



STANDARDS FOR SCIENTIFIC DIVING

FOREWORD

This standard exists to promote the health, safety and professional development of the faculty, students, and staff of the University of Connecticut Marine Sciences Diving Program (MSDP), and to assist in the planning of effective scientific diving operations.

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Volume 1

Sections 1.00 through 5.00 Required For All Organizational Members

Section 1.00 GENERAL POLICY

1.10 Scientific Diving Standards

Purpose

The purpose of these Scientific Diving Standards is to ensure scientific diving is conducted in a manner that will maximize the protection of scientific divers from accidental injury and/or illness, and to set forth standards for training and certification that will allow a working reciprocity between collaborating investigators and organizations.

This manual exceeds the minimum standards of the American Academy of Underwater Sciences

Historical Perspective

This *Manual* was developed 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.

Scientific Diving Definition

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).

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)(iii) are:

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

continuous contact with another diver in the water) for SCUBA diving.

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

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

Recommendations for Changes to AAUS Manual

As part of the UCONN Marine Sciences Diving Program (MSDP) annual report to AAUS recommendations for modifications to AAUS minimum standards maybe submitted to AAUS for consideration.

1.20 Operational Control

UCONN MSDP operational control

MSDP operational control include any scientific diving operation in which it is connected because of ownership of life support equipment used, locations selected, or relationship with the individual(s) or auxiliary organizations concerned, where such individuals or auxiliary organizations are acting within the scope of their authorization.

Diving Safety Manual

The MSDP diving safety manual must meet or exceed current AAUS standards and be approved by a majority vote of the MSDP Diving Control Board (DCB).

Diving Control Board

- The Diving Control Board (DCB) must consist of a majority of active scientific divers. Voting members include the Diving Safety Officer (DSO), and other representatives of the diving program appointed by the UCONN Marine Sciences department head. The Marine & Waterfront Operations Manager shall serve as chairperson and a secretary may be chosen from the membership of the board.
- The DCB has autonomous and absolute authority over the scientific diving program's operations and may not abdicate responsibility for the safe conduct of the MSDP.
- It is the responsibility of the DCB to ensure adherence to this manual. Operational requirements herein must be observed at all locations where scientific diving is conducted.
- Non-voting members that can contribute to the mission of the MSDP may be appointed.
- The DCB may delegate operational oversight for portions of the program to the DSO; however, the DCB may not abdicate responsibility for the safe conduct of the diving program.
- The DCB must:
 - Establish MSDP standards, protocols, and operational procedures.
 - Approve project dive plans and monitor diving projects and ensuring no scientific diving operations including training are conducted without the review and approval of the DSO.
 - Review, revise and ensure compliance with the diving safety manual.
 - Act as the Department of Marine Sciences (DMS) official representative in matters concerning the scientific diving program.

- Act as a board of appeal to consider diver-related problems and approve disciplinary action including restriction or revocation of diving authorizations.
- Establish and/or approve training programs and techniques that satisfy the requirements of the diving safety manual.
- Establish and/or approve facilities for the inspection and maintenance of diving and associated equipment.
- Periodically review the DSO's and MSDP performance.
- Investigate MSDP diving incidents or violations of MSDP standards and dive plans.
- Investigate diving incidents within the MSDP's diving program or violations of the MSDP's diving safety manual.

Diving Safety Officer

Qualifications

- Must have broad technical expertise and experience in scientific diving.
- Must be an active scuba instructor from an internationally recognized certifying agency.
- Must be appointed by the Marine Sciences dept. head, with the advice and counsel of the DCB.
- Must qualify as a Full Voting Member of AAUS as defined by AAUS Bylaws
- Must attend an AAUS DSO Orientation within one year of accepting a position at an AAUS approved OM, unless he/she has served as a DSO for another current AAUS OM within the last year.

Duties and Responsibilities

- The DSO is responsible to the DCB and the Marine Science Dept. Head for the operational conduct of the MSDP.
- The DCB has delegated the routine operational authority for the MSDP to the DSO including but not limited to:
 - Maintenance of diving records include but are not limited to:
 - Current Diving Safety Manual
 - Most recent record of all required diving and emergency care equipment to include any modification, repairs, tests, calibrations, or maintenance service. To include date, work performed, serial number (if applicable), and the name of the individual or company performing the service.
 - Current compressor air tests shall be available.
 - 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.
 - Medical records must be available to an attending physician of a diver or former diver when released in writing by the diver.
 - Diver training, authorization, and disciplinary records - shall be retained for a minimum of 1 year beyond the life of the diver's program participation.
 - Dive plans, logs, and incident reports - shall be retained for a minimum of 1 year, except 5 years where there has been a pressure-related injury.
 - Ensuring adherence to the buddy system for scientific scuba diving.
 - Suspending divers or diving operations considered to be unsafe or non-compliant with UCONN MSDP standards and procedures
 - Establish criteria for equipment selection and use.
 - Ensure that breathing gases meet standards as described in this manual.
 - Diver training and authorization

- Assessing and authorized all personnel involved in diving instruction under the auspices of the MSDP
- Delegating duties and responsibilities to be carried out by qualified MSDP personnel
- The MSDP DSO may waive specific requirements of training, examinations, depth certification, and minimum activity to maintain diving authorization. MSDP medical standards may not be waived. The DSO must notify the DCB of the justification and duration of all waivers granted.

Lead Diver

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

- Ensuring dives are conducted in accordance with MSDP standards and procedures.
- Ensuring the dive plan has been approved and is followed or amended as permitted by the DSO or DCB.
- Coordination with other known activities in the vicinity that are likely to interfere with diving operations.
- Suspending diving operations if in their opinion conditions are not safe.
- Reporting to the DCB, through the DSO, any physical problems or adverse physiological effects including symptoms of pressure-related injuries.

Reciprocity and Visiting Scientific Diver

- When engaged with more than one organization in diving activities, or joint use of diving resources, one participating organization must be designated to govern diving activities. However, responsibility for individual divers ultimately resides with the diver's home organization.
- A Scientific Diver from another organization must apply for permission to dive under the control of the MSDP by submitting to the DSO a document containing all the information listed in Appendix 6, signed by the DSO or designee of their DCB.
- If the MSDP denies a visiting Scientific Diver permission to dive, the MSDP will notify the visiting Scientific Diver and their DCB with an explanation for the denial.
- MSDP divers working with non-AAUS organizations must submit a dive plan with medical reports, dive certifications, dive logs, emergency care certifications and any other documentation requested by the DCB to determine competency of non-AAUS divers. The MSDP DCB must approve diving with non-AAUS divers regardless of whose control the project is being conducted under.
- Any Scientific Diver may be asked to demonstrate their knowledge and skills for the planned dive.

1.30 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 the UCONN MSDP's AAUS membership. Scientific Divers may report violations to the MSDP DCB Chairperson or the AAUS Standards Committee Chairperson, (www.aaus.org).

SECTION 2.00 DIVING REGULATIONS

2.10 Introduction

No person shall engage in scientific diving operations under the auspices of the UCONN MSDP 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 MSDP, a dive plan must be formulated and submitted to the DSO for approval by the DCB. Dives should be planned around the competency of the least experienced diver. The dive plan should include the following:

- Diving mode(s) and gas(es)
- Divers' authorizations
- Diving environment
- 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
- Dive platform and procedures for entry, exit, descent, and ascent.
- Job hazard analysis and risk mitigation plan
- Emergency Management Plan including victim egress and evacuation ([Appendix 6](#))

Diver Responsibility and Refusal to Dive

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 MSDP standards and procedures.

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

- Scientific divers must conduct a check prior to the start of diving operations to ensure that all required equipment is on onsite, functioning, and appropriate for the planned operations.
- Prior to the pre-dive briefing the lead diver will evaluate environmental conditions, Diver fitness and safety equipment to verify readiness.

Pre-dive Briefings

Before conducting any diving operations under the auspices of the OM, the dive team members

must be briefed on:

- Dive objectives.
- Buddy assignments and tasks
- Maximum depth(s) and bottom time
- Gas management plan
- Entry, exit, descent, and ascent procedures
- Hazards and mitigations
- Emergency procedures
- Recall procedures if applicable

2.30 Diving Procedures

Solo Diving Prohibition

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

Decompression Management

- A DSO approved method of calculating appropriate dive profiles should be available at the dive site (e.g. tables, dive computers, decompression software).
- Divers must have received training on the model of decompression computer they use, and any manufacturers' guidelines should be followed.
- Dive Computers capable of changing inert gas and/or oxygen percentages should be checked by the diver prior to the start each dive to verify gas setting are consistent with cylinder contents.
- Diver team members must follow the most conservative dive computer profile in the team
- A safety stop shall be conducted on every no-decompression dive that exceeds 60fsw (18m) unless the stop would increase risk to the diver or delay treatment of an injury.

Termination of the Dive

- It is the responsibility of the diver to terminate a 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.
- Unless noted in an approved dive plan, no-decompression divers shall terminate a dive with sufficient cylinder pressure to permit the diver to safely reach the surface with 500 PSI. Decompression diving requires an approved dive plan with a detailed gas management section.

Emergencies and Deviations from Regulations

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

2.40 Post-Dive Procedures

Post-Dive Safety Checks

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

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

Divers may follow the DAN Flying after Diving recommendations:

- 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.

Or divers may follow the US Navy Ascent to Altitude after Diving / Flying after Diving recommendations (sec 9-14 US Navy Diving Manual Rev7).

2.60 Record Keeping Requirements

Personal Diving Log

Each authorized scientific diver must log every dive made under the auspices of the MSDP and is encouraged to log all other dives. MSDP Dive program logs must be submitted annually and include at least the following:

- Name of diver and buddy
- Date, time, and location
- Diving modes and breathing gases used
- General nature of diving activities
- Maximum depth and total dive time
- Decompression calculation method used
- Detailed report of any near or actual incidents

Required Incident Reporting

Diving incidents requiring recompression treatment, resulting in moderate or serious injury, or death must be reported to the MSDP DCB and AAUS. The DSO or MOM will report occupational injuries and illnesses to the University in accordance with appropriate State of Connecticut Labor Codes. The DCB will initiate an investigation of diving related injuries.

- 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 conditions that led up to incident.
 - Project dive logs.
 - The circumstances of the incident.
 - Description of symptoms, including depth and time of onset.
 - Description and results of treatment.
 - Disposition of case.
 - Recommendations to avoid repetition of incident.

After DCB review the DSO will submit the completed AAUS Incident Report during the annual reporting cycle (www.aaus.org).

SECTION 3.00 DIVING EQUIPMENT

3.10 General Policy

With the exception of cylinders all diving equipment should meet CE certification standards. Waivers for use of non-CE certified equipment maybe granted by the DCB. Equipment must be serviced according to manufacturer recommendations or DCB recommendations and functionally inspected before every dive.

3.20 Minimum equipment configuration for all open circuit dives:

- Mask
- Buoyancy compensator device (BCD) with sufficient lift to provide positive buoyance at the surface and a low-pressure (LP) power inflator
- Regulator with submersible pressure gauge and LP inflator hose
- Emergency breathing gas source, e.g., safe second, (octopus) or redundant air source
- Weight system
- Personal dive computer (PDC) or approved tables used with a submersible depth gauge and timing device
- Adequate exposure suit: dry suits must be equipped with inflation and exhaust valves
- Compressed gas cylinder meeting DOT specifications (or applicable design and requalification standard) and visually inspected within the previous 12 months
- Rescue signal(s)

BCDs, dry suits, or 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 by the DSO.
- Electrical tools, lights, and scientific equipment supplied with power from the surface must be de-energized before being placed into or retrieved from the water and must not be supplied with power 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 immediately available at the dive site.

Diver's Flag

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

MSDP Compressor Systems

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

- Low-pressure compressors 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. Air

compressor intakes must be located away from areas containing exhaust or other contaminants.

- Air compressors must have air tested when a compressor is put into service and quarterly thereafter.
- Oil lubricated compressor/filtration systems used to produce oxygen compatible air (modified E grade) should be checked for oil and hydrocarbon contamination quarterly.

3.50 Breathing Gas Standards

Air should meet or exceed the following CGA grade E specifications:

Oxygen	20 - 22%
Carbon Monoxide	10 ppm
Carbon Dioxide	1000 ppm
Condensed Hydrocarbons	5 mg/m ³
Total Hydrocarbons as Methane	25 ppm
Water Vapor ppm	0.0002%
Odors	None

Oxygen compatible air (modified E grade) must have a hydrocarbon contaminant less than .01 mg/m³.

Oxygen should meet or exceed the following specifications:

Oxygen	99.0%
Carbon Monoxide	0.001%
Carbon Dioxide	0.03%
Objectionable Odors	None

(USP and CGA grade A and E meet or exceed these specifications)

Helium should meet or exceed the following specifications:

Purity not less than	99.0%
Air not more than	1.0%
Carbon Monoxide not more than	0.001%
Carbon Dioxide	0.03%
Objectionable Odors	None

(CGA Grade B or grade 4.7 meet or exceed these specifications)

Breathing gases meeting EN 12021:2014 can be used when diving in countries adhering to EU standards.

In water temperatures less than 40°F (4C), breathing gases should not exceed a dew point of 50°F (46C), or 10 degrees lower than the coldest temperature expected in the area. Grade E (aviation) oxygen should be used for production of mixed gasses used under these conditions.

Remote Operations

For remote site operations every effort should be made to verify breathing gas meets the requirements of this standard. If the breathing gas grade is not verifiable, the dive plan must include procedures to mitigate risk to the divers.

SECTION 4.00 SCIENTIFIC DIVER CERTIFICATION AND AUTHORIZATIONS

This section defines the training and performance standards for MSDP Scientific Divers.

4.10 Prerequisites

Administrative

Scientific diving candidates must submit the following before training begins:

- Medical Evaluation of Fitness for Scuba Diving Report meeting the requirements of section 5.0 and Appendices 1-4 of this manual
- Diving Medical History Form
- MSDP Application
- Photocopy of Diver Certification or equivalent from an internationally recognized training agency

Swimming/Watermanship Evaluation

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

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

4.20 Training

Unless a diver's resume provides clear evidence of significant scientific diving experience, a candidate must successfully complete all prerequisites, plus theoretical and practical training, followed by examinations for a minimum time of 100 hours. This should be accomplished by completing the MARN 4160 scientific diving course and emergency care training. With DSO approval a diver with significant experience can be given credit for meeting portions of the training requirement but must complete all skill assessment list in the open water training section of this manual to the satisfaction of the DSO or their designee.

Theoretical Training / Knowledge Development

Required Topics:

- Scientific Diving Regulations and History
 - Appropriate Governmental Regulations
 - Coordination with other organizations
- MSDP Dive Equipment and Locker Orientation
 - HP Cylinders HazMat Training
- Diving Physics and Physiology
- Decompression theory
 - Dive Tables
 - Dive Computers
 - PC Based Software
- Hyperoxia
- Hypoxia

- Oxygen exposure management
- Hypercapnia
- Hazards of breath-hold diving and ascents
- Specialized Breathing Gases
- Nitrox
- Equipment and Procedures
- Introduction to Mixed gas
- Specialized Equipment (e.g. Line reels, Surface marker Buoys and lift bags, Closed circuit rebreathers)
- Local Diving Environments
- Scientific Dive Planning
- Navigation
- Scientific Diving Methods and Data Gathering Techniques
- Emergency Care Training
 - Cardiopulmonary Resuscitation (CPR), AED and Standard First Aid
 - Recognition of Decompression Illness and Field Neurological Exam
 - Oxygen Administration
- Dive Rescue
 - Prevention and Causes of Diving Accidents
 - Stress and psychological factors (i.e. causes of panic)
 - Situational awareness
 - Equipment
 - Near drowning
 - Diving Lifesaving
 - Self-rescue
 - Diver assists
 - Surface and underwater rescues
 - Types of transports
 - In-water artificial respiration
 - Boat and shore extraction techniques
 - Accident Management Plan
 - Information collection
 - Access to emergency transport/assistance and hyperbaric chambers
 - Accident reporting
 - Liability and related legal considerations

Practical Training / Skill Assessments

Divers-in-training should successfully complete a minimum of one confined water checkout dive and twelve open water training dives for a cumulative surface to surface time of 6 hours. After passing all open water skills demonstrations, subsequent training dives may be supervised by personnel authorization by the DSO. Training dives should not exceed 30 feet (9 m) until after students have logged 12 dives and no training dives should exceed 100 feet (30 m).

The following skill assessments must be completed to the satisfaction of the MSDP DSO or their designee prior to certification.

In confined water demonstrate:

- Appropriate entry in full scuba

- Remove, replace, and clear face mask
- Air sharing ascent using an alternate air source, as both donor and recipient, with and without a face mask
- Buddy breathing as both donor and recipient, with and without a face mask
- Understanding of underwater signs and signals
- Equipment removal and replacement while submerged
- Surface dive to a depth of 10 feet (3 meters) without scuba
- Acceptable watermanship skills for anticipated scientific diving conditions
- Surface rescues of both passive and active panic victims.
- Proper way to surface both a responsive diver and unresponsive diver
- Rescue tows, in water artificial respiration and dive equipment removal techniques.

In open water demonstrate:

- Surface dive to a depth of 10 feet (3 meters) without scuba*
- Appropriate entries and exits while wearing scuba gear ^^
- Four-hundred-yard (366 meters) surface swim while wearing scuba gear, but not breathing from the scuba unit*
- Proficiency in air sharing ascent as both donor and receiver*
- Ability to maneuver efficiently ^^
- A simulated emergency swimming ascent*
- Mask removal and replacement and regulator recovery and clear while submerged*
- Underwater communications^^
- Ability to achieve and maintain neutral buoyancy while submerged
- Techniques of self-rescue and buddy rescue*
- Underwater navigation ^
- Plan and execute a dive^
- Judgment adequate for safe scientific diving ^^

Open Water Rescue Skills, following the “Recommendations for Rescue of a Submerged Unresponsive Compressed Gas Diver (Appendix 9) demonstrate:

- Rescue from depth, a simulated unresponsive victim of a diving accident.
- Demonstrate simulated in-water artificial respiration and transport 25 yards (23 meters), a simulated unresponsive victim of a diving accident.
- Removal of victim from water to shore or boat

* Checkout dive element

^^ Evaluated on all dives

^ Evaluated at some point during the training cycle

Examinations

The trainee should pass a written examination that demonstrates knowledge of the following:

- Function, care, use, and maintenance of diving equipment
- Advanced physics and physiology of diving
- Diving regulations

- Applicable diving environments
- Emergency procedures including emergency ascents
- Currently accepted decompression theory and procedures
- Proper use of dive tables and decompression computers
- Hazards of breath-hold diving and ascents
- Planning and supervision of diving operations
- Navigation
- Diving hazards & mitigations
- Dive rescue procedures
- Cause, symptoms, treatment, and prevention of the following:
 - Near Drowning
 - Air Embolism
 - Hypercapnia
 - Squeezes
 - Oxygen Toxicity
 - Nitrogen Narcosis
 - Exhaustion
 - Panic
 - Respiratory Fatigue
 - Motion Sickness
 - Decompression Sickness
 - Hypothermia
 - Hypoxia/Anoxia

4.30 Diver Certification and Authorizations

Only a person diving under the auspices of the MSDP is eligible for MSDP scientific diver certification. Any candidate determined by the DSO and/or DCB to lack the necessary judgment to safely participate in scientific diving operations may be denied MSDP scientific diving privileges.

Diver-In-Training (DIT) Authorization

This authorization to dive, is usable only if current and for the purpose intended. It signifies that a diver meets the requirements of section 4.1 and has the knowledge, skills, and experience necessary to participate in a scientific diver program approved by the DCB. DIT status is intended to be a temporary authorization, not a substitute for Scientific Diver Certification.

Scientific Diver Certification

Signifies a diver has completed all requirements in [Section 4.20](#) and is certified by the UCONN MSDP to engage in approved scientific diving activities without supervision. Submission of documents and participation in aptitude examinations does not automatically result in certification. Scientific Diver Certification is only active when required authorizations and training requirements are in place and current.

Temporary Diver Authorization

A Temporary Diver Authorization constitutes a waiver of selected requirements of [Section 4.0](#) and is valid only for a limited time, as approved by the DSO. It may be granted to an individual that can contribute significantly to a project or scientific diver training program. A Temporary Diver Authorization must be restricted to the planned diving operation and must comply with all other policies, regulations, and standards of this manual, including medical requirements. It can only be granted after verification of the knowledge, skills, and experience necessary to participate in planned diving operations.

4.40 Depth Authorizations

Depth Ratings and Progression to Next Depth Level

Depth Rating indicates the maximum depth to which a diver can conduct science and supervise other divers holding a lesser depth authorization.

A diver may be authorized to the next depth level after successfully completing the requirements for that level. A diver may exceed his/her depth authorization when accompanied and supervised by a dive buddy authorized by the DSO and holding a depth authorization greater or equal to the intended depth. The diver must demonstrate proficiency in the management of dive time, breathing gases and decompression status on all dives.

- *Authorization to 30 Foot Depth* - Initial science diver depth authorization, approved upon the successful completion of training listed in Section 4.00. Cumulative minimum supervised dives: 12.
- *Authorization to 60 Foot Depth* - A scientific diver may be authorized to a depth of 60 feet after successfully completing 12 supervised dives to depths between 31 and 60 feet for a minimum total time of 4 hours. Cumulative minimum supervised dives: 24.
- *Authorization to 100 Foot Depth* - A diver holding a 60-foot authorization may be authorized to a depth of 100 feet after successfully completing 6 supervised dives to depths between 61 and 100 feet. Cumulative minimum supervised dives: 30.
- *Authorization to 130 Foot Depth* - A diver holding a 100-foot authorization may be authorized to a depth of 130 feet after successfully completing 6 supervised dives to depths between 100 and 130 feet. Cumulative minimum supervised dives: 36.
- *Authorization to 150 Foot Depth* - A diver holding a 130-foot authorization may be authorized to a depth of 150 feet after successfully completing 6 supervised dives to depths between 130 and 150 feet. The diver must demonstrate the knowledge and skills to safely conduct decompression dives. Cumulative minimum supervised dives: 42.
- *Authorization to 190 Foot Depth* - A diver holding a 150-foot authorization may be authorized to a depth of 190 feet after successfully completing 6 dives to depths between 150 and 190. Cumulative minimum supervised dives: 48.

Dives beyond 190 feet require the use of mixed gas.

- *Mixed gas authorization to 200 Foot Depth* - A diver holding a 150-foot authorization may be authorized to a depth of 200 feet after successfully completing training, demonstrating the knowledge and skills to safely conduct mixed gas diving and completing 6 dives in the depth range.
- *Authorization to 300 Foot Depth* - A diver holding a 200-foot authorization may be authorized to a depth of 300 feet after successfully completing training, demonstrating the knowledge and skills to safely conduct hypoxic mixed gas dives and completing 6 dives in the depth range.

Dives beyond 300 feet require the use of closed-circuit rebreathers and DCB approval.

- *Authorizations deeper than 300 Feet* – A diver holding a 300-foot authorization may be authorized to depths greater than 300 feet after successfully completing training dives deeper than 300 feet as required by the DCB. Divers authorized to depths greater than 300 feet must demonstrate the knowledge and skills to conduct responsible risk assessments and safely

conduct hypoxic mixed gas dives utilizing deep bailout methods approved by the DCB (e.g. Team bailout, SCR bailout, surface supported bailout, staged gas bailout).

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 two dives must be logged near the maximum depth of the diver's authorization during each 12-month period. Divers authorized to 150 feet or deeper may satisfy these requirements with dives to 130 feet or deeper. Failure to meet these requirements will result in revocation or restriction of authorization by the DCB.

Requalification of Authorization

A diver whose certification has lapsed can be reinstated by performing a checkout dive(s) under the supervision of the DSO or designee. The diver may not be eligible for a Letter of Reciprocity until minimum activity requirements have been completed. Previous depth authorizations can be restored by completing a supervised dive(s) in the lapsed depth range.

Medical Examination

All scientific divers must pass a medical examination at the intervals specified in [Section 5.0](#).

Emergency Care Training

The scientific diver must hold current certifications in the following:

- Adult CPR and AED
- Emergency oxygen administration
- First aid

4.60 Revocation of Authorization

- An individual's scientific diver certification may be restricted or suspended for cause by the DSO.
- Reasons for restrictions or suspensions will be reported by the DSO to the diver and DCB in writing.
- The diver will be given the opportunity to present their case in writing to the DCB for consideration.
- After consideration an individual's scientific diver certification may be permanently restricted or revoked for cause by the DCB or the diver may be reauthorized after complying with any conditions the DCB imposes.

SECTION 5.00 MEDICAL STANDARDS

5.10 Medical Requirements

General

- All medical evaluations required by this Manual must be performed by, or under the direction of, a licensed examining medical authority of the applicant-diver's choice, preferably one trained in diving/undersea medicine.
- All MSDP divers must verify fitness to dive by submitting a Medical Evaluation of Fitness for Scientific Diving Report to the DSO ([appendix 2](#)), including any recommended restrictions or limitations, and signed by a licensed medical authority.
- **Modifications or omissions of required tests are not permitted.**

5.20 Frequency of Medical Evaluations

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

5.30 Information Provided Examining Physician

- Copies of the medical evaluation requirements of this Manual must be provided to the examining physician. (Appendices 1, 2, and 3).
- Divers should maintain personal signed copies of appendices two and three.

5.40 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.

<https://www.uhms.org/resources/diving-medical-examiners-list.html>

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

Volume 2

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

SECTION 6.00 NITROX DIVING AND MIXED GAS

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

6.10 Requirements for Nitrox and Mixed Gas Authorizations

Only a certified Scientific Diver, DIT or Temporary Diver diving is eligible for authorization to use nitrox or other mixed gasses.

Training

Required Subjects

General Topics

- History of Nitrox
- Review of physics applicable to diving
- Dalton's law of partial pressures
- Physiology
 - Hypoxia
 - Hyperoxia
 - Hypercapnia
 - CO hazards and mitigations
- Exposure limits
 - CNS
 - OTU
 - Narcosis
 - Equivalent air depth
- Decompression planning
 - Dive tables
 - Equivalent air depth
 - Dive Computers
- Dive planning
- Risk assessment and job safety analysis
- Equipment considerations
 - Oxygen compatibility
 - Oxygen cleaning
 - Oxygen content rules
 - 40 percent
 - Navy
 - CGA
 - UConn
- Common mixing procedures
 - Partial pressure blending
 - Continuous blending
 - Membrane separation system

Nitrox Specific Training

Classroom:

- History of Enriched Air Nitrox (EAN)
- Advantages and Disadvantages of EAN

- Use for physiological advantage
- Use to extend no-decompression bottom times or shorten surface intervals
- Discussion of myths and facts regarding EAN mixtures
- Use and theory of oxygen analyzer

Written evaluation:

- Function and maintenance of equipment cleaned for nitrox use.
- Physical and physiological considerations of nitrox diving (e.g.: O₂ and CO₂ toxicity)
- Determination of MOD, oxygen partial pressure, best mix 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
- Diving regulations, procedures/operations, and dive planning as related to nitrox diving
- Equipment marking and maintenance requirements
- Dive table and/or dive computer usage

Practical Evaluation:

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

- Dive plan completion
- Oxygen analysis of nitrox mixtures cylinder labeling and gas log entries
- Care and use of nitrox equipment
- Nitrox dive computer use
- Situational awareness and buoyancy control

Trimix, and Heliox Specific Training

Can be conducted concurrently with decompression dive training.

Prerequisites

- Scientific Diver Certification
- Nitrox authorization
- Proof of 100 logged dives

Classroom training including:

- History of mixed gas diving
- Helium
 - HPNS
 - Counter diffusion
 - Heat Capacity
 - Thermal conductivity
- Equivalent Narcotic depth
- Equivalent gas density
- Gas planning
 - Bottom mix
 - Decompression gases
 - Travel gas
- Mixed gas decompression planning
 - Dive Computers and
 - Decompression software generated tables

- Gas analysis
- Mixed gas production methods
- Gas density limits
- Thermal considerations

Practical Training

- A minimum of 6 open water training dives. A minimum of four training dives shall be completed using trimix or heliox as a bottom gas.
- At least one initial dive must be in 130 feet or less to practice equipment handling and emergency procedures and subsequent dives should gradually increase in depth.
- Planned operational depth for initial training dives must not exceed 200 feet.
- Diving operations beyond 200 feet requires six additional training dives with at least two dives deeper than 61 meters (200 feet) utilizing two decompression gasses and travel gas.

6.20 Minimum Activity to Maintain Authorization

- A nitrox diver shall log at least one nitrox dive per year to maintain authorization.
- A mixed gas diver shall log at least one mixed gas dive per year to maintain authorization.
- A diver whose certification has lapsed can be reinstated by performing a checkout dive(s) under the supervision of the DSO or designee.

6.30 Nitrox and Mixed Gas Operational Requirements

Oxygen Exposure Limits:

- Planned oxygen partial pressure of the breathing gas shall not exceed 1.5 ATA for open-circuit no decompression dives.
- Planned oxygen partial pressure of the breathing gas shall not exceed 1.4 ATA for no decompression dives using rebreathers.
- Planned oxygen partial pressure of the breathing gas shall not exceed 1.4 ATA during the bottom phase and initial ascent to the first decompression stop for open-circuit decompression dives.
- Planned oxygen partial pressure of the breathing gas shall not exceed 1.3 ATA during the bottom phase and initial ascent to the first decompression stop for decompression dives using rebreathers.
- Planned oxygen partial pressure of the breathing gas for decompression shall not exceed 1.6 ATA
- The planned oxygen partial pressure should be reduced in cases where cold or strenuous dive conditions, or extended exposure times are expected.
- Divers must track oxygen exposures with an oxygen partial pressure greater than .5 ATA.
- When planning exposures to oxygen partial pressures of greater than 1.3 ATA, divers should use limits defined by NOAA Maximum Single Exposure table 4.4 and NOAA CNS O2 toxicity surface interval table 4.6. For oxygen exposures from 1.3 ATA to 0.5 ATA, divers may use limits defined by NOAA Table 4.7 REPEX oxygen exposure chart for tolerable multiple-day exposures, (NOAA Diving Manual, 2017).

Verification by User

- Prior to the dive, it is the responsibility of each diver to analyze the content of his/her cylinder(s) and acknowledge in writing the following information for each cylinder: oxygen percentage, helium percentage if applicable, MOD, cylinder pressure, date of analysis, and

user's name.

- Dive log reporting forms shall report gas mixture used.
- Gas content labels with the oxygen and helium (if applicable) percentages, maximum operating depth (MOD), partial pressure of oxygen used to calculate the MOD, date the cylinder was analyzed and the name or initials of the diver using the mix.

Decompression calculation, gas mix and gas volume requirements shall be addressed in the dive plan and approved by the DSO.

6.40 Nitrox and Mix Gas Diving Equipment

Required Equipment

All of the designated equipment and stated requirements regarding scuba equipment required in this manual apply to mixed gas operations. Additional minimal equipment includes:

- Labeled SCUBA Cylinders
 - Green and yellow nitrox labeled cylinders may contain any N₂O₂ with mixture greater than 21% oxygen.
 - Red and White trimix labeled cylinder may contain any He N₂O₂ mix
 - Red and White custom mix labeled cylinders may contain any mix that is breathable in the intended depth range.
 - Argon tanks must have a red or orange content label with the warning “Do Not Breath” affixed.
- Oxygen or oxygen/helium analyzer

Requirement for Oxygen Service

- All equipment which during the dive or cylinder filling process is exposed to concentrations greater than 23% oxygen at 30 bar (435psi), shall be cleaned and maintained for oxygen service.

Gas Mixing Requirements

- Oxygen systems over 125 psig must have slow-opening shut-off valves.
- MSDP gas mixing methods must be approved by the DSO.
- Personnel mixing nitrox or other gasses are subject to DSO approval and must demonstrate the required knowledge to safely fill and analysis nitrox and mixed gas cylinders.

SECTION 7.00 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.

7.10 Training

Prerequisites

- Scientific Diver Certification
- Minimum of 100 logged open water dives (per section 1.2 of this manual; the AAUS Standards for Scientific Diving and based on an in-water evaluation of the prospective student's open water skills by the DSO or designee The DSO may waive up to 75 dives of this requirement).
- Minimum 60 foot depth certification

Training Requirements

Theoretical Training

Minimum Training must include the following and can be conducted concurrently with nitrox training.

- Diving physics review
- Physiology of decompression diving including:
 - Hypoxia
 - Hyperoxia
 - Hypercapnia
 - Nitrogen absorption, elimination, and bubble formation
 - Safety stops vs. required stops
 - Advantages of hyperoxic mixes for decompression
- Psychological aspects of decompression diving
 - Stress
 - Task loading
 - Time management
 - Perceptual narrowing
 - Panic
- Equipment configuration
 - Cylinder options
 - Regulators
 - BCD / harness
 - Computer, depth gauge, bottom timer options
 - Spools, reels and lift bags/surface marker buoys
 - Proper weighting buoyancy control and trim
 - Dive Tables and Computers
- Dive Planning
 - Gas management
 - Oxygen and nitrogen limits
 - Decompression planning and procedures
 - Computers

- Dive Tables
 - Ascent / Descent rates
- Hyperthermia
- Hypothermia
- Diving operations
 - Gas analysis and logging
 - Rigging and deployment of decompression equipment
 - Entries
 - Descent techniques
 - Ascent techniques
 - Gas switching procedures and safeguards on decompression supply regulators
 - Fixed and drifting decompression methods
 - Up-lines fixed to bottom
 - Reels and lift bags/surface marker buoys
 - Self-contained versus surface supported
- Emergency planning
 - Equipment failure
 - Gas loss primary and decompression gas
 - Missed decompression procedures
 - Decompression sickness

Practical Training / Skill Development

A minimum of one pool/confined water training session, to include equipment configuration and handling, swimming and buoyancy control, gas consumption rates, and emergency procedures.

At least 6 open-water training dives simulating/requiring decompression must be conducted, emphasizing planning and execution of decompression and practice of emergency procedures.

No dives requiring decompression shall be conducted until the diver has demonstrated acceptable skills under simulated conditions.

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

- Situational awareness while task loaded
 - Use of way points (self and buddy checks)
 - Gas management
 - Time management
 - Team coordination
- Buoyancy control
 - Ascent/descent rates
 - Proper depth control
- Equipment manipulation
 - SMB deployment
- Gas switching
 - Stage/travel/decompression bottle use
- Emergency skills
 - Gas sharing bottom mix, deco and travel
 - Valve shutdown

- Breathing from a free flowing deco regulator
- BCD and/or drysuit inflator malfunction
- Deploy backup mask
- Emergency deco-schedule modification(s)

Upon completion of training, the diver must:

- Have completed training requirements safely and demonstrated sound judgment
- Successfully complete the written exam Complete four supervised dives targeting skills associated with planned science diving activities. Supervisor for these dives is the DSO or designee. The cumulative time of the supervised dives shall be 120 minutes.
- Be authorized by the DSO to conduct dives requiring decompression.

7.20 Minimum Equipment Requirements

- Valve and regulator systems for primary (bottom) gas supplies must be configured in a redundant manner allowing continued breathing gas delivery in the event of failure of any one component of the regulator/valve system.
- Cylinder(s) with volume and configuration adequate for planned diving operations
- 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.
- Divers shall have a redundant means of determining decompression requirements.
- Redundancy requirements for other equipment shall be included in the dive plan.
- Minimum dive equipment:
 - Divers shall have a redundant means of determining decompression requirements.
 - Buoyancy Control Devices
 - Lift bags and line reels
 - Underwater Slate

7.30 Minimum Operational Requirements

- Open-circuit divers shall start a dive with a minimum of 1.5 times calculated gas required for all gasses required for the dive.
- Mission specific rehearsal dives are recommended.

7.40 Minimum Activity to Maintain Authorization

- If a period of more than 6 months has elapsed since the last decompression dive, progressive workup dive(s) as defined by the DSO are required to return the diver(s) to proficiency status prior to the start of project diving operations.

SECTION 8.00 REBREATHERS

General

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

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

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

For rebreather dives that also involve staged decompression and/or mixed gas diving, all requirements for each of the relevant diving modes must be met. The DSO has 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.

Mixed mode (i.e. teams using both open-circuit and rebreather gear) and/or mixed platform (i.e. teams using different models or types of rebreathers) dives are permitted. All team members must be briefed on basic system operations for establishing positive buoyancy, closing a rebreather diver's breathing loop for each type of rebreather used on the dive. All mixed mode/platform divers must be briefed on loss of breathable gas emergency procedures for all types of equipment used.

8.10 Definition

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

There are three classes of rebreathers:

- **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.
- **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.
- **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 (ppO₂). 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 ppO₂ during the dive, regardless of depth.

8.20 Prerequisites for use of any rebreather

- Diver-in-Training or Scientific Diver status.
- A minimum of 25 open-water dives on open circuit SCUBA.
- Nitrox authorization

8.30 Equipment Requirements

- Only those models of rebreathers specifically approved by DCB shall be used.
- Rebreathers should meet the quality control/quality assurance protocols of the International Organization for Standardization (ISO) requirements: ISO 9004: 2009 or the most current version, AND successful completion of CE (Conformité Européenne) or DCB approved third party testing.
- 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 DSO prior to implementation.
- Sofnolime 797 or Intersorb 812 CO₂ adsorbents, of the size recommended by the rebreather manufacturer, are approved for use. Approval of a different adsorbent may be requested in the dive plan.
- Used CO₂ scrubber canisters may be stored unsealed for up to 24 hours before reuse.
- Used CO₂ scrubber canisters may be stored for up to 28 days in a vacuum-sealed bag before reuse.

Individual Equipment Requirements

- BCD capable of floating a diver with a flooded loop
- Bailout gas supply of sufficient volume for planned diving activities

Equipment Maintenance Requirements

- Rebreathers should be maintained in accordance with manufacturer servicing recommendations.
- The DCB or their designee should establish policies for the maintenance of rebreathers and related equipment maintenance not covered by manufacturer servicing recommendations.
- Field repairs and replacement of components covered in rebreather diver training is not annual maintenance and may be performed by the rebreather diver.
- Oxygen cell shall be replaced before 18 months after the date of manufacture (Gurr 2013).

8.40 Training

- Specific training requirements for use of each rebreather model must be defined by the DSO and must include factory-recommended requirements.

A. Entry Level Training

1. The training area for O₂ Rebreather should not exceed 20 fsw in depth.
2. Entry level CCR and SCR training is limited in depth of 130fsw and shallower.
3. Entry level CCR and SCR training is limited to nitrogen/oxygen breathing media.
4. Divers at the CCR and SCR entry level may not log dives that require a single

- decompression stop longer than 10 minutes.
5. Who may teach: Individuals authorized as a CCR, SCR, or O2 Rebreather Instructor by the DCB; in all cases, the individual authorized must have operational experience on the rebreather platform being taught, and where applicable the individual being authorized should be authorized as an instructor by the respective rebreather manufacturer or their designee.
 6. Maximum Student/Instructor Ratio: 4 to 1. This ratio is to be reduced as required by environmental conditions or operational constraints.
 7. Upon completion of practical training, the diver must demonstrate proficiency in pre-dive, dive, and post-dive operational procedures for the particular model of rebreather to be used.
 8. Supervised dives target activities associated with the planned science diving application. Supervisor for these dives is the DSO or designee, experienced with the make/model rebreather being used.

Rebreather Entry Level Training Requirements			
Key: X = include, IA = If Applicable, ISE = If So Equipped			
	O ₂	SCR	CCR
Required Training Topic			
Academic			
History of technology	X	X	X
Medical & physiological aspects of:			
Oxygen toxicity	X	X	X
Chemical burns & caustic cocktail	X	X	X
Hypoxia – insufficient O ₂	X	X	X
Hypercapnia – excessive CO ₂	X	X	X
Arterial gas embolism	X	X	X
Middle Ear Oxygen Absorption Syndrome (oxygen ear)	X	X	X
Hygienic concerns	X	X	X
Nitrogen absorption & decompression sickness		X	X
CO ₂ retention	X	X	X
Hyperoxia-induced myopia	X	X	X
System design, assembly, and operation, including:			
Layout and design	X	X	X
Oxygen control systems	X	X	X
Diluent control systems		ISE	ISE
Use of checklists	X	X	X
Complete assembly and disassembly of the unit	X	X	X
Canister design & proper packing and handling of chemical absorbent	X	X	X
Decompression management and applicable tracking methods		ISE	X
Oxygen and high pressure gas handling and safety	X	X	X
Fire triangle	X	X	X
Filling of cylinders	X	X	X
Pre-dive testing & trouble shooting	X	X	X
Post-dive break-down and maintenance	X	X	X
Trouble shooting and manufacturer authorized field repairs	X	X	X

Required maintenance and intervals	X	X	X
Manufacturer supported additional items (ADV, temp stick, CO ₂ monitor, etc.)	ISE	ISE	ISE
Dive planning:			
Operational planning	X	X	X
Gas requirements	X	X	X
Oxygen exposure and management	X	X	X
Gas density calculations		X	X
Oxygen metabolizing calculations	X	X	X
Scrubber limitations	X	X	X
Mixed mode diving (buddies using different dive modes)	X	X	X
Mixed platform diving (buddies using different rebreather platforms)	X	X	X
Problem Recognition & Emergency Procedures:			
Applicable open circuit emergency procedures for common gear	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
O ₂ 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. Decompression and Normoxic/Hypoxic Mixed Gas Rebreather 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:
 - Normoxic Mixes – 25 rebreather dives for a minimum cumulative dive time of 25

hours

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

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

Cell warnings	X	X	X
Battery warnings	X	X	X
Hypercapnia, hypoxia, hyperoxia	X	X	X
Practical Training and Evaluations			
Demonstrated skills must include, at a minimum:			
Proper demonstration of applicable skills from previous training	X	X	X
Proper manipulation of DSV and/or BOV	X	X	X
Proper descent and bubble check procedures	X	X	X
Proper monitoring of setpoint switching and pO2 levels	X	X	X
Proper interpretation and operation of system instrumentation	X	X	X
System monitoring & control during descent, dive operations, and ascent	X	X	X
Demonstrate the ability to manually change setpoint and electronics settings during the dive	ISE	ISE	ISE
Demonstrate buoyancy control; ability to hover at fixed position in water column without moving hands or feet	X	X	X
Demonstrate controlled ascent with an incapacitated diver including surface tow at least 30 meters / 100 feet with equipment removal on surface, in water too deep to stand	X	X	X
Onboard and off board valve manipulation for proper use, and reduction of gas loss	X	X	X
Diagnosis of and proper reactions for a flooded absorbent canister	X	X	X
Diagnosis of and proper reactions for CO2 breakthrough	X	X	X
Diagnosis of and proper response to Cell Errors	X	X	X
Diagnosis of and proper reactions for Low oxygen drills	X	X	X
Diagnosis of and proper reactions for Flooded Loop	X	X	X
Diagnosis of and proper reactions for High Oxygen Drills	X	X	X
Diagnosis of and proper reactions for electronics and battery	X	X	X
Operation in semi-closed mode	X	X	X
Properly execute the ascent procedures for an incapacitated	X	X	X
Proper buddy contact and communication	X	X	X
Use of a line reel or spool to deploy an SMB from planned dive depth and while controlling buoyancy in the water column	X	X	X
Proper management of line reel or spool, and SMB during ascents and safety or required stops	X	X	X
Demonstrate the ability to maintain minimum loop volume	X	X	X
Demonstrate comfort swimming on surface and at depth carrying a single bailout/decompression cylinder/bailout rebreather	X		
Demonstrate ability to pass and retrieve a single bailout/decompression cylinder or bailout rebreather while maintaining position in the water column	X		

Demonstrate ability to pass and receive multiple bailout/decompression cylinders or bailout rebreather while maintaining position in the water column	IA	X	X
Demonstration of the ability to perform simulated decompression stops at pre-determined depths for scheduled times	X	X	X
Demonstration of the ability to perform decompression stops at pre-determined depths for scheduled times	X	X	X
Demonstrate competence managing multiple bailout cylinders, including drop and recovery while maintaining position in the water column	IA	X	X
Demonstrate appropriate reaction to simulated free-flowing deco regulator	X	X	X
Gas share of deco gas for at least 1 minute	X	X	X
Demonstrate oxygen rebreather mode at appropriate stop depth		X	X
Complete bailout scenarios from depth to include decompression obligation on open circuit	X	X	X
Written Evaluation	X	X	X
Supervised Rebreather Dives	X	X	X
Minimum Underwater Requirements			
	Pool/Confined	Openwater	Supervised Dives**
Deco	1 Dive / 60 min	7 Dives / 420 min	4 Dives / 240 min.
Normoxic	1 Dive / 60 min	7 Dives / 420 min	4 Dives / 240 min.
Deco/Normoxic Combined	1 Dive / 60 min	7 Dives / 420 min 3 Normoxic Dives / 180 min	4 Dives / 240 min.
Hypoxic Mixes		7 Dives / 420 min	4 Dives / 240 min.
**A minimum of three supervised dives should comply with authorization parameters			

C. Rebreather Crossover Training

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

Diver Certification and Minimum Activity to Maintain Authorization

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

- A rebreather diver shall log at least 12 rebreather dives per year to maintain authorization.
- A diver whose certification has lapsed can be reinstated by performing practical training skills during a checkout dive, under the supervision of the DSO or their designee.
- Additional dives maybe required to remediate any skill deficiencies found during the checkout dive before reauthorization.

8.50 Operational Requirements

Project Plan

A Closed Circuit Rebreather Hazard Analysis should be included in the dive plan. Extremes in environmental conditions, expected exertions levels or the use of power equipment should be included. Mitigations for hazards likely to result in moderate to high risk should be adopted.

- In addition to standard dive plan components, at a minimum all dive plans that include the use of rebreathers must include:
 - Information about the specific rebreather model(s) to be used
 - Type of CO₂ absorbent material
 - Composition and volume(s) of supply gasses
 - Respired gas densities should be less than 5 g·L⁻¹, and should not exceed 6 g·L⁻¹ under normal circumstances.
 - Bailout procedures
 - Off-board bailout is not required under conditions where the onboard open-circuit reserves are adequate for the diver to safely surface. Mixed mode operation bailout procedures must address an emergency gas supply for open circuit diver(s).
- Rehearsal dives may be required for projects requiring decompression dives or complex dives. Rebreather dive plans must be submitted early enough to assess pre-project preparation needs

Pre Dive

- Unit-specific checklists should be used to ensure completion of essential steps during rebreather assemble and final pre-water entry phase. Copies of assemble checklists must be submitted to the DSO. Pre-entry checklists maybe mnemonic or printed.
- Daily dive plans should include waypoints where divers access equipment function, confirm that team member's equipment is functioning and determine whether the dive should continue or be aborted. These waypoints should be confirmed during the pre-dive briefing
- A pre-breath duration long enough to verify the control and monitoring systems shall be conducted as close to the start of every dive as is practicable.

Dive

- If practicable, at the beginning of each day of diving, divers should verify that oxygen cells are not current limited by doing an O₂ flush at 25 feet and ensuring that the display for each cell reaches at least 1.6 PPO₂.

Post Dive

- Briefing
 - Equipment problems should be noted by the lead diver and communicated to the DSO and

- Missed waypoints should be discussed with the intent of preventing future missed waypoints.
- Breathing loops should be disinfected daily by rinsing with sanitizer. Two Steramine tablets per gallon of fresh water is an effective sanitizer.

SECTION 9.00 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.

9.10 Prerequisites

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

9.20 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).
- The OM DCB is responsible for developing additional operational protocols

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. It is the OM DCB's responsibility to 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 containing sufficient volume to complete the ascent to the surface, including all required decompression and safety stops.
- Masks and Helmets
 - Surface supplied and mixed gas masks and helmets must have:

- A non-return valve at the attachment point between the mask/helmet and hose which must close readily and positively; and
- An exhaust valve
- Surface-supplied masks and helmets must have a minimum ventilation rate capability of 4.5 actual cubic feet per minute (acfm) at any depth at which they are operated or the capability of maintaining the diver's inspired carbon dioxide partial pressure below 0.02 atmospheres absolute (ATA) when the diver is producing carbon dioxide at the rate of 1.6 standard liters per minute
- Helmets or masks connected directly to the dry suit or other buoyancy-changing equipment must be equipped with an exhaust valve
- Air supplied to the diver must meet the air quality standards outlined in section 3.60

9.30 Hookah

Hookah Definition

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

Equipment Requirements

- The air supply hose must be rated for a minimum operating pressure of 130psi.
- Air supplied to the hookah diver must meet the air quality standards outlined in section 3.60
- Hookah supply systems must be capable of supplying all divers breathing from the system with sufficient gas for comfortable breathing for the planned depth and workload.
- Hookah system second stage should be capable of being attached to the diver in a way to avoid pulling stress on the second stage mouthpiece and affords easy release if the diver must jettison the regulator and hose.
- An independent reserve breathing gas supplied will be carried by each hookah diver:
 - When the diver does not have direct access to the surface or
 - At depths or distance from alternate breathing gas source determined by the DCB.

Operational Requirements

- Hookah diving must not be conducted beyond depths or distance from alternate breathing gas source as determined by the DCB.
- A diver's independent reserve breathing gas supply, if worn, must contain sufficient volume to allow the diver(s) to exit to the surface or alternate breathing gas source
- Hookah divers not supported by diving bell, or underwater habitat must not be exposed to dives that require staged decompression.
- The OM DCB is responsible for developing additional operational protocols.
- A hookah configured diver may operate without an in-water buddy provided the diver is tended from the surface; has visual, line pull, or voice communication with the tender; the diver carries an independent reserve breathing gas source containing sufficient volume to allow the diver to exit to the surface or alternate breathing gas source; and a standby diver is immediately available to render aid.

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 OM's DCB.

Cavern, Cave, or Flooded Mine Diving see [Section 12](#)

It is the responsibility of the OM'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 OM.

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 OM's DCB to establish the requirements and protocol under which diving will be safely conducted.

SECTION 11.00 SCIENTIFIC CAVE AND CAVERN DIVING

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

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

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

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

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

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

11.10 Definition

A dive team must be considered to be cave or cavern diving if at any time during the dive they find themselves in a position where they cannot complete a direct, unobstructed ascent to the surface because of rock formations. In addition to blocking direct access to surfacing, underwater caves have additional environmental hazards including but not limited to:

- The absence of natural light.
- Current or flow that vary in strength and direction. Of particular note is a condition known as siphoning. Siphoning caves have flow or current directed into the cave. This can cause poor visibility as a result of mud and silt being drawn into the cave entrance.
- The presences of silt, sand, mud, clay, etc. that can cause visibility to be reduced to nothing in a very short time.
- Restrictions – Any passage through which two divers cannot easily pass side by side while sharing air make air sharing difficult.
- Cave-Ins – Cave-Ins are a normal part of cave evolution; however experiencing a cave-in during diving operations is extremely unlikely.

11.20 Prerequisites

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

11.30 Training

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

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

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

11.40 Equipment Requirements

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

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

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

11.50 Operational Requirements and Safety Protocols

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

Appendices

APPENDIX 1

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 UConn Marine Sciences Diving Program. 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 Diving Safety Officer if you have any questions or concerns about diving medicine or the UConn Marine Sciences Diving Program standards. Thank you for your assistance.

Jeff M. Godfrey
Diving Safety Officer
University of Connecticut
1080 Shennecossett Road
Groton, CT 06340
Phone: 860-389-6104
Email: jeff.godfrey@uconn.edu

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.
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- 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.

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 UConn Marine Sciences Diving Program Diving Safety Officer and Diving Control Board or their designee at University of Connecticut, 1080 Shennecossett Road, Groton, CT 06340.

Signature of Applicant _____ Date _____

REFERENCES

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

APPENDIX 3 DIVING MEDICAL HISTORY FORM

(To Be Completed By Applicant-Diver)

Name _____ 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.

This form must be kept confidential by the examining physician. If you believe any question amounts to invasion of your privacy, you may elect to omit an answer, provided that you must subsequently discuss that matter with your own physician who must then indicate, in writing, that you have done so and that no health hazard exists.

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

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

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

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

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

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

Signature

Date

APPENDIX 4

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 (EAN_x) - 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.

fO₂ - Fraction of oxygen in a gas mixture, expressed as either a decimal or percentage, by volume.

FSW - Feet of seawater.

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

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

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

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

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

Hyperbaric Chamber - See decompression 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.

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 5

DIVING RECIPROCITY AND VERIFICATION OF DIVER TRAINING AND EXPERIENCE FORM

Diver: _____

Date: _____

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

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

(Date)

_____ Original diving authorization
_____ Written scientific diving examination
_____ Last diving medical examination Medical examination expiration date _____
_____ Most recent checkout dive
_____ Scuba regulator/equipment service/test
_____ CPR training (Agency) _____ CPR Exp. _____
_____ Oxygen administration (Agency) _____ O2 Exp. _____
_____ First aid for diving _____ F.A. Exp. _____
_____ Date of last dive _____ Depth _____
Number of dives completed within previous 12 months? _____ Depth Authorization _____ fsw
Total number of career dives? _____

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

Please indicate any pertinent authorizations or training:

Emergency Information:

Name: _____ Relationship: _____
Telephone: _____ (work) _____ (home)
Address: _____

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

Diving Safety Officer:

(Signature)

(Date)

(Print)

APPENDIX 6

EMERGENCY MANAGEMENT PLAN

Primary Response

1. Depending on and according to the nature of the diving accident:
2. Make appropriate contact with victim and rescue as required.
3. Establish (A)irway, (B)reathing, (C)irculation as required and stabilize the victim.
4. Administer 100% oxygen, if appropriate (in cases of Decompression Illness, or Near Drowning).
5. If the victim is conscious perform a secondary survey and neurological exam. Repeat at 30 minute intervals.
6. Initiate 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.

Secondary Response

1. Record details of incident including dive profiles.
2. Call appropriate Diving Accident Coordinator for contact with diving physician and decompression chamber. etc. (Divers Alert Network (DAN) phone number: 919-684-8111).
3. Secure victims equipment
 - a. Note cylinder(s) pressure (photograph if possible)
 - b. Turn off cylinder and note number of turns
 - c. Record all items of equipment secured and record any abnormalities or alterations (photograph if possible)
4. Notify Victims DSO or designee.

List of Emergency Contact Numbers Appropriate For Dive Location:

UCONN

DSO Jeff Godfrey 860-389-6104 (cell)
Marine Operations Manager Turner Cabaniss 860-389-0677 (cell) 860-405-9178 (office)

Other:

Available Procedures

- Emergency care
- Recompression
- Evacuation

Emergency Plan Content

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

APPENDIX 7

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

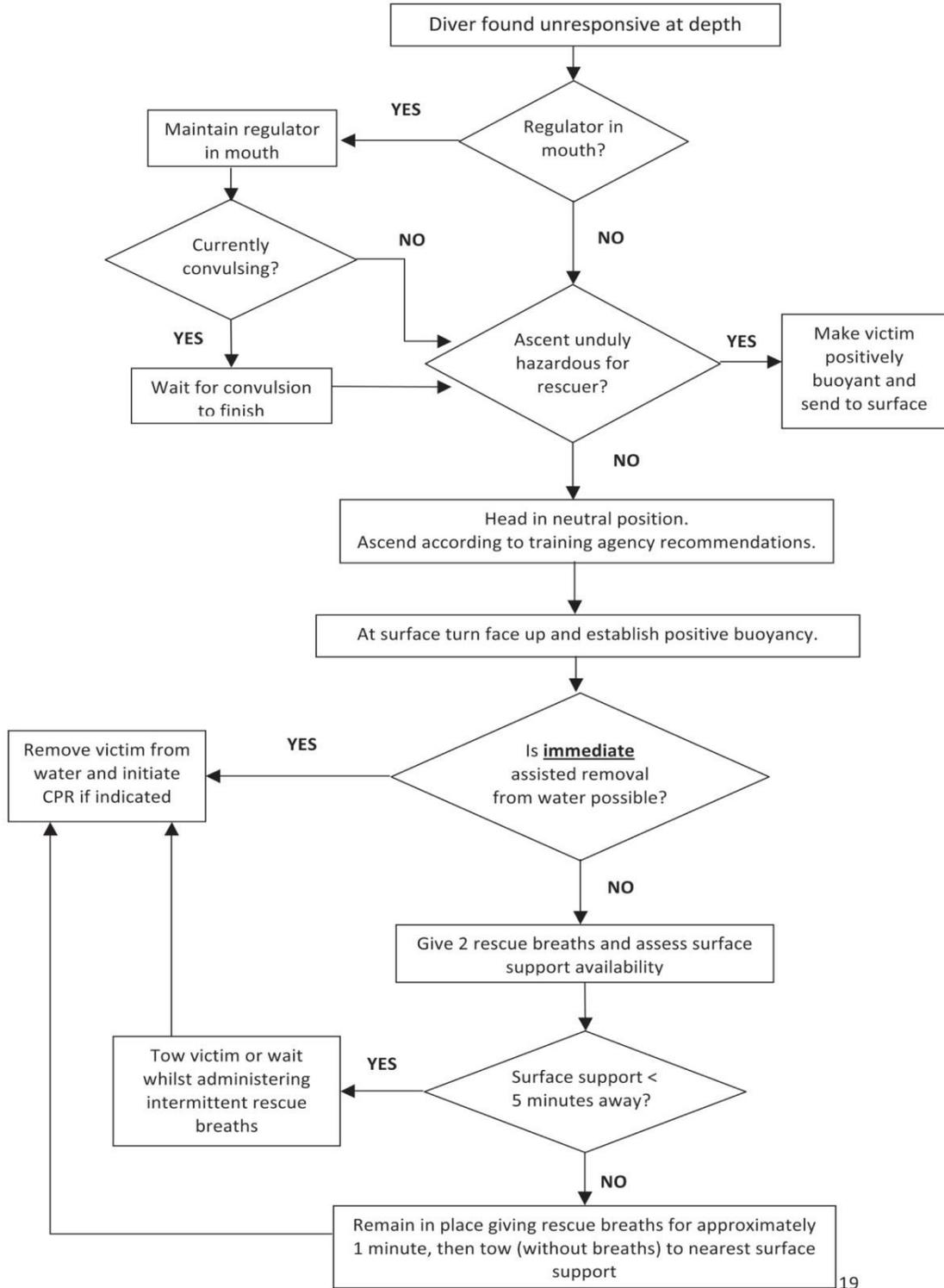
Incident Classification Rating Scale:

- 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.

APPENDIX 8

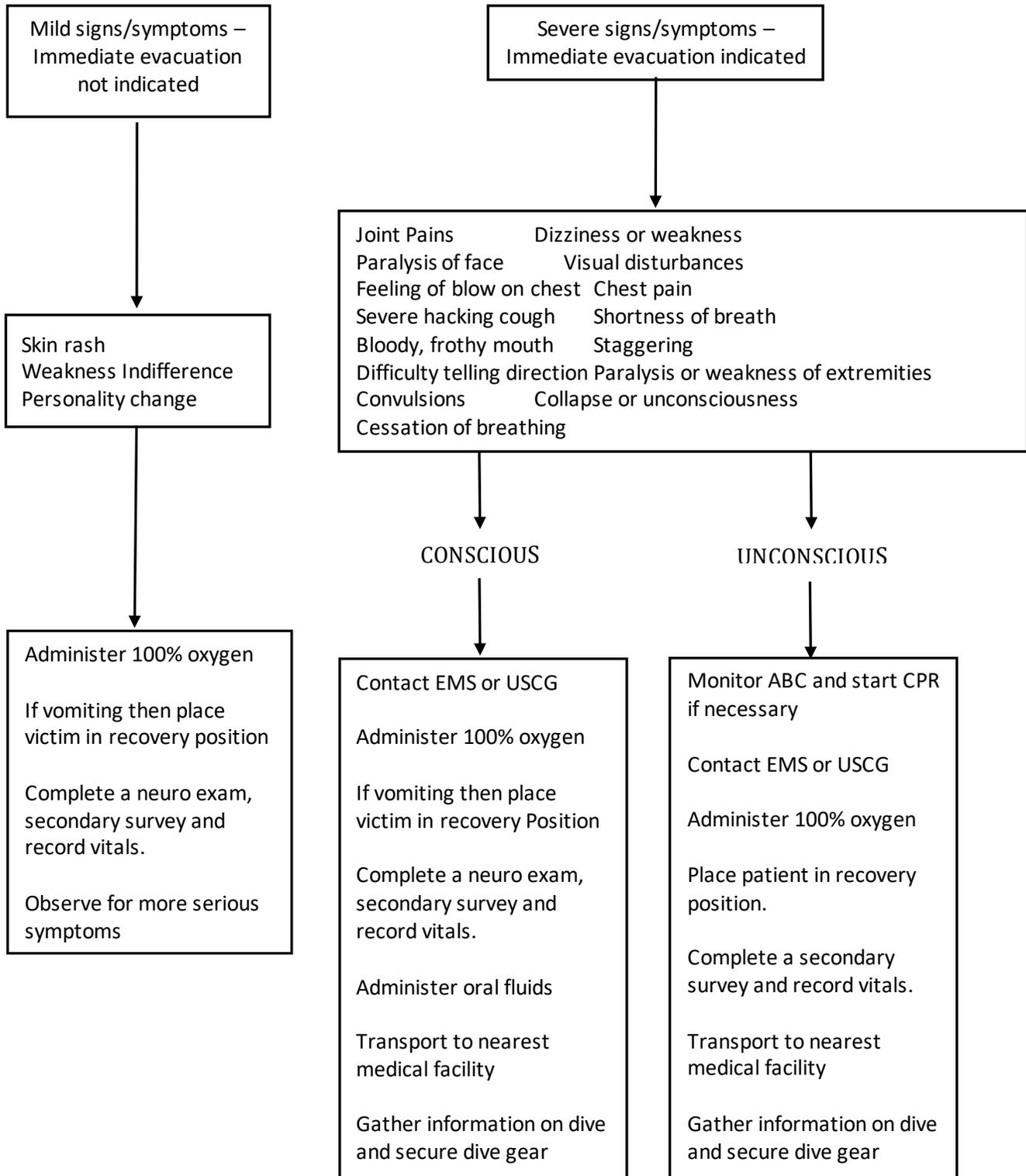
RECOMMENDATIONS FOR RESCUE OF A SUBMERGED UNRESPONSIVE COMPRESSED-GAS DIVER

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



APPENDIX 9

DECOMPRESSION ILLNESS EMERGENCY MANAGEMENT FLOWCHART



APPENDIX 10
DIVE ACCIDENT EXAM FORM

Date: _____ Time: _____
First Name _____ MI _____ Last _____
Check Consciousness: Alert Verbal stimuli Painful stimuli Unresponsive
Orientation: Name Date / Time Place Event

Vital Signs

Respiratory _____ min. Pulse _____ min. Temperature _____
Blood Pressure: ____ systolic / ____ diastolic

History

Symptoms _____
Allergies _____
Medications _____
Pre-existing conditions _____
Last oral intake (what and time) _____
Events leading up to incident _____
Location of any pain _____
Does movement change level of pain? (circle one) Yes No

Five Minute Neurological Exam

(Put a check next to any abnormal findings)

1. Orientation

- Does the diver know his/her own name and age?
- Does the diver know the present location?
- Does the diver know what time, day, year it is?

Note: The answers to these questions may reveal confusion. Do not omit them.

2. Eyes

- Have the diver count the number of fingers you display, using two or three different numbers.
- Check each eye separately and then together.
- Have the diver identify a distant object.
- Tell the diver to hold head still, or you gently hold it still, while placing your other hand about 18 inches/0.5 meters in front of the face. Ask the diver to follow your hand. Now move your hand up and down, then side to side. The diver's eyes should follow your hand and should not jerk to one side and return.
- Check that the pupils are equal in size.

3. Face

- Ask the diver to purse the lips. Look carefully to see that both sides of the face have the same expression.
- Ask the diver to grit the teeth. Feel the jaw muscles to confirm that they are contracted equally.
- Instruct the diver to close the eyes while you lightly touch your fingertips across the forehead and face to be sure sensation is present and the same everywhere.

4. Hearing

- Hearing can be evaluated by holding your hand about 2 feet/0.6 meters from the diver's ear and rubbing your thumb and finger together.
- Check both ears moving your hand closer until the diver hears it.
- Check several times and compare with your own hearing.

Note: If the surroundings are noisy, the test is difficult to evaluate. Ask bystanders to be quiet and to turn off unneeded machinery.

5. Swallowing Reflex

- Instruct the diver to swallow while you watch the "Adam's apple" to be sure it moves up and down.

6. Tongue

- Instruct the diver to stick out the tongue. It should come out straight in the middle of the mouth without deviating to either side.

7. Muscle Strength

- Instruct the diver to shrug shoulders while you bear down on them to observe for equal muscle strength.
- Check diver's arms by bringing the elbows up level with the shoulders, hands level with the arms and touching the chest. Instruct the diver to resist while you pull the arms away, push them back, up and down. The strength should be approximately equal in both arms in each direction.
- Check leg strength by having the diver lie flat and raise and lower the legs while you resist the movement.

If possible complete the following table: Scale: Normal (N), Weak (W), and Paralysis (P)

Upper Body Shoulders	L____ R____	Quadriceps	L____ R____
Lower Body Hip-Flexors	L____ R____	Hamstrings	L____ R____
Biceps	L____ R____	Foot - up	L____ R____
Triceps	L____ R____	Grip Strength	L____ R____
Grip Strength	L____ R____	Foot - down	L____ R____

8. Sensory Perception

- Check on both sides by touching lightly as was done on the face. Start at the top of the body and compare sides while moving downwards to cover the entire body. Note: The diver's eyes should be closed during this procedure. The diver should confirm the sensation in each area before you move to another area.

9. Balance and Coordination

- Have the diver walk heel to toe along a straight line while looking straight ahead. Have her walk both forward and backward for 10 feet or so. Note whether her movements are smooth and if she can maintain her balance without having to look down or hold onto something.
- Next, have the diver stand up with feet together and close eyes and hold the arms straight out in front of her with the palms up. The diver should be able to maintain balance if the platform is stable. Your arms should be around, but not touching, the diver. Be prepared to catch the diver who starts to fall.
- Check coordination by having the diver move an index finger back and forth rapidly between the diver's nose and your finger held approximately 18 inches/0.5 meters from the diver's face. The diver should be able to do this, even if you move your finger to different positions.
- Have the diver lie down and instruct him to slide the heel of one foot down the shin of his other leg, while keeping his eyes closed. The diver should be able to move his foot smoothly along his shin, without jagged, side-to-side movements.
- Check these tests on both right and left sides and observe carefully for unusual clumsiness on either side.

Note: Be prepared to protect the diver from injury when performing this test.

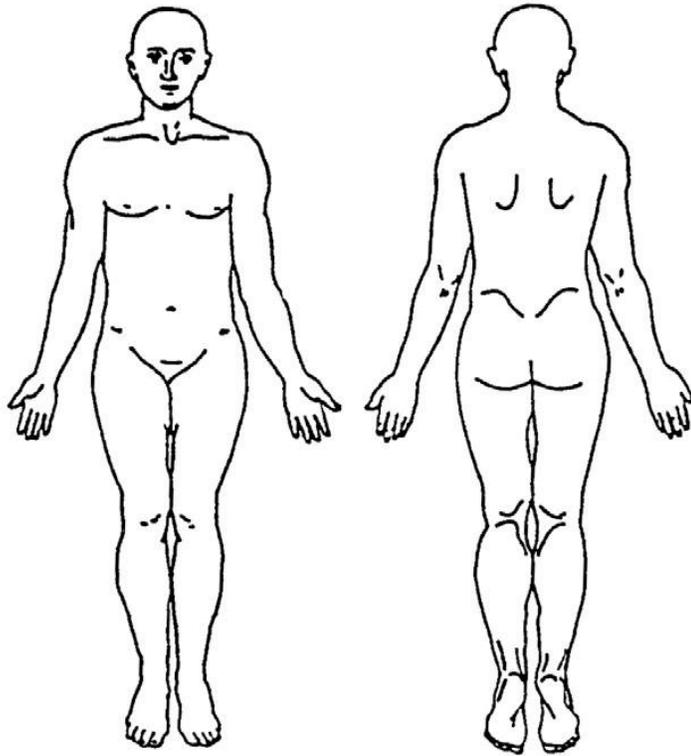
Important Notes:

Tests 1, 7, and 9 are the most important and should be given priority if not all tests can be performed.

The diver's condition may prevent the performance of one or more of these tests. Record any omitted test and the reason. If any of the tests are not normal, injury to the central nervous system should be suspected.

The tests should be repeated at 30- to 60-minute intervals while awaiting assistance in order to determine if any change occurs. Report the results to the emergency medical personnel responding to the call.

Examination of an injured diver's central nervous system soon after an accident may provide valuable information to the physician responsible for treatment.



Shade any areas of sensory loss on the diagram

Diving Activity	Depth	Bottom Time	Breathing Gas	Surface interval
Dive #				

Starting with the last dive, label dive numbers in descending order for all dives conducted in the 16 hours previous to initial symptoms.

Comments: