HANDBOOK FOR DIVING SAFETY

UNIVERSITY *of* NEW HAMPSHIRE

School of Marine Science and Ocean Engineering

REVISED IN CONFORMANCE WITH THE GUIDELINES, PROCEDURES,

AND STANDARDS OF THE AMERICAN ACADEMY OF UNDERWATER SCIENCES

January 1998, February 1999, August 2001, September 2004, January 2006, August 2010, March 2014, April 2016, March 2019

FOREWORD BY AAUS

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

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

American Academy of Underwater Sciences

ACKNOWLEDGEMENTS

The Academy thanks the numerous dedicated individual and organizational members for their contributions and editorial comments in the production of these standards. The University of New Hampshire's dive manual is based on the AAUS template that was approved by the AAUS BOD December 2018.

Revision History
Available at www.aaus.org/About/Diving Standards

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Volume 1

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Section 1.00 GENERAL POLICY

1.10 Scientific Diving Standards

Purpose

The purpose of these Scientific Diving Standards is to ensure scientific diving is conducted in a manner that will maximize the protection of scientific divers from accidental injury and/or illness, and to set forth standards for training and certification that will allow a working reciprocity between Organizational Members (OMs or OM). Fulfillment of these purposes shall be consistent with the furtherance of research and safety, and facilitation of collaborative opportunities between AAUS OMs.

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

Historical Perspective

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

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

Scientific Diving Definition

Scientific diving is defined (29CFR1910.402) as:

"Diving performed solely as a necessary part of a scientific, research, or educational activity by employees whose sole purpose for diving is to perform scientific research tasks. Scientific diving does not include performing any tasks usually associated with commercial diving such as: Placing or removing heavy objects underwater; inspection of pipelines and similar objects; construction; demolition; cutting or welding; or the use of explosives."

Scientific Diving Exemption

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

a) Diving safety manual which includes at a minimum: Procedures covering all diving operations specific to the program; procedures for emergency care, including recompression and evacuation; and criteria for diver training and certification.
b) Diving control (safety) board, with the majority of its members being active divers, which must at a minimum have the authority to: Approve and monitor diving projects; review and revise the diving safety manual; assure compliance with the manual; certify the depths to which a diver has been trained; take disciplinary action for unsafe practices;

and, assure adherence to the buddy system (a diver is accompanied by and is in continuous contact with another diver in the water) for SCUBA diving.

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

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

Recommendations for Changes to AAUS Manual

As an organizational member of AAUS UNH may annually make recommendations for modifications of this *Manual* and may be submitted to AAUS for consideration.

1.20 Operational Control

Organizational Member Auspices and Responsibilities

For the purposes of these standards the auspices of the University of New Hampshire (UNH) include any scientific diving operation in which UNH is connected because of ownership of life support equipment used, locations selected, or relationship with the individual(s) concerned. This includes all cases involving the operations of authorized individuals of UNH or auxiliary organizations, where such individuals are acting within the scope of their authorization.

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

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

The University of New Hampshire's Scientific Diving Safety Manual

UNH has developed and maintains a diving safety manual that includes wording on how UNH defines specific policies and procedures required for the proper function of a scientific diving program. This manual must address environmental and working conditions unique to UNH's Dive program's operations. UNH's diving manual must meet or exceed the AAUS standards.

"This manual cannot cover every nuance that might occur in all diving situations. Remember none of the regulations in this manual should ever be a substitute for sound judgment, common sense, and situational awareness that constantly leads to a concern for safety."

Diving Control Board

- The UNH Diving Control Board (DCB) must consist of a majority of active scientific divers. Voting members include the Diving Safety Officer (DSO), and at least one representative from each of UNH's dive projects and marine labs/facilities holding a seat on the DCB. Graduate students may be invited to sit on the board if their research involves diving. A chairperson will be chosen from the membership of the board, as a rotating position. The UNH DCB must convene a meeting face to face at least once per year.

- **The UNH DCB has autonomous and absolute authority over UNH's scientific diving program's operation.**

- **The UNH DCB duties and responsibilities:**

    - Establish additional standards, protocols, and operational procedures beyond the AAUS minimums to address UNH's specific needs and concerns.
    - Approve and monitor UNH diving projects.
    - Review and revise the UNH diving safety manual.
    - Ensure compliance with the UNH diving safety manual.
    - Approve the depth to which a UNH diver has been authorized to dive.
    - Take disciplinary action for unsafe practices.
    - Ensure adherence to the buddy system for scientific diving.
    - Act as the official representative of UNH in matters concerning the scientific diving program.
    - Act as a board of appeal to consider diver-related problems.
    - Recommend the issue, reissue, or the revocation of UNH diving authorizations.
    - Recommend changes in policy and amendments to AAUS and UNH's diving safety manual as the need arises.
    - Establish and/or approve training protocols or standards through which the applicants for authorization can satisfy the requirements of UNH's diving safety manual.
    - Suspend diving operations considered to be unsafe or unwise.
    - Establish criteria for equipment selection and use.
    - Recommend new equipment or techniques.
    - Establish and/or approve facilities for the inspection and maintenance of diving and associated equipment.
    - Ensure that UNH's air stations meet air quality standards as described in Section 3.60.
    - Periodically review the DSO's performance and program.
    - Investigate diving incidents within UNH's diving program or violations of UNH's diving safety manual.

- **The UNH DCB has delegated operational oversight for portions of the program to the DPO; however, the UNH DCB may not abdicate responsibility for the safe conduct of the diving program.**

Diving Program Officer

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

Qualifications:

1. Shall be appointed by the Director of the School of Marine Sciences and Ocean Engineering, with the advice and counsel of the UNH DCB.
2. 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."
3. Must be an active scuba instructor from an internationally recognized certifying agency. With experience as a scientific diver and supervisor for a minimum of 5 years in a variety of environmental conditions. Shall possess diving experience in cold water, current, low visibility, and from large and small vessels.
4. Must attend an AAUS DPO Orientation within one year of accepting a position at an AAUS approved OM, unless he/she has served as a DPO for another current AAUS OM within the last year.

Duties and Responsibilities

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

Instructional Personnel Qualifications

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

Diving Supervisor

Responsibilities:

- Act as the on-site representative of the Diving Program Officer for scientific diving projects and diver training activities.
- Maintain presence on all dives from vessels and, all other dives, which may present unusual or difficult circumstances.
- In water supervision for individuals who hold a Diver-In-Training Permit.

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

Qualifications:

- Meet all the qualification criteria for Scientific Diver as outlined in Section 4.00
- A minimum of 50 hours of documented dive time.
- Successful completion of approved Diver rescue training
- Diving experience in a variety of conditions including cold water, current, low visibility, and from large and small vessels.
- Experience supervising divers in various conditions.
- Recommendations from the DPO or UNH dive supervisors.

Lead Diver

The diving Program Officer or Project Dive Supervisor will appoint one member of each dive team as the Lead Diver. The Lead Diver shall hold a Scientific Diver certification and be experienced with the site, mode, and dive objectives.

The Lead Diver shall be responsible for:

- This individual shall be responsible for the in-water coordination of the scientific effort and the safety of the team while underwater.

- When diving operations are conducted in protected or shallow areas (less than 60ft/18m), with currents less than 0.5 knots, and at the discretion of the DSO, the Lead Diver may assume the on-site responsibilities of the Diving Supervisor.
- Ensuring safety and emergency equipment is in working order and at the dive site.
- Suspending diving operations if in their opinion conditions are not safe.
- Reporting to the DCB, through the DPO, any physical problems or adverse physiological effects including symptoms of pressure-related injuries.

Reciprocity and Visiting Scientific Diver

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

Waiver of Requirements

The UNH DCB may grant a waiver for specific requirements of training, examinations, depth authorizations, and minimum activity to maintain authorizations. UNH/AAUS medical standards may not be waived. Waivers will be documented in the diver's file.

1.30 Consequence of Violation of Regulations by Scientific Divers

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

1.40 Consequences of Violation of Regulations by Organizational Members

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

1.50 Record Maintenance

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

Availability of Records:

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

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

SECTION 2.00 DIVING REGULATIONS

2.10 Introduction

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

2.20 Pre-Dive Procedures

Dive Plans

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

- Diving Mode(s) and Gas(es)
- Divers' names, authorizations, and emergency contact information
- Shore contact if needed
- Approximate number of proposed dives
- Location(s) of proposed dives
- Estimated depth(s) and bottom time(s) anticipated
- Decompression status and repetitive dive plans, if required
- Proposed work, equipment, and boats to be employed
- Any hazardous conditions anticipated
- Emergency Action Plan (Appendix 7)
- In water details of the dive plan should include:
    - Dive Buddy assignments and tasks
    - Goals and objectives
    - Maximum depth(s) and bottom time
    - Gas management plan
    - Entry, exit, descent and ascent procedures
    - Perceived environmental and operational hazards and mitigations
    - Emergency and diver recall procedures

Diver Responsibility and Refusal to Dive

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

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

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

Pre-dive Safety Checks

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

of the dive buddy or tender. They must ensure the equipment is functioning properly and suitable for the type of diving operation being conducted.

- Each diver must have the capability of achieving and maintaining positive buoyancy at the surface.
- Environmental conditions at the site will be evaluated prior to entering the water.

Pre-dive Briefings

Before conducting any diving operations under the auspices of UNH, the dive team members must be briefed on:

- Dive Buddy assignments and tasks
- Dive objectives.
- Maximum depth(s) and bottom time
- Turn around pressure and required surfacing pressure
- Entry, exit, descent and ascent procedures
- Perceived environmental and operational hazards and mitigations
- Emergency and diver recall procedures

2.30 Diving Procedures

Solo Diving Prohibition

All UNH diving activities shall assure adherence to the buddy system. The buddy system is two comparably equipped divers in the water in constant communication. This buddy system is based upon mutual assistance, especially in the case of an emergency. An exception to this rule is during tethered diving described in sec 10.6. If dive team members become separated they shall search in the area for no longer than one minute before surfacing to relocate the other team members and resume the dive if possible.

Decompression Management

- On any given dive, both divers in the buddy pair must follow the most conservative dive profile
- The inclusion of a safety stop performed during the ascent phase of the dive is strongly recommended to minimize the formation of inert gas bubbles. Stops at 15 or 20 FSW (depending upon surface swell heights) for at least 3 minutes should be part of the in-water dive plan and air consumption calculations. NOTE: Surfacing, then going back down for a safety stop negates any beneficial effect of the stop. Once on the surface the diver must remain there.

Termination of the Dive

Any dive must be terminated while there is still sufficient cylinder pressure to permit the diver to safely reach the surface, including decompression time, or to safely reach an additional air source at the decompression station.

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

Emergencies and Deviations from Regulations

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

Diving from Vessels

All diving from University of New Hampshire owned or controlled vessels shall be limited to the following individuals:

- Those persons certified as UNH divers or guest divers engaged in recognized University research diving projects.
- Those persons certified as UNH divers engaged in training or certification activities as authorized by the Diving Program Officer.
- Students enrolled in a recognized UNH Diver Certification Course.
- Those persons who are paid by the UNH for diving services.

Vessel Diving Personal requirements

- When diving from UNH vessels the minimum crew shall consist of a boat operator and the dive team members. The boat operator shall be a certified UNH diver or have experience operating a vessel with divers, on at least 3 occasions under the supervision of a UNH qualified boat operator, or UNH certified diver. If the boat operator is not a UNH diver they must be certified in CPR/First Aid and Oxygen Administration for diving accidents.
- When diving from the RV Gulf Challenger or other large vessels operating under the auspices of the University of New Hampshire, the 'Zodiac' or other support vessels may be deployed when the vessel is at anchor. The decision to deploy the support vessel will be discussed by the Captain and the Diving Supervisor prior to the start of diving operations.
- All UNH diving activities conducted from vessels shall be under the direction of a Diving Supervisor. The Supervisor will be responsible for all diving activities and will cooperate with the vessel captain to ensure the safety of all aboard.
- When diving operations take place in protected waters near shore (0.25nm), at depths less than 60fsw with currents less than 0.5knots, and at the discretion of the DSO a designated Lead diver may substitute for the Diving Supervisor.
- Due to special conditions that might include but is not limited to; winter weather, remote dive sites, depth of dives, and diving mode the DPO may at require additional qualified personnel aboard the diving platform or vessel.

2.40 Post-Dive Procedures

Post-Dive Safety Checks

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

2.50 Emergency Procedures

UNH's Dive Program has developed emergency procedures which follow the standards of care of the community and includes procedures for emergency care, recompression, evacuation, and incident reporting. (Appendix 7- general EAP) Detailed procedures will be displayed on the project dive plan submitted to the UNH DCB.

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

- Following a Single No-Decompression Dive: Divers should have a minimum preflight surface interval of 12 hours.
- Following Multiple Dives per Day or Multiple Days of Diving: Divers should have a minimum preflight surface interval of 18 hours.
- Following Dives Requiring Decompression Stops: Divers should have a minimum preflight surface interval of 24 hours.
- Before Ascending to Altitude Above 1000 feet (304 meters): Divers should follow the appropriate guideline for preflight surface intervals unless the decompression procedure used has accounted for the increase in elevation.

2.70 Record Keeping Requirements

UNH Diving Log

Each authorized scientific diver must log every dive made under the auspices of UNH's dive program and is encouraged to log all other dives. UNH encourages divers to use the UNH/AAUS web-logging site to record dives. Or an Excel Log sheets may be submitted to the Diving Program Officer.

The dive log must include at least the following:

- Name of diver and buddy
- Date, time, and location
- Diving modes used
- General nature of diving activities
- Maximum depth and dive time
- Diving tables or computers used
- Detailed report of any near or actual incidents

Required Incident Reporting

Incident: "An occurrence that interrupts normal procedures or brings about a crisis."

All diving incidents requiring recompression treatment, or resulting in moderate or serious injury, or death must be reported to UNH's DCB and AAUS in a timely manner. UNH must record and report occupational injuries and illnesses in accordance with requirements of the appropriate Labor Code section. The UNH DCB must investigate and document any incident of pressure-related injury and prepare a report that is to be forwarded to AAUS during the annual reporting cycle.

- If pressure-related injuries are suspected, or if symptoms are evident, the following additional information must be recorded and retained by UNH, with the record of the dive, for a period of 5 years:
  - Written descriptive report shall include:
    - Name, address, phone numbers of the principal parties involved.
    - Summary of experience of divers involved.

- Location, description of dive site, and description of conditions that led up to incident.
- The circumstances of the incident and the extent of any injuries or illnesses.
- Description of symptoms, including depth and time of onset.
- Description and results of treatment.
- Disposition of case.
- Recommendations to avoid repetition of incident.

In addition to requirements specific to UNH, all diving incidents will be reported to the AAUS. This report must first be reviewed and released by UNH'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.

SECTION 3.00 DIVING EQUIPMENT

3.10 General Policy

All equipment must meet standards as determined by the DPO and the UNH DCB. All equipment must be regularly examined by the person using it and serviced according to manufacturer recommendations. Equipment that is subjected to extreme usage under adverse conditions should require more frequent testing and maintenance.

3.20 Equipment

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

Regulators and Gauges

- Scuba regulators and gauges must be inspected and tested prior to each use and serviced, at a minimum, according to manufacturer's recommendations
- Standard open circuit (OC) regulator configuration is:
  - A first stage
  - Primary 2nd stage
  - Back up 2nd stage
  - Submersible Pressure Gauge (SPG)
  - Inflator hose for a Buoyancy Compensator Device
  - A cutting tool or knife

  Highly recommended:
  - Surface marker buoy (SMB)
  - Whistle or audible alarm
- A Full-Face Mask may be used in place of the primary 2nd stage according to manufacturer's recommendations

Equipment for Determination of Decompression Status

- Each member of the buddy team must have an underwater timing device and depth indicator, or dive computer.
- UNH allows for the use of the NAUI dive tables (based on the USN tables). If tables are being used they must be available at the dive site. Exceptions for the use of dive planning software must be approved by the DPO/DCB prior to diving.
- Dive computers may be utilized in place of diving tables and must be approved by the DPO/DCB. If a dive computer is used the diver must use the same computer on repetitive dives.
- In an aquarium or other manmade structure (OE tank) of a known maximum obtainable depth:
  - A depth indicator is not required, except when a diver's decompression status must be taken into consideration on repetitive dives.
  - Only one buddy must be equipped with a timing device.
  - The maximum obtainable depth of the aquarium must be used as the diving depth.

Scuba Cylinders

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

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

Buoyancy Compensation Devices (BCD)

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

3.30 Auxiliary Equipment

Handheld Underwater Power Tools

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

3.40 Support Equipment

First Aid Supplies

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

Diver's Flag

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

Compressor Systems - UNH Controlled

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

- Low-pressure compressors used to supply air to the diver if equipped with a volume tank must have a check valve on the inlet side, a relief valve, and a drain valve.
- Compressed air systems over 500 psig must have slow-opening shut-off valves.
- All air compressor intakes must be located away from areas containing exhaust or other contaminants.

3.50 Equipment Maintenance

Record Keeping

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

- Regulators
- Gauges (SPG, Depth Gauges, Timers, and Dive Computers)
- BCDs
- Dry suits
- Scuba cylinders and valves
- Full Face Masks
- Compressors, air filtration systems, gas control panels, and storage banks

- Surface supplied equipment
- Rebreather systems
- Additional equipment categories as determined by the DCB

Compressor Operation and Air Test Records

Gas analyses and air tests must be performed on each UNH-controlled breathing air compressor at regular intervals of no more than 100 hours of operation or 6 months, whichever occurs first. If a compressor system is used less than 6 months per year and less than 100 hours, 1 air test shall be deemed appropriate for that unit. The results of these tests must be entered in a formal log and be maintained.

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

3.60 Air Quality Standards

Breathing Gas

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

CGA Grade E	
Component	**Maximum**
Oxygen	20 - 22%/v
Carbon Monoxide	10 PPM/v
Carbon Dioxide	1000 PPM/v
Condensed Hydrocarbons	5 mg/m3
Total Hydrocarbons as Methane	25 PPM/v
Water Vapor ppm	(2)
Objectionable Odors	None

For breathing air used in conjunction with self-contained breathing apparatus in extreme cold where moisture can condense and freeze, causing the breathing apparatus to malfunction, a dew point not to exceed -50°F (63 pm v/v) or 10 degrees lower than the coldest temperature expected in the area is required.

Remote Operations

For remote site operations using gas sources not controlled by UNH, every effort will 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. This information will be part of the dive project plan.

SECTION 4.00 SCIENTIFIC DIVER CERTIFICATION AND AUTHORIZATIONS

This section describes the training and performance standards for UNH Scientific Divers and represent the minimum required level of knowledge and skills presented in a generalized format.

4.10 Prerequisites

Administrative

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

Entry Level Diver Certification

The candidate must, at minimum, show documented proof of Diver Certification or equivalent from an internationally recognized training agency. UNH supports an open-water dive training program which follows the international standards promulgated by the National Association of Underwater Instructors (NAUI) These standards meet or exceed the most current version of the RSTC/WRSTC and/or ISO entry-level diver standards. Entry level diver training is a prerequisite to scientific diver training and therefore no part of entry level training may be counted in any way toward scientific diver training.

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

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

Medical Examination

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

Swimming/Watermanship Evaluation

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

a) Swim underwater for a distance of 25 yards (23 meters) without surfacing.
b) Swim 400 yards (366 meters) in less than 12 minutes.
c) Tread water for 10 minutes, or 2 minutes without the use of hands.
d) Transport a passive person of equal size a distance of 25 yards (23 meters) in the water.

For SML scientific diving courses taught only on Appledore, where access to a swimming pool is not available the following open water swimming evaluation will be used to evaluate the swimming competency of the students. Students applying to UNH for diving authorization will complete the pool evaluation at a later date. All divers will be weighted for neutral buoyancy in exposure suits.

a) Snorkel 900 yards/meters in open water in less than 18 minutes.
b) Swim underwater for 15-25 yards
c) Demonstrate surface dives and recovery of items from the bottom at least 10 feet deep.
d) Tread water for 10 minutes and demonstrate a leg cramp release.
e) Transport a passive person of equal size a distance of 25 yards/meters in open water and demonstrate how to lift a passive person out of the water and onto the dive float/platform, with the help of an additional person.

4.20 Training

The candidate must successfully complete prerequisites, theoretical aspects, practical training, and examinations for a minimum cumulative time of 100 hours and a minimum of 12 open water dives. Theoretical aspects must include principles and activities appropriate to the intended area of scientific study. Formats for meeting the 100-hour training requirement include UNH developed formalized training courses: UNH-Research diving techniques, UNH-Advanced diving technologies, and Shoals Marine Lab (SML)-Underwater research.

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

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

Theoretical Training / Knowledge Development-see course syllabus for details	
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 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

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

Practical Training / Skill Development	
Confined Water	At the completion of training, the trainee must satisfy the DPO or UNH 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 DPO, 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 • *Recommendation For Rescue Of A Submerged Unresponsive Compressed-Gas Diver* – Appendix 9
	Successfully complete a minimum of one checkout dive and at least eleven additional open water dives in a variety of dive sites, for a cumulative surface to surface time of 6 hours. Dives following the checkout dive(s) must be supervised by the DPO or Dive Supervisor holding the necessary depth authorization experienced in the type of diving planned, and with the knowledge and permission of the DPO
	The eleven dives (minimum) following the initial checkout dive may be conducted over a variety of depth ranges as specified by the UNH DCB. Depth progression must proceed shallower to deeper after acceptable skills and judgement have been demonstrated, and are not to exceed 100 feet (30 m) during the initial 12 dive cycle
	* Checkout dive element ^^ Evaluated on all dives ^ Evaluated at some point during the training cycle

Examinations	
Equipment	The trainee will be subject to examination/review of: • Personal diving equipment • Task specific equipment • Function and manipulation of decompression computer to be employed by the diver (if applicable)
Written Exams	The trainee must pass a written examination reviewed and approved by the UNH 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 UNH-specific dive mode(s) and environments, including buoyant ascent and ascent by air sharing • Currently accepted decompression theory and procedures • Proper use of dive tables • Hazards of breath-hold diving and ascents

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

4.30 Diver Certification and Authorizations

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

Scientific Diver-In-Training (SDIT) Authorization

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

Scientific Diver Certification

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

UNH Guest Diver Authorization

A Guest diver authorization may be given to a visiting scientist, student, technician or researcher from a non-AAUS institution. The individual in question must demonstrate proficiency in diving and can contribute measurably to a planned dive. A Guest Diver Authorization constitutes a waiver of selected requirements of Section 4.0 and is valid only for a limited time, as approved by the UNH DCB. A Guest Diver Authorization must be restricted to the planned diving operation and must comply with all other policies, regulations, and standards of this Manual, including medical requirements. This authorization is not to be utilized as a repeated mechanism to circumvent existing standards set forth in this Manual.

4.40 Depth Authorizations

Depth Ratings and Progression to Next Depth Level

Indicates the maximum depth in which a diver can conduct science and may supervise other divers holding a lesser depth authorization. A scientific diver requires a valid depth authorization to be considered active.
A diver may be authorized to the next depth level after successfully completing the requirements for that level. A diver may exceed his/her depth authorization when accompanied and supervised by a UNH dive buddy holding a depth authorization greater or equal to the intended depth. Dives must be planned and executed with the permission of the UNH DCB or designee.
In the event a diver within UNH does not hold an authorization at the desired next level, the UNH DCB may authorize a required progression or procedure for a diver to attain a deeper authorization.

a) ***Authorization to 60 foot is the initial depth level at UNH*** - Due to large tidal ranges in the Gulf of Maine, approved upon successful completion of the training requirements listed in Section 4.00. An additional 12 dives must be completed in the 31 to 60 foot authorization range before a diver may move beyond the 60 foot level or be considered a lead diver. These **12** dives must be with a lead diver or diving supervisor. At this point the total dives logged in the scientific program will be at least **24**. The minimum accumulated time for these dives should be 10 hours. (If a diver applies for reciprocity before the 24 dives are completed they will be considered a 30 foot diver).

c) ***Authorization to 100 Foot Depth*** - A diver holding a 60-foot authorization may be authorized to a depth of 100 feet after successfully completing and logging **6** supervised dives to depths between 61 and 100 feet under supervision of a dive buddy authorized by the DCB. The diver must also demonstrate proficiency in the use of the appropriate decompression profiling method, and air management skills. Cumulative minimum supervised dives: **30**.

d) ***Authorization to 130 Foot Depth*** - A diver holding a 100-foot authorization may be authorized to a depth of 130 feet after successfully completing and logging **6** supervised dives to depths between 100 and 130 feet under supervision of a dive buddy authorized by the DCB. The diver must also demonstrate proficiency in the use of the appropriate decompression profiling method, and air management skills. Cumulative minimum supervised dives: **36**.

e) ***Authorization to 150 Foot Depth*** - A diver holding a 130-foot authorization may be authorized to a depth of 150 feet after successfully completing and logging **6** supervised dives to depths between 130 and 150 feet under supervision of a dive buddy authorized by the DCB. The diver must also demonstrate knowledge of the special problems of deep diving and of special safety requirements. Cumulative minimum supervised dives: **42**.

f) ***Authorization to 190 Foot Depth*** - A diver holding a 150-foot authorization may be authorized to a depth of 190 feet after successfully completing and logging **6** dives to depths between 150 and 190 feet under supervision of a dive buddy authorized by the DCB. The diver must also demonstrate knowledge of the special problems of deep diving and of special safety requirements. Cumulative minimum supervised dives: **48**.

Diving on air is not permitted beyond a depth of 190 feet. Dives beyond 190 feet require the use of mixed gas. Further depth authorizations will require training in decompression and mixed gas techniques.

g) ***Authorization to 250 Foot Depth*** - A diver holding a 190-foot authorization may be authorized to a depth of 250 feet after successfully completing and logging **6** supervised dives to depths between 190 and 250 feet under supervision of a dive buddy authorized by the DCB. The diver must also

demonstrate knowledge of the special problems of deep diving and of special safety requirements.

h) ***Authorization to 300 Foot Depth*** - A diver holding a 250-foot authorization may be authorized to a depth of 300 feet after successfully completing and logging 6 supervised dives to depths between 200 and 250 feet under supervision of dive buddy authorized by the DCB. The diver must also demonstrate knowledge of the special problems of deep diving and of special safety requirements.

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

4.50 Maintaining Active Status

Minimum Activity to Maintain Authorizations

During any 12-month period, each scientific diver must log a minimum of 12 scientific, scientific training, or proficiency dives. At least one dive must be logged near the maximum depth, as defined by the UNH DCB, of the diver's authorization during each 6-month period. Divers authorized to 150 feet or deeper may satisfy these requirements with dives to 130 feet or deeper.
The UNH DCB has established 24 dives in 2 years policy to account for injuries/lapses in funding etc. If after 12 months the 12 dives have not been met the DSO will determine the process/supervision of the diver and they will need to meet the 24 dives in 2 years or the authorization will be revoked.

Requalification of Authorization

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

Medical Examination

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

Emergency Care Training

The scientific diver must hold current training in the following:

- Adult CPR and AED-UNH Divers shall complete a refresher course every 12 months
- Emergency oxygen administration must be current within 24 months
- First aid for diving accidents must be current within 24 months

4.60 Revocation of Authorization

An individual's scientific diver certification can be restricted or revoked for cause by the UNH DCB. Authorizations associated with an individual's scientific diver certification may be restricted or suspended for cause by the DPO. Restrictions or suspensions issued by the DPO may be rescinded by the DPO; these issues will be reported to and reviewed by the UNH DCB, and the outcomes or actions resulting from this review will be documented in the diver's UNH record. Violations of regulations set forth in this Manual or other governmental subdivisions not in conflict with this Manual, or demonstration of poor judgement, may be considered cause. The UNH DCB or designee must inform the diver in writing of the reason(s) for revocation. The diver will be given the opportunity to present their case in writing to the UNH DCB for reconsideration. Following revocation, the diver may be reauthorized after complying with conditions the UNH DCB may impose. All such written statements and requests, as identified in this section, are formal documents, and therefore part of the diver's file.

SECTION 5.00 MEDICAL STANDARDS

5.10 Medical Requirements

General

- All medical evaluations required by UNH must be performed by, or under the direction of, a licensed physician of the applicant-diver's choice, preferably one trained in diving/undersea medicine.
- The diver should be free of any chronic disabling disease and any conditions contained in the list of conditions for which restrictions from diving are generally recommended. (Appendix 1)
- UNH DCB must verify that divers have been declared by the examining medical authority to be fit to engage in diving activities.

5.20 Frequency of Medical Evaluations

***Medical evaluation must be completed**:* Before a diver may begin diving, unless an equivalent initial medical evaluation has been given within the appropriate age intervals		
Before Age 40	After age 40 Before Age 60	After Age 60
At 5-year intervals	At 3-year intervals	At 2-year intervals

5.30 Information Provided Examining Physician

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

5.40 Content of Medical Evaluations

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

1. Diving physical examination (Appendix 2). Modifications or omissions of required tests are not permitted
2. Applicant agreement for release of medical information to the Diving Program Officer and the UNH DCB (Appendix 2b)
3. Medical history (Appendix 3) UNH requires the Medical history form be updated every year.

5.50 Physician's Written Report

- A UNH Medical Evaluation of Fitness for Scuba Diving Report signed by the examining physician stating the individual's fitness to dive, including any recommended restrictions or limitations will be submitted to UNH for the diver's record after the examination is completed.
- The UNH Medical Evaluation of Fitness for Scuba Diving Report will be reviewed by the UNH DCB or designee and the diver's record and authorizations will be updated accordingly.
- A copy of any physician's written reports will be made available to the individual.
- It is the diver's responsibility to provide UNH a written statement from the examining medical authority listing any restrictions, limitations, or clearances to dive resulting from medical examinations obtained by the individual outside of their normal diving medical examination cycle. These statements will be reviewed by the UNH DCB or designee and the diver's record and authorizations will be updated accordingly.
- UNH divers will fill out a Diving Medical History form every 12 months

Volume 2

Sections 6.00 through 11.00

Described Modes of Diving Activities

UNH Specific Sections

SECTION 6.00 NITROX DIVING

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

6.10 Requirements for Nitrox Authorization

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

Prerequisites

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

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

Training

In lieu of writing/promulgating UNH/AAUS specific training standards for Nitrox divers, UNH/AAUS references the standards for Nitrox diver training as defined by the WRSTC and/or ISO. UNH Dive program training Nitrox divers may do so using one of the following options:

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

b) Under the auspices of AAUS using the minimum guidelines presented by the most current version of the RSTC/WRSTC and/or ISO Nitrox diver training standards.

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

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

Practical Evaluation

- Oxygen analysis of nitrox mixtures.
- Determination of MOD, oxygen partial pressure exposure, and oxygen toxicity time limits, for various nitrox mixtures at various depths.
- Determination of nitrogen-based dive limits status by EAD method using air dive tables, and/or using nitrox dive tables, as approved by the UNH DCB.
- Nitrox dive computer use may be included, as approved by the UNH DCB.
- A minimum of two supervised open water dives using nitrox is required for authorization.

Written Evaluation

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

6.20 Minimum Activity to Maintain Authorization

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

6.30 Operational Requirements

Oxygen Exposure Limits

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

Calculation of Decompression Status

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

Gas Mixture Requirements

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

Analysis Verification by User

- Prior to the dive, it is the responsibility of each diver to analyze the oxygen content of his/her scuba cylinder and acknowledge in writing the following information for each cylinder: fO_2, MOD, cylinder pressure, date of analysis, and user's name.
- Individual dive log reporting forms should report fO_2 of nitrox used, if different than 21%.

6.40 Nitrox Diving Equipment

Required Equipment

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

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

Requirement for Oxygen Service

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

Compressor system

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

SECTION 7.00 Surface Supplied Diving Technologies

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

7.10 Prerequisites

All surface supplied divers must be certified scientific divers or divers in training and have completed system specific training as authorized by UNH.

7.20 Surface Supplied Diving

Surface Supply Definition

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.

Procedures

- 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 100fsw (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 fsw (57.9 m).

Manning Requirements

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

Equipment

- 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 (bail-out bottle) 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 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
- Divers must carry at least one cutting tool

Surface Supplied in the Ocean Engineering tank

- In an aquarium habitat where the maximum depth is known, a pneumofathometer is not required.
- The maximum obtainable depth of the aquarium may be used as the diving depth
- One tender may line-tend multiple divers, provided the tender is monitoring only one air source, there is mutual assistance between divers, there are no overhead obstructions or entanglements, or other restrictions as defined by the UNH DCB.

7.30 Diving Gas Source

If the source of breathing gas is high pressure bottles, air consumption rates must be calculated to ensure an adequate safety margin.
An approved high to low pressure regulator must be employed to reduce the bottle pressure to that required by the diver (typically 100 psig plus 1/2 the depth in feet).

- If the breathing gas source is a low-pressure engine driven compressor, care must be taken to prevent contamination by the engine exhaust. Air supplied to the diver must meet the air quality standards outlined in section 3.60

7.40 Surface Supplied Tending and Communication

- A surface tender will be designated to handle the umbilical hose and at no time will the hose be unattended while the diver is in the water.
- All pull signals received shall be answered (*except for emergency signals) to ensure understanding and agreement. The presence of an electronic communication system does not alter the line pull requirement.

MINIMUM PULL SIGNALS

Pulls	Tender	Diver
1	Are you OK?	I am OK
2	Descend	Give me more hose or I am descending
3	Ascend	Take up my hose or I am ascending
4*	Emergency-come up!	Emergency-haul me up now!!!

- An electronic communication system is required for Surface supplied diving to depths greater than 100 FWS.
- If a failure of the electronic communication system occurs at a depth greater than 100 FSW, the working diver should be immediately notified by pull signal to terminate the dive and return to the surface.

SECTION 8.00 STAGED DECOMPRESSION DIVING

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

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

8.10 Minimum Experience and Training Requirements

Prerequisites

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

Training

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

1. A minimum of 6 hours of classroom training to ensure theoretical knowledge to include: physics and physiology of decompression; decompression planning and procedures; gas management; equipment configurations; decompression method, emergency procedures, and omitted decompression.
2. It is recommended that at least one training session be conducted in a pool or sheltered water setting, to cover equipment handling and familiarization, swimming and buoyancy control, to estimate gas consumption rates, and to practice emergency procedures.
3. At least 6 open-water training dives simulating/requiring decompression must be conducted, emphasizing planning and execution of required decompression dives, and including practice of emergency procedures.
4. Progression to greater depths must be by 6-dive increments at depth intervals as specified in Section 5.50.
5. No training dives requiring decompression shall be conducted until the diver has demonstrated acceptable skills under simulated conditions.
6. The following are the minimum skills the diver must demonstrate proficiently during dives simulating and requiring decompression:
   - Buoyancy control
   - Proper ascent rate
   - Proper depth control
   - Equipment manipulation
   - Stage/decompression bottle use as pertinent to planned diving operation
   - Buddy skills
   - Gas management
   - Time management
   - Task loading
   - Emergency skills

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

8.20 Minimum Equipment Requirements

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

8.30 Minimum Operational Requirements

1. The dive team prior to each dive must review emergency decompression procedures appropriate for the planned dive.
2. The maximum pO_2 to be used for planning required decompression dives is 1.6 for open circuit. It is recommended that a pO_2 of less than 1.6 be used during bottom exposure.
3. Decompression dives may be planned using dive tables, dive computers, and/or PC software approved by the DCB.
4. Breathing gases used while performing in-water decompression must contain the same or greater oxygen content as that used during the bottom phase of the dive.
5. Use of additional nitrox and/or high-oxygen fraction decompression mixtures as travel and decompression gases to decrease decompression obligations is recommended.
6. 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.
7. Use of Helium gas mixtures to limit narcosis is recommended for depths greater than 150 feet.
8. The maximum depth for required decompression using air as the bottom gas is 190 feet.
9. Mission specific workup dives are recommended. If 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.

SECTION 9.00 MIXED GAS DIVING

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

9.10 Minimum Experience and Training Requirements

Prerequisites

1. Nitrox authorization (Section 6.00).
2. If the intended use entails required decompression stops, divers will be previously authorized in decompression diving (Section 8.00).
3. Divers must demonstrate to the DCB's satisfaction skills, knowledge, and attitude appropriate for training in the safe use of mixed gases.

Classroom training including

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

Practical Training

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

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

9.20 Equipment and Gas Quality Requirements

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

9.30 Minimum Operational Requirements

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

SECTION 10.00 SPECIALIZED DIVING ENVIRONMENTS

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

10.10 Blue Water Diving

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

10.20 Ice and Polar Diving

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

10.30 Overhead Environments

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

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

Cavern, Cave, or Flooded Mine Diving see Section 12

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

10.40 Saturation Diving

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

10.50 Aquarium Diving

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

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

10.6 Tethered Diving

Tethered diving is used when a dive buddy situation is not safe, possibly due to poor visibility, swift currents or dive tasks do not allow for a buddy team. The minimum personnel would be the diver, the dive tender and a stand-by safety diver. Line pull signals sec 7.4 must be used. Full diver to tender communications are recommended. Tethered diving is not allowed below 60 feet.

With the consent of the UNH DPO, tethered solo diving from shore or a vessel is permitted when conducted under the following regulations:

The tether line must have a minimum diameter of one-half inch with an eye splice at the diver's end and the bitter end secured to a stationary object. Before the dive the line must be thoroughly examined for cuts or abrasions. The diver must carry a knife capable quickly severing the tether line in an emergency.

The diver will have an approved harness directly over his / her diving suit and beneath any other item of diving equipment. The connection between the tether line and the harness will be by locking carabiner. Knotting the tether line around the diver's waist or any part of his / her diving equipment is unacceptable.

A surface tender will be designated to control the tether line and under no circumstances will the line be left unattended while the diver is in the water. A series of pull signals (including those for emergency conditions) will be arranged between the diver and the tender. All signals will be returned (except the emergency signal) to ensure correct understanding and agreement. See Section 7.40.

A fully dressed safety diver will stand by prepared for immediate entry into the water to aid the working diver if by signal or lack of signals indicates that the diver requires assistance. Under no circumstances will the safety diver serve as the tender.
If it becomes necessary for the working diver to disengage himself / herself from the tether line, he / she must surface immediately. The safety of the dive is lost when contact between the surface and the diver is lost. Untethered solo diving is not permitted.

Tethered diving to depths greater than 60 FWS is not permitted.

SECTION 11.00 REBREATHERS

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

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

Application of this standard is in addition to pertinent requirements of all other sections of this *Manual*.

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

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

11.10 Definition

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

B. There are three classes of rebreathers:

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

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

3. *Closed-Circuit Rebreathers*: Closed-circuit mixed gas rebreathers (CCR) recycle all of the exhaled gas. Electronically controlled CCRs (eCCR) replace metabolized oxygen via an electronically controlled valve, governed by oxygen sensors. Manually controlled CCR (mCCR) rely on mechanical oxygen addition and diver monitoring to control oxygen partial pressure (ppO_2). Depending on the design, manual oxygen addition may be available on eCCR units as a diver override, in case of electronic system failure. Systems are equipped with two cylinders; one with oxygen, the other with a diluent gas source used to make up gas volume with depth increase and to dilute oxygen levels. CCR systems operate to maintain a constant ppO_2 during the dive,

regardless of depth.

11.20 Prerequisites for use of any rebreather

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

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

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

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

11.30 Training

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

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

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

Individual Equipment Requirements

Individual Equipment Requirements			
Key: X = include, IA = If Applicable			
	O_2	**SCR**	**CCR**
DCB approved rebreather make and model	X	X	X
Bottom timer, and depth gauge	X	X	X
Dive computer (separate from rebreather unit)		X	X
Approved dive tables		IA	IA
SMB (surface marker buoy) and line reel or spool with sufficient line to deploy an SMB from the bottom in the training environment	IA	IA	IA
Access to an oxygen analyzer	X	X	X
Cutting implement	X	X	X
BCD capable of floating a diver with a flooded loop and/or dry suit at the	X	X	X
Bailout gas supply of sufficient volume for planned diving activities	X	X	X
Approved CO2 absorbent and other consumables	X	X	X

11.40 Equipment Requirements

A. *General*

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

B. *Equipment Maintenance Requirements*

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

11.50 Operational Requirements

A. *Dive Plan*

In addition to standard dive plan components, at a minimum all dive plans that include the use of rebreathers must include:

a) Information about the specific rebreather model(s) to be used
b) Type of CO_2 absorbent material
c) Composition and volume(s) of supply gasses d) Bailout procedures
e) Work up dive procedures

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

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

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

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

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

G. Diver carried off-board bailout is not required under conditions where the onboard reserves are adequate to return the diver to the surface while meeting proper ascent rate and stop requirements, and the system is configured to allow access to onboard gas.

These calculations must take into consideration mixed mode operations where an open circuit diver could require assistance in an out of gas situation.

H. Use and reuse of CO_2 scrubber media should be per manufacture recommendations.

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

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

K. The UNH DCB allows for:

1. The use of electronic checklists are permitted for rebreather operations.
2. The use of pre- and post- dive equipment checks to be conducted by their divers.
3. Disinfection of rebreathers should be used on the CCR's after full break down of the unit.
4. Divers are to pre-breath the rebreathers prior to each dive.
5. Allows for the use of mixed mode and mixed rebreather platform dive teams under their auspices.
   a) Mixed mode and/or mixed platform dive teams are permitted.
   b) At minimum, divers must be cross briefed on basic system operations for establishing positive buoyancy, closing a rebreather diver's breathing loop, and procedures for gas sharing.
6. The maximum depth of dives conducted using a rebreather within the auspices of UNH diving operations is 100 meters or trained depth on unit if < 100 meters.
7. Depth authorization and maintenance for divers using rebreathers.
8. Policies for implementing workup dives within program
   a) Pre-operation workup dives, including review and practice of emergency recognition and response skills, and management of task loading are required for operations of CCR's at the start of each field project.
9. The minimum use of rebreathers to maintain proficiency:
   a) The minimum Annual rebreather diving activity should be 12 rebreather dives, with a minimum of 12 h underwater time.
   b) To count, dives should be no less than 30 min in duration. A required element of maintaining proficiency is the periodic performance and reevaluation of skills. related to in-water problem recognition and emergency procedures

L. Reauthorization for the use of rebreathers if minimum proficiency requirements are not met. This will occur on a case by case basis depending on the lack of proficiencies and project planned.

1. Reestablishment of authorization to use rebreathers must require more than just performing a dive on a particular make or model of rebreather.
2. At minimum demonstrated skills included in the required training elements for the level of rebreather operation must be performed and reevaluated.

11.60 REBREATHER TRAINING SECTION

A. *Entry Level Training*

1. The training area for O_2 Rebreather should not exceed 20 fsw in depth.
2. Entry level CCR and SCR training is limited in depth of 130fsw and shallower.
3. Entry level CCR and SCR training is limited to nitrogen/oxygen breathing media.
4. Divers at the CCR and SCR entry level may not log dives that require a single decompression stop longer than 10 minutes.
5. Who may teach: Individuals authorized as a CCR, SCR, or O_2 Rebreather Instructor by the UNH DCB; in all cases, the individual authorized must have operational experience on the rebreather platform being taught, and where applicable the individual being authorized should be authorized as an instructor by the respective rebreather manufacturer or their designee.
6. Maximum Student/Instructor Ratio: 4 to 1. This ratio is to be reduced as required by environmental conditions or operational constraints.
7. Upon completion of practical training, the diver must demonstrate proficiency in pre-dive, dive, and post-dive operational procedures for the particular model of rebreather to be used.
8. Supervised dives target activities associated with the planned science diving application. Supervisor for these dives is the DSO or designee, experienced with the make/model rebreather being used.

Rebreather Entry Level Training Requirements			
Key: X = include, IA = If Applicable, ISE = If So Equipped			
	O_2	SCR	CCR
Required Training Topic			
Academic			
History of technology	X	X	X
Medical & physiological aspects of:			
Oxygen toxicity	X	X	X
Chemical burns & caustic cocktail	X	X	X
Hypoxia – insufficient O_2	X	X	X
Hypercapnia – excessive CO_2	X	X	X
Arterial gas embolism	X	X	X
Middle Ear Oxygen Absorption Syndrome (oxygen ear)	X	X	X
Hygienic concerns	X	X	X
Nitrogen absorption & decompression sickness		X	X
CO_2 retention	X	X	X
Hyperoxia-induced myopia	X	X	X
System design, assembly, and operation, including:			
Layout and design	X	X	X
Oxygen control systems	X	X	X
Diluent control systems		ISE	ISE
Use of checklists	X	X	X

Complete assembly and disassembly of the unit	X	X	X
Canister design & proper packing and handling of chemical absorbent	X	X	X
Decompression management and applicable tracking methods		ISE	X
Oxygen and high pressure gas handling and safety	X	X	X
Fire triangle	X	X	X
Filling of cylinders	X	X	X
Pre-dive testing & trouble shooting	X	X	X
Post-dive break-down and maintenance	X	X	X
Trouble shooting and manufacturer authorized field repairs	X	X	X
Required maintenance and intervals	X	X	X
Manufacturer supported additional items (ADV, temp stick, CO2 monitor, etc.)	ISE	ISE	ISE
Dive planning:			
Operational planning	X	X	X
Gas requirements	X	X	X
Oxygen exposure and management	X	X	X
Gas density calculations		X	X
Oxygen metabolizing calculations	X	X	X
Scrubber limitations	X	X	X
Mixed mode diving (buddies using different dive modes)	X	X	X
Mixed platform diving (buddies using different rebreather platforms)	X	X	X
Problem Recognition & Emergency Procedures:			
Applicable open circuit emergency procedures for common gear	X	X	X
Loss of electronics	ISE	ISE	X
Partially flooded loop	X	X	X
Fully flooded loop	X	X	X
Cell warnings		ISE	X
Battery warnings	ISE	ISE	X
High O_2 warning	ISE	ISE	X
Low O_2 warning	ISE	ISE	X
High CO_2 warning	ISE	ISE	ISE
Recognizing issues as indicated by onboard scrubber monitors	ISE	ISE	ISE
Recognizing hypercapnia signs and symptoms in self or buddy	X	X	X
Excluded O_2 cell(s)	ISE	ISE	ISE
Loss of Heads Up Display (HUD)	ISE	ISE	ISE
Loss of buoyancy	X	X	X
Diluent manual add button not functioning		ISE	ISE
O2 manual add button not functioning	ISE	ISE	ISE
Exhausted oxygen supply	X	X	X
Exhausted diluent supply		ISE	ISE
Lost or exhausted bailout	ISE	ISE	ISE
Handset not functioning	ISE	ISE	ISE
Solenoid stuck open	ISE	ISE	ISE
Solenoid stuck closed	ISE	ISE	ISE
ADV stuck open	ISE	ISE	ISE
ADV stuck closed	ISE	ISE	ISE
Isolator valve(s) not functioning	ISE	ISE	ISE
Oxygen sensor validation	ISE	ISE	X
CO_2 sensor validation	IA	IA	IA

Gas sharing	X	X	X
Diver assist and diver rescue	X	X	X
Other problem recognition and emergency procedures specific to the particular unit, environment, or diving conditions	X	X	X
Practical Training and Evaluations			
Demonstrated skills must include, at a minimum:			
Use of checklists	X	X	X
Carbon dioxide absorbent canister packing	X	X	X
Supply gas cylinder analysis and pressure check	X	X	X
Test of one-way valves	X	X	X
System assembly and breathing loop leak testing	X	X	X
Oxygen control system calibration	ISE	ISE	X
Proper pre-breathe procedure	X	X	X
In-water bubble check	X	X	X
Proper buoyancy control during descent, dive operations, and ascent	X	X	X
System monitoring & control during descent, dive operations, and	X	X	X
Proper interpretation and operation of system instrumentation	X	X	X
Proper buddy contact and communication	X	X	X
Use of a line reel or spool to deploy an SMB from planned dive depth and while controlling buoyancy in the water column	X	X	X
Proper management of line reel or spool, and SMB during ascents and safety or required stops	X	X	X
Unit removal and replacement on the surface	X	X	X
Bailout and emergency procedures for self and buddy, including:			
System malfunction recognition and solution	X	X	X
Manual system control	ISE	ISE	ISE
Flooded breathing loop recovery	IA	IA	IA
Absorbent canister failure	X	X	X
Alternate bailout options	X	X	X
Manipulation of onboard and off board cylinder valves	X	X	X
Manipulation of bailout cylinders (removal, replacement, passing and receiving while maintaining buoyancy control)	ISE	ISE	ISE
Manipulation of quick disconnects, isolator valves, and manual controls specific to the unit and gear configuration	ISE	ISE	ISE
Proper system maintenance, including:			
Breathing loop disassembly and disinfection	X	X	X
Oxygen sensor replacement	ISE	ISE	ISE
Battery removal and replacement or recharging	ISE	ISE	ISE
Other tasks as required by specific rebreather models	X	X	X
Written Evaluation	X	X	X
Supervised Rebreather Dives	X	X	X

Entry Level Training – Minimum Underwater Requirements

	Pool/Confined Water	Open water	Supervised Dives
O2	1 Dive, 90 – 120 minutes	4 dives, 120 minute cumulative	2 Dives, 120 minute cumulative
SCR	1 Dive, 90 – 120 minutes	4 dives, 120 minute cumulative	4 dives, 120 minute cumulative
CCR	1 Dive, 90 – 120 minutes	8 dives, 380 minute cumulative	4 dives, 240 minute cumulative

B. Rebreather Required Decompression, Normoxic, and Hypoxic Mix Training

1. Required Decompression and Normoxic Training may be taught separately or combined.
2. Prerequisites:
   a) Required Decompression 25 rebreather dives for a minimum cumulative dive time of 25 hours
   b) Mixed Gas:
      (1) Normoxic Mixes – 25 rebreather dives for a minimum cumulative dive time of 25 hours
      (2) Hypoxic Mixes – Rebreather Required Decompression Certification and Normoxic Certification and 25 decompression rebreather dives for a minimum cumulative dive time of 40 hours on dives requiring decompression
3. Who may teach: Individuals authorized as a CCR/SRC required decompression and/or Normoxic and/or Hypoxic Mix instructor by the DCB or their designee (this is in addition to the original authorization from section A #5)
4. Maximum Student/Instructor Ratio: 2 to 1. This ratio is to be reduced as required by environmental conditions or operational constraints
5. Upon completion of practical training, the diver must demonstrate proficiency in pre-dive, dive, and post-dive operational procedures for the particular model of rebreather to be used
6. Supervised dives target activities associated with the planned science diving application. Supervisor for these dives is the DPO or designee, experienced with the make/model rebreather being used

Rebreather Required Decompression, Normoxic & Hypoxic Mix Training Requirements			
Key: X = include, IA = If Applicable, ISE = If So Equipped			
	Deco	Normoxic	Hypoxic Mixes
Required Training Topic			
Academic			
Review of applicable subject matter from previous training	X	X	X
Medical & physiological aspects of:			
Hypercapnia, hypoxia, hyperoxia	X	X	X
Oxygen limitations	X	X	X
Nitrogen limitations	X	X	X
Helium absorption and elimination		X	X
High Pressure Nervous Syndrome (HPNS)			X
System design, assembly, and operation, including:			
Gear considerations and rigging	X	X	X
Gas switching	X	X	X
Dive planning:			
Decompression calculation	X	X	X
Gradient Factors	X	X	X
Scrubber duration and the effects of depth on scrubber function	X	X	X

Gas requirements including bailout scenarios	X	X	X
Bailout gas management – individual vs team bailout	X	X	X
Gas density calculations	X	X	X
Operational Planning	X	X	X
Equivalent narcosis depth theory		X	X
Gas selection, gas mixing and gas formulas		X	X
Problem Recognition & Emergency Procedures:			
Applicable open circuit emergency procedures for common gear	X	X	X
Flooded loop	X	X	X
Cell warnings	X	X	X
Battery warnings	X	X	X
Hypercapnia, hypoxia, hyperoxia	X	X	X
Practical Training and Evaluations			
Demonstrated skills must include, at a minimum:			
Proper demonstration of applicable skills from previous training	X	X	X
Proper manipulation of DSV and/or BOV	X	X	X
Proper descent and bubble check procedures	X	X	X
Proper monitoring of setpoint switching and pO2 levels	X	X	X
Proper interpretation and operation of system instrumentation	X	X	X
System monitoring & control during descent, dive operations, and ascent	X	X	X
Demonstrate the ability to manually change setpoint and electronics settings during the dive	ISE	ISE	ISE
Demonstrate buoyancy control; ability to hover at fixed position in water column without moving hands or feet	X	X	X
Demonstrate controlled ascent with an incapacitated diver including surface tow at least 30 meters / 100 feet with equipment removal on surface, in water too deep to stand	X	X	X
Onboard and off board valve manipulation for proper use, and reduction of gas loss	X	X	X
Diagnosis of and proper reactions for a flooded absorbent canister	X	X	X
Diagnosis of and proper reactions for CO2 breakthrough	X	X	X
Diagnosis of and proper response to Cell Errors	X	X	X
Diagnosis of and proper reactions for Low oxygen drills	X	X	X
Diagnosis of and proper reactions for Flooded Loop	X	X	X
Diagnosis of and proper reactions for High Oxygen Drills	X	X	X
Diagnosis of and proper reactions for electronics and battery	X	X	X
Operation in semi-closed mode	X	X	X
Properly execute the ascent procedures for an incapacitated	X	X	X
Proper buddy contact and communication	X	X	X
Use of a line reel or spool to deploy an SMB from planned dive depth and while controlling buoyancy in the water column	X	X	X

Proper management of line reel or spool, and SMB during ascents and safety or required stops	X	X	X
Demonstrate the ability to maintain minimum loop volume	X	X	X
Demonstrate comfort swimming on surface and at depth carrying a single bailout/decompression cylinder/bailout rebreather	X		
Demonstrate ability to pass and retrieve a single bailout/decompression cylinder or bailout rebreather while maintaining position in the water column	X		
Demonstrate ability to pass and receive multiple bailout/decompression cylinders or bailout rebreather while maintaining position in the water column	IA	X	X
Demonstration of the ability to perform simulated decompression stops at pre-determined depths for scheduled times	X	X	X
Demonstration of the ability to perform decompression stops at pre-determined depths for scheduled times	X	X	X
Demonstrate competence managing multiple bailout cylinders, including drop and recovery while maintaining position in the water column	IA	X	X
Demonstrate appropriate reaction to simulated free-flowing deco regulator	X	X	X
Gas share of deco gas for at least 1 minute	X	X	X
Demonstrate oxygen rebreather mode at appropriate stop depth		X	X
Complete bailout scenarios from depth to include decompression obligation on open circuit	X	X	X
Written Evaluation	X	X	X
Supervised Rebreather Dives	X	X	X

Minimum Underwater Requirements

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

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

B. Rebreather Crossover Training

1. Crossover training to a new rebreather platform requires a minimum of 4 training dives for a minimum cumulative dive time of 240 min.
2. Advanced level certification on a new rebreather platform may be awarded upon successful demonstration of required skills using the new platform.

Appendices

UNH Specific Sections

APPENDIX 1
UNH DIVING MEDICAL EXAM OVERVIEW FOR THE EXAMINING PHYSICIAN

TO THE EXAMINING PHYSICIAN:
This person, _____, requires a medical examination to assess their fitness for certification as a Scientific Diver for the University of New Hampshire. Their answers on the Diving Medical History Form (attached) may indicate potential health or safety risks as noted. Your evaluation is requested on the attached scuba Diving Fitness Medical Evaluation Report. If you have questions about diving medicine, you may wish to consult one of the references on the attached list or contact one of the physicians with expertise in diving medicine whose names and phone numbers appear on an attached list, the Undersea Hyperbaric and Medical Society, or the Divers Alert Network. Please contact the undersigned Diving Safety Officer if you have any questions or concerns about diving medicine or the University of New Hampshire standards. Thank you for your assistance.

Elizabeth Kintzing	ek@unh.edu	603-834-1398	Diving Program Officer
Rebecca Toppin	Becca.Toppin@unh.edu	508-454-3571	SML Diving Safety Officer

Scuba and other modes of compressed-gas diving can be strenuous and hazardous. A special risk is present if the middle ear, sinuses, or lung segments do not readily equalize air pressure changes. The most common cause of distress is eustachian insufficiency. Recent deaths in the scientific diving community have been attributed to cardiovascular disease. Please consult the following list of conditions that usually restrict candidates from diving.
(Adapted from Bove, 1998: bracketed numbers are pages in Bove)

CONDITIONS WHICH MAY DISQUALIFY CANDIDATES FROM DIVING

1. Abnormalities of the tympanic membrane, such as perforation, presence of a monomeric membrane, or inability to autoinflate the middle ears. [5 ,7, 8, 9]
2. Vertigo, including Meniere's Disease. [13]
3. Stapedectomy or middle ear reconstructive surgery. [11]
4. Recent ocular surgery. [15, 18, 19]
5. Psychiatric disorders including claustrophobia, suicidal ideation, psychosis, anxiety states, untreated depression. [20 - 23]
6. Substance abuse, including alcohol. [24 - 25]
7. Episodic loss of consciousness. [1, 26, 27]
8. History of seizure. [27, 28]
9. History of stroke or a fixed neurological deficit. [29, 30]
10. Recurring neurologic disorders, including transient ischemic attacks. [29, 30]
11. History of intracranial aneurysm, other vascular malformation or intracranial hemorrhage. [31]
12. History of neurological decompression illness with residual deficit. [29, 30]
13. Head injury with sequelae. [26, 27]
14. Hematologic disorders including coagulopathies. [41, 42]
15. Evidence of coronary artery disease or high risk for coronary artery disease. [33 - 35]
16. Atrial septal defects. [39]
17. Significant valvular heart disease - isolated mitral valve prolapse is not disqualifying. [38]
18. Significant cardiac rhythm or conduction abnormalities. [36 - 37]
19. Implanted cardiac pacemakers and cardiac defibrillators (ICD). [39, 40]
20. Inadequate exercise tolerance. [34]
21. Severe hypertension. [35]
22. History of spontaneous or traumatic pneumothorax. [45]
23. Asthma. [42 - 44]
24. Chronic pulmonary disease, including radiographic evidence of pulmonary blebs, bullae, or cysts. [45,46]
25. Diabetes mellitus. [46 - 47]
26. Pregnancy. [56]

SELECTED REFERENCES IN DIVING MEDICINE

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

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

APPENDIX 2
UNH MEDICAL EVALUATION OF FITNESS FOR SCUBA DIVING REPORT

_____

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

To The Examining Physician: Scientific divers require periodic scuba diving medical examinations to assess their fitness to engage in diving with self-contained underwater breathing apparatus (scuba). Their answers on the Diving Medical History Form may indicate potential health or safety risks as noted. Scuba diving is an activity that puts unusual stress on the individual in several ways. Your evaluation is requested on this Medical Evaluation form. Your opinion on the applicant's medical fitness is requested. Scuba diving requires heavy exertion. The diver must be free of cardiovascular and respiratory disease (see references, following page). An absolute requirement is the ability of the lungs, middle ears and sinuses to equalize pressure. Any condition that risks the loss of consciousness should disqualify the applicant. Please proceed in accordance with the AAUS Medical Standards (Sec. 5.00). If you have questions about diving medicine, please consult with the Undersea Hyperbaric Medical Society or Divers Alert Network.

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

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

- Medical history
- Complete physical exam, with emphasis on neurological and otological components
- Chest X-Ray (required only on initial exam)
- Spirometry (required only on initial exam)
- Hematocrit or Hemoglobin
- Urinalysis
- Any further tests deemed necessary by the physician

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

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

- Urinalysis

PHYSICIAN'S STATEMENT:

I have evaluated the above mentioned individual according to the tests listed above. I have discussed with the patient any medical condition(s) that would not disqualify him/her from diving, but which may seriously compromise subsequent health. The patient understands the nature of the hazards and the risks involved in diving with these conditions.

_____ 01 I find no medical conditions that may be disqualifying for participation in scuba diving.
Diver **<u>IS</u>** medically qualified to dive for: _____2 years (over age 60)
_____3 years (age 40-59)
_____5 years (under age 40)

_____ 02 Diver **<u>IS NOT</u>** medically qualified to dive:_____Permanently_____Temporarily.

_____ MD or DO _____
Signature Date

_____
Name (Print or Type)

_____
Medical Practice name

_____
Address

_____ _____
Telephone Number E-Mail Address

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

My familiarity with diving medicine is: _____

APPLICANT'S RELEASE OF MEDICAL INFORMATION FORM

_____
Name of Applicant (Print or Type)

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

Signature of Applicant _____ Date_____

REFERENCES

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

APPENDIX 3
UNH DIVING MEDICAL HISTORY FORM

(To Be Completed By Applicant-Diver)

Name _____ DOB _____ Age ___ Wt.___ Ht. ___

Sponsor _____ Date ___/___/___
(Dept./Project/Program/School, etc.) (Mo/Day/Yr)

TO THE APPLICANT:

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

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

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

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

	Yes	No	Please indicate whether or not the following apply to you	Comments
59			Low blood pressure	
60			Recurrent or persistent swelling of the legs	
61			Pounding, rapid heartbeat or palpitations	
62			Easily fatigued or short of breath	
63			Abnormal EKG	
64			Joint problems, dislocations or arthritis	
65			Back trouble or back injuries	
66			Ruptured or slipped disk	
67			Limiting physical handicaps	
68			Muscle cramps	
69			Varicose veins	
70			Amputations	
71			Head injury causing unconsciousness	
72			Paralysis	
73			Have you ever had an adverse reaction to medication?	
74			Do you smoke?	
75			Have you ever had any other medical problems not listed? If so, please list or describe below;	
76			Is there a family history of high cholesterol?	
77			Is there a family history of heart disease or stroke?	
78			Is there a family history of diabetes?	
79			Is there a family history of asthma?	
80			Date of last tetanus shot? Vaccination dates?	

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

_____

_____

_____

_____

_____

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

_____

Signature Date

APPENDIX 4
RECOMMENDED PHYSICIANS WITH EXPERTISE IN DIVING MEDICINE

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

https://www.diversalertnetwork.org/medical/physicians.asp

Divers Alert Network		919 684-9111
Undersea & Hyperbaric Medical Society		

Names below may change over time-be sure to check ahead time if making an appointment

Dr. Sandra Maruszak	Emergency/Occupational Medicine	603 359 8618
Dr. Nathan Elder		603 795 9576
Dr. Christopher Kareores	Emergency Care	781 396 8224
Dr. Doug Ebersole	PFO/Cardiac Diving medicine-consult	863-680-7000
Dr. Geradine Ruffa	Groton CT	860-446-8265 x7091
Dr. Daniel Deschier	Director-Norman Night Hyperbaric Center	617-573-4411

APPENDIX 5
DEFINITION OF TERMS

Air sharing - Sharing of an air supply between divers.

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

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

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

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

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

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

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

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

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

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

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

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

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

Cylinder - A pressure vessel for the storage of gases.

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

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

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

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

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

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

Dive Table - A profile or set of profiles of depth-time relationships for ascent rates and breathing

mixtures to be followed after a specific depth-time exposure or exposures.

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

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

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

Diving Control Board (DCB) - Group of individuals who act as the official representative of the membership organization in matters concerning the scientific diving program (See Diving Control Board under Section 1.0).

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

DPIC – See Designated Person-In-Charge.

EAD - Equivalent Air Depth (see below).

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

Enriched Air (EANx) - A name for a breathing mixture of air and oxygen when the percent of oxygen exceeds 21%. This term is considered synonymous with the term "nitrox" (Section 6.00).

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

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

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

FSW - Feet of seawater.

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

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

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

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

his/her own depth, time, and diving profile.

Hyperbaric Chamber - See Recompression chamber.

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

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

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

Life Support Equipment – Underwater equipment necessary to sustain life.

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

Organizational Member (OM) - An organization which is a current member of the AAUS, and which has a program, which adheres to the standards of the AAUS as, set forth in the *AAUS Manual*.

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

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

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

MOD - Maximum Operating Depth, usually determined as the depth at which the pO_2 for a given gas mixture reaches a predetermined maximum.

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

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

OTU - Oxygen Toxicity Unit

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

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

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

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

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

Pressure Vessel - See cylinder.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Umbilical - Composite hose bundle between a dive location and a diver or bell, or between a diver and a bell, which supplies a diver or bell with breathing gas, communications, power, or heat, as appropriate to

the diving mode or conditions, and includes a safety line between the diver and the dive location.

APPENDIX 6

UNIVERSITY of NEW HAMPSHIRE

[redacted]

This Form is not valid unless issued by the Diving Program Officer

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

Name of Diver

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 as established by the University of New Hampshire Diving Safety Manual, and has demonstrated competency in the indicated areas. The University of New Hampshire 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 UNH

- _____ Original diving authorization
- _____ Written scientific diving examination
- _____ Last diving medical examination _____ Medical examination expiration
- _____ Most recent checkout dive
- _____ Scuba regulator/equipment service/test
- _____ CPR training expiration
- _____ Oxygen administration expiration
- _____ First aid for diving expiration
- _____ Date of last dive _____ Depth

Number of dives completed within previous 12 months?_____ Depth Certification_____ fsw

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

Pertinent specialty authorizations or training:

Emergency Contact Information-Person and relationship to diver:
Telephone:

This is to verify that the above individual is currently a certified scientific diver at the University of NH

Diving Safety Officer: signature Date

Elizabeth Kintzing 603 834 1398 ek@unh.edu

APPENDIX 7
UNH DIVING EMERGENCY MANAGEMENT PROCEDURES

Introduction

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

General Procedures-followed at all diving incidents

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

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

Each Project shall have detailed procedures for:

- Emergency contact for care-mobile phones, marine radio, sat phone.
- Evacuation methods-vehicle, vessel, helicopter.
- Recompression chamber location if available.

Emergency Plan Content

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

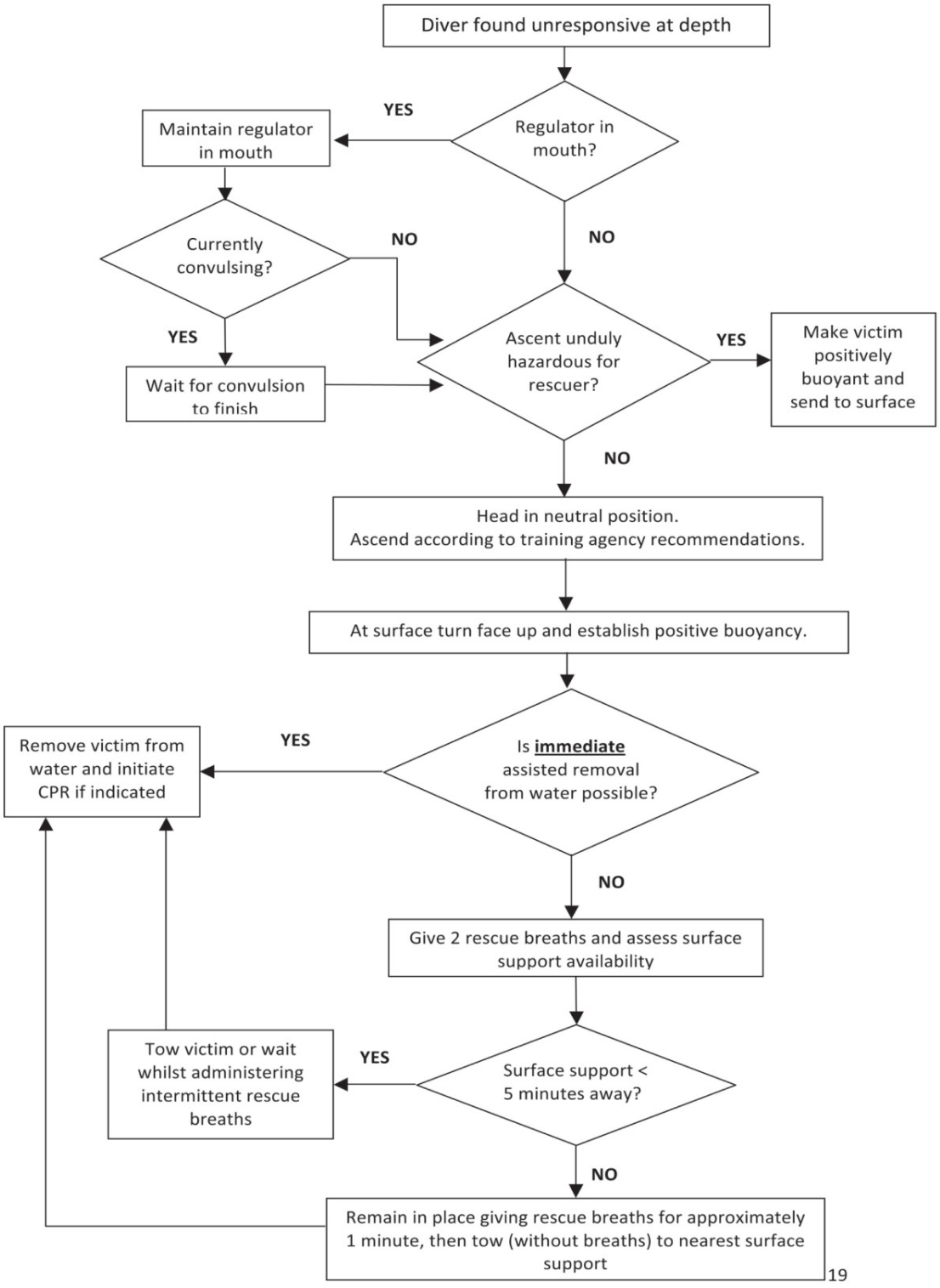
List of Emergency Contact Numbers Appropriate For Local Dive Locations

Diver's Alert Network (DAN)		800-446-2671/919-684-9111
Concord Hospital Hyperbaric Center	ERD 603-225-7511	603-230-1970
Norman Knight Hyperbaric Medicine Center		617-573-4411
UNH Dive Program Officer - Elizabeth Kintzing (Mobile)		603-834-1398
Portsmouth Regional Hospital		603-436-5110
York Hospital		207-363-4321
US Coast Guard (Portsmouth Harbor)	marine radio CH 16, or	603-436-4415

Appendix 8

Recommendations for Rescue Of A Submerged Unresponsive Compressed-Gas Diver

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



Appendix 9

University of New Hampshire Diving Operations Plan

This Plan must be submitted to the Diving Safety Officer for approval prior to implementation.

PROJECT TITLE

TIMELINE (From) **(To)**

PERSONNEL

Principal Investigator Phone
Diving Supervisor Phone

Divers Name	Scientific diver/diver in training	Depth certification
1.		
2.		
3.		
4.		

DIVE SITES (Use additional sheets as required)

Location (s)
Depth
Current
Hazards
(Pollution, Obstructions, Vessels, etc)
Comments

DIVING OPERATIONS

Vessel Required Yes, No, Vessel Name
Master Vessel Description
Diving Tasks Science ( ) Training ( ) Work ( )
Description (Use additional sheets as required)

Diving Mode and Equipment

( ) Scuba ( ) Surface Supply ( ) Mixed Gas ( ) Rebreather ( ) Other

Wet Suit (# of Divers) Dry Suit (# of Divers)

Special Equipment Required

Number of Dives per Day Number of Divers per dive
Night Dives ( ) Yes ( ) No

Planned Depth, Bottom time and Surface interval for dives each day

Computer ( ) Tables ( ) Dive planning software ( )
Decompression Required ( ) Yes ( ) No If Yes, provide details

Comments:

EMERGENCY MANAGEMENT PLAN FOR THIS PROJECT

General Procedures-supply additional information for this particular project
Depending on and according to the nature of the diving accident, stabilize the patient, administer 100% oxygen, contact local Emergency Medical System (EMS) for transport to medical facility, contact diving accident coordinator, as appropriate. Explain the circumstances of the dive incident to the evacuation teams, medics and physicians. Do not assume that they understand why 100% oxygen may be required for the diving accident victim or that recompression treatment may be necessary.

1. Make appropriate contact with victim or rescue as required.
2. Transport victim to boat or shore
3. Position victim (either flat with legs raised or recovery as needed)
4. Establish (A)irway, (B)reathing, (C)irculation as required. (CAB for suspected heart attacks)
5. Administer 100% oxygen, if appropriate (in cases of Decompression Illness, or Near Drowning).
6. Call local Emergency Medical System (EMS) for transport to nearest medical treatment facility.
7. Explain the circumstances of the dive incident to the evacuation teams, medics and physicians. Do NOT assume that they understand WHY 100% oxygen may be required for the diving accident victim, or that recompression may be necessary.
8. Call DAN or appropriate Diving Accident Coordinator for contact with diving physician and recompression chamber. etc.
9. Notify DSO or designee. UNH DSO Number 603-834-1398
10. Secure victims dive gear away for examination or incident inquiry

List of Emergency Contact Numbers Appropriate For Dive Location:

Durham Emergency Dispatch Center 911
Diver's Alert Network (DAN) **919-684-9111** 800-446-2671

Emergency Equipment Checklist
Oxygen Kit ( ) First Aid Kit ( ) AED ( ) Communications Radio ( ) Cell Phone ( )
Nearest Hospital:
Nearest Chamber information if available-most likely will be determined by DAN. (If diving in a remote area chamber information is required: Phone: 919-684-9111
Emergency contact for listed divers above
1.
2.
3.
4.

APPROVED AS SUBMITTED

APPROVED WITH THE FOLLOWING CHANGES
Documents Attached
By_____UNH DPO

Appendix 10

SHOALS MARINE LAB DIVING OPERATIONS

This section describes specific diving policies for scientific diving at Shoals Marine Lab (SML). These regulations are in addition to all previous sections of this manual, SML may present circumstances where increased oversight, or dive management is needed, and these policies are listed below.

Scientific Diving oversight at SML

The SML DSO shall meet all the criteria set forth in Sec 1.20 of this manual for DSO qualifications

Duties and Responsibilities

1. Shall be responsible, through the UNH DCB/DPO, for the conduct of the SML scientific diving program.
2. May permit portions of this program to be carried out by the SML Diving Coordinator (DC), although the DSO may not delegate responsibility for the safe conduct of the local diving program.
3. Shall suspend diving operations considered to be unsafe or unwise.

SML Diving Coordinator (supervisor)

Qualifications

The SML dive coordinator, an employee based at Appledore Island, and is appointed by the Director of SML with the advice of the UNH DCB/DPO and the SML DSO.

The SML dive coordinator is the person in charge of diving operations in the absence of the SML DSO.

The SML DC must be an AAUS/UNH qualified Scientific Diver and a certified Divemaster or Instructor from an internationally recognized agency. (The SML DSO and SML DC may be the same person.)

Responsibilities

Is responsible for on-site supervision of diving activities

Is responsible for the approval of dive plans (see form below) and to qualify individuals as Radio Operators, based on criteria established by the SML DSO and UNH DCB.

Maintenance of SML air station and SML-owned scuba equipment, using criteria and procedures established by the UNH DCB and SML DSO.

Is responsible for maintaining SML-owned equipment maintenance logs, which shall be submitted to the SML DSO at the end of the season.

Requirement for radio operator

Every dive outing requires a radio operator that is approved by the SML Dive Coordinator. The radio operator is responsible for pre-dive, post-dive, and any emergency communications with the SML office.

Shore or "Dive Platform dives"

When diving from shore or the 'Dive Platform' an additional non-diving radio operator is not required. In these instances the lead diver may act as the radio operator for communicating with the SML office. If weather conditions are such that additional personnel are deemed necessary for safe dive operations a non-diving radio operator will be required by the DSO or Dive Supervisor.

Vessel diving

When diving from SML vessels a person/boat operator shall remain on the boat at all times to act as the radio operator, and to render assistance to the divers during the boat diving operations.

First aid supplies

- A first aid kit and emergency oxygen shall be available at the dive site for all dives. Visiting Researchers must: (1) provide their own first aid and emergency oxygen kits and ensure they are properly maintained and inspected; or (2) make prior arrangements for use of SML equipment.

Diver's Flag

A diver's flag shall be displayed prominently whenever diving is conducted at Shoals Marine Lab.

Compressor Operation and Air Test Records

Gas analyses and air tests shall be performed on each SML-controlled breathing air compressor at beginning of each dive season (May-September). The results of these tests shall be entered in a formal log and be maintained.

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

EMERGENCY MANAGEMENT PLAN FOR
SHOALS MARINE LABORATORY SCUBA PROJECTS

General – Below are procedures for SCUBA emergencies involving Shoals Marine Laboratory (SML) divers. They are designed to integrate with general SML emergency response plans, adapt for the operating environment specific to the Isles of Shoals, and utilize the resources generally available during SML's operating season. SCUBA diving activities by SML divers or aboard SML vessels outside of the lab's operating season (May – September) or distant from the Isles of Shoals should follow the UNH Emergency Management Plan for SCUBA projects.

Recall Procedures – For dangerous weather, missing diver, or any other situation that requires divers to surface immediately:

1. Divers will immediately and safely surface when they hear a repeating pattern of three knocks. This sound pattern can be created by topside or underwater personnel using weights, tanks, boat hull, rocks, etc. It is important that at least one of the objects used to create the sound be submerged in the water, and the sound source should be as close to the divers being recalled as logistically possible.
2. Upon surfacing, divers will signal their presence to any topside personnel and be prepared to exit the area, search for a missing diver, or facilitate a rescue.
3. After being recalled from a dive and exiting the water, all divers will assemble at the K-House on Appledore Island for further instructions and incident debriefing.

Emergency Procedures - Depending on and according to the nature of the diving accident, stabilize the patient, administer 100% oxygen, arrange transport to medical facility, contact SML's Diving Coordinator, Dive Safety Officer, and UNH's Dive Program Officer. Explain the circumstances of the dive incident to the evacuation teams, medics and physicians. Do not assume that medical professionals understand why 100% oxygen may be required for the diving accident victim or that recompression treatment may be necessary.

11. Make appropriate contact with victim or rescue as required.
    a. In the event of lost or missing divers, request USCG and SML staff/vessel assistance for a search.
12. Transport victim to boat or shore.
13. Position victim (either flat with legs raised or recovery as needed)
14. Establish (A)irway, (B)reathing, (C)irculation as required. (CAB for suspected heart attacks)
15. Administer 100% oxygen, if appropriate (in cases of Decompression Illness, or Near Drowning).
16. Contact the SML Island Office on VHF channel 80 or 108 or by phone at 603-964-9011.
    a. Describe the incident and instruct SML office to contact the UNH dispatch center (603) 862-1212 to arrange patient transport.
    b. Ask SML office to mobilize local resources (vessels, staff, AED, additional oxygen or first aid supplies) to the scene as appropriate.
    c. If the SML Island Office cannot be reached, contact the UNH dispatch center directly by telephone (603) 862-1212 or call for general help on VHF channel 16.
17. <u>Do not delay transport if you determine the UNH dispatch center is unable to mobilize appropriate resources for the situation.</u> Use SML vessels or emergency contacts below to begin patient evacuation.
18. Explain the circumstances of the dive incident to any evacuation teams, medics, or physicians. Do NOT assume that they understand WHY 100% oxygen may be required for the diving accident victim, or that recompression may be necessary.
19. Call Divers Alert Network (for patients with suspected Decompression Illness)
20. Notify UNH/SML Dive Safety personnel:
    a. SML Dive Safety Officer (Becca Toppin) 508-454-3571
    b. SML Dive Coordinator (Mike Rosen) 603-897-5893
    c. UNH Dive Program Officer (Liz Kintzing) 603-834-1398
21. Secure victim's dive gear for examination or incident inquiry

List of Emergency Contact Numbers:

UNH Emergency Dispatch Center: 603-862-1212
Diver's Alert Network (DAN): 919-684-9111

SML DIVING OPERATIONS PLAN

To be filled out by the Lead Diver

Dive Operation Date _____ **Estimated Start Time**_____ **Number of Divers**____

Dive Location_____

Purpose of Dive_____

No. of Dives Planned_____ **No. of Tanks Needed**_____ **Dive Boat**_____

Depth(s) and bottom time(s) anticipated_____

Decompression status of divers at start of operation_____(attach repetitive dive plan, if required by decompression status of any diver)

List any hazardous conditions anticipated:

Will any special equipment be used? If yes, describe:

Name of Boat/Radio Operator:_____

Diver Information: in the table below, list the names of all divers, certification type (DIT= Diver in Training; SD= Scientific Diver), and current certification depth. Attach additional list if necessary.

Diver's Name (list lead diver first)	Cert. Type		Cert. Depth		
	DIT	SD	30'	60'	100'

Lead Diver Signature_____ Date: _____

Approval by DSO or Dive Coordinator

Signature_____ Date:_____

Appendix 11
Aquaculture Fish Pens

Introduction

The Aquafort project is an offshore Integrated multi-tropic aquaculture (IMTA) farm located at the permitted University of New Hampshire aquaculture site; 1 mile south of Isle of Shoals. The pens consist of 2-20 x 20 foot bays with net depths reaching 50 foot to allow for greater stocking density and provide fish with room to move below the thermocline. The farm will be secured by 4 moorings attached to the farm via a bridal system. In respect to the mussel and kelp cultivation, these will be attached to the outside pontoon.

Special Considerations

The fish cages are located 9 miles off shore as a stand-alone project area with minimal top-sides facilities (a walkway around the perimeter of the cages) and the vessel at the site. The cages are considered 'green or blue' water dives as no real bottom exists. Due to the increased risk at this site only those divers with sufficient skills and knowledge to work out there will be permitted. Any diver planning to work at the fish pens needs to be approved by the UNH DCB/DPO and the project Dive Coordinator.

1. Tasks

Listed below are details of the diving associated tasks that may be carried out on the Aquafort.

1.1. Mortality retrieval

Mortality retrieval refers to the retrieval of dead fish from within the grower nets. Because it is best practice to remove any mortality in a timely manner, mortality retrieval will be the foremost dive task required on the farm. As fresh morts will sink, collection is generally from the bottom of the pen. Due to the sporadic nature of mortality no definite time line can be forecast. However, there will be some specific times when mortality retrieval could potentially be required daily, for example, post transfer of fish to the Aquafort. The other constant will be diving the pens at least once a week. Manning requirements will entail two divers and a qualified tender.

1.2. Net checking and repair

While mort diving, it is common to also perform a net inspection for holes and tears. This is done while descending, starting with a swim around on the surface, descending to 20ft swimming the circumference of the pen, descending to just above the bottom of the pen and repeating the swim around while also checking the bottom of the net. Generally, if a hole is found, zip ties are used to close it. Manning requirements are the same as mortality retrieval.

1.3. Net swap out

Concerning swapping out grower nets. The current practice is to use two divers to release the old net and reattach a new net to the weighted frame. As this is outside of a grower net two divers and tender are present throughout the task.

1.4. Environment probes and loggers

The deployment, maintenance and retrieval of environmental probes and loggers, either inside grower nets or outside. No probes and loggers will exceeded 50 foot depth. A list will be compiled of all the monitoring equipment.

1.5. Mooring work

Due to the depth of the site any mooring work will be in the top 30 feet. The scope of work will primarily be associated with the bridal system. Tasks will include connection, disconnection, tensioning, maintenance and inspection. Connection, disconnection, tensioning and maintenance will require two dives, standby diver and dive tender. Inspection on the other hand will commonly be done on snorkel.

1.6. Snorkeling

Snorkeling will be employed to do quick surface inspections of the farm, mooring, mussel and kelp lines. Snorkeling in or around the farm will never be done without a surface tender.

2. Manning

Task	# of Divers	Standby Required	Tender Required
Snorkeling	N/A	No	Yes
Diving	2 Divers	No	Yes
Mooring Work	2 Divers	Yes	Yes

APPENDIX 12
OPERATIONAL PROCEDURES FOR DIVES BEYOND THE SCOPE OF SCIENTIFIC DIVING

1.0 DEFINITION

As defined in Part 1910 of the Occupational Safety and Health Standards, Subpart T - Commercial Diving Operations, Appendix B Guidelines for Scientific Diving IV: 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 within the scope of scientific diving.

2.0 SCOPE

Any dive, which involves tasks that extend beyond the definition of scientific diving as, described in Section 1.0 shall be conducted under the applicable regulations of the Commercial Diving Standards. This includes, but is not limited to, activities such as: underwater structure construction or repair; mooring emplacement; underwater rigging for and about heavy objects; underwater cutting, burning, welding, cleaning or demolition; erection of underwater habitats for human occupancy; etc.

3.0 PROCEDURES

3.1 Project supervisors who anticipate that such non-scientific dives will be required must submit a request to the DCB for permission to conduct these diving operations. This request must contain a written SOP for the detailing the specific dive tasks, and procedures to minimize hazards.

3.2 The request must include the following:

- Overall project plan and objectives
- Date, location, and time of the dive (s)
- Dive profile and the tasks to be performed
- Equipment to be used
- Names and qualifications of the divers involved-All divers must be trained in the work they are tasked with completing
- Identification of support vessels including size, capabilities, and the name of Captain
- Emergency procedures, and evacuation plan

1.3 The DCB will review the SOP and dive plan with respect to the requirements of the Commercial Diving Operations Regulations particularly Sections 1910.423 (c) and 1910.424 (b-2) which require more divers, and equipment than scientific dives.

1.4 Personnel and equipment requirements for non-scientific exemption dives include:

- All divers must be trained and experienced in the type of diving, equipment used, and tasks to be performed on the working dives.
- A SOP manual for the tasks and equipment used for the dive must be at the dive work site.
- There must be a designated person in charge (DPIC) at the dive site (not diving).
- There must be a stand-by diver dressed and ready to enter the water to assist the diver(s).
- If the diver is on Scuba they must have a comparably equipped buddy, or be line tended.
- A backup source of breathing gas shall be available to the diver, the amount and type must be appropriate for the dive, and tasks undertaken.
- If dives take place deeper than 100fsw, are stage decompression dives or utilize mixed gas, a staffed, operational recompression chamber shall be within 5 minutes of the dive site.
- 1.5 Once the SOP/dive plan has been approved, the DPO or his / her designee will monitor the operation to ensure compliance.

4.0 EMERGECY REPAIRS

4.1 If during scientific or training dive operations a situation occurs where underwater repairs to a vessel or structure are immediately required to maintain the safety of on-board personnel e.g. a fouled or bent propeller, leaking hull due to collision damage or penetrator failure etc, and the Diving Supervisor determines that these repairs are within the capability of the dive team (in terms of diver qualification, available air, and bottom time without decompression), then he/she is authorized to conduct dive operations to effect the necessary repairs.

4.2 A written report of the repair issues shall be forwarded to the DPO.

APPENDIX 13
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
- PC Based Decompression Software

Depth Ranges:

Depth ranges for sorting logged dives are: 0-30, 31-60, 61-100, 101-130, 131-150, 151-190, 191-250, 251-300, and 301->. Depths are in feet seawater (when measured in meters: 0-10, >10-30, >30-40, >40-45, >45-58, >58-76, >76-92, and >92->). A dive is logged to the maximum depth reached during the dive. Note: Only "The Number of Dives Logged" and "The Number of Divers Logging Dives" will be collected for this category.

Specialized Environments:

- Required Decompression: Any dive where the diver exceeds the no-decompression limit of the decompression planning method being employed.
- Overhead Environments: Any dive where the diver does not have direct access to the surface due to a physical obstruction.
- Blue Water Diving: Openwater diving where the bottom is generally greater than 200 feet deep and requires the use of multiple-tethers diving techniques.
- Ice and Polar Diving: Any dive conducted under ice or in polar conditions. Note: An Ice Dive would also be classified as an Overhead Environment dive.
- Saturation Diving: Excursion dives conducted as part of a saturation mission are to be logged by "classification", "mode", "gas", etc. The "surface" for these excursions is defined as leaving and surfacing within the Habitat. Time spent within the Habitat or chamber must not be logged by AAUS.
- Aquarium: An aquarium is a shallow, confined body of water, which is operated by or under the control of an institution and is used for the purposes of specimen exhibit, education, husbandry, or research (Not a swimming pool).

Incident Types:

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

Incident Classification Rating Scale:

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