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Louisiana Universities Marine Consortium
Diving Safety Manual
for
Scientific Dives

Revised November, 2018

Louisiana Universities Marine Consortium
8124 Highway 56 | Chauvin, LA 70344 | 985-851-2800
A division of the Louisiana Board of Regents

FOREWORD

Since 1951 the scientific diving community has endeavored to promote safe, effective diving through self-imposed diver training and education programs. Over the years, manuals for diving safety have been circulated between organizations, revised and modified for local implementation, and have resulted in an enviable safety record. As diving science progresses so must this standard, and it is the responsibility of every member of the Academy to see that it always reflects state of the art, safe diving practice.

This manual sets forth the minimal safety standards for state-of-the-art scientific diving conducted under the auspices of the Louisiana Universities Marine Consortium (LUMCON). The standards are based upon the American Academy of Underwater Sciences (AAUS) Standards for Scientific Diving, 2018 revision. AAUS is the nationally recognized authority for scientific diving in the United States of America.

ACKNOWLEDGEMENTS

The Diving Control Board of the Louisiana Universities Marine Consortium (LUMCON) recognizes and fully acknowledges the hard work of the AAUS and its member organizations in developing the standards and producing the manuals upon which this volume is based.

REVISION HISTORY

11-29-2018	Revised entire manual to new 2018 AAUS standards.

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Volume 1

Sections 1.00 through 5.00
Required For All Organizational Members

SECTION 1.00 GENERAL POLICY

1.10 Scientific Diving Standards

Purpose

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

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

Historical Perspective

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

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

Scientific Diving Definition

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

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

Scientific Diving Exemption

The two elements that a diving program must contain as defined by OSHA in 29 CFR 1910 Subpart T 1910.401(a)(2)(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 LUMCON's annual report, recommendations for modifications of this *Manual* must be submitted to AAUS for consideration.

1.20 Operational Control

Organizational Member Auspices and Responsibilities

Louisiana Universities Marine Consortium (LUMCON) auspices include any scientific diving operation in which LUMCON is connected because of ownership of life support equipment used, locations selected, or relationship with the individual(s) concerned. This includes all cases involving the operations of authorized individuals of LUMCON or auxiliary organizations, where such individuals are acting within the scope of their authorization.

It is LUMCON's responsibility to adhere to the AAUS Standards for Scientific Diving Certification and Operation of Scientific Diving Programs. The administration of the local diving program will reside with LUMCON's Diving Safety Committee (DSC).

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

Organizational Member Diving Safety Manual

Meeting AAUS minimum standards is a requirement for organizational membership in the Academy. LUMCON has developed and maintains a diving safety manual that includes wording on how LUMCON defines specific policies and procedures required for the proper function of a scientific diving program. LUMCON's manual addresses environmental and working conditions unique to the program's operations. The LUMCON diving manual meets or exceeds the AAUS standards.

AAUS standards must be the foundation for the development of LUMCON's scientific diving safety manual. The order and formatting of the LUMCON manual does not have to conform to the AAUS template. The information contained in Volume 1, Sections 1.00 through 5.00 and the

Appendices are required for all manuals. Volume 2, Sections 6.00 through 12.00 are required only when LUMCON conducts the specifically referenced diving mode or activity. Deviations or significant changes to AAUS minimum standards may require justification before approval is granted by the AAUS Standards Committee.

Diving Control Board

- Throughout this manual the Diving Safety Committee is equivalent to a Diving Control Board and may be used interchangeably. The Diving Safety Committee (DSC) must consist of a majority of active scientific divers. Voting members include the Diving Safety Officer (DSO), and other representatives of the diving program such as qualified divers and members selected by procedures established by LUMCON. A chairperson and a secretary may be chosen from the membership of the board according to local procedure.
- Has autonomous and absolute authority over the scientific diving program's operation.
- The DSC must:
  - Establish additional standards, protocols, and operational procedures beyond the AAUS minimums to address LUMCON specific needs and concerns.
  - Approve and monitor diving projects.
  - Review and revise the diving safety manual.
  - Ensure compliance with the diving safety manual.
  - Approve the depth to which a diver has been authorized to dive.
  - Take disciplinary action for unsafe practices.
  - Ensure adherence to the buddy system for scientific diving.
  - Act as the official representative of LUMCON in matters concerning the scientific diving program.
  - Act as a board of appeal to consider diver-related problems.
  - Recommend the issue, reissue, or the revocation of diving authorizations.
  - Recommend changes in policy and amendments to AAUS and LUMCON's diving safety manual as the need arises.
  - Establish and/or approve training protocols or standards through which the applicants for authorization can satisfy the requirements of LUMCON's diving safety manual.
  - Suspend diving operations considered to be unsafe or unwise.
  - Establish criteria for equipment selection and use.
  - Recommend new equipment or techniques.
  - Establish and/or approve facilities for the inspection and maintenance of diving and associated equipment.
  - Ensure that LUMCON's air station(s) meet air quality standards as described in Section 3.60.
  - Periodically review the DSO's performance and program.
  - Investigate diving incidents within LUMCON's diving program or violations of LUMCON's diving safety manual.
- The DSC may delegate operational oversight for portions of the program to the DSO; however, the DSC may not abdicate responsibility for the safe conduct of the diving program.

Diving Safety Officer

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

Qualifications:

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

   "(a) Holds a diving certification from a recognized national certifying agency or equivalent, and
   (b) Has engaged in sustained or successive scientific diving activities during the past two years, or

   (c) Has completed a course in scientific diving that meets the requirements as specified by the most current edition of the AAUS Standards for Scientific Diving."
4. Must attend an AAUS DSO Orientation within one year of accepting a position at an AAUS approved OM, unless he/she has served as a DSO for another current AAUS OM within the last year.

Duties and Responsibilities

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

Instructional Personnel Qualifications

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

Lead Diver

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

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

Reciprocity and Visiting Scientific Diver

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

Waiver of Requirements

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

1.30 Consequence of Violation of Regulations by Scientific Divers

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

1.40 Consequences of Violation of Regulations by Organizational Members

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

1.50 Record Maintenance

LUMCON must maintain consistent records for its diving program and for each participant. These records include but are not limited to: diving safety manual; equipment inspection, testing, and maintenance records; dive plans (project and/or individual); records of dive (project and/or individual); medical approval to dive; diver training records; diver authorization(s); individual

dive log; dive incident reports; reports of disciplinary actions by the DSC; and other pertinent information deemed necessary by LUMCON.

Availability of Records:

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

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

SECTION 2.00 DIVING REGULATIONS

2.10 Introduction

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

2.20 Pre-Dive Procedures

Dive Plans

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

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

Diver Responsibility and Refusal to Dive

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

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

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

Pre-dive Safety Checks

- Prior to commencing the dive, the team must assure that every team member is healthy, fit, and trained for the type of dive that is being attempted.
- Scientific divers must conduct a functional check of their diving equipment in the presence of the dive buddy or tender. They must ensure the equipment is functioning properly and suitable for the type of diving operation being conducted.
- Each diver must have the capability of achieving and maintaining positive buoyancy at the surface.
- Environmental conditions at the site will be evaluated prior to entering the water.

Pre-dive Briefings

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

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

2.30 Diving Procedures

Solo Diving Prohibition

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

Decompression Management

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

Termination of the Dive

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

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

Emergencies and Deviations from Regulations

Any diver may deviate from the requirements of this *Manual* to the extent necessary to prevent

or minimize a situation likely to cause death, serious physical harm, or major environmental damage. A written report must be submitted to the DSC 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 DSC.

2.50 Emergency Procedures

LUMCON will develop emergency procedures which follow the standards of care of the community and must include procedures and implementation criteria for emergency care, recompression, evacuation, and incident reporting.

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

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

2.70 Record Keeping Requirements

Personal Diving Log

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

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

Required Incident Reporting

All diving incidents requiring recompression treatment, or resulting in moderate or serious

injury, or death must be reported to LUMCON DSC and AAUS in a timely manner. LUMCON must record and report occupational injuries and illnesses in accordance with requirements of the appropriate Labor Code section. LUMCON must investigate and document any incident of pressure-related injury and prepare a report that is to be forwarded to AAUS during the annual reporting cycle.

- If pressure-related injuries are suspected, or if symptoms are evident, the following additional information must be recorded and retained by LUMCON, with the record of the dive, for a period of 5 years:
    - Written descriptive report shall include:
        - Name, address, phone numbers of the principal parties involved.
        - Summary of experience of divers involved.
        - Location, description of dive site, and description of conditions that led up to incident.
        - The circumstances of the incident and the extent of any injuries or illnesses.
        - Description of symptoms, including depth and time of onset.
        - Description and results of treatment.
        - Disposition of case.
        - Recommendations to avoid repetition of incident.

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

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

SECTION 3.00 DIVING EQUIPMENT

3.10 General Policy

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

3.20 Equipment

The LUMCON DSC must establish the minimum equipment configuration for all dives.

Regulators and Gauges

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

Equipment for Determination of Decompression Status

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

Scuba Cylinders

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

Buoyancy Compensation Devices (BCD)

- Each diver must have the capability of achieving and maintaining neutral buoyancy underwater and positive buoyancy at the surface.

- BCDs, dry suits, or other variable volume buoyancy compensation devices must be equipped with an exhaust valve.
- These devices must be functionally inspected and tested at intervals not to exceed 12 months.
- BCDs, dry suits, or other variable volume buoyancy compensation devices must not be used as a lifting device in lieu of lift bags.

3.30 Auxiliary Equipment

Handheld Underwater Power Tools

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

3.40 Support Equipment

First Aid Supplies

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

Diver's Flag

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

Compressor Systems - Organizational Member Controlled

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

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

3.50 Equipment Maintenance

Record Keeping

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

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

- Rebreather systems
- Additional equipment categories as determined by the DSC

Compressor Operation and Air Test Records

Gas analyses and air tests must be performed on each LUMCON-controlled breathing air compressor at regular intervals of no more than 100 hours of operation or 6 months, whichever occurs first. The results of these tests must be entered in a formal log and be maintained.

3.60 Air Quality Standards

Breathing Gas

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

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

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

Remote Operations

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

SECTION 4.00 SCIENTIFIC DIVER CERTIFICATION AND AUTHORIZATIONS

This section describes the training and performance standards for AAUS Scientific Divers and represent the minimum required level of knowledge and skills presented in a generalized format. Individual diving programs are encouraged to expand upon and augment these requirements, develop or utilize appropriate educational materials, and optimize instructional programs to suit and reflect their specific needs.

4.10 Prerequisites

Administrative

The candidate must complete all administrative and legal documentation required by LUMCON as described below.

Application to the Diving Safety Program

Submit completed Appendix A: Application to the LUMCON Diving Safety Plan to the DSO.

Entry Level Diver Certification

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

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

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

Medical Examination

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

DAN Insurance

All divers diving under the auspices of LUMCON must submit proof of current DAN membership and at least minimum levels of DAN diving insurance coverage.

Swimming/Watermanship Evaluation

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

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

4.20 Training

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

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

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

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

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

Practical Training / Skill Development	
Confined Water	At the completion of training, the trainee must satisfy the DSO or DSC-approved designee of their ability to perform the following, as a minimum, in a pool or in sheltered water: • Enter water fully equipped for diving • Clear fully flooded face mask • Demonstrate air sharing and ascent using an alternate air source, as both donor and recipient, with and without a face mask • Demonstrate buddy breathing as both donor and recipient, with and without a face mask • Demonstrate understanding of underwater signs and signals • Demonstrate ability to remove and replace equipment while submerged • Demonstrate acceptable watermanship skills for anticipated scientific diving conditions
Open Water	The trainee must satisfy the DSO, or DSC-approved designee, of their ability to perform at least the following in open water:

Skills	• Surface dive to a depth of 10 feet (3 meters) without scuba* • Enter and exit water while wearing scuba gear* ^^ • Kick on the surface 400 yards (366 meters) while wearing scuba gear, but not breathing from the scuba unit* • Demonstrate proficiency in air sharing ascent as both donor and receiver* • Demonstrate the ability to maneuver efficiently in the environment, at and below the surface* ^^ • Complete a simulated emergency swimming ascent* • Demonstrate clearing of mask and regulator while submerged* • Underwater communications^^ • Demonstrate ability to achieve and maintain neutral buoyancy while submerged* • Demonstrate techniques of self-rescue and buddy rescue* • Navigate underwater ^ • Plan and execute a dive^ • Demonstrate judgment adequate for safe scientific diving* ^^
	Rescue Skills: • Rescue from depth and transport 25 yards (23 meters), as a diver, a passive simulated victim of an accident: surface diver, establish buoyancy, stabilize victim • Demonstrate simulated in-water mouth-to-mouth resuscitation • Removal of victim from water to shore or boat • Stressed and panicked diver scenarios • Recommendations For Rescue Of A Submerged Unresponsive Compressed-Gas Diver – Appendix 9
	Successfully complete a minimum of one checkout dive and at least eleven additional open water dives in a variety of dive sites, for a cumulative surface to surface time of 6 hours. Dives following the checkout dive(s) may be supervised by an active Scientific Diver holding the necessary depth authorization experienced in the type of diving planned, and with the knowledge and permission of the DSO
	The eleven dives (minimum) following the initial checkout dive may be conducted over a variety of depth ranges as specified by the LUMCON DSC. Depth progression must proceed shallower to deeper after acceptable skills and judgement have been demonstrated, and are not to exceed 100 feet (30 m) during the initial 12 dive cycle
	* Checkout dive element ^^ Evaluated on all dives ^ Evaluated at some point during the training cycle

Examinations	
Equipment	The trainee will be subject to examination/review of: • Personal diving equipment • Task specific equipment

	• Function and manipulation of decompression computer to be employed by the diver (if applicable)
Written Exams	The trainee must pass a written examination reviewed and approved by the LUMCON DSC that demonstrates knowledge of at least the following: • Function, care, use, and maintenance of diving equipment • Advanced physics and physiology of diving • Diving regulations • Applicable diving environments • Emergency procedures for LUMCON-specific dive mode(s) and environments, including buoyant ascent and ascent by air sharing • Currently accepted decompression theory and procedures • Proper use of dive tables • Hazards of breath-hold diving and ascents • Planning and supervision of diving operations • Navigation • Diving hazards & mitigations • Cause, symptoms, treatment, and prevention of the following: near drowning, air embolism, hypercapnia, squeezes, oxygen toxicity, nitrogen narcosis, exhaustion and panic, respiratory fatigue, motion sickness, decompression sickness, hypothermia, and hypoxia/anoxia • Applicable theoretical training and knowledge development from the Required and Suggested Topics (above)

4.30 Diver Certification and Authorizations

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

Diver-In-Training (DIT) Authorization

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

Scientific Diver Certification

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

active when required authorizations are in place and current.

Scientific Aquarium Diver Certification

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

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

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

Temporary Diver Authorization

Only a diver not under the auspices of an AAUS OM may be granted a Temporary Diver Authorization. The individual in question must demonstrate proficiency in diving and can contribute measurably to a planned dive. A Temporary Diver Authorization constitutes a waiver of selected requirements of Section 4.0 and is valid only for a limited time, as approved by the DSC. A Temporary Diver Authorization must be restricted to the planned diving operation and must comply with all other policies, regulations, and standards of this Manual, including medical requirements. This authorization is not to be utilized as a repeated mechanism to circumvent existing standards set forth in this Manual.

4.40 Depth Authorizations

Depth Ratings and Progression to Next Depth Level

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

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

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

a) Authorization to 30 Foot Depth - Initial science diver depth authorization, approved upon the successful completion of training listed in Section 4.00. Cumulative minimum supervised dives: 12.

b) Authorization to 60 Foot Depth - A diver holding a 30-foot authorization may be authorized to a depth of 60 feet after successfully completing and logging 12 supervised

dives to depths between 31 and 60 feet under supervision of a diver authorized by the DSC, for a minimum total time of 4 hours. Cumulative minimum supervised dives: 24.

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

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

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

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

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

g) Authorization to 250 Foot Depth - A diver holding a 190-foot authorization may be authorized to a depth of 250 feet after successfully completing and logging 6 supervised dives to depths between 190 and 250 feet under supervision of a dive buddy authorized by the DSC. The diver must also demonstrate knowledge of the special problems of deep diving and of special safety requirements.

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

i) Authorizations deeper than 300 Feet – Depth authorizations deeper than 300 feet progress in 50-foot depth/6 dive increments. A diver holding a 300 foot, or deeper authorization may be authorized to the next depth authorization increment after successfully completing and logging 6 supervised dives under supervision of dive buddy authorized

by the DSC. The diver must also demonstrate knowledge of the special problems of deep diving and of special safety requirements.

4.50 Maintaining Active Status

Minimum Activity to Maintain Authorizations

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

Requalification of Authorization

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

Medical Examination

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

Emergency Care Training

The scientific diver must hold current training in the following:

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

4.60 Revocation of Authorization

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

SECTION 5.00 MEDICAL STANDARDS

5.10 Medical Requirements

General

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

5.20 Frequency of Medical Evaluations

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

5.30 Information Provided Examining Physician

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

5.40 Content of Medical Evaluations

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

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

(Appendix 2b)

3. Medical history (Appendix 3)

5.50 Physician's Written Report

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

VOLUME 2

SECTION 6.00 NITROX DIVING

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

6.10 Requirements for Nitrox Authorization

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

Prerequisites

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

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

Training

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

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

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

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

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

Practical Evaluation

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

Written Evaluation

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

6.20 Minimum Activity to Maintain Authorization

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

6.30 Operational Requirements

Oxygen Exposure Limits

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

Calculation of Decompression Status

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

Gas Mixture Requirements

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

Analysis Verification by User

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

6.40 Nitrox Diving Equipment

Required Equipment

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

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

Requirement for Oxygen Service

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

Compressor system

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

SECTION 7.00 SURFACE SUPPLIED DIVING TECHNOLOGIES

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

7.10 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 LUMCON.

7.20 Surface Supplied Diving

Surface Supply Definition

A mode of diving using open circuit, surface supplied, compressed gas delivered by means of a pressurized umbilical hose. The umbilical generally consists of a gas supply hose, strength member, pneumofathometer hose, and communication line. The umbilical supplies a helmet or full-face mask, often with voice communications.

Procedures

- Each diver must be continuously tended while in the water.
- A diver must be stationed at the underwater point of entry when diving is conducted in enclosed or physically confined spaces.
- Each diving operation must have a primary breathing gas supply sufficient to support divers for the duration of the planned dive including decompression.
- For dives deeper than 100fsw (30 m) or outside the no-decompression limits:
  - A separate dive team member must tend each diver in the water;
  - A standby diver must be available while a diver is in the water;
- A diver using Surface Supply may rely on surface personnel to keep the diver's depth, time and diving profile
- Surface supplied air diving must not be conducted at depths deeper than 190 fsw (57.9 m).
- The LUMCON DSC 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 LUMCON DSC'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

Surface Supplied in Aquariums

- In an aquarium habitat where the maximum depth is known, a pneumofathometer is not required.
- The maximum obtainable depth of the aquarium may be used as the diving depth
- One tender may line-tend multiple divers, provided the tender is monitoring only one air source, there is mutual assistance between divers, there are no overhead obstructions or entanglements, or other restrictions as defined by the LumCom DSC.
- The LUMCON DSC is responsible for developing additional operational protocols for surface supplied diving specific to the aquarium environment.

7.40 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 DSC.

Operational Requirements

- Hookah diving must not be conducted beyond depths or distance from alternate breathing gas

source as determined by the DSC.

- 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 LUMCON DSC is responsible for developing additional operational protocols.

Hookah Diving in Aquariums

- In an aquarium habitat where the maximum depth is known and planned for, a depth gauge is not required.
- The maximum obtainable depth of the aquarium may be used as the maximum diving depth.
- A hookah configured diver may operate without an in-water buddy in an aquarium 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 under other operational conditions as determined by the LUMCON DSC.
- The LUMCON DSC is responsible for developing additional operational protocols for hookah diving specific to the aquarium environment.

SECTION 8.00 STAGED DECOMPRESSION DIVING

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

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

8.10 Minimum Experience and Training Requirements

Prerequisites

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

Training

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

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

- Emergency skills

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

8.20 Minimum Equipment Requirements

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

8.30 Minimum Operational Requirements

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

150 feet.

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

SECTION 9.00 MIXED GAS DIVING

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

9.10 Minimum Experience and Training Requirements

Prerequisites

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

Classroom training including

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

Practical Training

1. Confined water session(s) in which divers demonstrate proficiency in required skills and techniques for proposed diving operations.
2. A minimum of 6 open water training dives.
3. At least one initial dive must be in 130 feet or less to practice equipment handling and emergency procedures.
4. Subsequent dives will gradually increase in depth, with a majority of the training dives being

conducted between 130 feet and the planned operational depth.

5. Planned operational depth for initial training dives must not exceed 260 feet.

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

9.20 Equipment and Gas Quality Requirements

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

9.30 Minimum Operational Requirements

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

SECTION 10.00 SPECIALIZED DIVING ENVIRONMENTS

Certain types of diving, some of which are listed below, require equipment or procedures that require training. Supplementary guidelines for these technologies are in development by the AAUS. LUMCON must have guidelines established by the Diving Safety Committee. 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 LUMCON DSC.

Cavern, Cave, or Flooded Mine Diving see Section 12

It is the responsibility of the LUMCON DSC 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 LUMCON.

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 LunmCon DSC to establish the requirements and protocol under which diving will be safely conducted.

10.60 Petroleum Platforms

Special care must be taken when diving in the vicinity of petroleum platforms. Much of the diving related work accomplished at LUMCON requires working in close proximity to oil and gas production platforms.

Permission to dive or anchor near oil platforms

The Principal Investigator is responsible for securing needed permissions and clearance from platform owner/operators prior to any diving activity.

Increased boat traffic near oil/gas platforms

Increased boat traffic in the vicinity of platforms is common. Divers must display a dive flag indicating divers in the area. Boat tenders/captains should be aware of any approaching boat traffic, and signal the presence of divers to approaching boat traffic as needed. Divers should take special care to avoid newly arrived vessels when surfacing.

Overhead obstructions

Working in the vicinity of oil and gas platforms often requires diving beneath structure (legs and other supports) that can block access to the surface. Divers should constantly monitor their surroundings and know the quickest route to the surface. All care should be taken to avoid the possibility of overhead obstruction. When possible, a down line should be deployed from the vessel, providing divers with a means to recognize a clear path to the surface.

Entanglement danger

Lost fishing line and discarded equipment around oil/gas platforms present an added danger of entanglement while diving in these locales. All divers must carry a dive knife capable of cutting a variety of materials likely to be encountered.

SECTION 11.00 REBREATHERS

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

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

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

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

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

In all cases, trainers must be qualified for the type of instruction to be provided. Training must be conducted by agencies or instructors approved by DSO and DSC.

11.10 Definition

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

B. There are three classes of rebreathers:

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

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

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

oxygen levels. CCR systems operate to maintain a constant ppO_2 during the dive, regardless of depth.

11.20 Prerequisites for use of any rebreather

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

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

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

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

11.30 Training

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

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

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

Individual Equipment Requirements

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

11.40 Equipment Requirements

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

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

11.50 Operational Requirements

A. Dive Plan

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

a) Information about the specific rebreather model(s) to be used
b) Type of CO_2 absorbent material
c) Composition and volume(s) of supply gasses d) Bailout procedures
e) Other specific details as required by the DSC

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

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

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

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

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

G. Diver carried off-board bailout is not required under conditions where the onboard reserves are adequate to return the diver to the surface while meeting proper ascent rate

and stop requirements, and the system is configured to allow access to onboard gas. These calculations must take into consideration mixed mode operations where an open circuit diver could require assistance in an out of gas situation.

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

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

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

K. The DSC or their designee will:

1. Establish policies for the use of checklists related to rebreather operations.
2. Establish policies for pre- and post- dive equipment checks to be conducted by their divers.
3. Establish policies for disinfection of rebreathers to be used by their divers.
4. Establish policies for pre-breathing of rebreathers used by their divers
5. Establish policies for the use of mixed mode and mixed rebreather platform dive teams under their auspices.
   a) Mixed mode and/or mixed platform dive teams are permitted.
   b) At minimum, divers must be cross briefed on basic system operations for establishing positive buoyancy, closing a rebreather diver's breathing loop, and procedures for gas sharing.
6. Establish policies for the maximum depth of dives conducted using a particular class of rebreather within the auspices of their diving operations.
7. Establish policies for depth authorization and maintenance for divers using rebreathers.
8. Establish policies for implementing workup dives within program
   a) Pre-operation workup dives, including review and practice of emergency recognition and response skills, and management of task loading are required for operations defined by the DSC as beyond the scope of normal operating conditions.
9. Establish policies for the minimum use of rebreathers to maintain proficiency.
   a) The minimum Annual rebreather diving activity should be 12 rebreather dives, with a minimum of 12 h underwater time.
   b) To count, dives should be no less than 30 min in duration. A required element of maintaining proficiency is the periodic performance and reevaluation of skills. related to in-water problem recognition and emergency procedures

L. Establish policies for reauthorization for the use of rebreathers if minimum proficiency requirements are not met.

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

11.60 Rebreather Training Section

A. Entry Level Training

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

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

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

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

Entry Level Training – Minimum Underwater Requirements

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

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

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

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

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

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

Minimum Underwater Requirements

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

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

B. Rebreather Crossover Training

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

SECTION 12.00 SCIENTIFIC CAVE AND CAVERN DIVING

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

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

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

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

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

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

12.10 Definition

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

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

12.20 Prerequisites

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

12.30 Training

Training	Cavern: OC or Rebreather	Cave OC	Rebreather Cave
Key: X = include, R = Review, IA = If Applicable, OC = Open Circuit			
Trainers must be qualified for the type of instruction to be provided. Training must be conducted by agencies or instructors approved by the DSC 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 DSC with a predetermined passing score, covering concepts of both classroom and practical training	X	X	X

12.40 Equipment Requirements

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

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

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

12.50 Operational Requirements and Safety Protocols

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

SECTION 13.00 USE OF SCUBA IN LUMCON ACTIVITIES

13.10 Faculty, students, and staff at member universities

LUMCON as an Organizational Member of AAUS offers scientific diving support services to all consortium members in the Louisiana educational system. Services include but are not limited to:

- Help in dive planning;
- Review and approval of consortium member dive plans meeting AAUS Standards;
- Maintenance of member university divers records to maintain AAUS compliance;
- Issuance of receipt of Letters of Reciprocity to institutions outside the LUMCON system.
- Access to the LUMCON dive locker and equipment;
- Access to LUMCON dive vessels and boats;
- Training of scientific divers;
- Dive teams to conduct work for non-diving researchers;
- On-site dive supervision by the LUMCON DSO or other qualified Dive Supervisors;
- Help in establishing satellite dive programs at consortium member institutions.

Requirements and Procedures to Dive under LUMCON Auspices

a) Contact the LUMCON DSO well in advance of anticipated diving needs. Qualification as a scientific diver may in some cases take several months to complete from DIT to scientific diver.

b) Review the diving component of the project for associated LUMCON costs. If needed, contact the LUMCON DSO for help in projecting costs.

c) All LUMCON diving activities by affiliated member universities must have an associated PI/Supervisor with the authority to sign dive plans and training requests. It is not required that PI/Supervisor be a qualified divers.

d) PI/supervisor must obtain written authorization from the respective member university administration releasing LUMCON from liability and assuming liability in the event of a diving incident or accident.

e) Dive plans from consortium member universities with the signature of the PI/Supervisor must be submitted to the LUMCON DSO at least 14 business days prior to the anticipated operation date. Dive plans are not activated until the LUMCON DSO has reviewed the plan, and returned the plan with signature approval to the PI/Supervisor.

f) Dive logs from all divers participating in the dive operations must be returned to the LUMCON DSO no later than the 5th of the month following the dives. If logs are not filed promptly, it is the responsibility of the PI/Supervisor and/or Lead Diver to expedite filing of logs. Non-filing of logs can be grounds for permanent dismissal from further diving under LUMCON auspices.

13.20 Volunteer divers, non-employee

Volunteer divers may be accepted to participate as divers on specific projects on a case by case basis as determined by the Diving Safety Committee, or designee. Volunteer solicitation and supervision as well as assuring that volunteer divers meet all volunteer requirements of LUMCON and the PI/Supervisor parent institution is the responsibility of the project PI/Supervisor.

Volunteer divers must meet all LUMCON diver requirements set as forth in this manual and if scientific diving must meet all AAUS Standards for scientific divers.

a) Volunteer divers must have on file with the LUMCON Diving Safety Office a current signed copy of Appendix C LUMCON Non-Employee Waiver of Liability.

All volunteers must be approved to dive by the LUMCON Diving Safety Officer.

13.30 Logistics and Cost

Cost Responsibility

The project PI/Supervisor and/or parent institution of the project PI/Supervisor is responsible for all costs associated with participation of the Diving Safety Officer and/or LUMCON staff divers when requested. Costs may include, but are not limited to:

a) Training activities including travel and travel expenses to and from training venues.

b) Participation in diving operations including planning, diving, and supervision.

PI/Supervisor Responsibility

a) All scheduling of training, check-out dives, swim tests, written tests, etc. will be done at the discretion of the Diving Safety Officer. When it is anticipated by a LUMCON faculty member or researcher at a member university that scientific diver certification will be necessary for upcoming dive operations, a request to begin the process should be made as soon as possible. Scientific diver certification may take up to several months to complete depending on the entry level diver baseline and availability of the LUMCON DSO.

b) It is the responsibility of the PI/Supervisor to determine the dive operation financial commitments prior to beginning planning of the dive operation, including training. The LUMCON DSO and LUMCON Office of the Marine Superintendent are available to assist in determining costs.

c) The PI/Supervisor must coordinate activities among their divers or diver candidates, and the LUMCON DSO, to minimize time spent by the DSO. The PI/Supervisor may delegate this supervision to an individual acceptable to the DSO and who is at a minimum a qualified Lead Diver.

Consortium Member Institution Responsibility

a) The LUMCON member institution is responsible, through the sponsoring PI/Supervisor for their employee expenses related to diving.

    1. Individual divers as agreed upon by the diver and LUMCON Institutional Member.

    2. Non-employee volunteers – LUMCON Institutional Members may provide financial support for some or all volunteer diving expenses as agreed upon between the LUMCON faculty member and the volunteer.

Individual Divers Responsibility

a) All dive gear used under LUMCON auspices must be inspected annually and prrof of inspection provided to the Diving Safety Office. Unless arranged otherwise, individual divers are responsible for expenses related to maintaining their personal dive gear if that gear will be used during LUMCON dive operations.

b) All divers-in-training under LUMCON auspices must complete 12 dives under the supervision of a certified scientific diver. All scientific divers under LUMCON auspices must complete 12 annual proficiency divers to maintain active scientific diver status. All active scientific divers with a depth rating deeper than 30fsw must complete one dive at or near their depth rating each six months. It is the responsibility of individual divers to seek out opportunities to complete required dives either by participating in ongoing dive operations or through recreational dive opportunities if applicable.

c) In addition to diving venues paid for by the sponsoring PI/researcher:

    1) Divers may solicit to be added to LUMCON research dive trips as available by the LUMCON faculty member or other LUMCON researchers if space is available and the researchers accepts them.

    2) Divers may arrange and pay for a LUMCON boat to be used by the DSO for open water dives in the area of LUMCON Marine Center.

    3) Divers may arrange and pay for a private boat, the time of the DSO, and the travel expenses of the DSO for open water dives away from the area of the LUMCON Marine Center.

    4) Divers may arrange to pay for the time and expenses of the DSO to travel to confined water land sites.

SECTION 14.00 DIVING OPERATIONS ABOARD LUMCON VESSELS

14.05 General Policy

Diving from LUMCON vessels and the procedures to be followed, falls under three broad categories based on vessel size.

a) Category I – Large ship class vessels such as *Pelican, Point Sur*.
   - Dedicated vessel captain or operator usually not physically located on dive deck;
   - Vessel is generally too large to serve as primary dive platform without special procedures in place;
   - Diving Supervisor oversees deck operations.

b) Category II – Small ship class vessels such as *Acadiana*.
   - Dedicated vessel captain may be in proximity of dive deck;
   - Vessel is serviceable as primary dive platform, but may also require special procedures;
   - Diving Supervisor oversees dive deck.

c) Category III – Small boat classes including center consoles, chase boats, inflatables.
   - Vessel operator in close proximity to dive operations;
   - Vessel is the primary dive platform;
   - Vessel operator may also act as Diving Supervisor and/or standby diver.

Regardless of the vessel used or the auspices of the divers, all dives must be reviewed and approved by the LUMCON Diving Safety Officer.

All scientific diving activities from LUMCON vessels must be in accordance with regulations as established by the American Academy of Underwater Sciences, Standards for Scientific Diving, and LUMCON Guidelines for Scientific Diving.

All commercial diving from LUMCON vessels must be in accordance with commercial dive regulations required by the State of Louisiana.

No recreational diving may be conducted from LUMCON vessels without written approval of the Marine Superintendent and the Diving Safety Committee, or Designee.

14.10 Standard Regulations for all Vessels

a) The vessel operator or Captain has responsibility for all activities aboard the ship. Diving activities can be terminated by the vessel operator or Captain in the event of unfavorable weather conditions, bad currents, other vessel activity in the area, or other circumstances that he/she feels may jeopardize the safety of the individuals involved. The Dive Supervisor or Lead Diver shall provide the vessel operator or captain with all information requested to assure safety of divers during dive operations.

b) The LUMCON DSO or the Lead Diver has the authority to disapprove or suspend diving activities that are deemed to be unsafe. The Lead Diver may request that a diver not dive if s/he decides that the diver is unprepared, hesitant, or impaired in some manner.

c) Prior to commencing dive operations, the Dive Supervisor or Lead Diver must conduct a dive briefing which includes all divers and dive support personnel, and the vessel Captain or operator. If any substantive changes are made in the dive operation post-briefing, the Dive Supervisor or Lead Diver must assure key personnel including the Captain or operator are notified.

d) A copy of the Dive Plan must be given to the vessel Captain or operator prior to departure and must include at a minimum:

    1. Procedures to follow in the event of a diving accident.

    2. Location and phone number of the nearest hospital emergency care;

    3. Location and phone number of the nearest chamber;

    4. Name and phone number of he Diving Safety Officer if other than LUMCON DSO.

e) Prior to the dive, the dive team must record the coordinates or location of the dive site, time of start of dive, and planned time for end of dive. This log should remain on board with the boat operator.

f) The use of LUMCOM compressors or other special equipment must be requested from the LUMCON Vessel Operations Department well in advance of diving activities, and must be e listed on page 3 of the LUMCON Dive Plan *Tools or Specialized Equipment Used* at the time of plan submission.

g) A boat Captain or operator shall remain aboard the support vessel at all times during the dive unless this requirement is waived by the Diving Supervisor under certain circumstances, such as shallow dives in calm conditions or use of permanently moored buoys.

h) No diving operation will commence until the vessel Captain or operator has given explicit permission to the Dive Supervisor or Lead Diver.

i) All engines must be turned off before deploying or retrieving divers. If it becomes necessary to activate engines during deployment or retrieval of divers to avoid injury, loss of life or damage to property, the vessel Captain or operator must be prepared to justify reasons in writing to the Diving Safety Committee, or designee.

j) If motoring into an area where divers are in the water, vessel must be slowed to idle speed and if available watches should be posted on the bow to look for bubbles.

k) It is the responsibility of the vessel Captain or operator to conduct a head count prior to departing the area of dive operations and assure that all divers and other personnel have been accounted for.

l) A legal diver's down flag or Alpha flag if in international waters must be displayed from the support vessel at all times when divers are in the water.

m) Support vessels shall be equipped with a SSB and/or VHF radio and/or cell phone or satellite phone, first-aid kit, emergency oxygen resuscitator and AED.

n) When diving in currents, if the vessel is at anchor, a tag line with a float shall be streamed approximately 50' behind the vessel. During drift dives a surface float will be towed by the dive party.

o) Divers must carry a whistle and inflatable emergency tube (SMB, "diver sausage"); for offshore diving, an air-powered horn and safety flares are recommended.

14.15 Missing Diver Protocols

a) In the event of a dive accident:
    1. The Dive Supervisor or Lead Diver is responsible for on-scene emergency response and emergency care.
    2. The vessel Captain or Operator is responsible for establishing radio communication with external emergency response agencies such as US Coast Guard or paramedics.

b) The Diver Supervisor or Lead Diver must notify the vessel operator or captain immediately if at any time a diver becomes missing.

c) A float should be anchored at the last known point where the diver was present and a second float should be deployed and allowed to drift with the current.

d) The vessel operator should recall and recover any remaining divers and begin a search beginning at the dive site and working down current considering the rate of drift.

e) The vessel operator or Captain should establish contact with the Coast Guard (Channel 16 in US).

f) The vessel operator should issue a general PAN call on Channel 16 and all commonly used channels with the statement: "PAN, PAN … all vessels please be on the lookout for missing divers, state name and description of your vessel, location, depth, how many divers, and the time they should have surfaced.

14.20 Regulations for Diving from Category I Vessels (R/V Point Sur, R.V Pelican)

In addition to the Standards stated above:

a) Whenever possible, the vessel must be tied to a structure or anchored before diving operations commence.

b) A standby boat must be available during all diving operations and must be able to be quickly deployed. Before departure or the voyage, it must be determined if the rescue boat normally carried on board is for planned diving activities, or if an alternative should be procured prior to departure from the dock.

c) A Dive Supervisor must be present on deck during all dive operations and have instant communications available with the bridge officer via VHF, non-VHF radio or cell phone.

d) A standby safety diver other than the Dive Supervisor must be on the deck and prepared to enter the water when divers are deployed.

e) Small boats may be used for dive operations away from the *Pelican.* A member of the ship's crew must be on the small boat and a standby diver must be onboard the *Pelican* (or on the small boat if the diving is far from the *Pelican*) during diving operations.

f) Depending on circumstances such as water depth, weather conditions or sea state which may interfere with the ability to retrieve divers, the number of divers permitted to enter the water at any one time may be restricted by the vessel operator or Captain, DSO, Dive Supervisor or Lead Diver.

g) Snorkeling is permitted while the vessel is adrift or tied or anchored. A tag line at least 50' in length must be available on the vessel and a safety diver must be stationed on the deck when skin divers are in the water.

14.30 Regulations for Diving from Category II Vessels (R/V Acadiana)

In addition to the Standards stated above:

a) A standby boat is not a routine piece of equipment for the Category II vessels. If requested, inflatable boats that can be provided. Otherwise, the Category II vessel serves as the primary dive platform. Maneuverability must be sufficient for emergency recovery, if needed.

1. If a standby boat is required for dive operations from the Category I vessels, a standby diver should be available on the parent vessel and ready to enter the water. The Deck Supervisor may act as standby diver.

2. Ready to deploy surface marker buoys with a line of sufficient depth and anchor/weight should be available on the standby boat should the need rise arise to return to the parent vessel and retrieve the standby diver, and rapidly relocate the dive site.

3. If there is adequate space available, a first-aid kit, oxygen kit and AED should be on the standby boat.

14.40 Regulations for Diving from Category III Vessels (small boats)

a) Radio contact should be established with LUMCON base, pre-designated contacts upon arrival at the dive location, or a contact made with a radio test for the area, attesting to the presence of a LUMCON small boat with divers.

b) A first-aid kit, oxygen kit and AED is required for all diving on small boats.

c) When conducting dive operations, the boat Captain or operator must be certified and current in CPR, first aid and oxygen first aid if there are no other qualified individuals remaining onboard.

14.50 Commercial Diving from LUMCON Vessels

Construction and trouble-shooting tasks traditionally associated with commercial diving are not considered a scientific dive.

LUMCON scientific divers cannot participate in commercial diving activities unless they are trained as and have current commercial diver status. Likewise, commercial divers are not trained scientific divers, and unless they have current LUMCON standing shall not be permitted to participate in scientific diving activities.

All commercial diving activities must meet standards and regulations of CFR 1910 Subpart T:

https://www.osha.gov/enforcement/directives/cpl-02-00-151

A commercial diver paid by LUMCON or member universities may dive from a LUMCON vessel if s/he:

a) Is a qualified and current commercial diver and has provided a valid and current commercial diver card;

b) meets the OSHA requirements for commercial diver standards as stated in CFR 1910 subpart T;

c) Has provided proof of a current business license acceptable in the State of Louisiana;

d) Has provided proof of current diver liability insurance with minimum coverage of $1,000,000;

e) Has on file with the LUMCON DSO a current commercial diver liability form.

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_____ (Organizational Member). Their answers on the Diving Medical History Form (attached) may indicate potential health or safety risks as noted. Your evaluation is requested on the attached scuba Diving Fitness Medical Evaluation Report. If you have questions about diving medicine, you may wish to consult one of the references on the attached list or contact one of the physicians with expertise in diving medicine whose names and phone numbers appear on an attached list, the Undersea Hyperbaric and Medical Society, or the Divers Alert Network. Please contact the undersigned Diving Safety Officer if you have any questions or concerns about diving medicine or the _____ standards. Thank you for your assistance.

Organizational Member

_____ _____

Diving Safety Officer Date

_____ _____

Printed Name Phone Number

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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- NOAA DIVING MANUAL, NOAA. Superintendent of Documents. Washington, DC: U.S. Government Printing Office.
- U.S. NAVY DIVING MANUAL. Superintendent of Documents, Washington, DC: U.S. Government Printing Office, Washington, D.C.

APPENDIX 2
AAUS MEDICAL EVALUATION OF FITNESS FOR SCUBA DIVING REPORT

_____ _____

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

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

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

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

- Medical history
- Complete physical exam, with emphasis on neurological and otological components
- Urinalysis
- Any further tests deemed necessary by the physician

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

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

PHYSICIAN'S STATEMENT:

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

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

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

_____ MD or DO _____
Signature Date

_____
Name (Print or Type)

_____
Address

_____ _____
Telephone Number E-Mail Address

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

My familiarity with diving medicine is: _____

APPENDIX 2b

AAUS MEDICAL EVALUATION OF FITNESS FOR SCUBA DIVING REPORT

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 _____ Diving Safety Officer and Diving Control Board or their designee at (place) _____ on (date) _____

Signature of Applicant _____ Date_____

REFERENCES

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

APPENDIX 3
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
RECOMMENDED PHYSICIANS WITH EXPERTISE IN DIVING MEDICINE

A List of Medical Doctors that have training and expertise in diving or undersea medicine can be found through the Undersea and Hyperbaric Medical Society or Divers Alert Network. See links below:

https://www.uhms.org/resources/diving-medical-examiners-list.html
https://www.diversalertnetwork.org/medical/physicians.asp

Agans	Stephen	New Orleans	LA	504-352-7856	to email click here	2011
Alleman	Tony	New Iberia	LA		to email click here	2010
Bello	Jerry		LA	337-233-4480	to email click here	18-Jan
Banaag	Lisa O.	Harahan	LA	662-614-9877	to email click here	2012
Bensusan	Ariana	New Orleans	LA	401-523-8850	to email click here	2017
Boquet	Mark	Houma	LA	985-868-2302	to email click here	18-Sep
Bourgeois	Brian	Getra	LA	504-443-5070	to email click here	2006
Buford	Kevin	New Orleans	LA	619-929-6836	to email click here	2011
Combs	Bewell	Shreveport	LA	318-212-5911		
Davis	Robert W.	Houma	LA	985-22-30032	to email click here	17-Sep
Engle	John	New Orleans	LA	985-768-8918	to email click here	2015
Fernandez	Greg	New Orleans	LA	985-873-1200	to email click here	19-Sep
Freeman	Mark		LA	337-233-4480	to email click here	18-Jan
Guidry	Lynn	Lafayette	LA	337-233-4480	to email click here	19-Sep
Gupta	Prashant	Broussard	LA	337-551-4946	to email click here	20-Sep
Haddad	Philip	Shreveport	LA	605-359-6090	to email click here	18-Sep
Hickey	Bradley	Belle Chasse	LA	850-387-5048	to email click here	2015
Kathmann	Brett	Metairie	LA	504-914-9797	to email click here	2016
Tracy	LeGros	New Orleans	LA	504 903 3594		
McEldrew	Patrick	Harvey	LA	904-502-2421	to email click here	23-Sep
O'Neal	Michael	New Orleans	LA	626-660-4503	to email click here	2015
Parks	Sarah	Gretna	LA		to email click here	2010
Pearson	Mark	New Orleans	LA	504-366-7638	to email click here	2014
Shamitko	Gregory	New Orleans	LA	404-630-4555	to email click here	2016
Siegel	Micah	New Orleans	LA		to email click here	2016
Silva	Francisco	Youngsville	LA	337-234-9925	to email click here	22-Sep
Smyth	Mike		LA	912-401-1242	to email click here	18-Jan
Steen	John	Harahan	LA	504-818-0006	to email click here	19-Sep
Van Meter	Keith		LA	504-366-7638	to email click here	18-Jan
Varughese	Lince	New Orleans	LA	516-375-3026	to email click here	2017
Yontz	Dustin		LA	504-366-7638	to email click here	18-Jan
Yountz	Dustin	Harvey	LA	330-280-2232	to email click here	2012

APPENDIX 5
DEFINITION OF TERMS

Air sharing - Sharing of an air supply between divers.

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

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

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

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

DPIC – See Designated Person-In-Charge.

EAD - Equivalent Air Depth (see below).

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

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

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

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

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

FSW - Feet of seawater.

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

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

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

Hookah - While similar to Surface Supplied in that the breathing gas is supplied from the surface by means of a pressurized hose, the supply hose does not require a strength member, pneumofathometer

hose, or communication line. Hookah equipment may be as simple as a long hose attached to a standard scuba cylinder supplying a standard scuba second stage. The diver is responsible for the monitoring his/her own depth, time, and diving profile.

Hyperbaric Chamber - See 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.

CONNECT | ENRICH | TRANSFORM

APPENDIX 6

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

Diver: _____ Date: _____

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

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

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

The Louisiana Universities Marine Consortium is a member in good standing of AAUS.

LUMCON Diving Safety Office 8124 Highway 56 Chauvin, LA 70344
ph: (985)851-2871; Fax: (985) 851-2874 dso@lumcon.edu

APPENDIX 7
DIVING EMERGENCY MANAGEMENT PROCEDURES

Contents

DIVING EMERGENCY TREATMENT AND EMERGENCY CONTACTS

Emergency Contact Numbers

US Coast Guard	VHF Channel 16
Terrebonne Parish EMS	911
Divers Alert Network	919-684-8111 (Emergency hotline)
	919-684-4DAN (Collect)
	800-446-2671 (Toll-free)
LUMCON Security	985-851-2800
LUMCON Dive Officer	985-851-2871
LUMCON Vessel Ops	985-851-2808
	985-855-1480 (Mobile, after hours)

Nearest Medical Centers

Terrebonne General Medical Center (TGMC)
8166 Main Street
Houma, Louisiana 70360
985-873-4141 985-873-4150
Emergency Care

Leonard J. Chabert Medical Center
1978 Industrial Blvd.
Houma, LA 70363
985-873-2200
Emergency Care

Memorial Hospital at Gulfport
4500 13th Street
Gulfport, MS 39501
228- 67- 4000

Nearest Recompression Chambers

West Jefferson Medical Care Center — Needs Confirmation
1101 Medical Care Blvd
Marrero LA 70072
504-349-6558

Springhill Medical Center — Needs Confirmation
3719 Dauphin Street
Mobile AL 36608
251-344-9630

NOTE- CHECK NUMBERS FOR ACCURACY PRIOR TO DIVING.
(Revised 11-30-2018)

EMS CALL-IN DATA REQUIREMENTS

In the event of a Diving Accident, the following data should be available if possible when EMS contact is initiated. And, should be given to EMS transport to be delivered to hyperbaric treatment personnel.

Name of Diver _____

Emergency Contact Name and Phone Number

_____

Details of last dive:

Name of buddy diver _____

Depth _____

Bottom time _____

Breathing gas (air, Nitrox, mix) _____

Decompression table or dive computer used _____

Time at end of dive _____

Time at onset of symptoms _____

Details of previous repetitive dive:

Date/Time _____

Surface Interval _____

Depth _____

Bottom time _____

Name of buddy diver _____

Decompression table or dive computer used _____

Breathing gas _____

Describe symptoms in detail:

What _____

Where _____

Intensity _____

Record any changes in symptoms and time _____

_____

Results of neurological exam, vital signs, and secondary assessment:

_____

_____

Diver's medical history:

Allergies _____

Current medication _____

Recent illness _____

Previous decompression sickness or embolism _____

Describe any treatment of diver:

Medication _____

Record time and volume of liquid intake and output _____

_____

Oxygen (time on/off, %) _____

_____

Recompression chamber:

Test of pressure results _____

Treatment table _____

Time and duration _____

Name of operator _____

Change in symptoms _____

Comments: _____

_____

_____

_____

_____

_____

_____

Introduction

The LUMCON Dive Accident Management Appendix is adapted from the Harbor Branch Oceanographic Institute's and Florida Atlantic Universities Diving Safety and Standards Manual, Appendix 2, and is a compilation of basic information on how to identify and stabilize a diving accident victim and how to get a diver into the hyperbaric trauma care system (diving physician and recompression chamber). It is meant for use as a guide by LUMCON divers, Diving Supervisors, Divers-in-Charge and evacuation personnel who have little understanding of hyperbaric (diving) medicine.

Portions of this manual have been excerpted from the following sources:

American Heart Association, 1992. Cardiopulmonary Resuscitation CPR. Fourth Edition. CPR Publishers, Inc./ Tulsa, OK, 56 pp.

Cory, J., 1989. Student Workbook for Emergency Oxygen Administration and Field Management of Scuba Diving Workshop. National Association of Underwater Instructors. 65 pp.

Daugherty, C.G., 1992. Field Guide for the Diver Medic. Coastal Aquatics Publications, Austin TX, 177 pp.

Davis, J. (ed.), 1986. Medical Examination of Sport Divers. Best Publ. Co., P.O. Box 1978, San Padre, CA 90733.

Divers Alert Network, 1993. DAN Underwater Diving Accident Manual. Divers Alert Network, Duke University Medical Center, Durham, NC, 69 pp.

Divers Alert Network, 1993. DAN Oxygen First Aid in Dive Accidents. Divers Alert Network, Duke University Medical Center, Durham, NC, 63 pp.

Hendrick, W. and A. Zaferes, 1991. The Field Neurological for Diving Emergencies. Lifeguard Systems, Inc., 28 pp.

NURP, 1987. Diving Operations and Procedures Manual. National Oceanic and Atmospheric Administration, National Undersea Research Program at Univ. North Carolina at Wilmington, 93 pp.

Harbor Branch Oceanographic Manual, 2009. Diving Standards and Safety Manual, Ft. Pierce, FL, 160pp.

Rutowski, D., 1991. Recompression Chamber Life Support Manual. Rosentiel School of Marine and Atmospheric Science, Univ. of Miami, 110 pp.

Woods Hole Oceanographic Institution, 1983. Diving Safety Manual, 89 pp.

General Procedures

A diving accident victim could be any person who has been breathing air underwater regardless of depth. It is essential that emergency procedures are pre-planned and that treatment is initiated as soon as possible. A comprehensive list of emergency phone numbers and contacts for diving physicians and recompression centers can be found in Appendix 7, pg. **Error! Bookmark not defined.** and in conjunction with this section should be used as a guide to on-site response to diving emergencies, and in preparing the Diving Accident Emergency Management Plan sheet of the LUMCON Dive Plan.

Preparedness

- All diving personnel must be prepared to respond in the event of a diving accident.
- Periodic retraining and routine practice are essential elements in emergency preparedness; emergency drills are encouraged.

On-Site Accident Management Procedures

- The Diver-in Charge or Diving Supervisor shall take charge at the scene of the accident and delegate tasks to other responsible individuals.
- Stabilize life-sustaining functions and follow the Accident Management Flow Chart.
- Establish radio communications through the Master of the Vessel, or phone contact with local EMS, with the predetermined medical facility.
- Transmit the following information to the physician:
    1. Accident Call-in Data
    2. Neurological Exam Checklist
    3. Checklist for Secondary Assessment of Injury
- All diving equipment of accident victim must be kept intact and tagged for later inspection and analysis.
- In certain cases or circumstances, recompression treatment may be conducted in onboard recompression chambers. In such circumstances, the medical standing orders shall follow the protocol of onsite Recompression Chamber Manual, Daugherty's Field Guide for the Diver's Medic (1992), and the U.S. Navy Diving Manual (1993).

Emergency Evacuation

- If afloat, the Master of Vessel should contact the U.S. Coast Guard (radio HF-2182, VHF Channel 16) or other appropriate authorities.
- If on land, contact local EMS and follow EMS directions.
- Follow medical evacuation procedures.
- Follow helicopter procedures, as necessary.

Notification of Authorities

- After any serious diving incident, The Lead Diver or Diving Supervisor must notify the Diving Safety Officer, or as soon as possible and provide the following:

- Complete AAUS Incident Report Form
- Name, address, phone numbers of the principal parties.
- Summary of experience of divers involved.
- Location, description of dive site and description of conditions that led up to the incident.
- Description of symptoms, including depth and time of onset.
- Description and results of treatment.
- Disposition of the case.
- Recommendations to avoid repetition of incident.

- The LUMCON DSC will investigate and document any incident of pressure-related injury and prepare a report which is to be forwarded to the AAUS during the annual reporting cycle. This report must be first reviewed and released by the LUMCON DSC.
- After any diving incident resulting in any injuries or symptoms, a written report (using the AAUS Accident or Incident Reporting Form), shall be submitted within one week by the Diver-In-Charge to the DSO.

Medical Procedures

Depending on the nature of the diving accident, stabilize the patient, administer oxygen, and contact the diving physician, and contact air transport and also recompression chamber, if necessary. Explain the following steps to evacuation teams, medics and physicians. Do not assume that they understand why oxygen may be required for all diving accident victims or that recompression treatment may be necessary.

- Administer CPR, if required.
- Keep air-way open and prevent aspiration of vomitus.
- Protect victim from excessive heat or cold and treat for shock, if necessary.
- Administer 100% oxygen by tight-fitting mask at the highest possible oxygen concentration.
- Do not remove oxygen unless necessary to reopen air-way or victim shops signs of convulsions.
- If convulsion occurs, do not forcefully restrain but hold loosely to prevent self-injury. Resume oxygen administration after convulsions subside.
- Do not give pain killing drugs.
- Give conscious patients non-alcoholic liquids such as fruit juices or water. Try to achieve urine output of 1-2 ounces (30-60 cc)/hour. Discontinue fluids if victim is unable to urinate.
- For conscious or seriously injured victims, qualified medical personnel may administer intravenous electrolyte solutions, e.g., Ringer's lactate or normal saline (100cc/hour). Do not use 5% dextrose in water.

- Administer rapid neurological exam, check for secondary injuries, and fill out medical logs, if time and circumstances permit.
- Contact physician experienced in diving medicine or Divers Alert Network, and state information recorded.
- If recompression treatment is required, contact recompression facility before sending victim.
- If air evacuation is required, instruct the flight crew that cabin pressure must be maintained s close to sea level as possible and below 800 feet.
- Transport with victim the information recorded above and also the diving buddy, if possible.
- The victims depth gauge, tank, regulator and other diving equipment must be kept intact and tagged for later inspection and analysis.

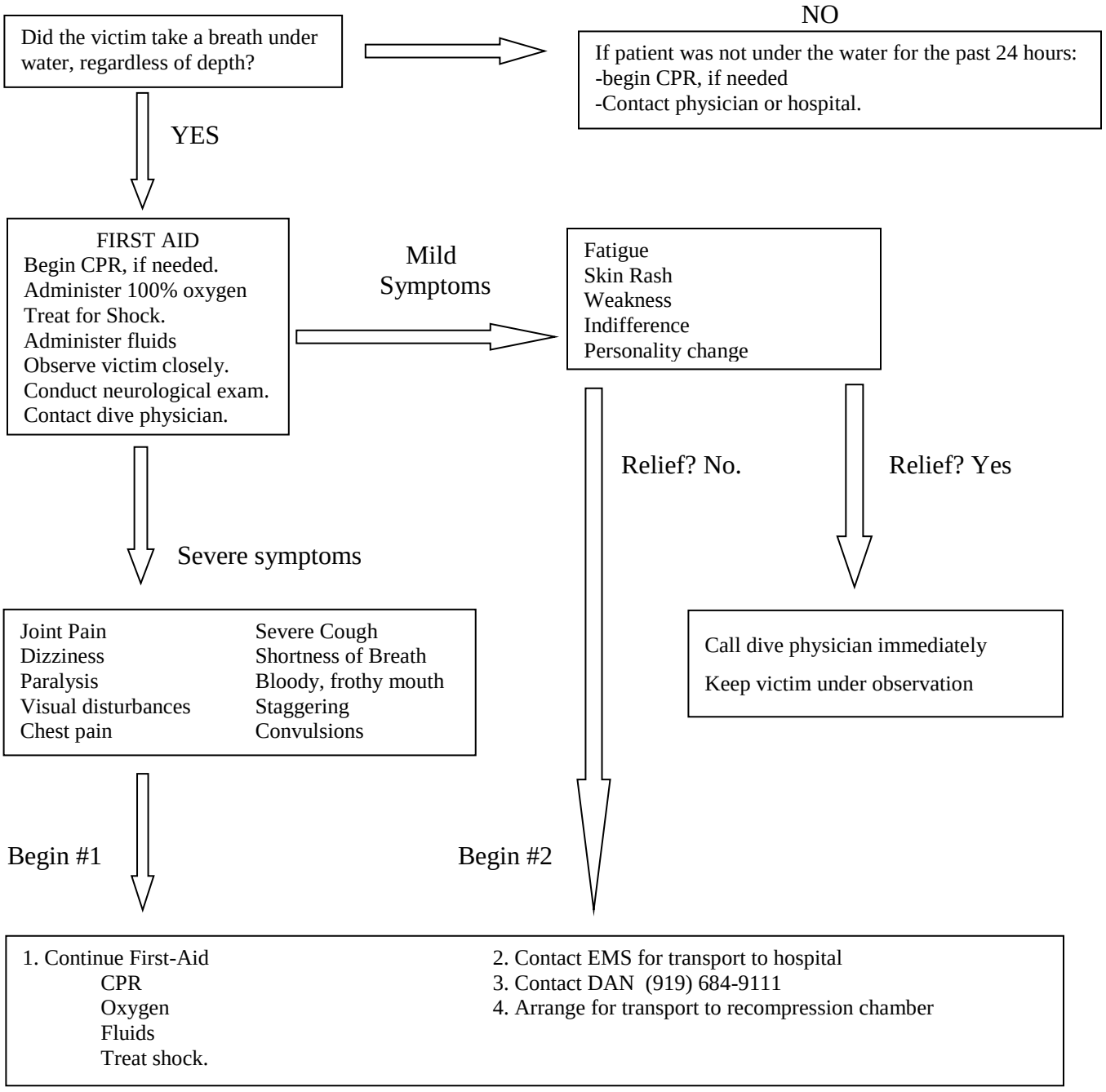
In any diving accident, certain questions should be resolved quickly in order to best ascertain course of action. Most important of all, did the victim breath compressor air at depth? If not the accident should not in fact be treated as a dive accident at all. This is an important consideration for emergency medical personal and physicians to know when a victim is to be transported to a treatment facility. Next, are the symptoms severe (life threatening), or mild (can wait until medical help is reached).

DIVING ACCIDENT MANAGEMENT FLOWCHART

Contact: Divers Alert Network (DAN)
Duke University Medical Center
Emergency Hotline (919) 684-9111
Non-Emergency (919) 684-2948 or (800) 446-2670

BASIC STEPS FOR DIVING ACCIDENTS

1. Establish (A)irway, (B)reathing, (C)ircualtion.
2. Administer 100% oxygen.
3. Call local Emergency Medical System (EMS) for transport to nearest hospital.
4. Call DAN (919-684-9111 in USA) for contact with diving physician and recompression chamber.



CARDIOPULMONARY RESUSCITATION (CPR)

	Objectives	Actions		
		Adult (over 8 yrs.)	Child (1 to 8 yrs.)	Infant (under 1 year)
A. Airway	1. Assessment: Determine unresponsiveness.	Tap or gently shake shoulder.		
		Say, "Are you okay?"		Observe
	2. Get help.	Call out "Help!"		
	3. Position the victim.	Turn on back as a unit, supporting head and neck if necessary. (4-10 seconds)		
	4. Open the Airway.	Head-tilt/chin-lift		
B. Breathing	5. Assessment: Determine breathlessness.	Maintain open airway. Place ear over mouth, observing chest. Look, listen, feel for breathing. (3-5 seconds)		
	6. Give 2 Rescue Breaths.	Maintain open airway.		
		Seal mouth to mouth.		Mouth to nose/mouth
		Give 2 rescue breaths, 1 to 1 ½ seconds each. Observe chest rise. Allow lung deflation between breaths.		
	7. Option for obstructed airway.	a. Reposition victim's head. Try again to give rescue breaths.		
		b. Activate the EMS system.		
		c. Give 6-10 subdiaphragmatic abdominal thrusts (the Heimlich maneuver).		Give 4 back blows. Give 4 chest thrusts.
		d. Tongue-jaw lift and finger sweep.	Tongue-jaw lift, but finger sweep only if you see a foreign object.	
		If unsuccessful, repeat a, c, and d until successful.		
C. Circulation	8. Assessment: Determine pulselessness.	Feel for carotid pulse with one hand: maintain head-tilt with the other. (5-10 seconds)		Feel for brachial pulse; keep head-tilt.
	9. Active EMS system	If someone responded to call for help, send them to activate the EMS system.		
	10. Begin Chest compressions:	Run middle finger along bottom edge of rib cage to notch at center (tip of sternum).		Imagine a line drawn between the nipples.
	11. Landmark check	Place index finger next to finger on notch:		Place 2-3 fingers on sternum, 1 finger's width below line. Depress ½-1 in.
	12. Hand position	Two hands next to index finger. Depress 1 ½-2 in.	Heel of one hand next to index finger. Depress 1-1 ½ in.	
	13. Compression rate	80-100 per minute		At least 100/minute
CPR Cycles	14. Compressions to breaths.	2 breaths to every 30 compressions.		
	15. Number of cycles.	4 (52-73 seconds)	10 (60-87 seconds	10 (45 seconds or less)
	16. Reassessment.	Feel for carotid pulse (5 seconds)		Feel for brachial pulse.
		If no pulse, resume CPR, starting with 2 breaths.	If no pulse, resume CPR, starting with 1 breath.	
Option for entrance of 2nd rescuer: "I know CPR. Can I help?"	1st rescuer ends CPR	End cycle with 2 rescue breaths.	End cycle with 1 rescue breath.	
	2nd rescuer checks pulse (5 seconds).	Feel for carotid pulse.		Feel for brachial pulse.
	If no pulse, 2nd rescuer begins CPR	Begin one-rescuer CPR, starting with 2 breaths.	Begin one-rescuer CPR, starting with 1 breath.	
	1st rescue monitors 2nd rescuer.	Watch for chest rise and fall during rescue breathing; check pulse during chest compressions.		
Option for pulse return	If no breathing, give rescue breaths.	1 breath every 5 seconds	1 breath every 4 seconds	1 breath every 3 seconds

Oxygen Administration

When oxygen is breathed, the oxygen partial pressure (PO2) of the blood is increased. This establishes a steeper gradient across the bubble-tissue interface and aids in the elimination of inert gases (from the bubble), reducing the bubble size to some extent. Additionally, the elevated (PO2) allows better oxygenation of tissues where the blood supply is marginal, because the initial bubble has impair that flow. Although this discussion relates to the use of oxygen at seas level as a first aid measure, the same principles apply to the use of oxygen under hyperbaric conditions.

Tissue integrity depends essentially upon two factors: (1) adequate PO2 and (2) adequate flow to deliver the oxygen. Even though there is some vasoconstriction, the flow should be adequate with the improved PO2 to help reduce bubble size to supply oxygen-poor tissues.

Oxygen Cautions and Recommendations

- If a demand mask is not properly sealing, re-position the mask on the face. Further problems may require pulling the mandible tighter into the mask. Do not push the mask tighter into the face as this may close the air-way.
- While most demand valves shut off automatically, over-inflation of a victim's lungs is still a concern. When positively ventilating a non-breathing victim, release the "purge button" as soon as the chest begins to rise to prevent damage to the lungs or inflation of the stomach. If gastric distension occurs during positive pressure ventilations, re-evaluate the airway.
- Only non-breathing <u>adult</u> victims may be manually ventilated with a positive pressure demand valve.
- It is important to watch for vomiting. Ventilating a victim with a demand valve often leads to vomiting. If a victim begins to vomit, remove any mask from the face, immediately pull the victim onto their side, and assist in removing any vomit from the airway.
- A diving victim should be closely monitored at all times. A diving victim on oxygen should never be left unattended.
- Flow rates should be adjusted such that mask reservoir bags do not completely deflate with each inspiration of the victim.
- Oxygen should be delivered with a diving victim in the supine position. The victim must be flat on their back if resuscitation is required.
- Oxygen equipment should not be used in the presence of oils, greases, flammable substances, or burning tobacco.
- High oxygen concentrations should not be delivered to hyperventilating victims or victims with chronic obstructive pulmonary disease (emphysema).
- Positive pressure demand valves and airway adjuncts should only be used on victims by rescuers with appropriate local certification(s).
- Rescuers should be CPR certified.
- Additional cylinders may be advantageous for extended oxygen delivery times.

- Extra regulator washers should be carried with oxygen equipment.
- Local protocols for the administration of oxygen should be followed.

Emergency Evacuation
Once it has been established that the patient is a diving accident victim, and someone is caring for his immediate medical needs (vital signs, surface oxygen, shock, etc.), someone must also be initiating the evacuation protocol into the hyperbaric trauma system.

Because many divers and/or boaters fail to plan emergency evacuation procedures in advance, a great amount of critical time is often lost, causing needless suffering and possible loss of life. The most important part of any dive and/or boat trip is to know your procedure for emergency evacuation.

Many medical problems, including those resulting from diving accidents, could occur at any time at sea. Because some symptoms are delayed in their onset, it is not only necessary to know how to contact a hyperbaric trauma team at sea, but also on land. Many divers have been diving in one country and returned to another before symptoms occurred.

Communications
If you have a radio on board, contact the Coast Guard Directly, 2182 HF or channel 16 VHF marine band. Declare an emergency and state the type of emergency, e.g., "This is a diving accident victim needing treatment in a recompression chamber". Give your exact location by direction and distance from prominent land marks. Give all symptoms of the victim and dive history if applicable. State the condition of victim, i.e., can he walk, sit up, or is he unconscious. Describe any unusual circumstances, and the number of victims. Give a detailed description of your boat including any outstanding features for identification. Give weather, sea condition, wind direction and speed.

If you should change your location, keep all concerned advised of your new location and your intentions.

The coast guard does monitor CB, CH9. This is a very unreliable means of communications for many reasons. If you are unable to raise the Coast Guard via CB, contact someone else to relay your messages.

If you have no radio on your boat, if practical, hail a boat with a marine band radio and give them the information to relay to the Coast Guard. Keep them with you for further contacts. The International Convention of safety of life at sea requires the providing of assistance to vessels in distress.

If no other boats are immediately available, proceed immediately to the nearest inhabited dockage and telephone local par-medical or USCG services. Advise them of a diving accident, state your need for transportation and your EXACT location. Have someone remain at the telephone for further assistance. Insure that they are aware at this time that a recompression chamber will be needed.

If symptoms occur on land after diving, contact local para-medics or USCG. They should be able to assist or advise location of nearest recompression chamber.

When the rescue aircraft arrives in your area, wave, fire flares or smokes, LET THEM KNOW YOU ARE THE ONES WHO WANT ASSISTANCE. Do not assume the pilot will recognize you. He may waste valuable time searching for you unnecessarily.

Helicopter Evacuation Procedures

Each helicopter evacuation is different, each one present s its own problems, but knowing what to expect and the procedures to follow can save time, effort, and perhaps a life.

- Try to establish communications with the helicopter. If your boat is unable to furnish the necessary frequency, try to work through another boat.
- Maintain speed of 10 to 15 knots, do not slow down or stop.
- Maintain speed into wind about 20 degree's n the port bow.
- Out all antennas down if possible, without losing communications.
- Secure all loose objects on/around decks.
- Always let the lifting device (stretcher) touch the boat before handling it to prevent electric shock.
- Place life jacket on the patient.
- Tie patient in basket, face up.
- If patient cannot communicate, place in the stretcher as much information as you can about him, such as name, age, address, what happened, and what medication he has been given.
- If the patient is a diving accident insure flight crew has a copy of, or is instructed on medical procedures for diving accidents.
- If diving victim, insure flight crew delivers victim to hyperbaric trauma system (recompression chamber complex).

Recompression Chamber Requirements

Diving accident management protocol suggests a recompression chamber that is a multi-lock and 6 atmospheres. Do not take critical diving accident victims to a chamber which is one-man, single lock, 3 atmospheres. There are two major reasons why.

1. Pressure may be sufficient to reduce bubble size (gas embolism requires 6 atmospheres).
2. Physicians have no way of getting hands on victim to:
    a. Maintain vital signs.
    b. Keep airway clear.
    c. Perform neurological examinations necessary to determine proper treatment, or reoccurrence of symptoms.
    d. Monitor vital signs during treatment.
    e. Operations may have to be performed, such as intubation.
    f. Pulmonary over-distention cases may have air leakage causing a tension pneumothorax which must be relieved, and monitored during decompression periods.
    g. Oxygen convulsions may close off victim's glottis, and victim could develop an embolism while dropping pressure to relieve convulsions.

3. Mixed gas capabilities for saturation treatments.

Be very cautious about transporting patients in small one-lock chambers for the above reasons. It is often better to transport without chamber and maintain vital signs using surface oxygen.

The Underwater Diving Accident Victim

Arterial gas embolism and decompression sickness are the two most frequent serious SCUBA related accidents. Arterial gas embolisms are blockages due to bubbles in arteries carrying blood up to the brain. Decompression sickness is the syndrome of joint pains (the bends), chest pains and shortness of breath, numbness, paralysis and other symptoms resulting from surfacing too rapidly from a dive. Both conditions can be fatal.

An underwater diving accident victim may be any person who has been breathing air underwater regardless of depth. Gas embolisms can occur in as little as four feet of water if one ascends holding their breath. Even a well-trained diver may encounter problems because of respiratory problems. Asthma, brocholithiasis, congenital or acquired cysts, emphysema, fibrosis, tuberculosis, infection, and obstructive lung diseases may result in air-trapping during ascent. The expansion of trapped air may be sufficient to rupture air spaces and the escaping air may cause emphysema of the lungs, mediastinum or neck. More serious problems of pneumothorax or arterial air embolisms may also result.

Decompression sickness can occur in any individual who violates the decompression tables either willingly or unintentionally when surfacing from greater than 30 feet.

To insure a successful treatment, instructors, dive masters, paramedics, emergency room personnel, and physicians must be able to recognize the problem and begin proper treatment while arranging entry into the hyperbaric trauma system.

In any situation suggesting an underwater diving accident, the primary question is "did the subject breathe compressed air underwater?" If the answer is "yes", or if the victim is unconscious then the subject must be regarded as a diving accident victim. The diving accident treatment procedure must be initiated immediately. This includes basic life support, administering oxygen, Trendelenburg position, and immediate evacuation to the recompression chamber complex. See Flow Chart.

Mild Symptoms

Mild symptoms may respond to treatment at the scene using oxygen. Fatigue, skin rash, and weakness are considered a minor symptom, but frequently require recompression and are handled as a severe symptom in the Flow Chart. A neurological examination must be completed to determine presence of severe symptoms.

If a diver surfaces from a dive and behaves in an unusual manner, appears confused or has fatigue, weakness or skin rash, he may have early symptoms of an underwater accident.

Immediately place the diver on 100% oxygen. Refer to the Flow Chart and follow through. Oxygen treatment often relieves the symptoms or prevents them from getting worse. The victim will probably deny the possibility of having a problem and any refuse oxygen. Good judgment should prevail and the diver should receive treatment. If the symptoms appear relieved after an interval of oxygen treatment, do not remove the oxygen immediately as the symptoms may recur. The victim should continue to receive oxygen for thirty minutes. Follow the Flow Chart for further instructions.

Severe Symptoms

Severe symptoms consisting of pain, weakness or paralysis, staggering, respiratory difficulties (chokes) or unconsciousness require immediate treatment and evacuation into the hyperbaric trauma system. Cardiopulmonary resuscitation will be required if the victim has no pulse or respiration. If a person at any time within 24 hours after a dive shows any of the severe symptoms indicated on the flow chart, immediately provide the victim with oxygen (100% or highest possible concentration). Monitor pulse and respiration and follow the instructions in the Flow Chart until evacuation to a recompression chamber has been accomplished.

It is important to remember that because these signs and symptoms can develop hours after diving, the patient may show up in a hospital emergency room or other medical facility in the community. For this reason, it is important for paramedics and physicians to recognize the symptoms and to understand this problem so that the underwater diving accident procedure can be initiated. It is also extremely important that any person delivering an underwater diving accident patient to a medical facility PROVIDE THAT FACILITY WITH THIS MANUAL AND THE COMPLETE HISTORY RECORDED ON THE FORMS UNCLUDED IN THIS MANUAL. The manual should stay with the patient until he reaches the Hyperbaric Trauma Center in order to provide those caring for the patient with full information concerning the accident.

Air Embolism

As a diver surfaces without exhaling, air trapped in the lungs expands and may rupture lung tissue releasing gas bubbles into the circulatory system where they may be distributed to the body tissues. The ascending diver is normally in a vertical position and the bubbles tend to travel upward toward the brain, eventually reaching a small artery blocking circulation. The effects of halting circulation to the brain are critical and require immediate treatment. Symptoms of embolism may be present when the victim reaches the surface or within a few minutes afterward.

CAUSE:
1. Holding breath during ascent while breathing compressed gas.
2. Possible result of panic.
3. Lung disease resulting in air trapping.

SYMPTOMS:
1. Dizziness
2. Visual blurring
3. Bloody froth from mouth or nose
4. Paralysis or weakness
5. Unconsciousness

Note: Symptoms usually appear immediately after surfacing or within 15 minutes usually.

SIGNS:
1. Bloody froth from mouth or nose
2. Paralysis or weakness
3. Convulsions
4. Unconsciousness
5. Cessation of breathing

PREVENTION
1. Always exhale during ascent
2. Get a periodic medical examination by a physician knowledgeable in diving medicine.

TREATMENT: Place victim flat on back, slight head down for shock; turn head if vomiting. Administer oxygen at 100% or highest possible concentration and continue while transporting to a recompression chamber. UNDER NO CIRCUMSTANCES SHOULD THE VICTIM BE RETURNED TO THE WATER FOR TREATMENT.

Decompression Sickness

Decompression sickness (bends, Caisson disease) is the result of inadequate decompression following exposure to increased pressure. While inadequate recompression is not usually a matter of life and death as with air embolism, the quicker recompression is initiated the better the rte of recovery. The body tissue absorbs gas in proportion to the surrounding pressure and as long as the diver remains at pressure, the gas presents no problem. If the pressure is too quickly removed (as in rapid surfacing), the inert gas comes out of solution and forms in the tissues and blood stream.

CAUSE: Inadequate decompression

SYMPTOMS:
1. Extreme fatigue
2. Skin itch
3. Pain in arms and legs
4. Dizziness
5. Paralysis
6. Shortness of breath
7. Collapse or unconsciousness

NOTE: Symptoms and signs usually appear anywhere between 15 minutes and 24 hours after surfacing.

SIGNS:
1. Skin may show a blotchy rash
2. Paralysis
3. Staggering
4. Choking

PREVENTION:
1. Strict observance of NO DECOMPRESSION LIMITS
2. No diving if hung over, intoxicated or tired.

TREATMENT Decompression sickness requires recompression as soon as possible. Any symptoms except itching are considered serious, but even the mild symptoms suggest that the victim should be monitored very closely for the later development of a more serious problem. The victim should receive 100% oxygen during transportation to a recompression chamber.

Carbon Dioxide Excess

CAUSE:
1. Loss of air supply
2. Improper use of closed circuit SCUBA
3. Over-exertion
4. Skip breathing

SYMPTOMS 1. Sometimes none

2. Labored or rapid breathing
3. Headache, dizziness, weakness, nausea
4. Unconsciousness

PREVENTION
1. Diver should stop, rest, ventilate and surface if breathing becomes labored
2. Avoid causes listed above

TREATMENT
1. Give oxygen
2. CPR if not breathing

Pneumothorax
Air enters chest cavity causing lungs to collapse.

CAUSE: Holding breath during ascent

SYMPTOMS
1. Shortness of breath
2. Sharp pain in chest

SIGNS:
1. Rapid shallow breathing
2. Blueness of skin, lips, and fingernails
3. Lungs sound different from one side to another

Prevention: Exhale during ascent

Treatment:
1. Do NOT use recompression without chest tube
2. Physician will insert chest tube to withdraw air and reinflate lung
3. 100% oxygen, medical attention, contact hyperbaric physician.

Mediastinal Emphysema
Air released into tissues surrounding the heart.

CAUSE: Holding breath during ascent

SYMPTOMS:
1. Faintness
2. Shortness of breath
3. Pain under breastbone

SIGNS:
1. Difficulty in breathing
2. Change in voice

PREVENTION: Exhale during ascent

TREATMENT:
1. Do NOT use recompression unless complicated with air embolism or decompression sickness or life-threatening complications.
2. Observe for other problems
3. 100% oxygen, medical attention, hyperbaric physician.

Subcutaneous Emphysema
Air trapped under skin (usually around neck)

CAUSE:	Holding breath during ascent
SYMPTOMS:	1. Feeling of fullness around neck 2. Change in voice
SIGNS:	1. Swelling during ascent 2. Difficulty swallowing 3. Crackling sound when skin is pressed
PREVENTION:	Exhale during ascent
TREATMENT:	1. No real emergency 2. Usually no treatment needed 3. Observe for other problems 4. 100% oxygen, medical attention, hyperbaric physician.

IMMERSION HYPOTHERMIA AND COLD WATER NEAR-DROWNING

BY Capt. M.J. Nemiroff, 1988 From NAUI Workbook

Immersion hypothermia and cold water near-drowning are often natural consequences of scuba diving accidents such as decompression sickness and air embolism. Hypothermia is a condition in which the body's core temperature has lowered below 95 degrees Fahrenheit. Cold water near-drowning is considered to be a submersion accident in water temperatures of 70 degrees Fahrenheit or less that often leads to unconsciousness or coma. A long submersion time is considered to be 4-6 minutes or longer.

The body loses heat to its environment by:

Conduction:	transfer of heat by direct contact with the water, air, or ground;
Convection:	transfer of heat by air or water that is moving away from the body;
Radiation:	transfer of energy by non-particulate means such as from an unprotected head;
Evaporation:	conversion or perspiration into water vapor thereby absorbing calories of heat; and
Respiration:	exhalation of water vapor carrying with it heat from the body.

Immersion Hypothermia

Hypothermia may be mild, moderate, or severe. The victim may exhibit symptoms ranging from shivering and piloerection ("goosebumps") to profound confusion, irreversible coma, and death. Significant hypothermia begins at core body temperatures 0f 95 degrees Fahrenheit and below. The lowering of the body temperature occurs as the body is robbed of heat by the surroundings. Water conducts body heat away up to 26 times faster than air of the same temperature. Normal body functions slow down with decreasing heart, respiratory, and metabolic rates. Thought processes are impaired and speech becomes confused while reflexes are slowed and muscles become stiff and unusable. In the advanced stages of hypothermia, life-threatening heart rhythms develop which are difficult to reverse.

Upon submersion of the body in very cold water, response actions occur immediately. An involuntary gasp and sudden hyperventilation are followed by a varying amount of diving response**.** The diving response is more evident in the very young (infants and toddlers). It consists of a slowing of the heart beat, a decrease or actual cessation or respiration, and a dramatic change in circulation with blood circulation to only the inner core of the body: heart, lungs, and brain. This individual appears dead to the casual observer who is seeing a cold, blue, non-breathing victim. Cold water immersion victims have been fully resuscitated when treated carefully with a variety of rewarming techniques ranging from warm blankets to complete cardiopulmonary bypass in major hospitals.

The potential rescuer must remember that there are differences in cooling rates depending upon the age, sex, body weight, clothing, nutritional status, general health, and specific diseases of the victim as well as the water temperature, length of exposure, areas exposed to heat loss, nature of the water movement, circumstances of the immersion, and ultimately, the victim's "will to live".

Remember: Immersion hypothermia should be considered a factor in most diving accidents. The body loses its temperature in a variety of ways while the victim is still in the water, during

management of the accident after removal from the water, and during transport. Cold water immersion victims may appear to be dead but may be resuscitatable.

SIGNS AND SYMPTOMS

1. Shivering
2. Lowered body temperature
3. Cold, blue skin
4. Slow heartbeat
5. Slow respiration
6. Slurred speech
7. Confusion
8. Muscle stiffness
9. Cardiopulmonary arrest

TREATMENT

The basic goals or treatment are to prevent cardiopulmonary arrest, stabilize the core temperature, and carefully transport the victim to definitive medical care.

1. REMOVE THE VICTIM FROM THE COLD ENVIRONMENT.

2. ENSURE AIRWAY, BREATHING, CIRCULATION, AND DEGREES (ABCD).

As well as ensuring that the victim has an open airway, is breathing, and has heart beat, determine the victim's body temperature. Most clinical thermometers only measure temperatures as low as 94 degrees Fahrenheit. Low reading thermometers for hypothermia victims are commercially available and should be included in all diving first aid kits. As always, if the victim is not breathing and the heart not beating, standard cardiopulmonary resuscitation

(CPR) should be started immediately.

3. PREVENT FURTHER HEAT LOSS.

Remove wet clothing, gently dry the neck, and cover high heat loss areas of the body such as the head, neck, lateral thorax, and groin areas. The head and neck account for 50% of the body's heat loss.

4. HANDLE THE VICTIM GENTLY.

As the body rewarms, it initially becomes colder for a short time. This is known as *afterdrop*. During this period, the heart is extremely vulnerable to the development of life-threatening rhythm disturbances. The victim should be removed horizontally from the water and kept in a supine position. A litter or stretcher should be used to carry the victim since exercising, jumping, climbing, or other exertion on the part of the victim may trigger the heart rhythm disturbance. Victims of hypothermia typically deny that are ill and tend to decline medical treatment. Many times they want to climb into the responding ambulance or helicopter without assistance. The victim's judgment may be clouded and the rescuer's should prevail! Afterdrop can be prolonged by certain "field treatments". A cigarette, hot cup of coffee, or a drink of alcohol which are all time-honored treatments, generally prolong the afterdrop exposing the victim to greater risk and do not help the hypothermic victim recover. They should not be provided to hypothermic individuals with core temperatures below 95 degrees Fahrenheit.

Cold Water Drowning

Submersion accidents leading to unconsciousness in waters colder than 70 degrees Fahrenheit occur with regularity. The body's oxygen requirements are significantly reduced when the body is cold. Permanent brain damage from low oxygen states will not occur as quickly as when the body is warm. Successful resuscitations have been seen with victims submerged as long as sixty (60) minutes. Similar to victims suffering from hypothermia, the cold water near-drowning victim will generally appear blue and cold to the touch, exhibit no apparent respiration or heart beat, and have pupils which are fixed and dilated. The following factors affect the survivability of cold water near-drowning victims:

Age	:	The younger the better;
Length of Submersion	:	The shorter the better;
Water Temperature	:	The colder the better;
CPR Quality	:	The cleaner the better;
Victim Struggle	:	The more they struggle the worse the results; and,
Other Injuries	:	Burn and blast injuries as well as fractures reduce the chances of survival.

Remember: Cold water near-drowning is more survivable than previously thought. Victims who have been submerged as long as an hour may still be fully resuscitated. Cold water may be protective to some body systems since oxygen needs are markedly reduced.

SIGNS AND SYMPTOMS

1. Cough with clear to frothy red sputum
2. Blue skin color
3. Shortness of breath
4. Confusion to coma
5. Respiratory arrest
6. cardiac arrest

TREATMENT

1. REMOVE THE VICTIM FROM THE WATER.

2. DO NOT PERFORM ABDOMINAL THRUSTS (HEIMLICH MANEUVER) EXCEPT TO CLEAR A CONFIRMED, OBSTRUCTED AIRWAY.

   Abdominal thrusts may induce vomiting and cause aspiration of vomitus and water into the lungs.

3. ENSURE AIRWAY, BREATHING, AND CIRCULATION (ABC).

   Initiate cardiopulmonary resuscitation (CPR) as required.

4. PREVENT FURTHER HEAT LOSS.

   Remove wet clothing, gently dry the skin, and cover high heat loss areas of the body such as the head, neck, lateral thorax, and groin areas. The head and neck account for 50% of the body's heat loss.

5. HANDLE THE VICTIM GENTLY.

6. ADMINISTER 100% OXYGEN.

   Heated oxygen administration should only be attempted with cardiac monitoring in place and only by personnel capable of treating cardiac dysrhythmias. In selected cases, heated oxygen (105 – 108 degrees Fahrenheit) has been successfully used to stabilize body temperature and reduce further loss.

7. TRANSPORT TO NEAREST MEDICAL FACILITY.

   The sooner a victim is transported to a medical facility the better he/she will probably resolve. Do not forget that a diving accident such as decompression sickness or air embolism may have led to the cold water near-drowning in the first place. A successful resuscitation may only be possible within a recompression chamber which will ultimately be necessary for treatment of the compressed-gas injuries.

DIVER INJURY DIAGNOSIS KEY

Symptom/Sign	Circumstances	Probable Injury	Management
Bleeding/external ear	Ear pain during descent/ascent	Ruptured eardrum	Terminate diving; nothing in ear; avoid contamination; medical attention
Bleeding/external ear	Hit head	Fractured skull	Keep victim lying down and inactive; keep warm; no fluid; do not elevate feet; constant attendance; immediate medical attention
Spitting blood	Ear pain during or following ascent	(1) Ruptured eardrum (2) Middle ear	See Above (Ruptured Eardrum) Terminate diving; medical attention if drainage/discomfort persist
Spitting/coughing blood; bloody froth	Emergency ascent	Pulmonary injury; possible air embolism	Observe for illness and signs of neurological damage (visual disturbances, paralysis, personality changes, etc.); head down; treat shock, 100% oxygen; medical attention; transport to recompression facility.
Bloody discharge/nose	Pain in sinuses during ascent/descent	Sinus squeeze (or reverse sinus squeeze)	Terminate diving; medical attention if drainage/discomfort persist.
Chest pain/ breathing	Emergency/ uncon-trolled ascent; Chest congestion prior to dive	Pneumothorax/mediastinal /emphysema/sub-cutaneous emphysema	See Air Embolism
Neurological abnormalities including: loss of balance/coordination visual disturbance rigidity/numbness of extremities paralysis personality changes	Emergency/uncontrolled ascent; congestion prior to diving; smoker; symptoms dramatic & sudden; inadequate decompression	Air embolism or decompression sickness	100% oxygen; medical transport to recompression facility; CPR if indicated; never leave victim unattended

Bluish coloration	Emergency/uncontrolled ascent; chest congestion prior to dive; chest pain following dive	Pneumothorax/mediastinal emphysema	See Air Embolism
Swelling in neck area	Emergency/uncontrolled ascent; chest congestion prior to dive; chest pain following dive	Subcutaneous emphysema	See Air Embolism
Unconsciousness	Occurs while or shortly after surfacing from a dive	Air embolism or decompression sickness	See Air Embolism
Respiratory or cardiac arrest	Occurs while or shortly after surfacing form a dive	Air embolism or decompression sickness	See Air Embolism
Pain in joints or extremities	Occurs shortly after surfacing from a dive near or beyond no-decompression limits	Decompression sickness	See Air Embolism
Bluish coloration	Loss of consciousness during dive; closed circuit or mixed gas	CO2 Excess or hypoxia	Surface; resuscitation; oxygen; medical attention; do not exclude air embolism
Reddish coloration	Loss of consciousness during or after dive	CO Poisoning	See CO excess; oxygen until turned over to physician; monitor continuously
Respiratory distress with strong oil taste	Oil contamination of breathing supply	Oil pneumonia	Medical attention

NEUROLOGICAL EXAMINATION

This short examination may be administered by personnel without medical training. It only requires the ability to recognize and report any abnormalities that may be the result of a diving malady and not a previous condition. Vital signs and neurological examination should be repeated every 15-30 minutes and reported as provided on page 112.

A. VITAL SIGNS

Pulse/minute
Blood Pressure
Respirations/minute

B. MENTAL STATUS

Orientation

Time – what day is this?
Place – where are you?
Person – what is your name?

Memory

Immediate – use simple math
Recent – happenings within past 24 hrs.
Remote – background

Mental Function

Test using serial 7's.
Subtract 7 from 100, then 7 from 93, etc.
If an error is repeated, like 93, 90, 83, 80, then state so in report.

Level of Conscious

Check for any fluctuations. Check whether alert, verbal, able to respond to mild pain, unresponsiveness.

Seizures

Describe degree and duration.

Bladder Control

Describe any difficulties with either retention or movement.

Bowel Control

Describe any difficulties with either retention or movement.

C. CRANIAL NERVES

Eyes

Sight – hold fingers up; test one eye at a time.

Movement – have patient's eyes follow your finger up and down, right and left. Eyes should track together.

Pupils – both should be round and nearly (not exactly) the same size. If light shined in one eye, both pupils should react. Repeat on opposite side.

Face

Both sides should move equally. Have diver raise eyebrows, frown, close eyes tightly, smile and show teeth. Clench teeth and feel jaw muscles on both sides for equal firmness.

Mouth

Uvula – should rise when patient says "ah"

Tongue – when stuck out, it should not deviate to either side; it should be able to wiggle side to side.

Ears

Ask if hearing seems normal, if there is any roaring, humming or ringing in ears. With patient's eyes closed, test one ear at a time by rubbing fingers approximately one inch from the ear.

Neck Muscles

Have patient shrug shoulders while you press down on them; note any unilateral weakness. Have patient turn chin sideways against palm of your hand; feel the force for each side.

D. STRENGTH

Major muscle groups are tested by feeling their force against resistance. The right and left sides are compared.

Upper Extremities

Have patient squeeze your fingers (dominant hand may be stronger). Grip patient's hand and have him pull and push against you. Have patient hold palms together while you attempt to separate them. Have patient hold elbows out to the side and resist downward pressure.

Trunk

Check for problems sitting or standing upright. Have patient bend over and straighten.

Lower Extremities

With patient sitting place your hands on patient's leg just above ankle and press down lightly; have patient try to lift legs. While your hand is beneath the ankle and pulling lightly upward; have patient push down with legs. Have patient raise each big toe and hold it against resistance.

E. SENSATION

Sensory symptoms may consist of pain, numbness, tingling, hot-cold sensations, or a wooly, heavy feeling in an extremity. Do not use the question, "Can you feel this?", but rather, "Does this feel normal?" Compare right and left sides. If any numb areas, mark area on body with pen and time.

Light Touch

Drag finger tips lightly over top, sides, and back of head, and face. Check front and back of arms, legs, and trunk. Check fingers, toes, palms and soles of feet.

Sharp and Dull

Using eraser and tip of pencil, press on patient's skin and ask patient to identify whether sharp or dull. Compare right and left sides as some areas are normally more sensitive. Drag point across body surface (vertically on body and around extremities) looking for strips of numbness or areas having a different feeling.

Position

Have patient close eyes. Move various joints up, then down, and have patient say which direction they were moved.

F. COORDINATION

Gait

Have patient walk heel to toe forward, then backwards. Check for unsteadiness, rubbery legs.

Balance

Have patient stand with feet together, arms away from sides, then close eyes. The patient should be able to stand easily, but some swaying is normal.

Orientation in Space

With eyes closed have patient put heel on opposite kneecap, then slide it down the front of the leg to the big toe; repeat on opposite side. With eyes open have patient move a finger from touching your finger tip to the tip of his nose, and repeat several times.

G. REFLEXES

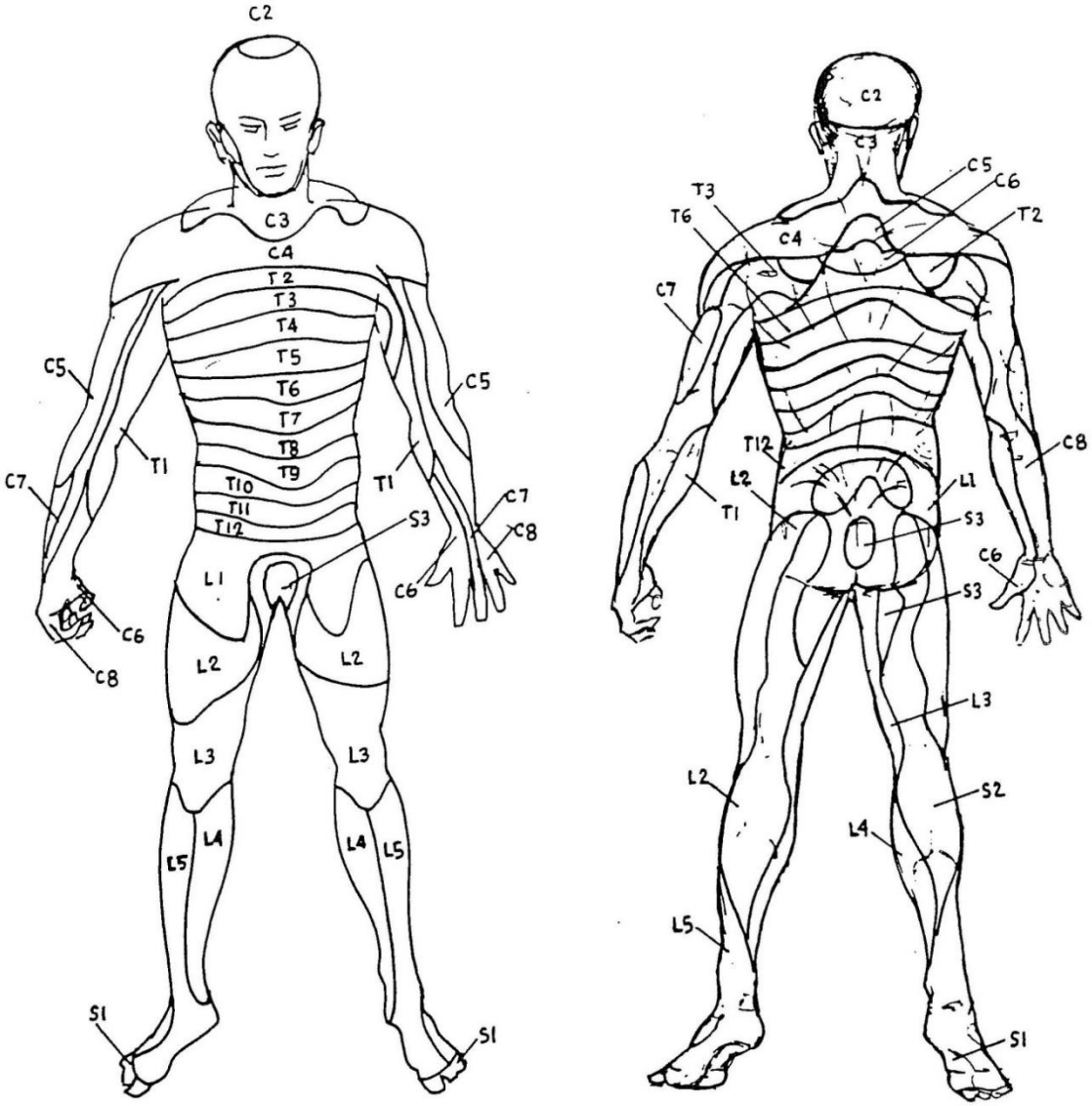
Babinski Reflex

Run a blunt object up the sole of the foot. If the toes curl down, a normal response is present. If nothing happens, no conclusion can be drawn. If the toes curl up, backward and spread, then the response indicates probable spinal involvement.

NEUROLOGICAL EXAMINATION CHECKLIST

Patient's Name _____

Date _____ Time of Exam _____



A central nervous system (CNS) problem can easily be missed in early stages if CNS symptoms are not understood. A little numbness or weakness developing in the pointer finger of one hand might for example, indicate a DCS "hit" in the C6 area of the spinal cord (the sixth bone in the cervical spine). Any signs or symptoms of numbness, tingling, weakness, and especially paralysis should be carefully, closely, and continuously monitored. Numbness in the right ring finger might lead to full right-sided paralysis if the problem is AGE, or to full paralysis from C7 down to the toes if there was a C7 DCS "hit". C (Cervical). T (Thoracic). L (Lumbar). S (Sacral).

A. VITAL SIGNS
   1. Pulse _____
   2. Blood Pressure _____
   3. Respiration _____

B. MENTAL STATUS
   1. Orientation
      Time _____
      Place _____
      Person _____
   2. Memory
      Immediate _____
      Recent _____
      Remote _____
   3. Mental Function
      _____
   4. Level of Consciousness
      _____
   5. Siezures
      _____
   6. Bladder Control
      _____
   7. Bowel Control
      _____

C. CRANIAL NERVES
   1. Eyes
      Sight R _____ L _____
      Movement R _____ L _____
      Pupils R _____ L _____
   2. Face
      Close Eyes Tightly _____
      Frown _____
      Smile _____
      Clench Teeth _____
   3. Mouth
      Uvula _____
      Tongue _____
   4. Hearing R _____ L _____
   5. Neck Muscles
      Shoulder Shrug _____
      Turn Head _____

D. STRENGTH
   1. Upper Extremities
      Hands R _____ L _____
      Arms R _____ L _____
   2. Trunk _____
   3. Lower Extremities
      Legs R _____ L _____
      Feet R _____ L _____

E. SENSATION
   1. Light Touch
      Head R _____ L _____
      Arms R _____ L _____
      Fingers R _____ L _____
      Palms R _____ L _____
      Front Torso R _____ L _____
      Back Torso R _____ L _____
      Legs R _____ L _____
      Toes R _____ L _____
      Soles R _____ L _____
   2. Sharp/Dull
      Arms R _____ L _____
      Front Torso R _____ L _____
      Back Torso R _____ L _____
      Legs R _____ L _____
   3. Position
      Arms R _____ L _____
      Legs R _____ L _____

F. COORDINATION
   1. Gait _____
   2. Balance _____
   3. Orientation _____

G. RELEXES
   1. Babinski R _____ L _____

CHECKLIST FOR SECONDARY ASSESSMENT OF INJURY

Equipment: This exam can be conducted with minimal equipment (a stethoscope, blood pressure cuff, watch and light are needed).

This exam is to be conducted after the primary exam and after life threatening conditions have been stabilized. When the exam is completed, all conditions noted are to be prioritized and emergency medical service contacted.

Examination Checklist

1. ___ Skull: Feel entire skull for fractures, lumps, cuts
2. ___ Skull: Check for fluid draining from ears or nose (do not stop fluid if present)
3. ___ Eyes: Pupils equal and reactive to light
4. ___ Face: Check for broken bones, cuts, missing/broken teeth
5. ___ Jaw and Throat: Take pulse on neck
6. ___ Upper Spine: Run fingers along spine as far as able without disturbing patient or twisting spinal cord and feel for any deformity
7. ___ Shoulders and Clavicle: Feel for breaks
8. ___ Chest: Feel ribs, sternum, and xiphoid
9. ___ Chest: Use stethoscope – listen to heart and lungs
10. ___ Lower Spine: Run fingers along and feel for deformity
11. ___ Abdomen: Gentle pressure in each of the four quadrants. Feel for hardness or pain stimulus

Upper Right	Upper Left
Liver	Stomach
Colon	Spleen
Gall Bladder	Transverse Colon
Lower Right	**Lower Left**
Cecum	Descending Colon
Appendix	
Ascending Colon	

12. ___ Pelvic: Check hips and pubic bone for breaks
13. ___ Legs: Check for breaks, check knee area
14. ___ Feet: Check for breaks and circulation
15. ___ Arms: Check for breaks and circulation
16. ___ Hands: Check for breaks
17. ___ Complete set of vitals:
    - _____ Blood Pressure
    - _____ Pulse Rate
    - _____ Respiration Rate

Comments: _____
_____

LUMCON DIVING ACCIDENT / INCIDENT REPORT FORM

NOTE: LUMCON Scientific Divers shall use this form to report diving related accidents, injuries, and incidents including; near-drowning, decompression sickness, gas embolism, lung overexpansion, or injuries that require hospitalization as well as any incidents that compromised diver safety or might result in later hospitalization, therapy, or litigation. **LUMCON Dive Logs for all dives related to the accident / incident must also be submitted with this report.** Contact the LUMCON Dive Safety Officer at 985-851-2871 with questions about whether or not to report an incident.

GENERAL INFORMATION ABOUT THE ACCIDENT/ INCIDENT VICTIM

DIVER NAME:		DATE & TIME OF INCIDENT:
DIVE LOCATION:	**DIVING CERTIFICATION LEVEL:** ☐ Scientific Diver ☐ Diver-In-Training ☐ Temporary Diver	**CERTIFICATION DEPTH:**
CURRENT MEDICATIONS:		**CURRENT HEALTH PROBLEMS:**

If the diver is not a LUMCON-certified diver, complete this section. LUMCON-certified divers skip to the next section.

AGE:	SEX: (M/F)	DIVER'S AGENCY OR ORGANIZATION:	AGENCY OR ORGANIZATION DSO NAME & TELEPHONE #:

# YEARS DIVING:	TOTAL # DIVES:	# DIVES LAST 6 MONTHS:	PREVIOUS DIVE INCIDENTS & DATES:

DESCRIPTION OF THE ACCIDENT / INCIDENT:

Please describe accident / incident in detail. Include ANY factor which you believe may have contributed to, or minimized the accident / incident. If more than one accident / incident occurred please fill out a separate form. Use extra paper if necessary.

What could have been done to prevent this accident / incident?

Did the accident / incident cause harm:
☐ Yes ☐ No ☐ Not known

Specify :

Did the accident / incident occur in training:
☐ Yes ☐ No ☐ Not known

Specify :

Diver's qualification: (may circle >1)

Diving student …… DS
Advanced diver…….AD
Dive instructor ….. DI
Professional …….. PD
Not known …….. NK
Other……

Open water ……...OW
Divemaster ……...DM
Untrained …… .. UT
Technical diver…..TD
CDAA… Cavern CA
.. Sinkhole SI
..Cave CV
.. Penetrat. PN

Contributing Factors (Check all that apply):

□ Inadequate knowledge	□ Poor physical fitness
□ Unfamiliar diving environment/conditions	□ Feeling unwell
□ Unfamiliar diving equipment	□ Error in judgement
□ Inexperience in diving	□ Poor communication
□ Poor dive planning	□ Malfunction of equipment
□ Insufficient training in diving	□ Failure to understand equipment
□ Failure to check	□ Lack of servicing of equipment
□ Lack of a buddy check	□ Poor servicing of equipment
□ Haste	□ Lack of post dive equipment maintenance
□ Inattention	□ Inadequate supervision of diver
□ Fatigue	□ Sea sickness
□ Anxiety	□ Poor technique
□ Recent illness	□ Recreational drug/alcohol/hangover pre dive

Did the accident / incident involve any of the following (Circle all that apply):

Low air situation ……	LA	Problem at deco stop …….	DE
Out of air situation ……...	OA	Poor buddy pairing …….	BP
Rapid ascent ……..	RA	Poor buddy response ……	BR
Unable to slow rapid ascent ...	US	Loss buddy contact …….	BC
Out of air ascent ……..	OR	Marine animal ……..	MA
Buddy breathing …….	BB	Equalization problem descent …	ED
Octopus breathing …….	OB	Equalization problem ascent …	EA
Pony bottle breathing ……	PB	Equipment ……	EP
Multiple ascents …….	AA	Poor visibility/silting ……	PV
Buoyancy problem …….	BP	Strong current ……	SC
Problem on ascent …….	PA	Flying <24hrs after diving …..	FL
Problem at safety stop …..	SS	Altitude >300ms after diving ..	AL
Deco stop missed …….	DS	Panic ……	PC
Not detected by buddy check …	ND	Anchor retrieval ……..	AR
Nausea, vomiting U/W ……	NV	Entanglement/trapped/guideline..	ET

First Aid:

□ No O_2 available / limited O_2 supply	□ Lack of trained 1st aid assistance
□ O_2 ran out	□ Lack of first aid supplies
□ O_2 used inappropriately	□ Poor first aid

Gas Supply

Gas supply in use during dive: □ Air □ Nitrox □ Mixed gas □ O_2 □ No/poor analysis predive
□ Confusion gas mix during dive Air consumption greater than usual this dive: □ Yes □ No

Equipment involved in the accident / incident (Check all that apply):

□ Hired □ Borrowed □ New □ Misuse □ Essential equipment lacking □ Equipment forgotten

□ Torch	□ Mask	□ Depth gauge	□ Mouthpiece
□ Surface signal device	□ BCD	□ Dive computer	□ Scooter
□ Dive Flag	□ Fins	□ Regulator	□ Reel or line
□ Alterative air supply	□ Snorkel	□ Watch/Timer	□ Shot/safety line
□ Weight belt	□ Wet suit	□ Camera/trophy bag	□ Gloves
□ Weights	□ Dry suit	□ Rebreather	□ Climbing equipment
□ Ankle weights	□ Lyrca suit	□ Exit ladder	□ Other
□ Tank/cylinder	□ Knife	□ Boat	Specify_____
□ Compressor/ Hookah	□ Contents gauge	□ Surface buoy	

Regulator and Gas Supply (Check all that apply):

□ Low to out of air □ Contents not analysed prior to dive or incorrectly □ Air not turned on □ Air not turned on fully □ Air turned on then off prior to dive □ Air supply turned off inappropriately □ Didn't check contents gauge regularly	□ Inaccurate contents gauge □ Unable to read contents gauge □ Contents gauge hose rupture/leak □ Hose rupture/leak □ Pillar valve problem □ 1st stage malfunction □ 2nd stage malfunction	□ Free flowing 2nd stage □ Octopus 2nd stage problem □ 'O' ring problem □ Regulator breathing resistance increased □ Unable to purge 2nd stage □ Pony bottle problem □ 'Octopus' reg snagged	□ Unable to locate alternative air supply □ Air used frequently to maintain buoyancy □ Tape on pillar valve □ 1st stage attached incorrectly □ Separation regulator parts □ Swivel problem

Miscellaneous Equipment (Check all that apply):

Weights and weight belts: □ Overweight □ Underweight □ Unable to release □ Didn't know how to release □ Quick release jammed □ Tongue overlap stopped release □ Snagged during release □ Weight belt /weights dropped □ Snagged causing release □ BCD integrated weight problem **Wet / dry suit:** □ Uncomfortable □ Tight - restricted breathing □ Changed buoyancy	Buoyancy Jacket (BCD): □ Unfamiliar with its use □ Spontaneously inflated □ Inflation device failed □ Inflator hose leaked □ Inflation device not connected □ Incorrect inflator hose □ Didn't know how to inflate BCD □ Didn't know how to deflate vest □ Inflator/octopus combination problem □ Dump valve malfunction □ Uncomfortable	□ Inflated restricted breathing □ Unable to deflate □ BCD air cylinder problem □ Unable to inflate □ Unable to inflate due to low air □ Provided inadequate buoyancy □ Confusion deflate/inflate buttons □ Buddy couldn't deflate vest □ Buddy couldn't inflate vest □ Leaked □ Incorrect size □ Other Specify :
Mask □ Flooding/dislodged caused panic □ Flooding/dislodged no panic □ Strap broke □ Unable to clear □ Clearing caused panic **Dive tables** □ Not used □ Misread □ Unable to understand	**Dive computer** □ Not used □ Inaccurate □ Stopped working □ Forgot to activate it □ Unable to read/layout confusing □ Battery problems **Fins** □ Strap broke □ Lost □ Caused cramp □ Incorrect size	**Depth gauge** □ Not used □ Inaccurate □ Unable to read □ Maxm depth indicator problem □ Confusion units used **Tank/cylinder** □ Out of test □ Faulty □ Changed buoyancy □ Not secured in backpack □ Size change between dives

Tank Configuration Used:

SINGLE TANK	TWIN TANKS	SLING TANKS OR STAGES
		Configuration and contents if known:
□ Yes □ **Configuration not known**	□ Independent back mounted □ Independent side mounted □ Manifolded (□ isolator problem) □ Not known	□ Yes □ No □ Not known □ One □ Two □ Not known

Report Prepared By:

_____ _____ _____

Signature Printed Name Date

APPENDIX 8
AAUS STATISTICS COLLECTION CRITERIA AND DEFINITIONS

COLLECTION CRITERIA:

The "Dive Time in Minutes", The Number of Dives Logged", and the "Number of Divers Logging Dives" will be collected for the following categories.

- Dive Classification
- Breathing Gas
- Diving Mode
- Decompression Planning and Calculation Method
- Depth Ranges
- Specialized Environments
- Incident Types

Dive Time in Minutes is defined as the surface-to-surface time including any safety or required decompression stops.

A Dive is defined as a descent underwater utilizing compressed gas and subsequent ascent/return to the surface with a minimum surface interval of 10 minutes.

Dives will not be differentiated as open water or confined water dives. But open water and confined water dives will be logged and submitted for AAUS statistics classified as either scientific or training/proficiency.

A "Diver Logging a Dive" is defined as a person who is diving under the auspices of your scientific diving organization. Dives logged by divers from another AAUS Organization will be reported with the diver's home organization. Only a diver who has actually logged a dive during the reporting period is counted under this category.

Incident(s) that occur during the collection cycle: Only incidents that occurred during, or resulting from, a dive where the diver is breathing a compressed gas will be submitted to AAUS.

DEFINITIONS:

Dive Classification:

- Scientific Dives: Dives that meet the scientific diving exemption as defined in 29 CFR 1910.402. Diving tasks traditionally associated with a specific scientific discipline are considered a scientific dive. Construction and trouble-shooting tasks traditionally associated with commercial diving are not considered a scientific dive.
- Training and Proficiency Dives: Dives performed as part of a scientific diver-training program, or dives performed in maintenance of a scientific diving certification/authorization.

Breathing Gas:

- Air: Dives where the bottom gas used for the dive is air.
- Nitrox: Dives where the bottom gas used for the dive is a combination of nitrogen and oxygen percentages different from those of air.

- Mixed Gas: Dives where the bottom gas used for the dive is a combination of oxygen, nitrogen, and helium (or other inert gas), or any other breathing gas combination not classified as air or nitrox.

Diving Mode:

- Open Circuit SCUBA: Dives where the breathing gas is inhaled from a self-contained underwater breathing apparatus and all of the exhaled gas leaves the breathing loop.
- Surface Supplied: Dives where the breathing gas is supplied from the surface by means of a pressurized umbilical hose. The umbilical generally consists of a gas supply hose, strength member, pneumofathometer hose, and communication line. The umbilical supplies a helmet or full-face mask. The diver may rely on the tender at the surface to monitor the divers' depth, time and diving profile.
- Hookah: While similar to Surface Supplied in that the breathing gas is supplied from the surface by means of a pressurized hose, the supply hose does not require a strength member, pneumofathometer hose, or communication line. Hookah equipment may be as simple as a long hose attached to a standard scuba cylinder supplying a standard scuba second stage. The diver is responsible for monitoring 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

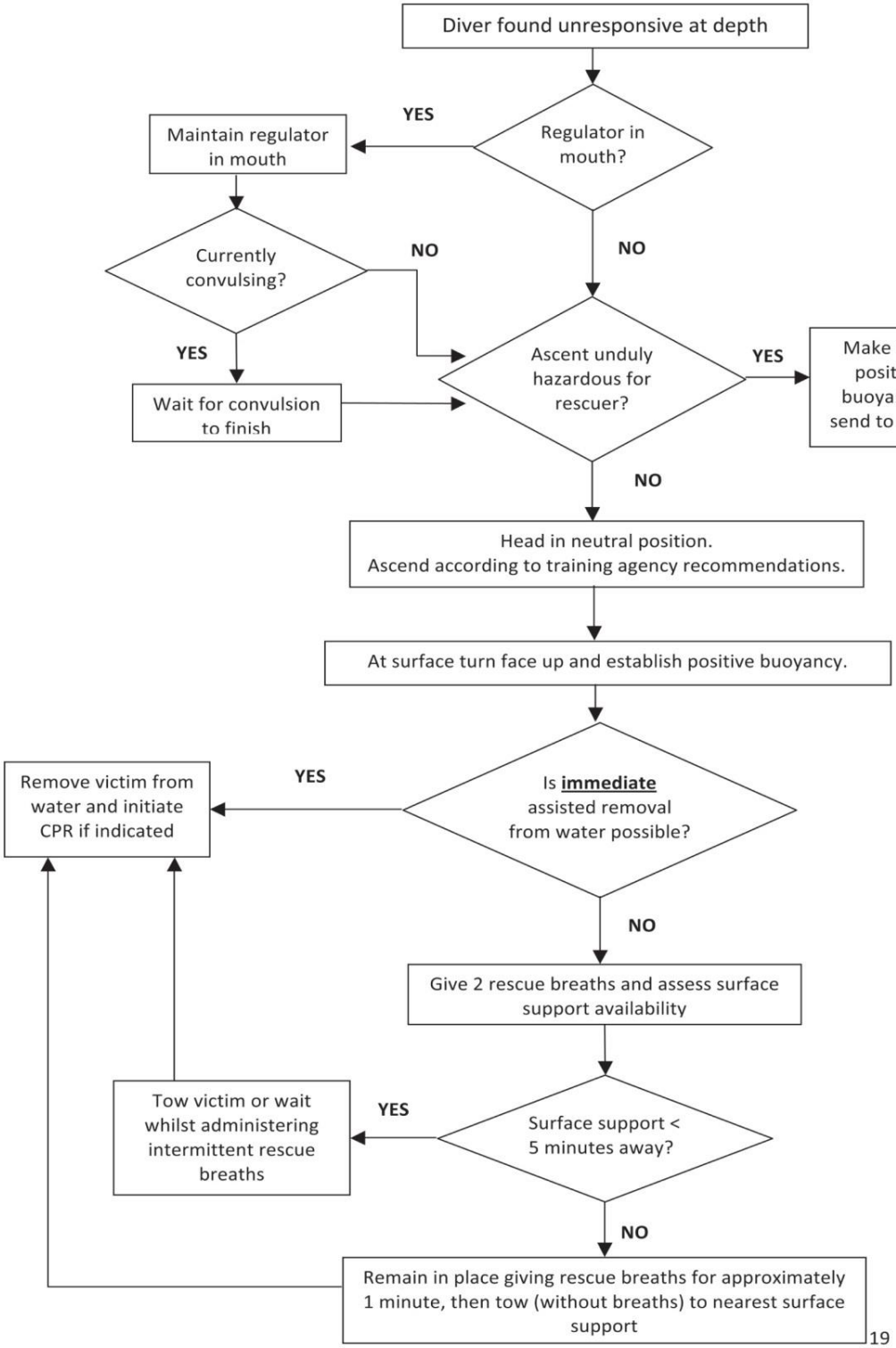
Incident Classification Rating Scale:

- Minor: Injuries that the LUMCON 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 LUMCON 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 9
RECOMMENDATIONS FOR RESCUE OF A SUBMERGED UNRESPONSIVE COMPRESSED-GAS DIVER

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



CONNECT | ENRICH | TRANSFORM

APPENDIX A APPLICATION TO THE LUMCON DIVING SAFETY PROGRAM

Name:	Date of Birth: / /	Sex: M F
College/Campus:	Department:	
Home ph./Cell: ( )	Office ph.: ( )	Email:
Are you currently scuba certified? Y N Certification organization? _____	Date of last dive physical? _____ Do you have DAN insurance? Y N Member # _____	

Diving Plans - Project, department and purpose with which you will be diving at LUMCON:

_____

_____

Home Address:

Street:_____ City:_____

Apt. No:_____ Zip:_____

Emergency Contact Information:

Name:_____ Relationship:_____

Street:_____ City:_____ State_____

Home Telephone: ( )_____-_____ Work Phone: ( )_____-_____

PI/Supervisor Endorsement (Required):

I understand the above named individual is applying to the LUMCON Diving Safety Program for the purpose of participating in diving operations. I attest that the applicant has a research or academic need to be diving as part of their employment or research requirements at _____. I endorse and support their application to the LUMCON Diving Safety Program.

_____ _____

Printed name *Institution and Dept.*

_____ _____

Signature *Date*

Previous Dive Training and Experience

DIVE TRAINING:

Level	Certifying Agency	Location	Total Hours Lecture/Pool/Water.			Date of Completion	Instructor name and # if known

OTHER RELATED TRAINING:

Date of Completion and Organization	
CPR	Water Safety Instructor
First Aid	Life Guard
EMT, DMT, or Paramedic	Swimming
Chamber Operator	CG Aux. Boating
Dive Accident Management	Oxygen First Aid

Brief description of other diving training (military, commercial, scientific, public safety): _____

_____

DIVE EXPERIENCE:

Total Number of Dives _____ Total Bottom Time _____

Maximum Depth _____ Date of Last Dive _____

Number of Dives (last year) _____ Maximum Depth (last year) _____

Indicate number of dives for each depth category and depth range that you have completed:							
Equipment	0-30’	31’-60	61’-100	101’-130	131’-150	151’-190	>190’
Scuba							
Decompression Scuba							
Mixed Gas							
Surface Supply							
Closed Circuit							
Lock-out or Bell							
Saturation							
Hard Hat							
Dry Suit							
Nitrox							

Indicate with appropriate letter your degree of experience diving in the following conditions:

E = Extensive (>20 times) L = Limited (1-4 times)
M =Moderate (5-20 times) _ = Leave blank if no experience

	Small Boat		Blue Water
	Ship		Cold Water (<45˚F)
	Beach		Turbid (<3' visibility)
	Rocky Shore		Fresh Water
	Heavy Surf		River
	Current (>1/2 knot		Ocean
	Ice		Mud/Silt Bottom
	Wreck		Kelp Forest
	Night		Coral Reef
	Altitude (>1000')		Vertical Wall
	Cave/Cavern		Blue Hole

List geographical areas that you have dived: _____

Have you experienced nitrogen narcosis? _____ If so, at what approximate depth? _____

Have you experienced any diving related injury? _____

Briefly describe each incident _____

_____

Have you ever been treated in a recompression chamber? _____ What depth? _____

Indicate date, place, and physician _____

✓	LUMCON AFFILIATION:	Supervisor	ph. # or Ext.
	LUMCON Faculty		
	LUMCON Employee (Postdoc, Technician, etc)		
	LUMCON Student/Intern		
	LUMCON Volunteer Diver		
	Consortium Member Faculty		
	Consortium Member Employee (Postdoc, Tech., etc)		
	Consortium Member Student		
	Volunteer		

STATEMENT

I wish to apply for entry into the LUMCON Diving Safety Program. I certify that the above information is correct. I agree to abide by the regulations of my parent institution, and all policies and standards of the LUMCON Diving Safety Committee and Diving Safety Manual and to adhere to their procedures concerning all diving activities conducted under LUMCON auspices.

_____ _____

Printed name *Date*

_____

Signature of participant or Signature of parent or guardian if under 18

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APPENDIX B
LUMCON SCIENTIFIC DIVER WAIVER OF LIABILITY

Initial

_____ I AM AWARE THAT SCUBA DIVING AND UNDERWATER RESEARCH ARE HAZARDOUS ACTIVITIES, AND I AM VOLUNTARILY PARTICIPATING IN THESE ACTIVITIES WITH KNOWLEDGE OF THE DANGER INVOLVED AND HEREBY AGREE TO ACCEPT ANY AND ALL RISKS OF INJURY OR DEATH.

_____ I FURTHER UNDERSTAND THAT BY SIGNING THIS DOCUMENT, I AM RELEASING ANY CLAIMS WHICH I MAY HAVE AGAINST MY INSTRUCTOR OR AGAINST LUMCON AS THE SPONSOR/PROMOTER OF THIS DIVING AND/OR UNDERWATER RESEARCH OPERATION, AND SUCH PERSONS ACTING AS LUMCON'S OFFICERS, EMPLOYEES, OR AGENTS FROM ANY LIABILITY FOR PERSONAL INJURY, PROPERTY DAMAGE AND/OR WRONGFUL DEATH ARISING FROM MY PARTICIPATION IN THE DIVING/UNDERWATER RESEARCH ACTIVITIES I WISH TO ENGAGE IN BETWEEN THE DATES OF _____ AND _____, INCLUSIVE.

_____ I HEREBY PERSONALLY ASSUME ALL RISKS IN CONNECTION WITH SAID DIVING AND UNDERWATER RESEARCH FOR ANY HARM, INJURY OR DAMAGE WHICH MAY BEFALL ME AS A RESULT OF MY PARTICIPATION IN THIS ACTIVITY WHETHER FORESEEN OR UNFORESEEN, I STILL WISH TO PROCEED WITH THE DIVING/UNDERWATER RESEARCH ACTIVITY IN SPITE OF THE POSSIBLE ABSENCE OF A RECOMPRESSION CHAMBER IN THE PROXIMITY OF THE DIVE SITE.

_____ I HAVE READ THIS FORM AND FULLY UNDERSTAND THAT DIVING/UNDERWATER RESEARCH ARE DANGEROUS ACTIVITIES AND THAT BY SIGNING THIS FORM, I AM GIVING UP LEGAL RIGHTS THAT I HAVE.

_____	_____	_____
Participant Name	*Participant Signature*	*Date*
_____	_____	_____
Witness Name	*Witness Signature*	*Date*

CONNECT | ENRICH | TRANSFORM

APPENDIX C
LUMCON NON-EMPLOYEE WAIVER OF LIABILITY

I, _____, am voluntarily and willingly participating in Science Diving activities under the authority of the Louisiana Universities Marine Consortium Diving Safety Office. I fully acknowledge that SCUBA diving is inherently dangerous and can result in injury or death. I am aware that as a volunteer/non-LUMCON employee I am not eligible for Workman's Compensation or other work related benefits from the Louisiana Universities Marine Consortium in the event of a diving accident. Furthermore, I assume all financial and other obligations in the event of any injuries resulting from participation in these diving activities.

_____	_____	_____
Participant Name	*Participant Signature*	*Date*
_____	_____	_____
Witness Name	*Witness Signature*	*Date*

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APPENDIX D
INDEMNIFICATION AND STATE OF RESPONSIBILITY OF MEMBER UNIVERSITY

In consideration of the Louisiana Universities Marine Consortium (LUMCON) providing the scientific diver named below with the opportunity to engage in scientific diving activities through training and administration of written exams, verification of SCUBA training and skills, verification of emergency safety training, and verification of swimming skills,

The_____,
Parent organization

_____,
Department

(The Organization) agrees to indemnify and hold harmless LUMCON, its officers, employees, and agents, from all claims, demands and actions, including but not limited to costs, expenses and legal fees incurred in defending any such claims, demands, or actions, for damage to personal property, personal injury or death arising by reason of the negligent or other acts or omissions of the Organization or the Organization's scientific diver.

The Organization also agrees to assume full responsibility and liability for compliance with the requirements set forth above.

_____ _____
Scientific Diver *Date*

_____ _____
Department Chairperson *Date*
or Designated University Representative

IMPORTANT: The non-employee scientific diver and department chair (or designated university representative) must complete, sign and submit this form as indicated above PRIOR to conducting any diving activity.

Return to:

LUMCON Diving Safety Officer
8124 Highway 56
Chauvin, LA 70344
ph: (985)851-2871; Fax: (985) 851-2874
dso@lumcon.edu

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APPENDIX E
COMMERCIAL DIVING OPERATIONS

I _____ certify
Print Name

That I am a qualified and current commercial diver (commercial diving card attached), that my diving safety guidelines meet the necessary OSHA requirements, and that I have provided proof of current diver insurance.

I am voluntarily and willingly participating in Commercial Diving activities associated with LUMCON research programs. I fully acknowledge that commercial diving is inherently dangerous and can result in injury or death. I am aware that as a non-LUMCON employee I am not eligible for
Workman's Compensation or other work related benefits from the Louisiana Universities Marine Consortium in the event of a diving accident. Furthermore, I assume all financial and other obligations in the event of any injuries resulting from participation in these diving activities.

_____	_____	_____
Participant Name	*Participant Signature*	*Date*

_____	_____	_____
Witness Name	*Witness Signature*	*Date*

LUMCON Diving Safety Officer
8124 Highway 56
Chauvin, LA 70344
ph: (985)851-2871; Fax: (985) 851-2874
dso@lumcon.edu

APPENDIX F
MEDICAL INFORMATION RELEASE

I, _____, hereby grant the Louisiana Universities Marine Consortium, the Diving Control Board, and Diving Safety Officer permission to release any and all medical information to an attending physician or emergency services personnel in the event of a dive related accident.

_____ _____

Participant Name *Date*

_____

Participant Signature

CONNECT | ENRICH | TRANSFORM

APPENDIX G LUMCON SCIENTIFIC DIVER TRAINING CHECKSHEET

Name of Applicant:			Start Date:
Date		Pool	
	Application to Diving Program		Swim Test
	Liability Waiver		Swim Strokes
	Statement of Gear Understanding		Snorkel Skills
	Diving Physical		Self-rescue
	CPR/First-Aid		Tows and Assists
	DAN O2 Oxygen First-Aid		Rescue Skills
	Gear Inspections		Carry's and Water Removals
	Date of Scuba Certification		Basic Scuba Skills
Academic Topics			Diver Assists and Tows
	History of Scientific Diving		Rescue Skills
	Diving Safety		Knot Tying
	Rescue Diving		Gear Clip-on
	HazMat Diving		Lift Bag Usage
	Hazardous Materials		Wreck and finger Reel Usage
	Test Score:		Transect/quadrats
	LUMCON Diving and Boating Manual		Underwater Construction
	Dive Hand Signals		Zero Visibility Swim
	Test Score:		Full face masks and communications
	Scientific Diving Methodology		Technical gear assembly and use
	General Decompression Rules		
	Dive Tables	O/W Rescue Evaluation/Checkout Dive	
	Dive Computers		Compass Usage
	Test Score:		Search and Recovery
	Diving Physiology		Rescue Unconscious Diver
	Diving Accident Management		Strip Gear
	First-aid for Diving Injuries		Assess
	Hazardous Aquatic Animals		Activate EMS
	Test Score:		CPR/First Aid
	Dive Physics		O2 First-Aid
	Equipment		
	Diving from Boats		Checkout Dive
	Test Score:		
Cumulative Exam Score			Completion Date
	Score:		Scientific Diving Certificate Issued

Training Dive	2	3	4	5	6	7	8	9	10	11	12
Date											

Diving Safety Officer _____ Date _____

CONNECT | ENRICH | TRANSFORM

APPENDIX H
LOUISIANA UNIVERSITIES MARINE CONSORTIUM DIVE PLAN

FOR LUMCON USE ONLY

Date Submitted: _____

Grant/ Project#: _____

DIVE PLAN SUBMITTAL FORM **DSO Signature _____**

Proposed Expedition Dates: _____ through _____

General Dive Site Location: _____

Dive Plan Submitted By: _____

Principal Investigator: _____ Lead Diver: _____

Is this Dive Plan in Support of a Grant: _____ Grant No.: _____

Proposed No. of Dives: _____ Proposed No. of Divers: _____
(Profile each dive if different) (List each diver on info. Sheet)

Will this Plan Involve? :

- ☐ Boats or larger vessels
- ☐ Multiple days of diving
- ☐ Decompression diving
- ☐ Specialty diving
- ☐ Flying after diving
- ☐ International travel
- ☐ Non-LUMCON personnel

General Dive Plan Considerations

- Any diver has the right to refuse to dive without fear of penalty if s/he feels the conditions are unsafe or unfavorable **OR** the dive violates the precepts of their training **OR** the regulations of the LUMCON Diving Safety Program.
- It is the responsibility of each diver to terminate the dive, without fear of penalty, whenever s/he feels it is unsafe to continue the dive, unless it compromises the safety of another diver already in the water.
- All Dive plans **MUST** be based on the competency of the least experienced diver.
- All Divers-in-training must be buddied with a Scientific Diver.
- Absolutely No Solo Diving is allowed.
- Depth certification levels may be extended only to the next deepest certification level and only if the diver with the limiting depth certification level is buddied with a diver certified to the deeper depth level.
- For all diving conducted under hazardous conditions a plan must be formulated to deal with such conditions.
- A Dive Profile **MUST** be completed for each proposed dive (copy forms as needed).
- If dives are to be conducted from vessels, a Float Plan must also be completed.

An Emergency Plan **MUST** be completed for each expedition including the following: emergency contact information (including name, relation and telephone number) for each diver, nearest recompression chamber, nearest accessible hospital and anticipated means of transportation.

DIVE PLAN

Diving Roster

	Name	Level	Depth Certification
1.		Lead Diver-Scientific Diver	fsw
2.			fsw
3.			fsw
4.			fsw
5.			fsw
6.			fsw
7.			fsw
8.			fsw
9.			fsw
10.			fsw

Any Non-LUMCON Personnel: _____
(Include parent organization or auspices)

_____

Purpose of Dives:_____

_____

Operational Plan

Maximum Depth: _____Ft **Number of dives/diver/day: _____/_____/_____**

Dive Tables and/or dive computers to be used: _____

Decompression schedules and repetitive dive plans: _____
(Use dive profile worksheet for detailed plan)

_____

Diving work plans: _____
(Attach detailed explanation if necessary)

_____

Specialty dives if planned: _____
(See DBSM Section 11.00)

_____

Nitrox, or mixed gases: _____
(Include percentages)

_____

Tools or Specialized Equipment Used: _____

(Diving sleds, scooters, drills, surface supply, hookah, tethers, etc.)

_____

Dive Site

Name of Boat or Vessel:_____ **Reg. #:** _____

☐ LUMCON ☐ Charter ☐ Personnel ☐ Other

Beach or Other Site: _____

Safety Considerations

Any Hazardous Conditions Anticipated: _____
(ie: Cold water, night diving, extreme currents, extreme depths)

_____

Safety Precautions: (i.e.: Chase vessel, dry suits) _____

☐ First-Aid Kit
☐ Emergency Oxygen Resuscitator _____
☐ Dive flag

_____

International Travel

Contacts in country: _____
(Include name and phone number)

U. S. Consulate or Embassy: _____
(Include phone, fax, and address)

For International Travel: Attach a copy of all itineraries including flight times and accommodations with contact information which will be utilized.

DIVE PROFILE WORKSHEET

Date: _____ **Location**: _____ **Dive No.:** _____

Note: Use one sheet per dive profile.

Lead Diver _____

Buddy Team 1:_____&_____
Buddy Team 2:_____&_____
Buddy Team 3:_____&_____
Buddy Team 4:_____&_____
Buddy Team 5:_____& _____

Weather:_____
Seas:_____
Current:_____
Visibility:_____
Temperature:_____
Substrate: _____

SI=____ RG ____ RG_____

_____ _____

| _____| Safety stop

Depth_____ | _____min

No-D_____| |

Gas used: Limit | Time in: _____

☐ Air

RNT=_____ Time out: _____

☐ Nitro _____ % O2 BT= _____

TBT/EBT=_____

Safety Dive Profile Planning

Use this table to plan contingency depths and times in the event planned depth or planned time profiles are exceeded.

PLANNED DEPTH (PD)		NO – D LIMIT	PT + 5MIN	NEW NDL	DECOMPRESSION TIME(S) 30’	20’	10’
PD + 10 ft.							
PD + 20 ft.							

Additional Comments:

_____

_____

_____

_____

**** USE ADDITIONAL SHEETS AS NEEDED *****

DIVING ACCIDENT EMERGENCY MANAGEMENT PLAN

A diving accident victim is any person who has been breathing air underwater regardless of depth. It is essential that emergency procedures are pre-planned and that medical treatment is initiated as soon as possible. It is the responsibility of the expedition's Dive master to develop procedures for such emergencies including evacuation and medical treatment for each dive location.

General Procedures:
Depending on and according to the nature of the diving accident, stabilize the patient, administer 100% oxygen, and initiate the local Emergency Medical System (EMS) for transport to nearest medical facility. Explain the circumstances of the dive incident to the evacuation team, 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. If time allows, complete some or of the CALL-IN DATA SHEET.

1. **Rescue victim and/or position so the proper procedures may be initiated.**
2. **Establish (A)irway, (B)reathing and (C)irculation as required.**
3. **Administer 100% oxygen, if appropriate (in cases of Decompression Illness or Near Drowning).**
4. **Activate the local EMS for transport to the nearest appropriate medical facility. (the local EMS will vary from site to site – it must be stated in dive plan)**
5. **Contact the Diver's Alert Network as deemed necessary.**
6. **Contact Diving Safety Officer (DSO) and Emergency Contact Person, as deemed necessary.**
7. **Complete and submit Incident Report Form (in manual) to DSO.**

Expedition Emergency Contact Numbers:

- United States Coast Guard – Channel 16 on Marine VHF Radio
- Local EMS telephone number - _____

(Appendix 7)

Nearest Medical Treatment Facility to Dive Site:

- Location: _____
- Telephone: _____

(Appendix 7)

Nearest Recompression Facility to Dive Site:

- Location: _____
- Telephone: _____

(Appendix 7)

Diver's Alert Network (DAN):

- **EMERGENCY 1-919-684-9111** or 1-800-446-2671

24 hour medical advice–if necessary call collect and state "I have a Medical Emergency"– Use to locate closest recompression chamber or physician consultations.

EMERGENCY CONTACT INFORMATION FOR EACH DIVER

Diver: _____

Emergency Contact:_____Relation: _____

Work Telephone:_____Home Telephone: _____

Street Address: _____

City:_____State:_____Zip: _____

Diver: _____

Emergency Contact:_____Relation: _____

Work Telephone:_____Home Telephone: _____

Street Address: _____

City:_____State:_____Zip: _____

Diver: _____

Emergency Contact:_____Relation: _____

Work Telephone:_____Home Telephone: _____

Street Address: _____

City:_____State:_____Zip: _____

Diver: _____

Emergency Contact:_____Relation: _____

Work Telephone:_____Home Telephone: _____

Street Address: _____

City:_____State:_____Zip: _____

***** USE ADDITIONAL SHEETS AS NEEDED *****

DIVE PLAN APPROVAL

I certify that this dive plan has been completed in compliance with the LUMCON Diving Safety Subcommittee policies and procedures as promulgated in the current LUMCON Diving Safety Manual, as well as 29 CFR 1910.401. I further certify that all information provided in this plan is true and correct to the best of my knowledge.

All completed dive plans should be returned to the LUMCON Diving Safety Officer, or designee within one week following completion of the planned dives(s).

Principle Investigator: _____
(Print Name)

_____ _____
(Signature) (Date)

Dive Team Leader: _____
(Print Name)

_____ _____
(Signature) (Date)

For LUMCON Use Only

Approved: ☐ Yes ☐ No

Dive Plan reviewed by: _____ _____
(Print name) (Title)

Reviewer: _____ _____
(Signature) (Date)

APPENDIX I MONTHLY DIVE LOG

LUMCON
DIVING SAFETY PROGRAM

NAME: (Last, First, Middle Initial)	DATE: (mm/yy)	
SIGNATURE:	CERT. (Note 1)	CERT. DEPTH

INSTRUCTIONS:

1. Submit this report to the DSO, LUMCON, 8124 Highway 56 Rm 226, Chavin LA 70344 by the fifth day of each month.
2. Use a separate dive log for each month.
3. Use a separate line for each dive. Print all information legibly.
4. Log repetitive dives using the date, a decimal point, and consecutive numbers (i.e., three dives conducted on the 15th would be listed 15.1, 15.2, 15.3).
5. Use notes provided below to code information on the form.
6. One dive to your certified depth is required every 6 months.
7. A minimum of 12 logged dives are required for any 12-month period.
8. If more dives are completed then this form will allow, please use another form.
9. A detailed report of any near or actual incidents must be submitted immediately to the DSO.

NOTES:

1. CERTIFICATION: 1 – Scientific Diver; 2 – Diver-In-Training; 3 – Temp. Diver
2. DIVING MODES: 1 – Standard; 2 – Saturation; 3 – Staged deco; 4 – Blue Water; 5 – Ice/polar; 6 – Restricted overhead; 7 – Hookah; 8 – Surface supplied; 9 – Rebreather; 10 – Snorkel/skin diving; 11 – Night
3. PURPOSE OF DIVE: 1 – Data/sample collection; 2 – Observation/ Monitoring; 3 – Installation/ construction; 4 – Search/recovery; 5 – Sport/Rec; 6 - Training
4. PLATFORM: 1 – Small boat; 2 – Shore; 3 – Ship; 4 – Pier/dock; 5 – Habitat; 6 – Chamber; 7 – Pool/tank
5. AUSPICES: 1 – LUMCON; 2 – FIO; 3-Other (specify)
6. BREATHING GAS: 1 – Air; 2 – Nitrox (indicate O_2%); 3 – Trimix (indicate O_2%); 4 – Heliox (indicate O_2%); 5 – Oxygen
7. TABLES USED 1 – Navy; 2 – PADI; 3 – NAUI; 4 – Computer/Other (specify)
8. LOCATION:
   KML – Keys Marine Lab
   C6B – Station C6B
   CMRC – Caribbean Marine Research Center
   KEY – Florida Keys
   C6C – Station C6C
   C9
   VTS – Vortex Springs
   GSR – Greys Reef
   ST52
   EGB
   FGS – Flower Gardens NMS
   PLM – Palm Beach/West Palm
   BHM – Bahamas
   PR – Puerto Rico
   USVI – United States Virgin Islands
   BVI – British Virgin Islands
   DOM – Dominican Republic
   OTH – Other (indicate location)

DAY	TIME OF DIVE	DIVE MODE (Note 2)	PURPOSE OF DIVE (Note 3)	DIVE PLATFORM (Note 4)	AUSPICES (Note 5)	BREATHING GAS (Note 6)	TABLES (Note 7)	SURFACE INTERVAL (Minutes)	MAX. DEPTH (Feet)	BOTTOM TIME (Minutes)	DECO/ SAFETY TIME (Minutes)	DIVE LOCATION (Note 8)	U/W VISIBILITY (Feet)	WATER TEMP (Degrees F)	CURRENT SPEED (Knots)	LEAD DIVER / DIVE BUDDY