individuals are eligible for the Diver in Training (DIT) permit:

- Those individuals who as a part of the Diver Training Program have completed the requirements outlined in Sections 3.B and 3.C, or
- Those individuals certified as divers who meet the following minimum requirements:
  - Complete an Application for UH Scientific Diver authorization;
  - Complete a medical examination as outlined in Chapter 7;
  - Complete an entry-level diver training compliant with Section 3.D;
  - Entry-level SCUBA 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.

B. PRE-TRAINING

1. Application.

The applicant for training must complete the Application for UH Scientific Diver Authorization (Appendix 1), and provide supporting documentation as specified in the current version of the Application forms. The current version of the Application forms must be available on the UHDSP website, or by request from the DSO.

2. Medical Examination

The applicant for training must be certified by a licensed physician to be medically qualified for diving before proceeding with the training designated in Section 3.B.3 or Section 3.C (see also Chapter 7; Appendix 3, Diving Medical Exam).

3. Swimming Test

The applicant for training must successfully perform the following tests or their equivalent. The evaluation must be conducted in the presence of the DSO or an examiner approved by the DSO. Listed performance standards are designed for pool or pool-like conditions and with the approval of the DSO may be modified to a reasonable extent to address less optimal environments:

- Swim underwater without swim aids excepting goggles or mask for a distance of 75 feet without surfacing;
- Swim 400 yards in less than 10minutes without swim aids excepting goggles or mask;
  - A time of 12 minutes will be provisionally accepted for supervised training purposes, but the nominal time standard must be met before the completion of training and awarding of Scientific Diver designation.
- Tread water for ten minutes, including two minutes without use of hands, without swim aids.
- Without the use of swim aids, transport in the water another person of equal size a distance of 75 feet.

C. ENTRY-LEVEL SCUBA TRAINING

Entry-level scuba training must comply with the standards of the most current version of the RSTC/WRSTC and/or ISO entry-level diver standards:

> *"Minimum Course Content for Open Water Diver Certification"- World Recreational Scuba Training Council (WRSTC), www.wrstc.com.*
>
> *"Safety related minimum requirements for the training of recreational scuba divers -- Part 2: Level 2 -- Autonomous diver". ISO 24801-2:2007- International Organization for Standardization (ISO) www.iso.org.*

1. Practical DIT Skill Evaluations: Confined Water

The DIT Candidate must satisfy the DSO or approved evaluator of his/her ability to perform at least the following in a pool or sheltered water:

- Enter water fully equipped for diving;
- Alternate between snorkel and SCUBA on the surface;
- Remove, replace and clear face mask while submerged breathing from the regulator;
- Demonstrate the ability to remove and replace SCUBA equipment while submerged;
- Demonstrate understanding of underwater signs and signals;
- Demonstrate air sharing and ascent using an alternate air source, as both donor and recipient, stationary and swimming, with and without a face mask;
- Demonstrate buddy breathing, as both donor and recipient, stationary and swimming, with and without a face mask;
- Demonstrate water skills and ability acceptable to the evaluator for the anticipated scientific diving conditions;
- Demonstrate understanding of underwater signs and signals; Demonstrate ability to perform and emergency ascent.

2. Practical DIT Skill Evaluations: Open Water

The DIT Candidate must satisfy the DSO or an approved evaluator of his/her 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;*
- Demonstrate the ability to achieve and maintain neutral buoyancy and proper trim while submerged;
- Demonstrate an understanding of underwater signs and signals for communication;^^
- Demonstrate ability to achieve and maintain neutral buoyancy while submerged*
- Demonstrate techniques of self-rescue and buddy rescue*
- Navigate underwater at least a reciprocal compass course; ^
- Plan and execute a dive;^
- Demonstrate judgment adequate for safe scientific diving;* ^^
- Demonstrate basic techniques of self-rescue, buddy assist for a tired diver, and recovery and transport of an unconscious diver.

CHAPTER 4. SCIENTIFIC DIVER TRAINING AND AUTHORIZATION

This section describes required training under University auspices for Scientific Diver authorization, and must be used as basis for equivalency evaluation of previously certified applicants.

The Scientific Diver authorization is a permit to dive, usable only while it is current and for the purpose intended. The University requires that no person will be allowed to engage in scientific diving under University jurisdiction unless that person is authorized pursuant to provisions of this manual. The following are considered minimal standards for authorization as a University Scientific Diver.

A. PREREQUISITES

1. Eligibility

Only a person diving under the auspices of the University (Section 1.D.1) is eligible for Scientific Diver Authorization.

2. Application

If not previously completed as part of DIT training, the applicant for Scientific Diver training must complete the Application for UH Scientific Diver Authorization (Appendix 1), and provide supporting documentation as specified in the current version of the Application forms. The current version of the Application forms must be available on the UHDSP website or by request from the DSO.

3. Medical Examination

Each applicant for Scientific Diver Authorization must submit a statement from a licensed physician trained in diving/undersea medicine, based on the medical examination defined in this manual (Chapter 7, Appendix 3, Diving Medical Exam), attesting to the applicant's fitness for diving.

4. Qualification

Each applicant must hold a Diver-In-Training permit, or its equivalent (Chapter 3), completed within the last four months, or must demonstrate similar acceptable proficiency and knowledge to the DSO.

B. REQUIREMENTS FOR SCIENTIFIC DIVER AUTHORIZATION

Submission of documents and participation in aptitude examinations does not automatically result in authorization. Authorization to dive under University auspices is a privilege granted by the DCB after the applicant demonstrates to the DCB that he/she is sufficiently skilled and proficient to be authorized, and possesses the appropriate attitudes.

Authorization will be acknowledged by the signature of the DSO. Any applicant may be denied authorization who, in the evaluation of the DSO or the DCB does not possess the necessary knowledge, skills, or judgment under diving conditions for the safety of the diver and his/her partner or team. Minimum documentation and examinations required are as follows.

1. Documentation

The following completed documentation must be submitted for review by the DSO and/or DCB:

- Application for Scientific Diving (Appendix 1), including:
  - Diver contact information and university affiliation;

- Diver training and experience summary;
- Employment insurability verification;
- Medical consent and emergency contact information;

- Medical approval for diving (Chapter 7, Appendix 3);
- Proof of Diver-In-Training Permit level or its equivalent (Chapter 3).

2. Scientific Diver Training

UH Scientific Diver Training must be conducted in accordance with the following AAUS training and evaluation standards as specified in Appendix 13, as well as those of any other certifying agency under which the divers are to be certified.

- As part of training, the candidate must 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 a Scientific Diver in Active status, holding the necessary depth authorization and qualified and experienced in the training, supervision and evaluation of 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 DCB. Depth progression must proceed shallower to deeper after acceptable skills and judgment have been demonstrated.
- Excepting two specific dives for depth experience late in the training cycle directly supervised by the DSO, UDC, or other qualified and approved instructors, no training dives may exceed 40 feet (12 m) during the initial 12 dive cycle.

3. Waiver of Training Requirements

When a diver's resume provides clear evidence of significant scientific diving experience, the DSO and the DCB may grant a waiver for specific requirements of training and experience. The diver may be given credit for meeting portions of the 100 hour course requirements. However, divers may not "test-out" of knowledge and skill evaluations, regardless of experience, when they have no previous experience in scientific diving.

- The DCB may 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. In any case, completion of current equivalent skill and knowledge evaluations and 12 dives supervised by a qualified evaluator approved by the DCB is required.
- The medical examination requirement (Chapter 7) may not be waived.
- If equivalent dive training is obtained outside University auspices, the applicant must provide evidence of such training in the form of documentation to the satisfaction of the DCB. The DSO must conduct written, oral, confined water and open water evaluations as necessary, to determine that the diver's knowledge and skills are substantially equivalent to those expected of a UH Scientific Diver trained according to the requirements of Sections 4.A and 4.B, and Appendix 13.
- Upon satisfactory completion of challenge evaluations, the diver must be placed under Restricted Diver status, with a depth authorization commensurate with the diver's skill and experience level, as determined by the DSO.
- Upon satisfactorily completion and logging 12 supervised dives under University auspices and other outstanding items, the diver's status may be upgraded to Scientific Diver.

C. DIVER DESIGNATIONS AND DEPTH AUTHORIZATIONS

Only a person diving under UH auspices is eligible for UH Scientific Diver designation.

1. Diver In Training (DIT)

This is an authorization to dive, usable only while it is current and for the purpose intended. This is the initial authorization level, granted upon completion of training requirements listed in Chapter 3.

- This designation 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 in process 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.
- The DIT may dive under supervision to a maximum depth of 40 feet seawater (feet) unless in the course of approved training as specified in Section 4.B.2 or otherwise approved by the DCB.

2. Scientific Diver

This designation signifies a diver has completed all requirements in Section 4.B.2 and Appendix 13 and is authorized to engage in scientific diving without supervision, as approved by the DCB through the DSO. It authorizes the diver to work as a Lead Diver or lead member of a buddy pair to the limit of the diver's depth authorization, during activities and under conditions with which the diver is experienced.

- Submission of documents and participation in aptitude examinations does not automatically result in Scientific Diver authorization. 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 judgment for their safety and/or that of the dive team. The diver must also convince the DSO that the diver possesses the requisite knowledge, skill and attitudes to serve as Lead Diver to the indicated depth.
- The Scientific Diver authorization is only active when required authorizations and endorsements are in place and current.

3. Scientific Aquarium Diver

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.
- This designation is not applicable to husbandry and maintenance activities not meeting requirements of the Scientific Diving Exemption (Section 1.A.2, 1.A.3). Such diving must be conducted in accordance with policies and procedures for Non-Exempt Diving (Appendix 12).

4. Depth Ratings and Progression to the Next Depth Level

The University diving depth authorization indicates the depth to which a diver may conduct science and may supervise other divers holding a lesser depth authorization. A scientific diver requires a valid depth authorization to be considered active.

An authorized diver diving under University auspices must not exceed his/her depth authorization, except by no more than one level when accompanied by a diver authorized to at least the greater depth.

For diving using air, the authorization depths are 40, 60, 100, 130, 150, and 190 feet.

Depth authorizations greater than 40 feet require dive computer authorization.

Depth authorizations greater than 130 feet require specific DCB approval and special training and protocols (Chapters 10 through 13).

In addition to experience and knowledge verification, authorization to depths greater than 130 feet requires a demonstration of need to the satisfaction of the DCB, or DSO before authorization will be given. The necessity must be based on scientific project objectives.

Depth authorizations greater than 190 feet may be granted by the DCB upon a case-by-case basis for divers authorized to use Mixed Gas (Chapters 10 through 13).

In the event a UH diver 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.

Authorization to a Depth of 40 feet

This is the initial Scientific Diver authorization level, granted upon the successful completion of requirements listed in Section 4.2.

If advanced diving experience, knowledge, skills and judgment are documented and demonstrated by superior performance on evaluations, the DSO may recommend to the DCB that an entering diver be granted a deeper initial depth authorization. A cumulative minimum of 12 supervised dives under UH auspices is required.

Progression to Greater Depth Levels

An authorized Scientific Diver in Active status (Section 1.D.3) diving under the auspices of the University may exceed his/her depth authorization only when accompanied by an approved Active-status UH Scientific Diver authorized to at least that greater depth level. Under these circumstances, the diver may exceed his/her authorized depth by one step.

Qualification dives should be verified by an approved Lead Diver on the submitted dive log, or by written or email communication from the supervisor to the DSO. A single Lead Diver may not attest to all qualification dives. At least one dive must be done under the supervision of and attested to by a different Lead Diver.

At the discretion of the DSO, the diver may be required to conduct a dive in the deeper depth range under supervision while serving in the role of the Lead Diver, to demonstrate proficiency in coordinating and supervising deeper diving operations.

Authorization to 60 Feet

An Active-status Scientific Diver holding a 40 feet authorization may be authorized to a depth of 60 feet after successfully completing and logging 12 supervised dives to depths between 41 and 60 feet under supervision of a diver authorized by the DCB, for a minimum total time of 4 hours. Cumulative total minimum supervised dives: 24.

Authorization to 60 feet requires Dive Computer Authorization (Section 2.B.8)

Authorization to 100 Feet

An Active-status Scientific Diver holding a 60 feet 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 diver authorized by the DCB. Cumulative total minimum supervised dives: 30.

For authorization deeper to 100 feet, the diver must also demonstrate proficiency in the use of appropriate decompression tracking methods and mastery of concepts related to deeper diving.

Authorization to 130 Feet

An Active-status Scientific Diver holding a 100 feet authorization may be authorized to a depth of 130 feet after successfully completing and logging 6 supervised dives to depths between 101 and 130 feet under the supervision of a diver authorized by the DCB. The diver must also demonstrate proficiency in the use of the appropriate decompression profiling method. Cumulative total minimum supervised dives: 36.

Authorization to 150 Feet and 190 Feet

Authorizations to 150 and 190 feet may only be granted by the DCB, and must be based at a minimum on similar provisions of 6 supervised dives progressively in each depth range.

For such authorizations, the DCB may require additional training and qualification in use of nitrox (Chapter 10), staged decompression diving (Chapter 11), oxygen use for decompression (Chapter 12), or mixed gas diving, (Chapter 13), as pertinent to the activity.

Authorizations to Depths Beyond 190 feet.

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

Authorization to depths over 190 feet may only be granted by the DCB, and must be based at a minimum on similar provisions of 6 supervised dives progressively in each depth range as above, in 50 foot increments (200 feet, 250 feet, 300 feet, and 330 feet). The diver must also demonstrate knowledge of the special problems of deep diving and of special safety requirements.

Authorizations beyond 190 feet require additional training and qualification in use of nitrox (Chapter 10), staged decompression (Chapter 11), oxygen use for decompression (Chapter 12), and mixed gas diving, (Chapter 13), as pertinent to the activity.

Maximum Depth Authorization.

The maximum depth authorization for UH Scientific Divers is 330 feet (100m).

D. CONTINUATION OF AUTHORIZATION

1.Term of Authorization

Active-status Scientific Diver authorization will expire one year from the date of issuance, or six months from the date of the last logged dive, or upon expiration of medical clearance, or first aid, CPR, or oxygen administration certification.

2. Minimum Activity to Maintain Authorization

During any 12-month period, an authorized Scientific Diver must log a minimum of 12 dives. At least one dive must be logged near the maximum depth of the diver's authorization during each six-month period. Divers authorized to 150 feet or deeper may satisfy these requirements with dives to 130 feet or deeper. Failure to meet the above requirements may be cause for revocation or restriction of authorization.

3. Medical Examination

Authorized Scientific Divers must pass a periodic medical examination, as specified in Chapter 7.

After each major illness or injury as described in Section 7.A.5 and Appendix 3, an Authorized Scientific Diver must submit to a medical interview or examination before resuming diving activities.

E. RESTRICTED SCIENTIFIC DIVER AUTHORIZATION

A UH Scientific Diver whose emergency response certifications (CPR, First Aid, or Oxygen Administration) have expired or who has completed less than the required minimum required periodic dives (Section 4.D.2), but who otherwise is currently qualified as a Scientific Diver according to the requirements of Chapter 4, may be granted an authorization to dive on a Restricted Diver status. It is intended in most cases that the Restricted Status be of temporary duration while the diver obtains recertification in the expired emergency response training.

- A UH Diver on Restricted status is eligible to dive on projects under UH jurisdiction, provided the diver is under the supervision of a fully authorized UH Scientific Diver. Diving must only be conducted within the Restricted Diver's depth authorization.
- A UH Diver on Restricted status is ineligible:
  - to serve as a Lead Diver or Lead Buddy on a dive under UH jurisdiction;
  - for referral to other institutions under reciprocity agreements;
  - to work on projects involving joint operations with other institutions.

F. INACTIVE OR DISQUALIFIED DIVER STATUS.

A diver placed on Inactive or Disqualified status must not dive under UH jurisdiction until the conditions for the designation are remedied.

- Inactive Diver Status. A UH Diver must be placed on Inactive Diver status if: his/her medical clearance to dive (Chapter 7) has expired, or the diver has logged no dives or otherwise not maintained current records in the past 12 months.
- Disqualified Status: A UH Diver or Diver candidate must be placed on Disqualified status, if upon medical examination the diver fails to gain medical approval to dive, in accordance with Chapter 7.

G. REVOCATION OF AUTHORIZATION

1. Revocation for Cause

An individual’s scientific diver authorization 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. Violations of regulations set forth in this Manual or other governmental subdivisions not in conflict with this Manual, or demonstration of poor judgment, may be considered cause.

- 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 record.

- The DCB or designee must inform the diver in writing (hard copy or email) 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.

2. Medical Revocation

A diving authorization may be revoked or restricted for medical reasons by the diver's examining physician, or the DCB upon recommendation of the DMAP Chair (see Chapter 7 and Appendix 3.)

H. REAUTHORIZATION

If a diver's authorization expires or is revoked, he/she may be re-authorized after complying with such conditions as the DSO may impose. If the diver disagrees with the conditions, he/she must be given an opportunity to present his/her case to the DCB before conditions for reauthorization are enforced. The diver must not dive under jurisdiction of the University during the appeal period.

I. TEMPORARY DIVER AUTHORIZATION

A diver visiting UH 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 that they can contribute measurably to the objectives of a planned dive.
- A Temporary Diver Authorization constitutes a waiver of selected requirements of Chapters 3 and 4, 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.
- A Temporary Diver may serve as Lead Diver only if specifically approved by the DSO and/or DCB.

2. Documentation of Temporary Diver

The following must be submitted, at a minimum, to the DSO as part of the Dive Plan Application (Section 2.B.9; Appendix 1):

- Application for Scientific Diving Application (Appendix 1), including Assumption of Risk, Waiver, and Release Form, and Medical Consent and Emergency Contact Form;
- Evidence of scuba certification;
- Evidence of a medical evaluation and approval for diving consistent with the requirements of Chapter 7 (Appendix 3);
- Emergency response training certificates (as appropriate);
- A statement of the temporary diver's qualifications to justify waiver of requirements.
- Documentation of practical diving skill evaluation by DSO or DSO's delegate.

CHAPTER 5. DIVING EQUIPMENT

A. GENERAL POLICY

All equipment must meet standards as determined by the DSO and the DCB, and as specified in this manual. All equipment must be regularly examined by the person using it and serviced according to manufacturer recommendations. Equipment subjected to extreme usage under adverse conditions requires more frequent testing and maintenance.

B. EQUIPMENT

All formal inspections, tests, and maintenance specified in this manual must be accomplished by qualified technicians or facilities approved by the DSO and the DCB. Equipment must be formally inspected, serviced and tested, at a minimum, according to the manufacturer's recommendations, and functionally inspected prior to each use by the user.

1. Regulators

- The DCB has the authority to approve or disapprove those makes and models used. Inspection and Testing: SCUBA regulators used in the Scientific Diving Program must be inspected and tested prior to their first use. Regulators must be serviced, inspected and tested periodically in accordance with manufacturer's recommendations. The DSO may require more frequent inspection and testing for some regulators, or if heavy use indicates a need.
- The DCB must establish the minimum equipment configuration for all dives. 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 by authorized divers in place of the primary 2nd stage according to manufacturer's recommendations.
- If an independent reserve breathing gas supply is used, it must be sufficient to return the diver to the surface at a safe, normal ascent rate, allowing for all indicated decompression stops, either precautionary or required.

2. Breathing Masks and Helmets

Breathing masks and helmets must have the following features:

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

3. 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 U.S. Department of Transportation standards.

- SCUBA cylinders must have an internal and external visual inspection at intervals not to exceed 12 months.
- SCUBA cylinder valves must be functionally tested at intervals not to exceed 12 months.
- SCUBA cylinders and valves which are subjected to usage higher than 15 dives per month or filling by multiple users may require inspection at a more frequent interval.

4. Buoyancy Control Devices (BCD)

- Each diver must have a buoyancy control device capable of providing neutral buoyancy at depth, a controlled ascent, and positive flotation on the surface.
- *A* separate buoyancy control device must be worn when diving in a drysuit.
- Personal flotation systems, buoyancy compensators, dry suits or other variable-volume buoyancy compensation devices must be equipped with an exhaust valve.
- BCD must be functionally inspected and tested at intervals not to exceed 12 months.
- BC and drysuit Inflation mechanisms must be serviced in accordance with manufacturers' recommendations. In most cases, this is an annual requirement.
- BCDs, dry suits, or other variable volume buoyancy compensation devices must not be used as a lifting device in lieu of lift bags.

5. Backpacks and Weighting Systems

- Backpacks and weighting systems without integrated buoyancy devices must have quick release devices designed to permit jettisoning with a rapid motion from either hand.
- Backpacks and weighting systems must be regularly inspected by the persons using them.

6. Timing Devices, Depth Gauges and Submersible Pressure Gauges

- Each Diver in open water must have an underwater timing device, an approved depth indicator, and a submersible cylinder pressure gauge.
  - Divers working in confined waters of a known, fixed maximum depth such as pools or aquaria may forgo use of a depth gauge. In such cases, the maximum depth of the facility must be used for decompression management purposes.
- The DSO and the DCB may specify those makes and models of submersible pressure gauges and depth gauges approved for use.
- Gauges must be inspected and tested by the DSO or his/her designee before first use. Gauges in normal use should be inspected and tested at twelve month intervals. No gauge should be used unless it has been inspected and tested within the twelve months prior to its use.
- Submersible pressure gauge swivels must be serviced in accordance with manufacturers' recommendations. For gauges on primary regulators in regular service, swivels must be replaced annually.

7. Equipment for Determination of Decompression Status.

Each member of the buddy team must have an underwater timing device and depth indicator, or a dive computer.

Dive Tables.

Only those dive tables approved by the DCB may be used.

When used for decompression management, a set of approved dive tables must be available at the dive site.

Dive tables must be at least as conservative as the current version of the US Navy Tables.

Dive Computers.

The DCB has the authority to review and approve specific makes and models of dive tables, dive computers and decompression software. If a dive computer is used, the diver must use the same computer on all 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 or the topside tender must be equipped with a timing device.

The maximum obtainable depth of the aquarium must be used as the diving depth.

C. AUXILIARY AND SUPPORT EQUIPMENT

All auxiliary and support equipment must be of a type approved by the DCB.

1. First Aid Supplies and Emergency Equipment

- A first-aid kit adequate for the diving operation must be available at the dive location.
- When used in a hyperbaric chamber or bell, the first-aid kit must be suitable for use under hyperbaric conditions.
- An emergency oxygen supply adequate for the diving operation must be available at the dive location. The supply must be equipped with a multi-function regulator with demand valve and constant-flow (15 lpm, minimum) capability, The regulator must fitted with:
  - A demand inhalator or resuscitator with oronasal mask;
  - A resuscitation mask with supplemental oxygen fitting;
  - A non-rebreather mask (high concentration).

2. 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.

3. Underwater Hand-held Power Tools

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

4. Power head Spears

- Authorization to carry power head spears requires DCB approval.
- Power heads must be equipped with a safety locking device and/or only be loaded when in the water.

D. RECORD KEEPING

For University-owned equipment, each equipment modification, repair, test, calibration, or maintenance service must be logged including the date and nature of work performed, serial or identification number of item (if applicable), and the name of the person performing the work. Records must be kept for the equipment listed in Table 5.1

Table 5.1 Diving Equipment for Which Records Must be Kept.

Regulators	Submersible Pressure Gauges
Depth Gauges	Dive Computers
Buoyancy Control Devices	Drysuits
SCUBA Cylinders and Valves	Full-Face Masks
Diving Helmets	Rebreathers
Compressors	Air Filtration Systems
Gas Control Panels	Gas Storage Cylinder Banks
Analytical Instruments	

All non-University equipment (e.g. personal, rental, etc.) used in conjunction with University scientific diving operations must meet the same standards as University-owned equipment, as determined by the DSO, or other designee approved by the DCB.

CHAPTER 6. BREATHING GAS

A. BREATHING AIR STANDARDS

1. Breathing Air

Breathing air for SCUBA must meet the following minimal specifications as set forth by the Compressed Gas Association (CGA Pamphlet G-7.1) and referenced in OSHA 29 CFR 1910.134.

Table 6.1. CGA Grade E Specifications.

Component	Maximum Concentration
Oxygen	20-22%/v
Carbon Monoxide	10 ppm/v
Carbon Dioxide	1000ppm/v
Condensed Hydrocarbons	5 mg/m^3
Total Hydrocarbons as Methane	25 ppm/v
Water Vapor	2 ppm/v

2. Breathing air in Extreme Cold

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.

3. Air to be Mixed with Greater than 40% Oxygen

In addition to the standards outlined in Section 6.A.1, the following standards must be met for breathing air that is:

- Placed in contact with oxygen concentrations greater than 40%, or
- Used in Enriched Air Nitrox (EAN) filling operations by the partial pressure mixing method, with greater than 40% oxygen as the enriching agent:

Table 6.2. Specifications for Air to be Mixed with Greater than 40% Oxygen.

Air Purity	CGA Grade E (Section 6.A.1)
Condensed Hydrocarbons	less than or equal to 0.5 mg/m2
Hydrocarbon Contaminants	less than or equal to 0.1 mg/m3

B. OXYGEN AND MIXED GAS

1. Oxygen

Oxygen used for mixing Enriched Air Nitrox (EAN), mixed gas, or a oxygen for rebreathers or emergency response must meet the purity levels for Medical (U.S.P.) Grade or Aviation Grade.

Medical (U.S.P.) Grade Oxygen Specifications.

Oxygen Content	Minimum 99.5%
Contaminants	Maximum
Nitrogen	0.1%
Argon	0.4%

Hydrocarbons	3 ppm
Methane	25 ppm
Carbon Dioxide	5 ppm
Carbon Monoxide	1 ppm
Moisture	25 ppm

2. Helium

Helium used to produce EAN or other mixed gas breathing mixtures must be of an acceptable grade for breathing by humans.

Helium Specifications.

Helium Content	Minimum 99.5%
Contaminants	Maximum
Oxygen	50 ppm
Hydrocarbons	1 ppm
Carbon Dioxide	1 ppm
Carbon Monoxide	1 ppm
Moisture	25 ppm

C. COMPRESSOR SYSTEMS – UH CONTROLLED

1. Design and Location of Compressor

The following features should be considered in the design and location of compressor systems:

- Low pressure compressors used to supply air to the diver must be equipped with a volume tank with a check valve on the inlet side, a pressure gauge, a relief valve, and a drain valve;
- Compressed air systems over 500 psig equipped with slow-opening shut-off valves;
- Pressurized gas bank cylinders must be secured to prevent falling;
- High pressure lines and fittings must be of appropriate rated working pressures and secured every 2 feet;
- All air compressor intakes must be located away from areas containing engine exhaust or other contaminants.

2. Compressors for Enriched Air Nitrox or Mixed Gas Systems

- An oil-free or oil-less compressor is recommended when blending or mixing nitrox using oxygen concentrations greater than 40%, to reduce the presence of oil mist and reduce the possibility for oxygen ignition of hydrocarbons. Quality of a hyper-filtered air supply from an oil-lubricated compressor used for EAN production must be tested quarterly and checked for oil and hydrocarbon contamination on a frequent basis.
- The DCB and DSO must review and approve the design of EAN filling stations under University control. Only those designs approved by the DSO and DCB may be used in University-controlled filling operations. Methods for producing EAN (membrane filtration, etc.) which do not require the addition to the SCUBA cylinder of oxygen concentrations above 40% must be regarded as preferable to partial pressure mixing methods using high concentration oxygen.

3. Compressor Operation and Air Test Records

- Gas analysis and air tests must be performed on each University-controlled breathing air compressor at regular intervals of no more than 100 hours of operation or six months, whichever occurs first. The results of these tests must be entered in a formal log and be maintained. Copies of the results must be kept on file by the DSO, or the DSO's designee.
- A log must be maintained showing operation, repair, overhaul, filter maintenance, and temperature adjustment for each compressor.
- Personnel filling pressure cylinders from University-owned compressors must be periodically trained and qualified in the operation of the fill station used. Training must be documented and kept on file by the department/program controlling fill station operations, and must be available to the DSO or DCB upon request.

4. Oxygen Systems and Systems using Greater Than 40% Oxygen (EAN)

- Diving equipment used with oxygen or mixtures containing over 40% oxygen by volume at pressures greater than 200 psig must be cleaned and maintained for oxygen service.
- Components of cylinder filling stations exposed to oxygen or gas mixtures containing oxygen concentrations over 40% by volume must be cleaned for oxygen service, and equipped with oxygen-clean fill whips, gauges, valves, and plumbing, etc. These measures are intended to maintain EAN system integrity.
- Oxygen delivery systems and breathing gas systems using greater than 40% oxygen at pressures over 200 psig must have slow-opening shut-off valves.
- SCUBA cylinders and valves used in EAN production during which oxygen concentrations greater than 40% are passed into the cylinder must be cleaned and maintained for oxygen service.

D. PRODUCTION OF SPECIAL GAS MIXTURES

- Production of special gas mixtures (EAN, Heliox, Trimix, etc...) must be as authorized and approved by the DCB.
- Personnel involved in the production of EAN and mixed gas must be trained and qualified for the method of production used, as determined by the DCB.

E. REMOTE OPERATIONS

For remote site operations using gas sources not controlled by the OM, 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.

Chapter 7. MEDICAL STANDARDS

A. GENERAL

- The University must determine that dive team members who are exposed to hyperbaric conditions have passed a current diving physical examination in compliance with this chapter, and have been declared by a licensed physician to be fit to engage in diving activities as may be limited or restricted in the medical evaluation report (Appendix 3).
- All medical evaluations required by this standard 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 (Appendix 4).
- The diver should be free of any chronic disabling disease and be free of any condition contained in the list of conditions for which restrictions from diving is generally recommended (Appendix 3).

B. 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 3), 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.		

C. INFORMATION PROVIDED EXAMINING PHYSICIAN

The University must provide a copy of the medical evaluation requirements of this standard to the examining physician as part of the diving medical examination forms (Appendix 3).

D. CONTENT OF MEDICAL EXAMINATIONS

Medical examinations conducted initially and periodically must consist of the

Following, as outlined in Appendix 3:

- Diving Medical Exam Instructions, including list of conditions which may disqualify candidates from diving;
- Medical History
- Applicant Agreement for Release of Medical Information
- Diving Physical Examination and Required Tests;
- Any additional tests the physician may consider necessary;
- Medical Evaluation of Fitness for SCUBA Diving Report

E. RESTRICTION FROM DIVING

Restriction from diving may be made based on conditions which may disqualify candidates from diving (Appendix 3).

F. PHYSICIAN'S WRITTEN REPORT

- After any medical examination relating to the individual's fitness to dive, the University must be provided with a written report prepared by the examining physician, which must contain the examining physician's opinion of the individual's fitness to dive, including any recommended restrictions or limitations (Appendix 3).
- In the event of outstanding questions regarding fitness to dive based on the exam's findings, the DCB may refer the exam results to the DMA or other designated diving medical authority for additional review prior to approval.
- Copies of the medical history, medical information release agreement, medical examination, and test results shall be returned to the DSO and included in the diver's file.
- The University must make a copy of the physician's written report available to the individual upon request.

VOLUME II. SPECIALIZED DIVING MODES

GENERAL INTRODUCTION

Any dive requiring staged decompression, conducted in restricted overhead environments (cavern, cave, tunnel, ice, or shipwreck penetration), conducted in bluewater (open ocean), incorporating breathing gas mixtures other than air, involving breathing gas delivery systems other than self-contained, open-circuit systems, or conducted in any other particularly hazardous environments, must be considered Specialized Diving.

For each of these modes, the following Chapters 8 through 18 define specific considerations regarding the following issues:

- Training prerequisite requirements, if any;
- Training and/or experience verification requirements for University authorization;
- Equipment requirements;
- Operational Requirements and additional safety protocols to be used.

For dives that involve more than one specialized diving mode, all requirements for each of the relevant diving modes must be met.

The DCB reserves the authority to review each application of specialized diving modes, and include any further requirements deemed necessary on a case-by-case basis.

Chapter 8. RESTRICTED OVERHEAD ENVIRONMENTS

Restricted overhead environments include any diving environment in which a direct ascent to the surface is impeded by a physical barrier, including cave, cavern, under-ice and shipwreck penetration. It does not include underwater arches, lava tubes, opened shipwrecks or kelp forests, in which:

1. Two divers can easily swim abreast;
2. There is no significant danger of entrapment or entanglement
3. Loss of visibility due to siltation is unlikely;
4. Direct sunlight is always available for illumination.

A. TRAINING PREREQUISITES

Active status Scientific Diver, Temporary Diver or DIT authorization, with depth authorization adequate for the planned operations is required. Restricted overhead environment training may be included as a component of scientific diver training, but only after the DIT has demonstrated general diving proficiency to the satisfaction of the DSO and/or DCB, especially buoyancy control and awareness.

B. TRAINING REQUIREMENTS

1. Divers must document training in restricted overhead environment diving appropriate for the conditions in which dive operations are to be conducted. Such documentation must be to the satisfaction of the DSO and/or DCB. Training must be conducted by agencies and instructors approved by the DSO and DCB.
2. Divers must demonstrate to the satisfaction of the DSO or his/her designee, proficiency in planning and executing dives in a restricted overhead environment appropriate to the conditions in which diving operations are to be conducted.

C. EQUIPMENT REQUIREMENTS

1. Divers must employ a continuous guideline from a point outside the restricted overhead environment to their position. A minimum of three lights must be carried by each diver. In environments in which direct sunlight is visible, each diver must carry a minimum of two lights.
2. Redundant breathing gas delivery systems must be designed such that no single component failure can prevent access by the diver to an appropriate breathing gas supply.
3. An alternate second stage must be included with a hose of adequate length to facilitate emergency gas sharing while swimming in a single file formation.
4. The DCB may require redundancy in other equipment systems to ensure dive team safety, including:
    - Submersible Cylinder Pressure Gauges;
    - Dive Computers or Decompression Calculation Devices;
    - Dive Timing Devices;
    - Depth gauges;
    - Buoyancy Control Devices;

D. OPERATIONAL REQUIREMENTS

1. Restricted overhead environment diving authorization will be acknowledged by the signed initials of the DSO on the UH Scientific Diver authorization card.

2. Divers must immediately begin exiting from a restricted overhead environment when a light source or a piece of equipment fails or malfunctions.
3. Divers must begin exiting the overhead environment as soon as any member of the dive team reaches two-thirds of his/her starting air supply.
4. Where an enclosed or confined space is not large enough for two divers, a diver must be stationed at the underwater point of entry, an orientation line must be used, and an emergency breathing gas supply will be available at the point of entry.
5. Emergency procedures for loss of gas supply, equipment malfunction, team separation, unexpected diving conditions and loss of visibility must be developed. Emergency procedures must be reviewed by the divers prior to each dive.

Chapter 9. BLUEWATER DIVING

Bluewater diving is defined as diving conducted in any body of water in which there is no physical bottom within diving depth ranges. The following regulations are derived from the publication, Bluewater Diving Guidelines (Heine, J.N., Ed., 1986. California Sea Grant College Program Publication No. T-CSGCP-014.)

Exceptions to this standard may be made on a case-by-case basis, if a risk of entanglement with other structures exists, or there are other means of physical control. Procedures for diver control and communication must be developed to the satisfaction of the DSO and/or DCB.

A. PREREQUISITES FOR TRAINING

Active status Scientific Diver, Temporary Diver or DIT authorization, with depth authorization adequate for the planned operations is required. Bluewater training may be included as a component of scientific diver training, but only after the DIT has demonstrated general diving proficiency to the satisfaction of the DSO and/or DCB, especially buoyancy control and awareness.

B. TRAINING REQUIREMENTS

The diver must complete classroom and practical training in bluewater diving techniques, and demonstrate knowledge and proficiency in bluewater diving to the satisfaction of the DSO or his/her designee.

1. Theoretical Training

Theoretical training must include:

- Bluewater diving equipment design and deployment;
- Support vessel configuration for bluewater diving and procedures for live-boat operations;
- Entry procedures;
- Buoyancy control and awareness;
- Diver communication;
- Dive Team control and coordination;
- Roles and responsibilities of safety diver;
- Scientific procedure familiarization;
- Out-of-air procedures;
- Dangerous marine life defensive techniques;
- Exit procedures;
- Emergency communication and protocols.

2. Practical Training

Practical training must include a minimum of 4 bluewater dives under the supervision of the DSO or his/her designee.

- The duration of each training dive should be a minimum of 20 minutes
- The first dive should be in waters in which the bottom is within safe depths.
- On at least one dive, the trainee should serve in the role of safety diver.

C. BLUEWATER AUTHORIZATION.

- Upon completion of the above training, the diver is authorized to participate in bluewater diving operations under the supervision of a qualified Lead Diver, under conditions and depths with which the diver is familiar.
- Upon completion of 6 additional bluewater dives under the supervision of a qualified Lead Diver, the diver may be authorized to serve as Lead Diver for bluewater diving under conditions and depths with which the diver is familiar.
- Bluewater diving authorization must be recorded by the DSO in the diver's records, and communicated as part of any Letter of Reciprocity sent on the diver's behalf for diving operations that include Bluewater diving.

D. EQUIPMENT REQUIREMENTS

In the absence of other mid-ocean features by which divers may orient and control their dive depth and maintain communication with each other and their support vessel, divers (except the safety diver) must employ a down-line system with one counterweighted control line per diver in order to maintain diver contact and depth control.

- The total weight in water of the down-line and tether array must be no greater than that which a single diver can easily swim to the surface with his/her BCD deflated. A maximum weight of 10 lb. is suggested.
- All diver tether attachments must be made with connectors that can be quickly released by the diver while the line is under a tension at least equivalent to the weight of the entire array. Attachments must be to either the diver’s BCD, or to a separate harness, but not to the diver’s weight belt.
- The safety diver should be attached to the trapeze array by a short line with quick-disconnect features as above, enabling sufficient mobility to complete assigned responsibilities while ensuring contact with the array. This safety tether need not be counter-weighted.

E. OPERATIONAL REQUIREMENTS

- A safety diver must be stationed at the trapeze attachment point. This diver’s sole function is to monitor and control the dive team, solve entanglements, and monitor the diving environment for potential hazards. The safety diver must be authorized to terminate diving operations for any or all members of the dive team.
- A lookout/boat operator must be stationed aboard any small craft from which bluewater diving is conducted as long as divers are in the water.
- Live-boat procedures must be developed as part of the dive plan to ensure that reliable tracking of the dive team by the support vessel is enabled and diver safety is ensured when entering or exiting the water from the boat. Especially, support vessel motors should be off or the propellers otherwise reliably disengaged during water entry and exit.

Chapter 10. NITROX FOR STANDARD DIVING OPERATIONS

The University sets forth the following guidelines for the use of Enriched-Air Nitrox (Nitrox, EAN) mixtures in non-staged decompression diving, and the guidelines in Chapter 12 for the use of such mixtures on dives requiring staged decompression.

A. PREREQUISITES

Divers applying for authorization to use or be trained in the use of EAN mixtures for non-stage decompression diving must hold a currently valid Diver-In-Training or Scientific Diver authorization (see Section 1.D.2, Chapters 3 and 4). The applicant must document completion of at least 12 logged open water SCUBA dives using compressed air.

B. TRAINING REQUIREMENTS

Divers must present documentation of training in the use of EAN for the conditions in which dive operations are to be conducted. Such documentation must be to the satisfaction of the DSO and/or DCB. Training must be conducted under agencies and by instructors approved by the DCB.

Submission of documents and participation in aptitude examinations does not automatically result in authorization to use EAN under University auspices. The applicant must convince the DSO and DCB that he/she is sufficiently skilled and knowledgeable to be certified.

Authorization to use EAN may be denied to any applicant who does not demonstrate to the satisfaction of the DSO and/or DCB the appropriate judgment or proficiency to ensure the safety of the diver and dive buddy.

In lieu of promulgating specific training standards for Nitrox divers, the DCB references the standards for Nitrox diver training as defined by the WRSTC and/or ISO. UH entities who 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

1. Practical Evaluation.

- Upon completion of training or upon application for authorization, divers must demonstrate proficiency in the following to the satisfaction of the DSO or his designee:
  - 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.

2. Written Evaluation.

- Upon completion of training or upon application for authorization, divers must demonstrate proficiency in the following to the satisfaction of the DSO or his designee:
  - Function, care, use, and maintenance of equipment cleaned for nitrox use.
  - Physical and physiological considerations of nitrox diving (eg.: O2 and CO2 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, pO2, and other aspects of Nitrox diving as required by the DCB

3. Water Evaluation.

- A minimum of two open water EAN dives supervised by the DSO or his/her designee is required for authorization. Such dives will incorporate any specialized diving modes in which the diver expects to use EAN.

4. Limits of Authorization.

- Authorization to use EAN is valid only within the depth range for which the diver is authorized.

5. Waiver of Requirements.

- The DSO and/or DCB may grant a waiver to the above requirements of training and experience, if evidence of qualifying knowledge and experience for EAN diving can be demonstrated.

6. Maintenance of EAN Authorization.

Failure to meet the minimum activity criteria may be cause for loss or restriction of EAN authorization. To maintain EAN authorization, a UH Scientific Diver must:

- Maintain current authorization as a Scientific Diver;
- Log at least one dive every 6 months using EAN

7. Temporary EAN Authorization.

- With the exception of the medical examination requirements, other requirements for EAN authorization may be temporarily waived by the DSO if the diver seeking temporary authorization has demonstrated proficiency in EAN diving and can add measurably to a planned dive operation.
  - A statement of the temporary diver's qualifications and other supportive material (including medical approval) must be submitted to the DSO as part of the Dive Plan Application.
  - The diver will dive only under the supervision of a designated Lead Diver, authorized by the DSO;
  - Temporary EAN authorization must be restricted to the planned diving operations and must comply with all other policies, regulations, and standards of this manual.

C. EQUIPMENT REQUIREMENTS

1. 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

2. 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.

3. Compressor Systems

- Compressor/filtration systems 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.

D. OPERATIONAL REQUIREMENTS

1. Authorization

- If EAN is to be used by any diver on a University dive, the diver must be authorized for EAN use appropriate with the parameters of the dive plan.

2. Oxygen Exposure Limits

- The maximum inspired oxygen partial pressure experienced at depth must not exceed 1.6 ATA.
- A limit of 1.4 ATA is recommended for most working dives.
- The maximum allowable exposure limit must be reduced in cases where cold or strenuous dive conditions, or extended exposure times are expected.
- Maximum single- and cumulative oxygen exposures must be within limits approved by the DCB. Unless otherwise specifically approved by the DCB, adherence to the NOAA Single- and Daily-Exposure limits is required.

3. 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 pO2 limit and fO2 adjustment should be checked by the diver prior to the start each dive to ensure conformity with the mix being used.

4. **Lead Diver Responsibilities.**

- When EAN is to be used during a UH project, the Lead Diver must be authorized in EAN use under conditions and applications similar to those expected during the project.
- On dives in which EAN is to be used, briefings must include all those specified in Section 2.E13, as well as the following:
  - Verification of EAN authorization of all divers using EAN;
  - Verification of EAN mixtures used and MOD and decompression calculations of project divers.

5. 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: fO2, MOD, cylinder pressure, date of analysis, and user's name.
- Individual dive log reporting forms should report fO2 of nitrox used, if different than 21%.

Chapter 11. STAGED DECOMPRESSION DIVING

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

The following procedures must be observed when conducting dives requiring staged decompression stops or incurring a decompression ceiling.

A. PREREQUISITES

- Scientific Diver qualification according to Chapter 4, with minimum depth authorization of 100 feet
- Minimum of 100 logged dives with substantial experience in the depth range where decompression dives will be conducted.
- Demonstration of ability to safely plan and conduct dives deeper than 100 feet.
- Nitrox training/authorization according to Chapter 10 and Chapter 12 is recommended.

B. MINIMUM TRAINING AND PROFICIENCY REQUIREMENTS

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

- 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.
- 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.
- 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.
- Progression to greater depths must be by 6-dive increments at depth intervals as specified in Section 4.C.4.
- No training dives requiring decompression shall be conducted until the diver has demonstrated acceptable skills under simulated conditions.
- 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

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

C. MINIMUM EQUIPMENT REQUIREMENTS

- 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.
- One of the second stages on the primary gas supply must be configures with a hose of adequate length to facilitate effective emergency gas sharing in the intended environment.
- Cylinders with volume, configuration, and gas type(s) adequate and appropriate for planned diving operations.
- Minimum dive equipment must include;
  - Diver location devices adequate for the planned operations and environment.
  - Compass.
- A snorkel is optional at the DCB's discretion, as determined by the conditions and environment.
- Redundancy in the following components is desirable, and may be required at the discretion of the DSO or DCB.
  - Decompression Schedules;
  - Dive Timing Devices;
  - Depth gauges;
  - Buoyancy Control Devices;
  - Cutting devices;
  - Lift bags and line reels;

D. MINIMUM OPERATIONAL REQUIREMENTS

- Staged decompression authorization will be acknowledged on the UH Scientific Diver authorization document, and recorded in the diver's file and database entry.
- Approval of Dive Plan Applications to conduct staged decompression dives are be on a case-by-case basis. Review by the DCB is required for each Dive Plan Application.
- Staged decompression diving must only be conducted in the presence of the DSO, or another qualified designee approved by the DCB.
- Diver's gas supplies must be adequate to meet planned operational requirements and foreseeable emergency situations. Such information must be provided as part of the Dive Plan Application.
- At least one third of each open-circuit gas supply must be reserved for emergencies. Except in the event of an emergency, all divers must surface with at least one-third of the gas supply remaining.
- Decompression gas must be available in 150% the amount estimated to be needed for a full ascent schedule as planned.

- 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.
- Breathing gases used while performing in-water decompression stops must contain the same or greater oxygen content as that used during the dive.
- Use of additional nitrox and/or high-oxygen fraction decompression mixtures as travel and decompression gases to decrease decompression obligations is recommended.
- Use of alternate inert gas mixtures to limit narcosis is recommended for depths greater than 130 feet and required for depths greater than 150 feet.
- The maximum pO2 to be used for planning required decompression dives for open circuit is 1.4 for the bottom phase. For non-strenuous stage stops in the decompression phase, a maximum PO2 of 1.6 may be used.
- Emergency procedures approved by the DCB for loss of gas supply, equipment malfunction, unexpected diving conditions, or dive team separation must be developed. Emergency procedures must be reviewed by the divers prior to each dive.
- Personnel requirements and duties must be established for the following roles in the dive team:
  - Boat Captain
  - Diving Supervisor
  - Diver Tender (if needed)
  - Safety Diver(s)
  - Project Diver(s)
- Diver/vessel contact and communications procedures must be reviewed and approved by the DSO, and established and rehearsed to the satisfaction of the DSO or his/her designee.
- When conducting staged decompression diving from an anchored vessel deeper than 100 feet, the dive team must maintain contact with the vessel by one of the following means, to assist in diver location and rescue in the event of an emergency:
  - maintaining direct visual contact with the anchor;
  - following a predetermined, prominent underwater feature;
  - maintaining a continuous guideline between the vessel anchor and the divers;
  - Towing a surface marker buoy.
- Mission specific workup dives are recommended.

Chapter 12. HIGH OXYGEN CONCENTRATION NITROX FOR STAGE DECOMPRESSION

A. TRAINING PREREQUISITES

- Candidates for training must possess authorization or complete training in Scientific Diver (Chapter 4) and Nitrox (Chapter 10)
- Divers must be trained in staged decompression as outlined in Chapter 11, or must complete such training as part of training listed below.

B. TRAINING REQUIREMENTS

- Divers must document training in staged decompression diving using high oxygen concentration mixtures appropriate for the conditions in which dive operations are to be conducted. Such documentation must be to the satisfaction of the DCB. Training must be conducted by agencies or instructors approved by the DCB upon recommendation of the DSO.
- Divers must demonstrate proficiency in planning and executing staged decompression dives using high oxygen concentration mixtures appropriate to the conditions in which diving operations are to be conducted, to the satisfaction of the DSO or his designee.

C. EQUIPMENT REQUIREMENTS

- All equipment requirements for staged decompression diving must be met, as outlined in Section 11.C.
- All SCUBA cylinders, regulators, compressors, and gas handling and storage equipment coming in contact with oxygen concentrations greater than 40% must be cleaned and maintained for oxygen service.

D. OPERATIONAL REQUIREMENTS

- All operational requirements for staged decompression diving must be met, as outlined in Section 11.D.
- Oxygen partial pressure in the breathing gas mixtures during staged decompression stops must not exceed 1.6 ATA.
- Dives must be planned within recognized acute and sub- acute oxygen exposure limits approved by the DCB (E.g., NOAA Oxygen Exposure Limits; UPTD or OTU).
- An in-water safety/support diver must monitor divers decompressing on mixtures presenting a PO2 greater than 1.4 atm.

Chapter 13. 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. The use of such mixed gas under University auspices must be reviewed and approved by the DCB on a case-by-case basis.

A. PREREQUISITES FOR TRAINING

- Candidates for training must possess authorization or complete training in:
  - Scientific Diver (Chapter 4);
  - Nitrox (Chapter 10);
  - Staged Decompression (Chapter 11);
  - High Oxygen Concentrations for Staged Decompression (Chapter 12).
- Divers must demonstrate to the DCB's satisfaction skills, knowledge, and attitude appropriate for training in the safe use of mixed gases.

B. TRAINING REQUIREMENTS

1. Theoretical Training

Classroom training must include:

- Review of topics and issues previously outlined in nitrox and required decompression diving training as pertinent to the planned operations;
- The use of helium or other inert gases, and the use of multiple decompression gases;
- Equipment configurations;
- Mixed gas decompression planning;
- Gas management planning;
- Thermal considerations;
- Equivalent narcotic depth (END) determination;
- Mission planning and logistics;
- Emergency procedures;
- Mixed gas production methods;
- Methods of gas handling and cylinder filling;
- Oxygen exposure management;
- Gas analysis;
- Mixed gas physics and physiology;

2. Practical Training

Practical Training must include:

- At least one confined or sheltered water session, in which divers demonstrate proficiency in required skills and techniques for the proposed diving operations.
- A minimum of 6 open water training dives. Mixed gas training may be conducted simultaneously with that for staged decompression training. In this case, a minimum total of 10 open water training dives are required.
- At least one initial dive must be in 130 feet or less to practice equipment handling and emergency procedures.

- Subsequent dives will gradually increase in depth, with a majority of the training dives being conducted between 130 feet and the planned operational depth.
- The planned operational depth for initial training dives must not exceed 150 feet.

3. Depth of Authorization

- Authorization to 150 feet. Completion of the initial training outlined above will qualify the diver to a depth of 150 feet.
- Authorization to 200 feet requires an additional 6 training dives between 150 and 200 feet.
- Deeper authorizations. Authorizations to 250, 300 and 330 feet require an additional and progressive 6 training dives between 200 to 250 feet, 250 to 300 feet, and 300 feet to 330 feet, respectively.
- The maximum depth limit for diving under University auspices is 330 feet (100m)

C. EQUIPMENT AND GAS QUALITY REQUIREMENTS

- Specific equipment requirements for each project must be developed and approved by the DCB, and met by divers, prior to engaging in mixed-gas diving. Equipment must meet other pertinent requirements set forth elsewhere in this standard.
- Mixed-gas equipment requirements must comply with those specified for nitrox, staged decompression diving and use of high-oxygen percentage mixtures for decompression (Chapter 10, Chapter 11, Chapter 12, Chapter 14).
- The quality of inert gases used to produce breathing mixtures must be of an acceptable grade for human consumption (Chapter 6).

D. OPERATIONAL REQUIREMENTS

- Approval of dive plan applications to conduct mixed gas dives must be on a case-by-case basis.
- All applicable operational requirements for nitrox and decompression diving and any specialized equipment (e.g., rebreathers) must be met.
- The maximum pO2 to be used for planning required decompression dives is 1.6. It is recommended that a pO2 of less than 1.6 be used during bottom exposure.
- Dives must be planned within recognized acute and sub- acute oxygen exposure limits approved by the DCB (E.g., NOAA Oxygen Exposure Limits; UPTD or OTU).
- Maximum planned Oxygen Toxicity Units (OTU) will be considered based on mission duration.
- An in-water safety/support diver must monitor divers decompressing on mixtures presenting a PO2 greater than 1.4 atm.
- Divers decompressing on high-oxygen concentration mixtures must closely monitor one another for signs of acute oxygen toxicity.
- If a period of more than 6 months has elapsed since the last mixed gas dive, a series of progressive workup dives to return the diver(s) to proficiency status before the start of project diving operations are recommended.
- Mission specific workup dives are recommended

Chapter 14. REBREATHERS

A. GENERAL

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 (Chapter 10, Chapter 11, Chapter 12, Chapter 13). The Diving Control Board reserves the authority to review each application of all specialized diving modes, and include any further requirements deemed necessary beyond those listed here on a case-by-case basis.

No diver is authorized to 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.

B. GENERAL INFORMATION

1. Definition

Rebreathers are defined as any device that recycles some or all of the exhaled gas in the breathing loop and returns it to the diver. Rebreathers maintain levels of oxygen and carbon dioxide that will 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.

2. Advantages

Advantages of rebreathers may include increased gas utilization efficiencies that are often independent of depth, extended no-decompression bottom times and greater decompression efficiency, and reduction or elimination of exhaust bubbles that may disturb aquatic life or sensitive environments.

3. Disadvantages and Hazards

Disadvantages of rebreathers include high cost and, in some cases, a high degree of system complexity and reliance on instrumentation for gas composition control and monitoring, which may fail. The diver is more likely to experience hazardous levels of hypoxia, hyperoxia or hypercapnia due to user error or equipment malfunction, conditions which may lead to underwater blackout and drowning. Inadvertent flooding of the breathing loop and wetting of the carbon dioxide absorbent may expose the diver to ingestion of an alkaline slurry ("caustic cocktail").

An increased level of discipline and attention to rebreather system status by the diver is required for safe operation, with a greater need for self-reliance. Rebreather system design and operation varies significantly between make and model. For these reasons when evaluating any dive plan incorporating rebreathers, risk-management emphasis must be placed on the individual qualifications of the diver on the specific rebreather make and model to be used, in addition to specific equipment requirements and associated operational protocols.

4. Rebreather Types

There are three classes of rebreathers:

- Oxygen Rebreathers (O2CCR). Oxygen rebreathers recycle breathing gas, consisting of pure oxygen, replenishing the oxygen metabolized by the diver. Oxygen rebreathers are generally the least complicated design, but are normally limited to a maximum operation depth of 20 feet (6 msw) due to the risk of unsafe hyperoxic exposure.
- Semi-Closed Circuit Rebreathers (SCR). Semi-closed circuit rebreathers (SCR) recycle the majority of exhaled breathing gas, venting a portion into the water and replenishing it with a constant or variable amount of a single oxygen-enriched gas mixture. Gas addition and venting is balanced against diver metabolism to maintain safe oxygen levels by means which differ between SCR models, but the mechanism usually provides a semi-constant fraction of oxygen (FO2) in the breathing loop at all depths, similar to open-circuit SCUBA.
- Closed-Circuit Mixed Gas Rebreathers (CCR). Closed-circuit mixed gas rebreathers (CCR) recycle all of the exhaled gas and replace metabolized oxygen via an electronically controlled valve, governed by electronic oxygen sensors. Manual oxygen addition is available as a diver override, in case of electronic system failure. A separate inert gas source (diluent), usually containing primarily air, heliox, or trimix, is used to maintain oxygen levels at safe levels when diving below 20feet/6m. CCR systems operate to maintain a constant oxygen partial pressure (PPO2) during the dive, regardless of depth.

C. MINIMUM PREREQUISITES, TRAINING, AND EXPERIENCE REQUIREMENTS

Specific training requirements for use of each rebreather model will 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).

1. Prerequisites for Training.

The following are prerequisites for entry into rebreather training:

- Active-status Scientific Diver, with depth qualification (Chapter 4) sufficient for the type, make and model of rebreather, and planned application.
- Completion of a minimum of 50 open-water dives on SCUBA. The DCB may require increased dive experience depending upon the intended use of the rebreather system for scientific diving.
- For SCR or CCR, a minimum 100-feet-depth qualification is generally recommended, to ensure the diver is sufficiently conversant with the complications of deeper diving. If the sole expected application for use of rebreathers is shallower than this, a lesser depth qualification may be allowed with the approval of the DCB;
- Nitrox training. Training in use of nitrox mixtures containing 25% to 40% oxygen is required. Training in use of mixtures containing 40% to 100% oxygen may be required, as needed for the planned application and rebreather system. Training may be provided as part of rebreather training.

2. Training.

- Training curricula must be approved by the DCB. All training must be in compliance with the current AAUS rebreather training standards (Appendix 14), those of any training agency through which certifications are to be awarded, and any recommendations or requirements from the manufacturer.
- 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.
- Post-training supervised dives are required before the diver is authorized to use rebreathers for research dives. (See Section 14.C.4, Appendix 14).

3. Written Evaluation.

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

4. Supervised Scientific Rebreather Dives

Upon successful completion of open water training dives, the diver is authorized to conduct a series of supervised rebreather dives, during which the diver gains additional experience and proficiency.

- The supervisor for these dives should be the DSO or his/her designee, and should be an active scientific diver experienced in diving with the make/model of rebreather being used.
- Dives at this level may be targeted to activities associated with the planned science diving application. See Table 14.1 for number and cumulative water time for different rebreather types.
- Maximum ratio of divers per designated dive supervisor is 4:1. The supervisor may dive as part of the planned operations.

5. Initial Authorization

Successful completion of the above shall qualify the diver for rebreather diving using the system on which the diver was trained, in depths of 130 feet and shallower, for dives that do not require decompression stops, using nitrogen/oxygen breathing media.

6. Extended Range, Required Decompression and Helium-Based Mixed Gas

Rebreather dives involving operational depths in excess of 130 feet, requiring staged decompression, or using diluents containing inert gases other than nitrogen are subject to additional training requirements, as determined by DCB on a case-by-case basis. Prior experience with required decompression and mixed gas diving using open-circuit SCUBA is desirable, but is not sufficient for transfer to dives using rebreathers without additional training.

- As a prerequisite for training in staged decompression using rebreathers, the diver must have logged a minimum of 25 hours of underwater time on the rebreather system to be used, with at least 10 rebreather dives in the 100 feet to 130 feet range.
- As a prerequisite for training for use of rebreathers with gas mixtures containing inert gas other than nitrogen, the diver must have logged a minimum of 50 hours of underwater time on the rebreather system to be used and must have completed training in stage decompression methods using rebreathers. The diver must have completed at least 12 dives requiring staged decompression on the rebreather model to be used, with at least 4 dives near 130 feet.

- Training must be in accordance with standards for staged-decompression (Chapter 11, Chapter 12) and mixed gas diving (Chapter 13), as applicable to rebreather systems, starting at the130 feet level.

7. Maintenance of Authorization.

To maintain authorization to dive with rebreathers, an authorized diver must make at least one dive using a rebreather every 8 weeks. For divers authorized for the conduct of extended range, stage decompression or mixed-gas diving, at least one dive per month should be made to a depth near 130 feet, practicing decompression protocols.

8. Reauthorization after Inactivity

For a diver in arrears, the DCB must approve a program of remedial knowledge and skill tune-up training and a course of dives required to return the diver to full authorization. The extent of this program should be directly related to the complexity of the planned rebreather diving operations.

D. REBREATHER EQUIPMENT REQUIREMENTS

Only those models of rebreathers specifically approved by DCB are allowed.

1. Documentation

Rebreathers must meet the quality control/quality assurance protocols of the International Organization for Standardization (ISO) requirements: ISO 9004:2009 or (most current version).

- As a minimum, the unit must be certified as compliant with current applicable Conformité Européenne (CE) standards or other third-party testing approved by the DCB.
- Prior to approval, the DCB shall receive and approve documentation detailing the methods of specification determination by a recognized third-party testing agency.
- The following documentation for each rebreather model to be used should be available as a set of manufacturer's specifications. These shall include:
  - Tested operational depth range;
  - Tested operational temperature range;
  - Approved breathing gas mixtures;
  - Maximum exercise level (VO_2) supported as a function of breathing gas and depth;
  - Breathing gas supply duration of standard equipment as a function of exercise level (VO_2) and depth;
  - CO2 absorbent durations, as a function of depth, exercise level (VCO_2), breathing gas, and water temperature;
  - Method, range and precision of inspired PPO2 control, as a function of depth, exercise level, breathing gas, and temperature;
  - A Failure Mode Criticality Assessment, indicating likely failure modes and backup or redundant systems designed to protect the diver if such failures occur;
  - Accuracy and precision of all readouts and sensors;
  - Expected battery duration as a function of load, and pertinent environmental parameters;
  - Mean time between failures of each subsystem and method of determination.
- A complete instruction manual is required, fully describing the operation of all rebreather components and subsystems as well as maintenance procedures.
- Manufacturer-published, standardized maintenance and service technician guides must be available to qualified personnel.

2. Equipment Requirements for All Rebreathers.

All rebreathers must be equipped with:

- An alternate life support capability (open-circuit bail-out or redundant rebreather) sufficient to allow the solution of minor problems and allow reliable access to a pre-planned alternate life support system.
- A surface/dive valve (SDV) in the mouthpiece assembly, allowing sealing of the breathing loop from the external environment when not in use, and designed such that the diver may switch from the rebreather to a safe alternative bail-out breathing mixture without removal of the mouthpiece or (if applicable) full-facemask
- An automatic gas addition valve (ADV), so that manual volumetric compensation during descent is unnecessary.
- Manual gas addition valves, so that manual volumetric compensation during descent, loop flushing and oxygen addition are possible at all times during the dive.
- Integrated inert gas loading/decompression management functionality (i.e., dive computer, except for O2CCR).
    - OEM systems are preferred over after-market, second-party systems.
- Rebreathers used on dives incurring a decompression ceiling or in restricted overhead environments must be equipped with:
    - A minimum of two independent displays of oxygen sensor readings available to the diver;
    - Two independent power supplies and redundant CPU able to operate the unit are desirable. If only one is present, a secondary system to monitor and allow manual control of oxygen levels without power from the primary battery must be incorporated.
- Redundancies in onboard electronics, power supplies, life support systems and inert gas management are highly desirable.

3. Requirements for Semi-Closed Circuit Rebreathers (SCR).

- Semi-Closed Circuit rebreathers must be equipped with at least one manufacturer-approved oxygen sensor sufficient to warn the diver of impending hypoxia. Sensor redundancy is desirable.
- Electronically-controlled SCR (eSCR) must incorporate reliable computer-controlled oxygen control systems.

4. Requirements for Closed Circuit Rebreathers (CCR).

Closed-Circuit Rebreathers must be equipped with:

- Reliable computer-controlled oxygen control systems;
- Manual diluent and oxygen addition valves, to enable the diver to maintain safe oxygen levels in the event of failure of the primary power supply or automatic gas addition systems.

5. Requirements for Electronically-Controlled Rebreathers.

Electronic rebreathers must be equipped with:

- Alarm systems to alert the diver and dive team of life-critical conditions including hyperoxia, hypoxia, oxygen sensor malfunction, low power or power failure, and decompression violation.

- Alarms must be designed to be unambiguously distinct from system monitoring instrumentation.
- Alarms to the diver must be designed to be detected by at least two different sensory modalities.
- Alarms to the dive team are required, and must be designed to be easily detectable by team members without active communication from the diver. Incorporation of an audible alarm is preferred.

- A manufacturer-designed “black box” functionality to facilitate post-dive diagnosis of systems control performance, diver action and decompression management, as well as post-incident forensics

6. Modifications to Rebreather Systems

Modifications to rebreather systems must be made with the approval of the DCB.

- Any modification of a rebreather from its standard configuration that is likely to affect life support performance specifications (work of breathing, CO2 control, oxygen control, etc.) should be done only after consultation with the manufacturer.

E. REBREATHER OPERATIONAL REQUIREMENTS

1. General Requirements

Dives involving rebreathers must comply with applicable operational requirements for open-circuit SCUBA dives to equivalent depths. In addition, rebreather divers must comply with the following minimum operational requirements:

- No rebreather system will be used in situations beyond the manufacturer's stated design limits (dive depth, duration, water temperature, etc.).
- Dive Plan. In addition to standard dive plan components stipulated in Section 2.B.12, all dive plans that include the use of rebreathers must include, at minimum, the following details:
  - Information about the specific rebreather model to be used; including:
    - Make, model and type of rebreather system;
    - Type of CO2 absorbent material;
    - Composition and volume(s) of supply gases;
    - Complete description of bailout procedure alternatives to be employed, including manual rebreather operation and open-circuit procedures;
    - Other specific details as requested by DCB.
- Particular attention should be paid to using rebreathers under conditions where vibration or pulsating water movement could affect electronics or control switches and systems.
- Particular attention should be paid to using rebreathers under conditions where heavy physical exertion is anticipated.

2. Buddy Qualifications

- A diver whose buddy is diving with a rebreather must be trained in basic rebreather operation, hazard identification and assist/rescue procedures for a rebreather diver.
- If a rebreather diver’s buddy is using open-circuit scuba, the rebreather diver must be equipped with a means to provide the open-circuit scuba diver with a sufficient supply of open-circuit breathing gas to allow the open-circuit diver to return safely to the surface.

3. Exposure Limits

- The planned oxygen partial pressure (PO2) in the breathing gas must not exceed 1.4 atm at depths greater than 30 feet.
- The PO2 setpoint for eSCR or CCR must not exceed 1.4 atm, or be less than 0.5 atm. Setpoint at depth may be reduced to manage oxygen toxicity.
- The direct PO2 of CCR diluent at maximum planned depth must not exceed 1.0 atm. A PO2 of 0.8 atm is preferred.
- Oxygen exposure indices should be tracked for each diver, based on exposure limits approved by the DCB.
- The inspired nitrogen partial pressure (PN2) at maximum planned depth must not exceed 3.2 atm.
- Respired gas densities should be less than 5 g/L, and should not exceed 6 g/L under normal circumstances.

4. Decompression Management

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

- Use of OEM integrated systems for primary decompression management is preferred.
- Back-up depth and dive time recording device is required.
- For dives requiring decompression stops must incorporate approved redundancy in decompression management, and include contingency planning for over-time and over-depth, delayed ascent, and lost gas scenarios.

5. Rebreather Maintenance and Documentation

- Maintenance must be in compliance with manufacturer's recommendations including sanitizing, replacement of consumables (sensors, CO2 absorbent, gas, batteries, etc.), periodic servicing and upgrades and safety recalls or advisories.
- Maintenance logs are required and will be developed for the model of rebreather used. Logs will minimally include:
  - Dates of service
  - Service performed
  - Individuals or company performing the service.

6. Checklists

Written pre- and post-dive checklists must be developed for the model of rebreather used, and completed by the diver before and after every dive. Checklists should be maintained as permanent project records.

- A rebreather must not be dived if it has failed any portion of the pre-dive check, or is found to not be operating in accordance with manufacturer's specifications.
- Pre-dive assembly and function checks must include:
  - Gas supply cylinder filling;
  - Analysis and supply of all rebreather and bail-out gases;
  - Oxygen sensor calibration;
  - Carbon dioxide canister preparation and installation;
  - Remaining duration of CO_2 canister;
  - Breathing loop assembly;
  - Positive and negative pressure leak checks;

- Automatic volume addition system working;
- Automatic oxygen addition systems working;
- Manual gas addition systems working;
- Buoyancy systems assembled and functioning;
- System pre-breathe system for 3 minutes (5 minutes in cold water) to ensure proper oxygen addition and carbon dioxide removal (be alert for signs of hypoxia or hypercapnia);
- Other procedures specific to the model of rebreather used;
- Documentation of ALL components assembled;
- Complete pre-dive system check performed;

- Final operational verification immediately before to entering the water:
  - The PO2 in the rebreather is not hypoxic;
  - Oxygen addition system is functioning;
  - Volumetric addition is functioning;
  - Manual addition systems are functioning (if applicable);
  - Buoyancy systems are in place and functioning;
  - Bail-out life support is functioning;
  - Electronic systems are properly set and functioning

7. Bail-Out Systems

- Each diver must have reliable access to an alternate life support system designed to safely return the diver to the surface at normal ascent rates, including any required decompression in the event of primary rebreather failure. The complexity and extent of such systems are directly related to the depth/time profiles of the mission. Examples of such systems include, but are not limited to:
  - Open-circuit bailout cylinders or sets of cylinders, either carried or pre-positioned;
  - Redundant rebreather;
  - Pre-positioned life support equipment with topside support.

8. Carbon Dioxide Absorbent

- Only those brands and types of absorbent recommended by the rebreather manufacturer may be used.
- The carbon dioxide absorption canister must be filled in accordance with the manufacturer's specifications.
- The CO2 absorbent material must be used in accordance with the manufacturer's specifications for expected duration.
- If the CO2 absorbent canister is not exhausted and storage between dives is planned, the canister should be removed from the unit and stored sealed and protected from ambient air, to ensure the absorbent retains its activity for subsequent dives.
- Long-term storage of carbon dioxide absorbents should be in a cool, dry location in a sealed container. Field storage must be adequate to maintain viability of the material until use.

9. Other Consumables

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

10. Sanitation and Disinfecting

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

11. Oxygen Rebreathers

- Oxygen rebreathers must not be used at depths greater than 20 feet.
- The breathing loop and diver's lungs must be adequately flushed with pure oxygen prior to entering the water on each dive. Once done, the diver must breathe continuously and solely from the intact loop, or re-flushing is required.
- The breathing loop must be flushed with fresh oxygen prior to ascending to avoid hypoxia due to inert gas in the loop.

12. Semi-Closed Circuit Rebreathers

- The composition of the injection gas supply of a semi-closed rebreather must be chosen such that the partial pressure of oxygen in the breathing loop will not drop below 0.4 atm, even at maximum exertion at the surface.
- The gas addition rate of active-addition SCR (e.g., Draeger Dolphin and similar units) must be checked before every dive, to ensure it is balanced against expected workload and supply gas FO2.
- The intermediate pressure of supply gas delivery in active-addition SCR must be checked periodically, in compliance with manufacturer's recommendations.
- The maximum operating depth must be based upon the FO2 in the active supply cylinder, with a maximum inspired PO2 of 1.4 atm.
- Prior to ascent to the surface the diver must flush the breathing loop with fresh gas or switch to an open-circuit system to avoid hypoxia.
- Divers must monitor oxygen display systems at regular intervals throughout the dive, to verify that readings are within limits, that redundant displays are providing similar values, and whether readings are dynamic or static (as an indicator of sensor failure).

13. Closed-Circuit Rebreathers

- Diluent gas supply must be chosen so that, if breathed directly while in the depth range for which its use is intended, it will produce an inspired PPO2 greater than 0.20 atm but no greater than 1.4 atm.
- Diluent gas supply must be chosen so that, if breathed directly while in the depth range for which its use is intended, it will produce an inspired a PN2 no greater than 4.0atm. A PN2 of 3.2 atm is preferred.
- Divers must monitor oxygen display systems at regular intervals throughout the dive, to verify that readings are within limits, that redundant displays are providing similar values, and whether readings are dynamic or static (as an indicator of sensor failure).

Chapter 14. SURFACE SUPPLIED DIVING—HOOKAH

Hookah is an open circuit diving mode comprised of a remote gas supply, a long hose, and a standard scuba second stage or full face mask. Hookah is generally used in shallow water (30 feet or less), though the configuration has been used to supply breathing gas from a diving bell, habitat, or submersible/submarine.

Hookah Diving in Aquariums may only be used for activities that are in compliance with requirements of the Scientific Diving Exemption. Use of hookah for non-exempt diving is not allowed.

A. PREREQUISITES

Scientific Diver or DIT authorization is required.

B. TRAINING REQUIREMENTS

- A Scientific Diver experienced in hookah operations must serve as Lead Diver.
- Divers must demonstrate the following skills and knowledge:
  - Explain hookah rig function, significant advantages and hazards of the hookah system, and contingency plans for air supply loss or entanglement;
  - Using proper care, perform set-up, pre- and post-dive procedures, storage, and record-keeping for the equipment;
  - Demonstrate ability to safely and efficiently operate the equipment with two divers (at least one checkout dive required);
- Divers must complete a minimum of 12 dives under supervision using hookah before serving as Lead Diver.

C. EQUIPMENT REQUIREMENTS

- Only hookah units approved by the DSO may be used under University jurisdiction.
- Manufacturer's recommendations for maintenance and operation must be followed.
- The air supply hose must be rated for a minimum operating pressure of 130psi.
- Air supplied to the hookah diver must meet the breathing air quality standards outlined in Chapter 6.
- Hookah supply systems must be capable of supplying all divers breathing from the system with sufficient gas for comfortable breathing for the planned depth and workload.
- Hookah system second stage must be attached to the diver in a way to avoid pulling stress on the second stage mouthpiece and affords easy release if the diver must jettison the regulator and hose.
- Each diver will be equipped with a harness to which the hookah hose will be anchored. For open water diving, the anchor must incorporate a mechanism that can be rapidly disconnected under load.
- Compressor air intakes must be located so as to avoid exhaust from compressor or boat engines.
- An independent reserve breathing gas supplied will be carried by each hookah diver:
  - When the diver does not have direct access to the surface or
  - At depths or distance from alternate breathing gas source determined by the DCB.

D. OPERATIONAL REQUIREMENTS

- Hookah divers must follow buddy diving protocols or be surface tended.

- An equipped safety diver capable of safely reaching the divers at the planned depth must be on standby at the surface.
- In water deeper than 30 feet or when a significant hazard of entanglement or current exists, each diver must be hose-tended by a separate surface tender.
- The dive team must establish effective communication signals between hose tenders and divers.
- Divers must comply with all applicable sections of this manual regarding Scientific Diver training and authorization, equipment inspection and maintenance, air quality testing, record keeping, and operational control.
- The hookah gas supply (based on fuel and compressor capacity or surface cylinder volume) must be sufficient to support all divers attached for the duration of the planned dive, including decompression.
- The compressor engine must not be loaded with fuel until it has been shut off and cooled down for at least 15 minutes.
- Hookah diving must not be conducted beyond depths or distance from alternate breathing gas source as determined by the DCB.
- A diver's independent reserve breathing gas supply, if worn, must contain sufficient volume to allow the diver(s) to exit to the surface or alternate breathing gas source.
- On dives below 30 feet, each diver must be equipped with an independent diver-carried breathing gas supply, sufficient to return the diver to the surface in using safe ascent procedures, including any required decompression stops.
- Hookah divers not supported by diving bell, or underwater habitat must not be exposed to dives that require staged decompression.
- When diving in Aquariums, pools or other confined water environments:
    - Where the maximum depth is known and planned for, a depth gauge is not required;
    - A diver using hookah may operate without an in-water buddy provided the diver is tended from the surface; has visual, line pull, or voice communication with the tender; the diver carries an independent reserve breathing gas source containing sufficient volume to allow the diver to exit to the surface or alternate breathing gas source; and meets other operational requirements as determined by the OM DCB.
    - The OM DCB is responsible for developing additional operational protocols for hookah diving specific to the aquarium environment.

Chapter 15. SURFACE SUPPLIED DIVING – HEAVY

Surface-Supplied Diving – Heavy is a mode of diving using open circuit, surface supplied, compressed gas delivered 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, often with voice communications.

Surface-supplied helmet divers must comply with all applicable regulations elsewhere in this manual. Surface supplied diving must not be conducted at depths greater than 190 feet.

A. PREREQUISITES

Scientific Diver or DIT authorization is required.

B. TRAINING AND QUALIFICATION REQUIREMENTS

- Authorization as a UH Scientific Diver is required.
- Divers must satisfy the DCB that they possess the required training, skills, and knowledge to conduct surface-supplied operations. Divers must meet training and experience requirements, as defined by the DCB on a case-by-case basis. Generally, this will include training and certification from a recognized training agency or school for surface-supplied diving operations.

C. EQUIPMENT REQUIREMENTS

- 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 air supply to the diver.
- 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.
- Masks and Helmets
  - Surface supplied and mixed gas masks and helmets must have:
    - A non-return valve at the attachment point between the mask/helmet and hose which must close readily and positively; and
    - An exhaust valve.
  - Surface-supplied masks and helmets must 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
- Air supplied to the diver must meet the air quality standards outlined in Chapter 6.

D. OPERATIONAL REQUIREMENTS

- Each diver must be continuously tended while in the water.
- A diver must be stationed at the underwater point of entry when diving is conducted in enclosed or physically confined spaces.

- 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 m) or outside the no-decompression limits:
  - A separate dive team member must tend each diver in the water;
  - A standby diver must be available while a diver is in the water;
- A diver using Surface Supply 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 deeper than 190 feet (57.9 m).
- Manning: 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 DCB's responsibility to define when the surface supplied dive team must be expanded beyond the minimum manning requirements.
- The DCB may require additional operational protocols as required.

Chapter 16. SATURATION DIVING

Saturation is not currently conducted under the control or auspices of the University of Hawai'i. If operation at other facilities, UH divers must comply with standards meeting the Standards of the American Academy of Underwater Sciences (current version).

No saturation dive will be conducted by UH divers until all members of the team have been trained in saturation diving by a program/facility approved by the DCB and authorized for this type of diving.

Chapter 17. SHIPBOARD DIVING

A. DEFINITION

Shipboard diving operations are defined as any operations conducted from UH Research ships on which a licensed Master is in charge of vessel operations. Generally, this will pertain to the larger vessels operated by the University Marine Center, including the *R/V Kilo Moana*. This includes operations:

- In support of research operations;
- In support of shipboard operations that may require shipboard or embarked divers, when commercial divers are not available, or
- That provide diving support for emergency situations where divers are necessary to ensure the safety of the vessel, embarked personnel, or to avert major property or environmental damage.

B. AUTHORITY AND RESPONSIBILITY

The main participants during shipboard diving operations are the Master of the Vessel, the Principal Investigator or Operations Director, and the Diving Supervisor.

- The Master of the Vessel is responsible for the overall safety of the vessel and all personnel aboard. The Master can request diver assistance in a shipboard emergency.
- The Principal Investigator or Operations Director may require diver assistance to support research dives.
- The Diving Supervisor is responsible for the execution of any research diving operations or any shipboard support dives. The Diving Supervisor will determine if the divers are fit and possess adequate training and experience to respond to research or shipboard diving situations.

C. GENERAL POLICY

- Diving in response to shipboard emergencies or science support dives is voluntary. Any diver may refuse to dive at any time for any reason without concern of penalty.
- Scheduled shipboard diving operations must be outlined in an operations plan and submitted for review by the DSO and DCB.
- Scheduled shipboard dives will be reviewed by all participants involved before the start of the cruise, in a meeting between the On-board Diving Supervisor, the Master, and the Chief Scientist, along with other identified key personnel involved in the diving operation.
- On UNOLS vessels, these regulations must complement and supplement the UNOLS diving regulations (Appendix 10).

University of Hawaii Diving Safety Program

APPENDIX 1. UNIVERSITY OF HAWAI'I DIVING CONTROL BOARD

Diving Safety Officer:
David F. Pence, M.S.
UH Diving Safety Program, EHSO
2040 East West Road
Honolulu, HI, 96822
(808) 956-6420 work
(808) 956-6952 fax
dpence@hawaii.edu

Diving Medical Advisor
VACANT

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Jason C. Jones
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Akaraporn Blaies
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DCB Chair
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Daniela Escontrela
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Emma Kennedy, Director (ex-officio)
Environmental Health and Safety Office
ekennedy@hawaii.edu

APPENDIX 2. UH DIVING SAFETY PROGRAM APPLICATION FORMS

A. SCIENTIFIC DIVING AUTHORIZATION APPLICATION

FORM-FILLABLE PDF

B. SCIENTIFIC DIVER AUTHORIZATION RENEWAL APPLICATION

FORM-FILLABLE PDF

C. INSTRUCTIONS AND APPLICATION FORMS FOR VISITING DIVERS

ALL VISITORS EXCEPT GOVERNMENT EMPLOYEES

VISITING GOVERNMENT EMPLOYEES

(Including state college and university employees)

D. SCIENTIFIC DIVING RESEARCH PROPOSAL APPROVAL

WORD VERSION

E. STUDENT PROJECT, THESIS OR DISSERTATION RESEARCH APPROVAL

WORD VERSION

GOOGLE FORMS VERSION

F. DIVE PLAN APPROVAL APPLICATION

WORD VERSION

APPENDIX 3. DIVING MEDICAL EXAM INSTRUCTIONS, INSTRUCTIONS TO PHYSICIANS AND EXAM FORMS

UH DIVING MEDICAL EXAM INSTRUCTIONS TO DIVER

UH DIVING MEDICAL EXAM FORMS AND EXAMINING PHYSICIAN INSTRUCTIONS

APPENDIX 4. PHYSICIANS WITH EXPERTISE IN DIVING AND HYPERBARIC MEDICINE

OAHU:

Dr. Michael Kusaka
Straub-Beretania Occupational Medical Clinic
839 S. Beretania St.
Honolulu, HI 96813
Phone 808-522-4546

MAUI:

Dr. Maria Theresa David
3860 Wailea Alanui Drive, Suite 102
Kihei, HI 96753
(808) 875-1270
(808) 875-1281

APPENDIX 5. PERSONAL DIVE LOG REPORTING FORMS

UH MONTHLY DIVE LOG REPORT FORM

COVID PANDEMIC DAILY DIVE REPORT FORM

APPENDIX 6. PERSONAL DIVE LOG SHEET GUIDELINES AND DEFINITIONS

PDF VERSION

APPENDIX 7. UH LOR REQUEST FORM AND AAUS RECIPROCITY LETTER EXAMPLE

To obtain a LOR, UH divers must submit to the DSO a LOR request form, available on the UHDSP web site:

http://www.hawaii.edu/ehso/diving-safety-request/

Below is an example of content required in a Letter of Reciprocity minimally compliant with AAUS Standards.

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

Diver: _____ Date: _____

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

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

_____ Original diving authorization
_____ Written scientific diving examination
_____ Last diving medical examination Medical examination expiration date_____
_____ Most recent checkout dive
_____ Scuba regulator/equipment service/test
_____ CPR training (Agency) _____ CPR Exp. _____
_____ Oxygen administration (Agency) _____ 02 Exp. _____
_____ First aid for diving _____ F.A. Exp. _____
_____ Date of last dive _____ Depth
Number of dives completed within previous 12 months?_____ Depth 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 8. DIVING EMERGENCY MANAGEMENT PROCEDURES

Introduction.

A diving accident victim could be any person who has been breathing air underwater regardless of depth. It is essential that emergency procedures are pre-planned, and that medical treatment is initiated as soon as possible. It is the responsibility of the Lead Diver for each project or dive to establish effective diving emergency procedures for the local diving operations, including evacuation and medical treatment.

General Procedures.

AS PART OF THE DIVE PLAN:

1. Develop an Access and Treatment Plan for the following:
   - Available Equipment, Assets, and Procedures
   - Emergency care
   - Recompression
   - Evacuation
2. Assemble a List of Emergency Contact Numbers Appropriate For the Dive Location:
   - 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.

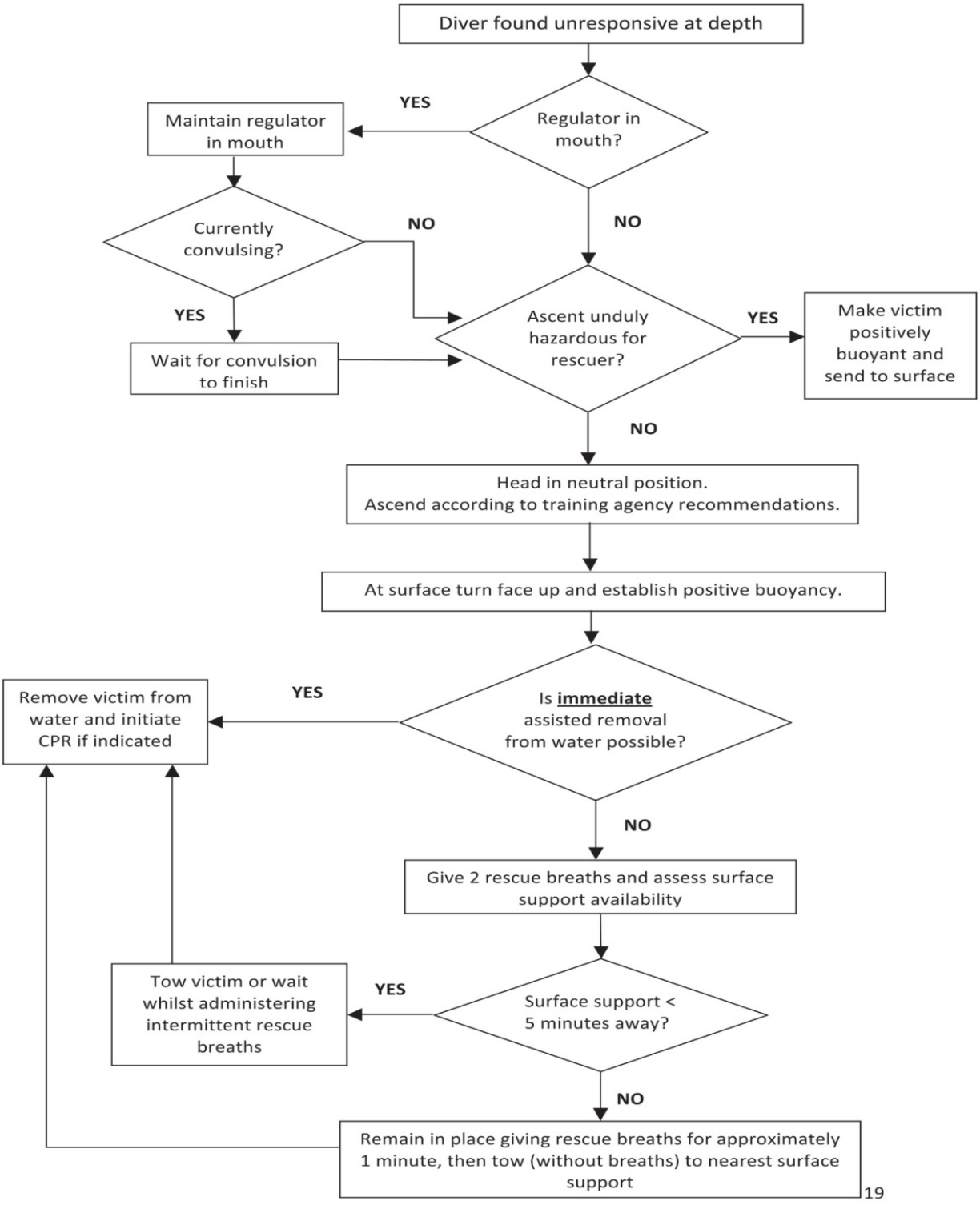
IN THE EVENT OF AN ACCIDENT:

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

1. Make appropriate contact with, rescue and stabilize the victim, as required.
2. Establish **(A)**irway, **(B)**reathing, **(C)**irculation, as required. Control severe bleeding and treat for Shock, as per First Aid guidelines.
3. Administer 100% oxygen, if appropriate (in cases of suspected Near Drowning, DCS, AGE, Cardiac Emergencies, or Breathing Emergencies).
4. Contact local Emergency Medical System (EMS) for transport to nearest medical treatment facility
   - Explain the circumstances of the dive accident to 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 may be necessary.
5. If possible, complete or assign additional personnel to complete the following actions:
   - Take notes of how the incident occurred, and all response measures taken, including a time table of actions;
   - Isolate the victim's equipment for inspection by the DSO and authorities;
   - Manage the accident scene for crowd control, Assign someone to keep bystanders from interfering;
   - Make statements regarding the incident only to University and EMS/Medical personnel. University representatives must be responsible for providing information to the media.
6. Call the UH DSO for contact with diving physician and recompression chamber. If in Hawaii and the DSO cannot be reached, call the UH Hyperbaric Medical Center directly.
7. Notify the DSO, DCB Chair, or Director of the Environmental Health and Safety Office.
8. Complete and submit the **UH Near Miss, Incident or Accident Reporting Form** to the UH DSO.

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



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University of Hawai'i Diving Safety Program

Emergency Contact Information

(Unless specified, all area codes are 808)

UNIVERSITY CONTACTS

SYSTEM DIVING SAFETY OFFICER
David Pence
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342-8871 mobile
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SYSTEM ADMINISTRATIVE SPECIALIST
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MANOA LOGISTICS SPECIALIST
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UNIT DIVING COORDINATORS

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clint.collins@hawaii.edu

Jason C. Jones
Hawaii Institute of Marine Biology
P.O. Box 1620
Kaneohe, HI 96744
(808) 440-8608
jasoncj@hawaii.edu

DIVING MEDICAL ADVISOR

VACANT

SEARCH, RESCUE AND CASUALTY EVACUATION CONTACT INFORMATION

EMT/AMBULANCE, ALL MAIN HAWAIIAN ISLANDS: **Call 911**

U.S. COAST GUARD

Search and Rescue Operations Center:	541-2500
Honolulu, HI	toll free cellular:*8724 (*USCG)
Response Stations:	
Honolulu Harbor, Oahu	541-2454
Ma'alaea Harbor, Maui	244-7235
USCGC Point Evans, Nawiliwili Harbor, Kauai	246-0390
USCGC Kiska, Hilo Harbor, Big Island	933-6944
Air Evacuation Barber's Point NAS, Oahu	(through Ops Center)

City and County of Honolulu

Fire and Rescue	Call 911
Lifeguard Service	922-3888

HOSPITAL EMERGENCY ROOMS

OAHU:

Kuakini Hospital 347 N. Kuakini St., Honolulu	547-9540
Castle Memorial Hospital 640 Ulukahiki St., Kailua, HI	263-5500
Kahuku Hospital, Kahuku	293-9221
Kapi'olani Medical Center 1319 Punahou St., Honolulu	973-8511
Queens Hospital 1301 Punchbowl St., Honolulu	538-9011
Straub Hospital 888 S. King St., Honolulu	522-4000
Wahiawa General Hospital 128 Lehua St., Wahiawa	621-8411

MAUI:

Maui Memorial Hospital 221 Mahalani St., Kahului	242-2343

LANAI:

Lanai Community Hospital	565-6411

MOLOKAI:

Molokai General Hospital	553-5331

BIG ISLAND (HAWAII):

Hilo Medical Center 1190 Waianuenue Ave., Hilo	969-4111

Kona Community Hospital* Kealakekua (Captain Cook)	322-9311*
Kohala Hospital* Kapaau (Hawi)	889-6211*
North Hawai'i Community Hospital* 67-1125 Mamalahoa Hwy, Kamuela	885-4444*
Honokaa Hospital, Honokaa	775-7211*

* at significant altitude

REGIONAL HYPERBARIC TREATMENT CENTERS

HAWAII:

University of Hawaii Hyperbaric Treatment Center Kuakini Hospital 347 N. Kuakini St. (Staffed 24 hours, M.D. on call)	(808) 587-3425 Honolulu, HI 96817

GUAM:

Apra Harbor U.S. Naval Station Ship Repair Facility	(671) 339-7143

MEDICAL ADVICE AND GUIDANCE

University of Hawaii Hyperbaric Medical Center	(808) 587-3425 (staffed 24 hours)
Diver's Alert Network (DAN) Duke University Medical Center Durham, NC (Eastern Standard Time)	(919) 684-2948 (General Diving Medicine information) (919) 684-8111 (Emergencies only. Call COLLECT and state: ("I am reporting a diving accident")

APPENDIX 9. DIVING INCIDENT AND ACCIDENT REPORT FORM

Serious near-miss incidents and accidents must be immediately reported by the Lead Diver or Project Supervisor to the DSO or DCB Chair by phone, text or email. An Incident or Accident report must be completed within 24 hours using the UH Diving Near Miss, Incident or Accident Reporting Form, available at:

GOOGLE FORMS VERSION

APPENDIX 10. UNIVERSITY NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM RESEARCH VESSEL OPERATING COMMITTEE SHIPBOARD DIVING REGULATIONS

(Reprinted from the UNOLS Shipboard Safety Standards, RVOC Safety Training Manual)

University National Oceanographic Laboratory System Research Vessel Operating Committee Shipboard Diving Regulations

POLICY

Scientific diving is a normal part of oceanographic research vessel operations. Such diving conducted from a University-National Oceanographic Laboratory System (UNOLS) vessel must be under the auspices of a diving program that meets the minimum American Academy of Underwater Sciences (AAUS) Standards for Scientific Diving Certification and Operation of Scientific Diving Programs. Operators without a program may accommodate scientific diving cruises which are under the auspices of an institution with such a program.

DIVING PROCEDURES, RULES AND REGULATIONS

For all cruises a single lead institution's campus diving administration will be designated. This is usually accomplished by agreement of all campus diving administrations involved. Items which refer to the campus diving administration may, in fact, be the concern of the Diving Safety Officer according to the practices of the institutions involved. The procedures, rules and regulations that govern the diving operation are those of the designated lead institution, subject to the approval of the operator's Marine Office.

CRUISE PLANNING

In a timely fashion prior to the cruise:

1. The Principal Investigator will ensure that a cruise plan is supplied to his or her campus diving administration, who will forward the cruise plan, once approved, to the lead institution's campus diving administration and the Chief Scientist. The dive plan, prepared in a standard format, includes: diving credentials for all diving members of the scientific party, detailed operational plans, emergency plans including accident management and emergency evacuation protocols, a list of needed medical supplies, a specified quantity of medical grade oxygen with a positive pressure demand delivery system and required diving support equipment (e.g., small boats).

2. The lead institution's diving administration will, after approving this plan, forward it to the operator's Marine Office.

CRUISE PERSONNEL

1. The Master has ultimate responsibility for the safety of all activities aboard including diving.

2. The Chief Scientist is responsible for the coordination and execution of the entire scientific mission.

3. The Principal Investigator of the diving project (who may or may not be the Chief Scientist) is responsible for the planning and coordination of the research diving operations.

4. The On-Board Diving Supervisor will be proposed by the Principal Investigator and approved by the lead institution's diving administration. The On-Board Diving Supervisor is responsible for the execution of the research diving operations in accordance with the cruise dive plan. He or she has the authority to restrict or suspend diving operations and alter the cruise dive plan in consultation with the Master and Principal Investigator/Chief Scientist. The On-Board Diving Supervisor's responsibilities include:

- **a.** Meeting with the Master and Chief Scientist to review the cruise dive plan and emergency procedures prior to diving.
- **b.** Remaining in regular communication with the Master on the progress of the research diving operation.
- **c.** Assuring that both the lead and operating institution's diving manuals are available to the scientists and crew aboard the vessel.
- **d.** Inspecting high pressure cylinders and breathing air compressors to assure that they meet the lead institution's standards.

5. Research Divers must recognize their individual responsibility for their safety.

APPENDIX 11. AAUS SAFE ASCENT RECOMMENDATIONS

From: AAUS BIOMECHANICS OF SAFE ASCENTS WORKSHOP, 1990, Lang and Egstrom (Eds.)

1. It has long been the position of the American Academy of Underwater Sciences that the ultimate responsibility for safety rests with the individual diver.
2. The time has come to encourage divers to slow their ascents.
3. Buoyancy compensation is a significant problem in the control of ascents.
4. Training in, and understanding of, proper ascent techniques is fundamental to safe diving practice.
5. Before certification, the diver is to demonstrate proper buoyancy, weighting, and a controlled ascent, including a “hovering” stop.
6. Divers must periodically review proper ascent techniques to maintain proficiency.
7. Ascent rates must not exceed 60 feet per minute.
8. A stop in the 10-30 feet zone for 3-5 minutes is recommended on every dive.
9. When using a dive computer or tables, non-emergency ascents are to be at the rate specified for the system being used.
10. Each diver must have instrumentation to monitor ascent rates.
11. Divers using dry suits must have training in their use.
12. Dry suits must have a hands-free exhaust valve.
13. BC’s must have a reliable rapid exhaust valve which can be operated in a horizontal swimming position.
14. A buoyancy compensator is required with dry suit use for ascent control and emergency flotation.
15. Breathing 100% oxygen above water is preferred to in-water air procedures for omitted decompression.

APPENDIX 12. GUIDELINES FOR NON-EXEMPT DIVING IN SUPPORT OF SCIENCE (NEDSS)

In some instances, diving operations under University auspices may be necessary in support of the research and education mission that do not meet the requirements for conduct under the OSHA Commercial Diving Regulations' Scientific Diving Exemption (29 CFR Part 1910, Subpart T, Paragraph B). In such cases, the following requirements must be implemented. The following measures are in addition or variance to applicable measures specified in previous sections of this manual.

1. **Staffing.** All participating personnel must be Active-status Scientific Divers in good standing, qualified for the planned activity and their role therein.
    a. **Designated Person In Charge (DPIC).** A DPIC must be topside and on site during the conduct of diving operations. The DPIC must perform the duties of the project Lead Diver (Section 1.E.2), including:
        i. Overseeing operations to comply with applicable sections of this standard, and the approved dive plan (Section 2.B.12);
        ii. Confirming participating divers are fit to dive;
        iii. Conducting the pre-dive briefing and safety checks and post-dive briefings (Sections. 2.B.12, 2.B.13);
        iv. Managing any required response to an accident or injury.
    b. **Response Diver.** A Response Diver must be on standby at the dive site, equipped and ready to respond to a diver in distress in a timely fashion upon direction of the DPIC.
    c. **Divers.** Divers must operate in strict adherence to the buddy system, unless line-tended.
2. **Equipment.** Each diver must be equipped with the following, in addition to or variance from other requirements of this manual (Section 2.B.3 – 2.B.7, Chapter 5).
    a. **Reserve Air Supply (RAS).** Each Diver must carry an independent reserve air supply.
        i. The RAS must contain sufficient volume to safely return the diver to the surface or to other adequate reserve breathing supply, according to established standard safe ascent procedures.
        ii. The RAS must have a diver-activated on/off valve capable of preventing inadvertent emptying while in reserve. The valve must be in the "OFF" position when the diver is not breathing from the RAS
    b. **Buoyancy Compensator**. A buoyancy compensator capable of floating an unconscious diver in a face up position without other support;
3. **Procedures.** The following procedures are in addition or varied from those otherwise stated in the previous chapters of this manual
    a. A full copy of the diving safety manual and dive plan will be available on site.
        i. The dive plan will contain current status reports for each participating diver, and a detailed hazard risk assessment and management plan including any changes to SOP for daily operations.
        ii. The dive plan will be reviewed by the DPIC with the dive team before the start of the day's diving operations.
    b. Project pre-dive and post-dive checklists will be developed and used, including a daily dive log.
    c. Reliable contact and communication must be maintained between the divers and the Tender/Response Diver.
        i. Scuba divers swimming free will strictly adhere to the buddy system and keep continuous contact with topside personnel.
    d. Divers must be line-tended during any dives
        i. conducted by a single diver;

ii. on dives deeper than 100 feet; or

iii. in currents exceeding 1 knot.

e. The minimum number of dive staff required for a single, line-tended diver is three: DPIC; Response Diver/Line Tender, and Diver.

i. The DPIC must be equipped and prepared to serve as tender in the event that the Response Diver must deploy.

f. The minimum number of dive staff required for a pair of scuba divers is four: DPIC, Response Diver and two divers.

i. A buddy pair may be line tended by one tender with a single line to the primary diver, if a buddy line is used between the divers, and there is no risk of entanglement.

g. In the event of a diver in distress or loss of contact or communication, the Response Diver/Tender will notify the DPIC and deploy to assist the diver(s). The DPIC will take the role of the Tender, while the Response Diver deploys.

h. An approved recompression chamber must be on site during any diving operation:

i. Conducted to depths in excess of 100 ;

ii. Requiring decompression stops (other than precautionary stops);

iii. Using breathing gases other than air.

APPENDIX 13. AAUS SCIENTIFIC DIVER TRAINING REQUIREMENTS

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-location • Specialized Data Gathering Equipment	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 • 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 8
	* 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 OM 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 OM-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)

APPENDIX 14. AAUS REBREATHER TRAINING STANDARDS (DEC 2018)

AAUS Section 11.60 REBREATHER TRAINING

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, CO_2 monitor, etc.)	ISE	ISE	ISE
Dive planning:			
Operational planning	X	X	X
Gas requirements	X	X	X
Oxygen exposure and management	X	X	X
Gas density calculations		X	X
Oxygen metabolizing calculations	X	X	X
Scrubber limitations	X	X	X
Mixed mode diving (buddies using different dive modes)	X	X	X
Mixed platform diving (buddies using different rebreather platforms)	X	X	X
Problem Recognition & Emergency Procedures:			
Applicable open circuit emergency procedures for common gear elements	X	X	X
Loss of electronics	ISE	ISE	X
Partially flooded loop	X	X	X
Fully flooded loop	X	X	X
Cell warnings		ISE	X
Battery warnings	ISE	ISE	X
High O_2 warning	ISE	ISE	X
Low O_2 warning	ISE	ISE	X
High CO_2 warning	ISE	ISE	ISE
Recognizing issues as indicated by onboard scrubber monitors	ISE	ISE	ISE
Recognizing hypercapnia signs and symptoms in self or 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 ascent	X	X	X
Proper interpretation and operation of system instrumentation	X	X	X
Proper buddy contact and communication	X	X	X
Use of a line reel or spool to deploy an SMB from planned dive depth and while controlling buoyancy in the water column	X	X	X
Proper management of line reel or spool, and SMB during ascents and safety or required stops	X	X	X
Unit removal and replacement on the surface	X	X	X
Bailout and emergency procedures for self and buddy, including:			
System malfunction recognition and solution	X	X	X
Manual system control	ISE	ISE	ISE
Flooded breathing loop recovery	IA	IA	IA
Absorbent canister failure	X	X	X
Alternate bailout options	X	X	X
Manipulation of onboard and 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. Decompression, Normoxic, and Hypoxic Mix Training Required for Rebreathers

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 Appendix 1)
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 failure	X	X	X
Operation in semi-closed mode	X	X	X
Properly execute the ascent procedures for an incapacitated dive buddy	X	X	X
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 Water	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

C. 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.

APPENDIX 15. AAUS GLOSSARY AND 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).

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

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”.

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.

fO2 - 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 pO2 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.

pO2 - 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 16. AAUS STATISTICS COLLECTION CRITERIA AND DEFINITIONS

COLLECTION CRITERIA:

- The "Dive Time in Minutes", The Number of Dives Logged", and the "Number of Divers Logging Dives" will be collected for the following categories.
  - Dive Classification
  - Breathing Gas
  - Diving Mode
  - Decompression Planning and Calculation Method
  - Depth Ranges
  - Specialized Environments
  - Incident Types

- Dive Time in Minutes is defined as the surface-to-surface time including any safety or required decompression stops.
- A Dive is defined as a descent 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 his/her 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
- 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.
- Hypercapnia: An incident that can be attributed to the diver being exposed to an excess of carbon dioxide.
- Fatality: Any death accruing during a dive or resulting from the diving exposure.
- Other: An incident that does not fit one of the listed incident types

Incident Classification Rating Scale:

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