PSDiver

CONSENSUS STANDARDS

FOR

PUBLIC SAFETY DIVING IN ZERO OR LOW VISIBILITY

June 12, 2021

Preface

Over the years we have witnessed a growth in what we term Public Safety Diving. As we have grown, more and more formal training programs have become available from various training agencies. In this same time, some teams and instructors have developed their own training programs. Yet, in all of this time, there has never been guidance as to what should incur before calling oneself and working as a Public Safety Diver.

These consensus standards were written by public safety divers for public safety divers and represent what we believe is a solid base for the formation of a public safety dive team and the path necessary to become a public safety diver. The divers who have helped draft these standards come from a range of dive organizations and have worked to present a consensus standard that is effective and will provide for greater safety in public safety diving.

Public Comment – These consensus standards are to be a living document. You may submit comments and / or suggestions at any time for consideration to: **Standards@PSDiver.com .**

Updates – Updates will occur as necessary to improve the consensus standard and may not be acted upon until the consensus standard is updated or revised.

Additional Copies of the Consensus Standard for Public Safety Diving may be downloaded at **www.PSDiver.com.**

ACKNOWLEDGEMENTS

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Participants:
Mark Phillips, Tim Andro, Gene Battaglia, David Bebout, Ron Becker PhD, Dr. Benjamin Brackett, Wayne Brusate, Buck Buchanan, Eric Crawford, Kasey Davis, Chuck Elgin, Lt Blake Faumuina, Mark Feulner, PhD, Matt Foro, Kerry Foster, Patrico Galaz – Chile, Joshua Gibbs, Phillip Graf, Jim Gunderson, Sean Hidalgo, Robert Kinder, Boy Kleijn – Nederlands, Tom Maddox, Greg Mactye, Dan Marelli, PhD, Wendell Nope, Lt Todd Rishling, Steve Trenish, Mary White, Greg Jolly, Butch Hendrick, Ronny Phillips, Randy Malm, David Concannon

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Available at: www.PSDiver.com

This document was created for Public Safety Dive teams and divers. In the discipline of public safety diving, clear and clean water conditions can be rare. Best practice should dictate the use or variation of these standards, as some requirements listed in this document may not be necessary in clear or clean water.

Whether operations are undertaken in zero, low or limited visibility (10 foot/ 3 meters or less) or clear water; the ability to protect and potentially rescue our own divers is the highest priority.

Dive operations, missions or training that occur in environments that could change to low or zero visibility should be treated as such from the initial planning stage.

This document also establishes a framework for reciprocity between PSDTC member agencies that adhere to these minimum standards.

This document is NOT to be used as a substitute for proper training or as a stand-alone text for training.

Table of Contents

CONSENSUS STANDARDS FOR PUBLIC SAFETY DIVING IN LOW OR ZERO VISIBILITY

Minimum Requirements for Public Safety Diver

Section 1.00 GENERAL POLICY

1.05 Safe Practices:

A. General

1. Public Safety Dive Teams shall develop and maintain their own safe practices manual - **S**tandard Operational Procedures (SOP) or Standard Operational Guidelines (SOG).

2. The SOP/SOG shall be made available to each dive team member and be present at the dive location.

3. The Guidelines or Standard Operational Procedures manual should be available when requested by the Agency Having Jurisdiction (AHJ) or the Incident Command (IC).

4. The Guidelines or Standard Operational Procedures manual should be reviewed and updated annually.

B. Contents

1. The team safe practices manual shall contain a copy of this standard and the employer's or governing authorities' policies for implementing the requirements of this standard.

2. For each diving mode engaged in, the safe practices manual shall include:

a) Safety procedures and checklists for all diving

b) Assignments and responsibilities of each of the dive team members

c) Equipment procedures and checklists

d) Decontamination procedures; and

e) Emergency procedures for fire, equipment failure, adverse environmental conditions, medical illness and injury

1.10 Public Safety Diving Standards Purpose:

The purpose of these Public Safety Diving Consensus Standards is to ensure Public Safety Diving is conducted in a manner that will maximize protection of public safety divers from accidental injury, illness, and or death and to set forth standards for training and certification that will allow a working understanding between public safety dive teams trained by different training agencies.

This document sets minimum standards for the establishment of the PSDiver Training Council (PSDTC) recognized Public Safety Diving programs, the organization for the conduct of these programs, and the basic regulations and procedures for safety in Public Safety Diving. It also establishes a framework for reciprocity between PSDTC member Training Agencies that adhere to these minimum standards.

1.20 Public Safety Diving Definition:

"Public safety diving is the underwater work conducted by law enforcement, fire rescue, joint jurisdictional or independent and volunteer search and rescue/recovery dive teams. Public safety divers differ from recreational, scientific, and commercial divers who can generally plan the date, time, location of a dive, and dive only if the conditions are conducive to the task. Public safety divers respond to emergencies 24 hours a day, 7 days a week, and may be required to dive in the middle of the night, during inclement weather, in zero visibility - "black water", or in waters contaminated with chemicals and/or biohazards. The Public Safety Dive Team is a group of divers who perform underwater functions which includes rescue and search and recovery for evidence and/or human remains.

1.21 Scope and Application:

A. This document applies to diving and related support operations conducted in connection with all aspects of public safety diving, including training, rescue, and recovery.

B. When working or training outside of the precepts of this document, the OSHA Directives 29 CFR Part 1910, Subpart T - Commercial Diving Operations will be followed.

OSHA considers Public Safety Diving to be commercial diving. To be exempt from OSHA, you must first be covered by OSHA. Public Safety Divers in a State with an OSHA approved workplace safety standard, a State Plan State or a state with a state commercial regulation ARE covered by OSHA. Volunteers and divers working with no employee / employer relationship are NOT covered by OSHA. The Act does not cover **Employees of state and local governments, unless they are in one of the states operating an OSHA-approved state plan.**

NOTE: OSHA'S Public Safety Diving Exemption

The OSHA – exemption - ONLY allows for a deviation from standard safe practices under certain conditions and is TEMPORARY and applied per diving event. Additional information can be found here: http://psdiver.com/images/112-_PSDiverMonthly.pdf

C. PSD teams shall, at a minimum, assure compliance with this document, certify the depths and conditions to which a diver has been trained and work to improve safe diving practices.

Section 2.00 ASSIGNMENTS

2.05 Assignments:

Each active dive team member should be assigned tasks in accordance with their experience and training. Limited tasks may be assigned by the Dive Supervisor to Diver in Training (DIT) team members provided they have the knowledge and ability to perform the task without direct supervision.

A. Primary Diver (PD)

The Primary Diver (PD) must be a qualified diver able and capable of performing underwater activities relating to the dive mission at the expected depth and conditions.

B. Backup Diver (BuD)

The Backup Diver (**BuD)** should be fully dressed, ready to assist the Primary Diver and must be a qualified diver able and capable of performing underwater activities relating to the dive mission at the expected depth and conditions.

C. Safety Diver (90% Diver)

The Safety (90%) Diver should be 90% dressed and have their equipment at hand. The 90% Diver must be a qualified diver able and capable of performing underwater activities relating to the dive mission at the expected depth and conditions.

D. Dive Tender (Tender)

The Dive Tender will be the surface support person responsible for handling a single diver's tether and for maintaining communications with the Primary Diver through either voice communications or line signals.

E. Diving Safety Officer / Dive Team Leader (DSO)

a. The Diving Safety Officer (DSO) serves as a member of the AHJ and public safety dive team.

b. The DSO **must** be an appropriately qualified diver with a full understanding of public safety dive team operations.

c. The DSO should hold professional ratings from an internationally recognized SCUBA training agency and a minimum of 2 years of active public safety diver status.

1. Qualifications

a. Shall be appointed by the responsible Agency Having Jurisdiction (AHJ) officer or designee

b. The DOS shall be trained as a Public Safety Diver (PSD) with a full understanding of dive team operations.

c. Should be an active and insured scuba instructor from an internationally recognized certifying agency

2. **Duties and Responsibilities**

a. The DSO is responsible for management of the public safety diving program including training and dive missions.

b. The routine operational authority for public safety dive team, including the conduct of training and certification, approval of dive plans, maintenance of diving records, and ensuring compliance with this standard.

c. All relevant interpretations of the regulations of the membership organization rests with the DSO.

d. Shall suspend diving operations considered to be unsafe or unwise.

e. May permit portions of this program to be carried out by a qualified delegate, although the DSO may not delegate responsibility for the safe conduct of the public safety dive team program.

f. Shall be guided in the performance of the required duties by the AHJ, but operational responsibility for the conduct of the public safety diving program will be retained by the DSO.

F. Dive Supervisor (DS)

a. The Dive Supervisor (DS) will be appointed or designated by the DSO. If the DSO is unable to make the appointment, the AHJ will designate the Dive Supervisor.

b. The Dive Supervisor should be a trained Public Safety Diver (PSD) and have the experience to conduct a training or mission dive.

c. The role of DS will include all the responsibilities of the DSO unless the DSO is on site and has designated a DS.

d. The DS must have the ability to direct, instruct and train other personnel in diving procedures as well as equipment use and equipment maintenance.

e. The DS should have the ability to complete appropriate documentation, logs, inventory and reports.

f. The DS is responsible for the dive mission at hand. The position is not necessarily a permanent position rather a function of an individual dive mission. When circumstances allow it, the DS can function as the Line Tender or depending on circumstances and safety measures in place, allow the Safety Diver to line tend the Primary Diver.

g. The DS has the responsibility for the divers, the dive mission and all associated functions.

h. The DS has the dive / no dive authority.

i. The DS will either be or will answer to the Incident Commander (IC).

Section 3.00 PUBLIC SAFETY DIVER / TENDER

3.05 Authorization and Requirements:

This section describes the training and performance standards for public safety divers, representing the minimum required level of knowledge and skills. Presented in a generalized format, individual public safety diving programs are encouraged to expand upon and augment these requirements; and develop or utilize appropriate educational materials, optimize instructional programs to suit and reflect their specific needs.

3.10 Public Safety Diver Authorizations:

A. Diver-in-Training (DIT) Authorization

This is an authorization to dive, usable only while the authorization is current and for the purpose intended. This authorization signifies that a diver has completed and been certified as a minimum, an Open Water SCUBA Diver through an internationally recognized SCUBA training agency and has the knowledge, skills and experience necessary to commence and continue training as a public safety diver under supervision, as approved by the Dive Safety Officer (DSO). DIT status must only be used when the diver is in the process of becoming certified as an active public safety diver. While it is recommended for DIT's to have hands-on public safety diving experience during their training, the DIT status is intended to be a temporary authorization, not a substitute for Public Safety Diver qualification. DIT status divers may only participate in public safety dive training under the direct supervision of a DS or DSO and are not considered to be active public safety dive team divers.

A DIT may, with the approval of the DSO train to a 30 foot depth authorization and those dives and time may be applied to the required prerequisite training hours. However, a DIT is not to exceed a 30 foot depth authorization when training in zero or low visibility.

B. Public Safety Diver (PSD) Qualification

Signifies a diver has completed all requirements in Section 3.0 and is qualified or authorized to actively engage in Public Safety Diving. To be certified, the applicant must demonstrate that they are sufficiently skilled, proficient and possesses the necessary judgement for their safety and/or that of the public safety dive team. Public Safety Diver (PSD) qualification is only active when required authorizations are in place and current.

3.20 PUBLIC SAFETY DIVER REQUIREMENTS:

3.21 Diver in Training (DIT) Prerequisites:

To be classified as an Entry Level or Diver in Training (DIT), individuals must meet the following **MINIMUM** criteria:

- **A.** Be certified as an Open Water SCUBA Diver through an internationally recognized SCUBA training agency.
- **B.** Be currently certified as a provider of CPR with AED, First Aid and Emergency Oxygen Administration from a recognized training agency; American Heart Association, American Red Cross, Divers Alert Network etc.
- **C.** Documented Hazmat Awareness Level Training.

D. Documented completion of the National Incident Management System (NIM) Incident Command System (ICS) 100, 200, 700 and 800 level training.

E. Complete the swimming/watermanship evaluations as described in Section 3.30

F. Must have a medical evaluation and approval to dive from a medical professional. (Section 3.40, Appendices 1.5 and Appendix 1.6)

3.22 Active Public Safety Diver Prerequisites:

To be classified as an active PSD, individuals must meet the following **MINIMUM** criteria:

A. Must meet and have completed DIT prerequisites.

B. Accumulate –after SCUBA certification – a combined minimum of 100 hours of formal and on the job PSD training (Annex 5).

C. Once OW certified, have logged a minimum of 12 supervised **public safety dive team open water training dives**. These training dives may count towards required accumulated hours subject to DSO approval.

D. Pool dive training may count towards required accumulated hours but will not count towards supervised public safety dive team open water training dives.

E. Log a minimum of 2 hours in zero or low visibility water while training, working with and supervised by a PSD Team.

F. Line Tender training as approved by the DSO (Section 3.95).

G. ALL divers and additional team members should know how to calculate and document surface air consumption (SAC) rates and calculate air consumption at various depths. (Annex, 5).

3.23 Additional Training by Internationally Recognized Training Agencies:

Recreational SCUBA certifications may apply to the required DIT hours and required team public safety dives. However, no more than 3 total dives may count towards the required 12 and will NOT be credited toward the 2 hours in zero vis requirement. No more than 12 total recreational diving hours should be credited.

As approved by the DSO, credited training hours and experience can include:

A. Recreational Advanced Diver or equivalent
- **a.** 1 Hours 1 Dive

B. Recreational Search and Recovery
- **a.** 1 Hour 1 Dive

C. Recreational Night Dive
- **a.** 1 Hour 1 Dive

D. Recreational Navigation / Compass Use
- **a.** 1 Hour 1 Dive

E. Recreational Rescue Diver or equivalent.
- **a.** 3 Hours 1 Dive

F. Recreational Full Face Mask (FFM) Diver
- **a.** 3 Hours

G. Recreational Dry Suit Diver
- **a.** 3 Hours 1 Dive

H. PSD/Emergency Response
- **a.** 36 hours/5 dives

Additional Public Safety diving specific programs to be credited based on the program at the discretion of the DSO.

Note: - For future contract negotiations or employment agreements CONSIDER adding the following: Any diver acting on behalf of a municipality, state, government or for the purpose of executing the duties of said government: In the event of accident, injury or death of said diver shall be treated as a line of duty incident and be given all benefits afforded a full-time vested employee of said department, agency or government.

3.30 Swimming / Watermanship Evaluation (Conducted Annually):

The candidate should 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. Eight hundred (800) meters mask, snorkel, and fins distance swim, non-stop. Use of arms is not permitted. The recommended completion time is 16 minutes or less.

B. Five hundred (500) meters distance swim nonstop, without the use of swim aids. Swim goggles may be allowed. The recommended completion time is 16 minutes or less.

C. One hundred (100) meter buddy tow in full SCUBA gear for both the participant and the candidate. The recommended completion time is 4 minutes or less.

D. Survival Float, without aids (to include no exposure protection), for fifteen (15) minutes. During the last two (2) minutes the candidates will keep their hands above the waterline.

3.40 Medical Examination:

A. The candidate must have a medical evaluation and approval to dive from a medical professional. (Section 3.40, Appendices 1.5 and Appendix 1.6) Medical standards requirements may not be waived.

B. Appendices 1.5 and Appendix 1.6 of this document. Medical standards requirements may not be waived.

3.50 Training:

The candidate should successfully complete prerequisites, theoretical aspects, practical training, and relevant examinations for a minimum cumulative time of 100 hours **and** a minimum of 12 supervised open water public safety training dives over a defined period not to exceed 18 months. The candidate should successfully complete 2 hours of logged time in zero / low visibility and may be included within the 12 required dives.

Theoretical aspects must include principles and activities appropriate to the intended response

area. Formats for meeting the 100-hour training requirement include formal training courses or a combination of formalized and on the job training as approved by the DSO.

3.60 Experienced Public Safety Divers:

When a diver's resume provides clear evidence of significant public safety diving experience, the diver can be given credit for meeting portions of the 100-hour course requirements. The DSO will identify any specific overlap between on-the-job training, previous public safety diving training / experience, course requirements and then determine how potential deficiencies will be resolved. Applicants cannot - test-out -, regardless of experience, when they have no previous experience in public safety diving. Documentation of appropriate prior public safety diving training **is** required in order for the DSO to consider the prior experience.

Any candidate who does not / cannot demonstrate to the DSO that they possess the necessary basic open water skills, knowledge, skills and abilities and / or the judgment, under stressful diving conditions, for their own safety and or the public safety dive team, may be denied mission diving privileges.

Any remediation deemed necessary will be conducted within the guidelines of this document and the diver will be designated as a **D**iver **i**n **T**raining (**DIT**) until they meet the necessary requirements.

3.70 Maintaining Active Diving Status:

The DSO should conduct an annual review of skills and knowledge. Divers unable to complete annual testing should be given time to remediate and improve their skills but until that time, used for surface support only.

Minimum Activity to Maintain Authorizations

During any 12-month period, each public safety diver should log a minimum of 12 public safety dives, PSD training or proficiency dives utilizing team gear (if available) and personal protective equipment (PPE). At least one dive should be logged near their maximum certified depth, as defined by this document. And at least 3 dives should be in zero or simulated zero visibility conditions. If a public safety dive team expects to operate in water colder than 75 degrees F, at least two dives should be logged using thermal protection.

For ANY diving conducted beyond 60 feet, 29 CFR Part 1910, Subpart T - Commercial Diving Operations SHALL be used.

3.80 Depth Authorizations:

Public Safety Diving is generally conducted in relatively shallow (less than 33feet) waters. However, there are teams that operate in deeper depths where exceeding no decompression limits is possible. As a general rule, Public Safety Diving should be conducted within the no decompression limits. It is recommended that Public Safety Dive teams train under the conditions they dive in and use the following depth limitations and ratings.

3.85 Depth Ratings and Progression to Next Depth Level:

Depth rating indicates the maximum depth in which a public safety diver should work or may supervise other divers holding an equal or lesser depth authorization. A public safety diver should possess a valid depth authorization to be considered active.

3.90 Depth Authorization – Zero / Low Visibility:

Depth authorization is intended for zero or low visibility only. Depth authorizations will increase with approved training and require cumulative minimum number of dives before moving to the next 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. Rating dives must be planned and executed with the permission of the DSO or designee.

> ***Note: Depth ratings indicate a maximum depth. Depth authorizations consider a minimum 10 feet operational safety margin above the maximum depth rating. For example, 60 feet maximum, 50 feet operational depth.***

In the event a diver within the team does not hold an authorization at the desired next level, the DSO may authorize a required progression or procedure for a diver to attain a deeper authorization. If local conditions do not conform to traditional PSDTC depth progressions, the DSO 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 active public safety diver depth authorization, approved upon the successful completion of training listed in Section 3.0.

B. Training authorization to 60 Foot Depth - A diver holding a 30-foot authorization may be authorized train to a depth of 60 feet after successfully completing and logging 12 supervised dives to depths between 0 and 30 feet totaling a minimum of 2 hours of bottom time. **Cumulative minimum supervised dives: 12. Bottom Time: 2 Hours**

C. 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 30 and 60 feet. (60 foot depth is the maximum depth. Local depth conditions that are between 30 and 60 feet will dictate the team maximum limit.

D. Teams with working depths greater than 60 feet may extend their depth by 10 % if they are able to see their target.

E. For ANY diving conducted beyond 60 feet, 29 CFR Part 1910, Subpart T - Commercial Diving Operations should be used.

3.95 Dive Tender Prerequisites:

Tender: Individuals must meet the following **MINIMUM** criteria:

A. Must be at least 18 years old.

B. Must be physically fit. Medical evaluation and requirements will be determined by the AHJ.

C. Be formally accepted as a member of a public safety dive team.

D. Be currently certified as a provider of CPR with AED, First Aid and Emergency Oxygen Administration from a recognized training agency, American Heart Association, American Red Cross, Divers Alert Network etc.

E. ALL divers and additional team members should know how to calculate and document surface air consumption rates (SAC) and calculate air consumption at various depths. (Annex 5, Section 3.30).

F. Documented Hazmat Awareness Level Training.

G. Documented completion of the National Incident Management System (NIMS) Incident Command System (ICS) 100, 200, 700 and 800 level training**.**

H. Successfully complete Tender training.

I. Tender training should include:

- Dive team operational guidelines or SOPs.
- Basic scuba equipment function including and set up and take down.
- Assisting a diver dress and preparation.
- Line signals.
- Search patterns.
- Dive physics including dive tables.

J. Swim / Water Comfort

a. 100-yard swim, no time limit

b. Tread water for 10 minutes without a personal floatation device (PFD)

c. While wearing a PFD, tow an unconscious person 100 yards

Note: If an exposure suit is worn for any of the above skills, the wearer must be neutrally buoyant at the surface.

3.96 Minimum Activity to Maintain Authorizations:

During any 12-month period, each tender should document participation in a minimum of 12 public safety dives, PSD training or proficiency dives utilizing team gear (if available) and personal protective equipment (PPE).

Section 4.00 MEDICAL EXAMINATION

All public safety divers *must pass a medical examination at the intervals specified* in Section 16.0. A medically cleared diver experiencing any conditions which may disqualify candidates from diving Appendix 1.5 and Appendix 1.6 must receive clearance, in writing from a qualified medical provider, to return to diving before resuming diving activities.

This written medical examination requirement cannot be waived for any diver.

***Reminder:* A swim test and SCUBA skills evaluation may be required by the public safety diving team depending on the team's SOP / SOG.**

Section 5.00 EMERGENCY CARE TRAINING

The PSD must hold current training in the following:

A. Adult, Child and Infant CPR and AED.

B. Emergency oxygen first aid administration.

C. DAN Neurological Assessment.

D. First aid.

- Recommended: DAN Diving First Aid for Professional Divers (DFA Pro), First Response Training International or professional medical ratings, such as Emergency Medical Technician, Paramedic, etc.

Section 6.00 REVOCATION OF AUTHORIZATION

An individual's PSD authorization can be restricted, suspended or revoked for cause by the DSO. Cause for restriction or removal should be outlined in the public safety dive team's SOP / SOG. Authorizations associated with an individual's public safety diver authorization 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 and reviewed and the outcomes or actions resulting from this review will be documented in the PSD's team record in accordance with the public safety dive team's SOPs / SOGs.

Section 7.00 QUALIFICATIONS OF THE PUBLIC SAFETY DIVE TEAM

A. Each dive team member should have the experience or training necessary to perform assigned tasks in a safe, efficient and effective manner.

B. Each diver should be trained, qualified and certified for the dive.

C. Each diver should have experience and training in the following:

1) Knowledge and understanding of the team SOP/SOGs, team safe diving practices manual.

2) The use of the instruments and equipment appropriate to the diving activity to be conducted and associated conditions;

3) Dive planning.

4) Emergency procedures and guidelines.

5) Diver rescue techniques: Both self-rescue and rescue of other divers.

6) The ability and knowledge to recognize pressure-related injuries.

7) Current certifications in Adult, Child and Infant CPR and AED, Emergency Oxygen Administration and Basic First Aid.

At a minimum, an operational public safety dive team should consist of at least four qualified team members. Of the four, **three MUST be able and capable divers**. *A DIT **is not** an able and capable diver*. The three will become the Primary Diver, the Backup Diver and the Safety (90%) Diver.

Five members with three being operational able and capable divers as a qualified team **is highly recommended.**

ALL DIVES IN LIMITED OR ZERO VISIBILITY WATER MUST BE CONDUCTED USING TENDED DIVERS.

No person shall engage in Public Safety Diving operations in low or zero visibility conditions unless they are authorized / qualified pursuant to the provisions of this document *and their own SOP / SOG.*

Section 8.00 DIVE PLANNING AND HAZARD ASSESSMENT

Before conducting any diving operations, a dive plan for the proposed dive must be formulated. ***Dives should be planned around the competency and abilities of the least experienced diver***.

Planning of a diving mission should include an assessment of the suitability, serviceability, condition, and safety and health aspects of the following:

A. Assessment of diver fitness may include an on-site pre-dive medical screening for blood pressure, EKG strip and vital signs as well as a Rapid Field Neuro. Potential plans for flight within the next 24 hours should be considered.

B. Repetitive dive designation or residual inert gas status of dive team members.

C. Diving mode;

1) Rescue.

a) In a true Rescue Mode, there exists the chance to save a life or prevent a catastrophic event from occurring. The team SOP/SOG will dictate manpower and equipment requirements based on local conditions. Divers engaging in the dive will fall under the OSHA Exemption *ONLY* as long as the conditions for rescue exist. When rescue conditions no longer exist, the exemption no longer applies.

2) Recovery.

a) Crime Scene Security and Investigation where search and recovery may include both or either:

i. Human remains.

ii. Property/evidence.

3) Training

D. Identify Necessary Assignments.

E. Determine Required Manpower.

1) No less than 3 operational *able and capable divers* plus one other team member.

2) Minimum of 5 people is recommended with **no less than 3** being able and capable divers.

F. Breathing Air Supplies (including reserves).

G. Diving and Necessary Support Equipment.

1) Necessary and functioning equipment to field the full team of divers needed for the mission.

2) Necessary equipment to call for outside aid if necessary – cell phone, radios etc.

H. Emergency Aid. A list shall be kept at the dive location of the telephone or call numbers

of the following:

1) Nearest and secondary operational decompression chambers; *consultation with the Dive Alert Network may be necessary to confirm the availability of the chambers.*

DAN Emergency Hotline - +1-919-684-9111

2) Accessible hospitals;

3) Local EMS if not on site;

4) Available means of transportation; and

5) If applicable, the nearest U.S. Coast Guard Rescue Coordination Center.

I. First Aid Supplies.

1) A first aid kit appropriate for the diving mission shall be available at the dive location.

2) In addition to any other first aid supplies, emergency oxygen and related equipment and supplies appropriate to the diving being conducted shall be available at the dive location.

J. Determine the required or the minimum allowed level of PPE for thermal and environmental protection;

K. Identify surface and underwater conditions and hazards including:

1) Current velocity.

2) Tidal currents and schedules where applicable.

3) Water clarity/visibility

4) Underwater vegetation and marine life hazards.

5) Estimated air consumption rates for divers at the expected depth, duration of the dive, and estimated remaining air upon surfacing.

6) Entry and Exit points.

7) Visible hazards

8) Known hazards—In locations where previous dives have been made and the hazards are known or suspected.

9) Potential hazards—In environments where there is a high probability of encountering a hazard not initially present (i.e., Delta P, floating debris or entanglement hazards), someone with direct communication to the DS and dive team should be assigned to scan the upstream area for potential hazards flowing into the dive area.

a. When working in moving water a downstream safety team shall be deployed in the event a diver becomes untethered.

L. Emergency procedures including:

1) Method of alerting team members of a dive emergency.

2) Diver recall procedures.

3) Advanced Life Support unit onsite or enroot and Basic Life Support personnel onsite.

4) Method(s) to assist an injured diver from the water if necessary.

5) Emergency evacuation of an injured diver if necessary.

6) Location and distance to the nearest available hyperbaric recompression chamber capable of treating a decompression injury / event.

7) Appropriate medical transport for a diver requiring hyperbaric treatment.

8) **DAN Emergency Hotline - 919-684-9111 or +1 919-684-9111 (for PSD teams outside the US). Collect calls ARE accepted.**

9) For any dive outside the no-decompression limits or deeper than 100 feet, the diver will remain out of the water for a minimum of 24 hours and should be monitored and remain awake for at least one hour after the dive

M. Diver Down Flags

When diving from shore or in shallow water in areas of vessel traffic, at least one diver down flag is a minimum requirement and should be prominently displayed. Teams must follow US Coast Guard and State laws regarding dive flags.

A diver's flag must be displayed prominently whenever diving is conducted under circumstances where required or where water traffic is probable. Assorted dive flags and buoy markers are needed to mark dive location and divers that are down.

Section 9.00 DIVE TEAM BRIEFING

The DS should conduct a briefing of dive team members prior to each dive. The briefing should include:

A. The reason for the response and the tasks to be undertaken.
- **a.** Witness Interviews.
- **b.** Establish Last Seen Point.
- **c.** Risk Assessment.
- **d.** Other needs.

B. The diving mode.

C. The dive plan.

D. Divers that have driven to dive site from a lower altitude must report their repetitive pressure group before making altitude dive if the change is greater than 1000ft. (See ascent to altitude pressure group table NOAA Dive Manual in appendix)

E. Prior to making individual dive team member assignments, the DS shall inquire and document the current state of health of each dive team member that will be utilized, and indicate to the dive team member the procedure for reporting physical problems or adverse physiological effects during and after the dive.

F. Divers who have been diving within the prior 24 hours are required to report their last dive and residual nitrogen time.

- **a.** A repetitive dive work sheet should be completed before the diver is deployed with maximum depth and bottom times confirmed by the DS and DSO

G. Diver Assignments (Prior to making individual dive team member assignments, operational divers must report if they are ***Able AND Capable*** of performing a dive.)

H. Non-Diver Assignments.

I. Entry and Exit Points.

J. Safety procedures.

K. Any unusual hazards or environmental conditions likely to affect the safety of the diving operation.

L. Any modifications of existing standards or operational guidelines.

M. Equipment inspection. This is a written pre-dive safety check for all assigned divers that involves assembling and checking the breathing gas supply system including reserve breathing gas supplies, masks, thermal protection, buoyancy control devices, surface supplied systems and helmets, weight systems, cutting devices and any other diver carried inventory shall be inspected and documented prior to each dive.

N. Any emergency procedures necessitated by the specific diving operation.

O. Method(s) to assist an injured diver from the water surface, if necessary.

P. Method(s) to assist aid or respond to a diver emergency underwater.

Q. Emergency evacuation of an injured diver if necessary.

Section 10.00 PROCEDURES DURING DIVE

10.05 General:

A. Diving operations should be conducted within no decompression limits.

B. Diving operations should be conducted with at least two qualified fully suited ready-to-dive divers and one partially dressed diver with equipment at the ready; PD, BuD, 90% diver. These **three** divers MUST be able and capable divers.

C. Divers should be provided with a means of safely entering and exiting the water.

D. In zero or low visibility water divers must be tethered and line-tended from the surface. One tended line may be used for two divers if the divers remain in continuous contact with each other and are both physically attached to the tended line using a tag line or contingency strap.

E. Search lines should be no more than 150 feet long and search distances on a line should not exceed 125 feet.

F. A BuD or 90% Diver will be considered to be tended if they are physically attached via a contingency strap or tag line to the PD's tended line.

G. Regular gas supply checks should be attempted and logged during the dive to confirm and adjust the planned air consumption rates. If a diver is unable to see the pressure gauges, the dive must be planned using a higher air consumption rate than normal.

H. Public safety diving missions on SCUBA **should not** be conducted in currents exceeding one (1) knot.

I. While recreational drift diving in clear water is somewhat common, the inability to swim against a surface current may be used as the measure to stop or postpone a public safety dive. Additional surface support watercraft (boats), upstream spotters with communication capability with the DS and dive team and / or downstream safety personnel must be deployed ***IF*** diving in currents exceeding 1 knot. A team diving in currents exceeding 1 knot should have additional training specific to diving in currents.

J. An operational, two-way surface communication system should be available at the dive location to obtain emergency assistance.

K. All personnel within 10 feet of the water's edge or at greater risk of accidental immersion (bridges, slopes or where there are potential fall factors etc.,) must wear an approved PFD and operationally necessary PPE such as thermal protection, whistle or audible signaling device, gloves and a cutting tool.

L. Public Safety Divers should not enter enclosed or confined spaces or overhead environments without prior training and specific certification.

M. Nitrox is not recommended (Annex 5, Section 9.0(N).

N. Hookah diving should not be performed for public safety diving and related support operations.

10.10 Communication between Diver and Surface:

A. The tender must be able to communicate with the diver at all times.

B. Two-way voice communication systems are preferred **as part** of a dive team's standard equipment.

C. *Line signals along the search line* are recommended to be the primary means of **basic** communication with a voice system as a backup.

D. Decompression, repetitive, and no-decompression dive tables (as appropriate) should be used at the dive location and consulted in the proposed dive plans. All team members must use the same standard table. The table used must be the most current available from the agency producing the table. (US Navy, commercial, recreational – such as TDI, ERDI, NAUI, PADI, etc.)

E. A depth-time and subsurface location profile must be maintained for each diver during the dive.

It is recommended that one person be designated as a recorder and responsible for recording dive profiles and scene information.

10.20 Termination of a Dive:

If conditions or an incident occurs that may jeopardize the health or safety of a diver, diving operations should be stopped and the diver(s) should immediately exit the water.

NOTE: Consideration should be given to team safety during termination, as spatial awareness of associated risk may decrease by thinking the mission is over. All safety protocols and diver observation must continue until the missions has been concluded and / or requirements have been met.

A dive should be terminated when any of the following occur:

A. A diver repeatedly fails to respond correctly to communications or signals from a dive team member and/or

B. Communications are lost and cannot be quickly re-established between the diver and the tender and/or

C. A diver begins to use diver-carried reserve breathing air or the dive location reserve breathing air and/or

D. A breach of personal protective equipment; and/or

E. Diving conditions degrade and/or

F. Shore conditions degrade significantly affecting the capability of the shore support to function safely e.g., thunderstorms. tidal change, change in current direction or speed, etc. and / or

G. Water conditions change and impact the diver's ability to work or exit the water safely.

H. ANY diver has the right to refuse to dive without penalty. 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.

10.30 Emergencies and Deviations from Standards or Regulations:

A. Each Public Safety Dive Team will develop emergency procedures and must include procedures and implementation criteria for underwater emergencies, above water emergency administration of oxygen first aid, potential recompression needs, evacuation and incident reporting.

B. Any diver may deviate from the requirements of this document to the extent necessary to prevent or minimize a situation likely to cause death, serious physical harm or major environmental damage.

C. A written report must be submitted within 48 hours to the DSO explaining the circumstances and justifications.

Section 11.00 POST-DIVE PROCEDURES

The divers and the team should comply with the following requirements, which are applicable after each diving operation.

11.05 Post-Dive Safety Checks:

After the completion of a dive, each diver and all affected diving equipment:

A. Must be decontaminated according to the team SOP/SOG.

B. Must report any physical problems, symptoms of decompression illness, or equipment malfunctions to the DS / DSO and their assigned Dive Tender. Any defective equipment should be tagged and removed from service until repaired and tested by a qualified person.

C. Should have a Rapid Field Neuro test performed and undergo an assessment of physical condition that may include an on-site medical screening for blood pressure, EKG strip, vital signs and signs and symptoms of decompression illness. (Appendix 1.0)

D. Upon completion of a dive, the diver must remain on site or be accompanied by a trained teammate or medic for 1 hour post dive - especially if the dive was nearing the no decompression limits (NDL). **This must occur for any decompression dives.**

E. For any dive outside the no-decompression limits or deeper than 100 feet, the diver will remain out of the water for a minimum of 24 hours and should be monitored and remain awake for at least one hour after the dive.

F. ***Record the Dive(s)***

Keep in mind that the documentation created is evidence that, when necessary, can and will be, used in any future legal proceedings.

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

A. Following a Single No-Decompression Dive: Divers should have a minimum preflight surface interval of 12 hours.

B. Following Multiple Dives per Day or Multiple Days of Diving: Divers should have a minimum preflight surface interval of 18 hours.

C. Following Dives Requiring Decompression Stops: Divers should have a minimum preflight surface interval of 24 hours.

D. 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.

E. For any dive outside the no-decompression limits, deeper than 100 fsw divers shall remain awake and monitored for potential decompression illness, for at least one hour after the dive.

F. Any questions concerning flying after diving or ascending to altitude after diving will default to DAN. **Diversalertnetwork.org. For dive emergencies in the USA, call DAN +1-919-684-9111. For dive emergencies outside the USA, call +1 919-684-9111.**

Section 12.00 RECORD KEEPING

12.05 Team Log:

The following information should be recorded and maintained for each dive mission:

A. Name and signature of person who filled out the team log book.

B. Name and assignments of dive team members.

C. Pre and post dive vital signs.

D. Date, time and location.

E. Diving modes used.

F. General nature of work performed.

G. Mission objective.

H. Approximate underwater and surface conditions (visibility, water temperature and current) .

I. Maximum depth and bottom time for each diver, including repetitive dives.

J. For ANY dive outside the no-decompression limits and / or deeper than 100 feet, the following additional information should be recorded and maintained:

1) Depth and time.

2) Repetitive Group designation (including modification); and if used, name and model of dive computer.

3) Elapsed time since last pressure exposure if less than 24 hours or repetitive group dive designation for each diver.

K. For each dive in which a pressure related injury is suspected or symptoms are evident, the following additional information should be recorded and maintained:

1) Description of signs and symptoms (including depth and time of onset).

2) Description and results of treatment on site.

3) Baselines taken at intervals to establish abatement or intensification of the issue / condition.

4) The AHJ providing treatment and location transported to if applicable.

12.10 Personal Dive Log:

Each diver shall log every operation and training dive made. Divers are encouraged to log all other personal dives. The personal diving log shall be retained by the diver and will include at least the following:

A. Names of other divers.

B. Personal diver assignment(s).

C. Date, time, and location.

D. Diving modes used.

E. Diving gas used.

F. General nature of diving activities.

G. Mission objective.

H. Approximate surface and underwater conditions.

I. Maximum depths, bottom time, and surface interval time.

J. Diving tables or computers used.

K. Detailed report of any near or actual incidents.

L. Detail what equipment was used and serial numbers where applicable.

ALL PSDivers are encouraged to write and keep a personal written account of the dive mission, detailing events as much as is remembered.

12.20 Required Incident Reporting:

Reporting near misses, minor incidents – those that result in time off work – should be reported to the PSDTC for study / formation of a data base etc. There should be a requirement to contact their training and / or SCUBA certification agency or state agency. The PSDTC has not been formed yet and is a work in progress.

For now, email information to PSD Incident@PSDiver.com

All diving incidents requiring recompression treatment or resulting in moderate or serious injury or death should be reported **to the PSDTC** in a timely manner. Incidents and / or occupational injuries and illnesses must be recorded and reported in accordance with requirements of the appropriate State Code section and / or AHJ.

The DSO or designated assignee must investigate and document any incident of pressure-related injury and prepare a report that is to be made available to any investigating authority within 48 hours.

A. If pressure-related injuries are suspected, or if symptoms are evident, the following additional information must be recorded and retained by the dive team, with the record of the dive, for a period required by the AHJ or 7 years.

B. Written descriptive report shall include:

1. Name, address, phone numbers of all the parties involved

2. Summary of experience of divers involved

3. Location, description of dive site, and description of conditions that led up to the incident

4. The circumstances of the incident and the extent of any injuries or illnesses.

5. Description of symptoms, including depth and time of onset.

6. Description and results of treatment by any AHJ providing treatment.

7. Disposition of case. (Detail the evidence, materials, who reports were handed off to and documented by, signature and witness).
8. Recommendations to avoid repetition of incident.

12.30 Injury and Illness Assessment:

If a team member is exposed to suspected hazards in the water or while on land, a medical exposure form must be filled out and filed according to their operational guidelines.

Each exposure, injury or illness incident should be investigated, evaluated and reported; per departmental or team SUPs/SOGs.

Appropriate corrective action should be taken to prevent future recurrence.

Section 13.00 DIVING EQUIPMENT

13.05 General Policy:

A. 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.

B. Equipment should be used in accordance with safe diving practices and within the manufacturers' specifications.

C. All team members should ensure that the appropriate protective clothing and equipment is provided and properly worn to protect personnel from hazards to which they are exposed or could be exposed.

D. Protective clothing and equipment should be appropriate to the tasks that are expected to be performed during any diving mission or training.

E. All diving equipment should be maintained in a safe and fully functional condition.

F. Any damaged or defective equipment should be removed from service immediately and clearly identified in order to preclude its use.

G. Each equipment modification, repair, test, calibration or maintenance service should be documented and the work performed by a certified technician.

H. Scuba cylinders must be visually inspected annually by a qualified inspector and hydrostatically tested and date stamped every five (5) years.

I. All equipment should be inspected at least quarterly by a qualified person and a record of inspection and results maintained. Personal equipment and / or assigned equipment should follow the same requirements per the dive team SOPs/SOGs. *Equipment subjected to extreme use or adverse conditions may require more frequent testing and maintenance*.

J. Any servicing, maintenance or repairs made to any diving or life support equipment must be documented and records kept for a period of time required by the AHJ or a minimum of 7 years. Equipment taken out of service permanently may not be reinstated without factory authorized repair or servicing with or without warranty.

13.10 Equipment:

The DSO must establish the minimum equipment configuration for all dives.

13.20 Regulators:

A. PSD teams should use regulators that are environmentally sealed.

B. Regulators should be inspected and function tested by the diver and tender prior to use.

C. Regulators should be inspected and performance tested by a certified technician at least once a year or as suggested by the manufacturer - or more often.

D. Regulators must be cleaned and decontaminated after each use before being placed back into service.

E. Standard open circuit regulator configuration is:

1) 1st stage regulator.

2) Primary 2nd stage regulator.

3) Back up 2nd stage regulator and / or Gas Switch Block.

4) Redundant air system immediately available to the diver.

5) Submersible Pressure Gauge (SPG).

6) Inflator hose for a Buoyancy Compensator Device.

7) Inflator hose for dry suit when applicable.

13.21 Equipment for Determination of Decompression Status:

A. Each diver entering the water must have an accurate dive log created and maintained after every dive.

B. If dive tables are being used a set must be available at the dive location.

C. If a dive computer is used the diver must use the same computer on ALL repetitive dives. Dive computers cannot be shared with other divers within 24 hours of use or until the dive computer times itself off, per manufacturer's guidelines.

D. A depth indicator is required. On repetitive dives a diver's decompression status must be taken into consideration.

E. A timing device must be used for each diver. Timing devices may be diver worn, single diver use computers and / or dive time recorded by topside.

13.22 Masks:

A. A full face mask that is capable of maintaining a diver's airway while in an unconscious state should be used for primary missions.

B. Full face mask with communications is preferred. This will normally allow for diver to diver as well as diver to topside communication. If a full face mask is used, a redundant half mask should be carried by each diver to be used as a backup. ANY mask used must suitable for operational missions or training.

C. Half mask (typical recreational SCUBA mask) - A face mask that covers both the eyes and nose allowing the diver to see and clear their ears. A half mask is to be used when full face mask is unavailable or as a backup mask while using a full face mask.

13.23 Exposure Protection:

Exposure protection should be dictated by the diving environment. Both wetsuits and dry suits provide protection against abrasion, UV exposure and thermal loss. In environments where the possibility of chemical or biological contamination exists, divers should be dressed, at a minimum, in dry suits with attached hoods, dry gloves and full face masks. In heavy contamination dry suits with dry gloves and a helmet should be worn.

13.24a SCUBA Cylinders: (Annex 1.0)

A. An alternate supply of air must be immediately available to a diver in zero / low visibility.

B. Scuba cylinders used in the USA must be hydrostatically tested in accordance with DOT standards.

C. Scuba cylinders used outside the USA must be hydrostatically tested in accordance with ISO standards.

D. Scuba cylinders must have an internal and external inspection at intervals not to exceed 12 months.

E. Scuba cylinder valves must be functionally tested and serviced at intervals not to exceed 12 months.

F. Primary dive cylinders should be 80 cubic foot cylinders or larger that have current visual inspection (VIP), hydro tested and filled to service pressure and well as pony cylinders.

G. A 13 cubic foot cylinder may be used when diving at depths of 40 feet or less.

H. When using 80 cu ft cylinders, no dive should start if the carried air of the diver is less than 10 percent of the maximum fill rating of the cylinder(s).

I. When using high volume cylinders, no dive should start if the carried air of the diver is less than 20 percent of the maximum fill rating of the primary cylinder or 10 percent of the maximum fill rating of the pony cylinder.

13.24b SCUBA Pony Cylinders: (Annex 1.0)

A. An alternate supply of air usually a pony cylinder must be immediately available to a diver in zero / low visibility.

B. Scuba cylinders used in the USA must be hydrostatically tested in accordance with DOT standards.

C. Scuba cylinders used outside the USA must be hydrostatically tested in accordance with ISO standards.

D. Scuba cylinders must have an internal and external inspection at intervals not to exceed 12 months.

E. Scuba cylinder valves must be functionally tested and serviced at intervals not to exceed 12 months.

F. Pony dive cylinders should be 13 cubic foot cylinders or larger, that have current visual inspection (VIP), hydro tested and filled to service pressure.

J. When using high volume cylinders, no dive should start if the carried air of the diver is less than 20 percent of the maximum fill rating of the primary cylinder or 10 percent of the maximum fill rating of the pony cylinder.

13.25 Fins / Boots:

A. Fins should be able to provide a means of underwater propulsion and maneuverability and suitable for the conditions dived and the kick style that may be necessitated by the conditions of the dive.

B. Booties or boots with **a hard sole** appropriate for the dive.

13.26 Buoyancy Compensation Devices (BCDs):

A. Each diver should utilize a Buoyancy Control Device - An inflatable flotation device capable of providing buoyancy to the diver at the surface, and includes oral inflation capability.

B. BCDs, dry suits (unless diving with a dry suit and mated helmet) or other variable volume buoyancy compensation devices must be equipped with an exhaust valve. These devices should be functionally inspected and tested in accordance with the maintenance schedule in the SOP / SOG.

C. BCD Weight systems should have a quick release device designed to permit jettisoning with a single motion from either hand.

D. When using integrated weights, alternate weighting systems should be included. **The loss of a single weight pocket should not result in an uncontrolled ascent.**

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

F. BCDs should have a minimum of 40 lbs. lift rating or a rating that exceeds the weight of the fully equipped diver in the water.

13.27 Gauges and Timekeeping Devices:

A. Gauges indicating diver maximum depth should be used for all dives.

B. Gauges should be inspected and readied for use by the diver and tender prior to use.

C. A timekeeping device should be used at each dive location to record and maintain dive times and diver surface intervals.

D. A timing device must be used for each diver. Timing devices may be diver worn, single diver use computers and / or dive time recorded by topside

E. Where practical, dive computers may be used.

1. Dive computers are not to be shared within a 24hour period

2. Secondary time keeping must be used to back up the dive computer

13.28 Weights and Harnesses:

A. Divers should be equipped with a weight system or assembly capable of quick one hand release.

B. When a safety harness is worn in diving, it should be worn under the BCD and should be equipped with:

1. Metal D-rings or attachment points

2. A buckling device.

13.29 Cutting Tools:

Each diver must have **no less than three different cutting tools** secured in different

locations. Divers should have at least two different cutting tools. Each of these three cutting tools and their placement locations should be consistent for all team members. These three cutting tools should be accessible with either hand. Additional tools may be added as necessary.

Tools notated with * should be required and additional tools can include but are not limited to:

Knife(s)	Wire Saw
*Heavy Duty EMT Style Sheers	*Seatbelt Cutters / Trilobite Style Razor Cutters
Wire Cutters	Wire Snips
Cutting Shears	Bolt Cutters
Limb Saw	Other

*** Cutting tools MUST be tested for functionality BEFORE designating them as mission ready!**

13.30 SUPPORT EQUIPMENT:

13.31 First Aid / Rescue Supplies:

A. A first aid kit appropriate for the diving operation shall be available at the dive location.

B. Emergency oxygen volume appropriate for the diving being conducted.

C. Throw bags or other surface rescue equipment must be available at the dive location.

13.32 Diver Flag / Surface Markers:

A diver's flag must be displayed prominently whenever diving is conducted under circumstances where required or where water traffic is probable. Assorted dive flags and buoy markers may be needed to mark dive location and divers that are down.

13.33 Miscellaneous Ropes, Throw Bags, Evidence Containers, Weights, and Lift Bags:

A. Ropes and throw bags should be chosen on the type of environment they are to be used in. They must be washed and appropriately decontaminated after each use.

B. Evidence containers can include zip lock bags, PVC pipe, sealable plastic containers, trash bags, and body bags.

C. Weights - either shot bags and / or solid environmentally friendly lead should be in abundant supply and readily available to divers.

D. Lift bags with the capacity of at least 10 to 50 lbs. should be immediately available.

E. Lifting requiring more than 100 lbs. of lift requires additional and specific training.

13.34 Forensic Diving Equipment (as needed):

A. Photography and / or video equipment

B. Distance measuring tools

C. Underwater slates

D. Underwater lightings

E. Evidence collection tools

13.35 Compressor Systems – Dive Team:

A. The Following will be considered in design and location of a compressor system:

1. Low-Pressure compressors used to supply to a diver or diver must be of sufficient size to provide at least 4 CFM per diver at depth.

2. Compressors must be equipped with a volume tank. The tank must have a one-way valve (check valve) on the inlet. Tank shall have a water drain located at the low point on the tank for removal of excess moisture.

3. A pressure gauge. An over pressure (pop off) valve, that also has a ball valve installed before the over pressure valve; in case of failure.

4. On the outlet of the tank a filtration system sufficient to provide Grade E air.

B. Compressor air systems over 500 psig must have slow-opening shut off valves.

C. All compressor intakes must be located away from areas containing exhaust gasses or other contaminates.

1. Intake should be elevated at least 5 feet above the compressor exhaust, or other sources of contamination.

2. It is recommended that the compressor be located upwind of any other sources of contamination.

13.36 EQUIPMENT MAINTENANCE:

13.37 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:

A. Regulators.

B. Gauges (SPG, depth gauges, timers, and dive computers).

C. BCDs.

D. Dry suits.

E. SCUBA cylinders and valves.

F. Full Face Masks.

G. Compressors, air filtration systems, gas control panels, and storage banks.

H. Surface supplied equipment.

I. Helmets.

J. Rebreather systems.

K. Additional equipment categories as needed.

13.38 Compressor Operation and Air Test Records:

Gas analyses and air tests should be performed on each dive team 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.

13.40 AIR QUALITY STANDARDS:

13.41 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

13.42 Remote Operations:

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

Section 14.00: SURFACE SUPPLIED DIVING

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

14.05 Prerequisites:

All surface supplied divers must be certified public safety divers or divers in training and have completed system specific training as authorized by the DSO.

14.10 Procedures:

A. Each diver must be continuously tended while in the water

B. Surface supplied diving should not be conducted in currents exceeding 2 knots

C. Each diving operation must have a primary breathing gas supply sufficient to support divers for the duration of the planned dive including potential decompression needs.

1. A separate dive team member must tend each diver in the water

2. A standby diver must be available while a diver is in the water and be tended by their own tender

D. A diver using surfaced supplied gas should rely on surface personnel to keep the diver's depth, time and diving profile

E. The DSO is responsible for developing additional operational protocols

14.20 Manning Requirements:

The minimum number of personnel comprising a surface supplied dive team is 6 (six). They consist of: a DS, PD, a BuD, a Air/Comm attendant and two Tenders. Additional dive team members are required when a diving mission or dive site is considered complex or when the task loading of a dive team member is deemed excessive. It is the DS's responsibility to define when the surface supplied dive team must be expanded beyond the minimum manning requirements.

14.30 Equipment:

The diver will wear a positive buckling device on the safety harness to which the umbilical hose will be secured. The safety harness should include an attachment point for the umbilical to prevent strain on the mask or helmet; and 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.

14.40 Masks and Helmets:

Surface supplied and mixed gas masks and helmets must have:

A. A non-return valve at the attachment point between the mask / helmet and hose which must close readily and positively; and an exhaust valve

B. 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 when the diver is producing carbon dioxide at the rate of 1.6 standard liters per minute

C. Helmets or masks connected directly to the dry suit or other buoyancy-changing equipment must be equipped with an exhaust valve

D. Air supplied to the diver must meet the air quality standards outlined in Section 13.40

14.50 Additional Considerations:

Refer to OSHA §1910.425 - Surface-supplied air diving for any condition or circumstance not covered by this section

Section 15.00 BOAT OPERATIONS

15.05 General:

A. Public safety divers should not engage in live boating

Live Boating – maintaining a mobile chase vessel in support of dive operations. This method of dive tending is preferred in clear waters in instances where anchoring is difficult, under conditions with high currents, when the dive plan makes it likely that divers will move away from the initial dive location, and in locations where divers may need to be shielded from other vessel traffic.

Diving operations involving a stationary or anchored boat or floating platform shall maintain risk assessment and dive procedures.

B. Limits

Public safety dives should not be conducted from:

1. A floating platform or boat in rough seas which significantly impede diver mobility or work function; or

2. In other than daylight hours unless the environment can be illuminated with scene lighting.

3. In currents exceeding 1 knot on SCUBA or 2 knots utilizing surface supplied air.

C. Procedures

1. A boat or floating platform used as dive platform must be securely and safely anchored following maritime requirements for the specific body of water and local conditions.

2. A diver's flag must be displayed prominently whenever diving is conducted under circumstances where required or where water traffic is probable. Assorted dive flags and buoy markers are needed to mark dive location and divers that are down.

3. The propeller of the vessel shall be stopped before the diver enters or exits the water.

4. Divers should be tethered from the platform or boat.

5. Two-way voice communication between the DSO and the person controlling the vessel shall be available while the diver is in the water.

6. A backup and safety diver shall be available while a diver is in the water.

7. A diver carried reserve breathing gas supply shall be carried by each diver engaged in boat operations.

Section 16.00 MEDICAL STANDARDS

16.05 Medical Requirements:

General

- All medical evaluations required by this document must be performed by, or under the direction of, a licensed physician of the applicant/diver's choice. Preferably one familiar with diving and trained in hyperbaric 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 1.5)
- The DSO must verify that divers have been declared by a licensed physician to be fit to engage in diving activities.

16.10 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 1.6) 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 licensed physician trained in hyperbaric medicine.		

16.20 Information Provided Examining Physician:

The team member being evaluated must provide a copy of the medical evaluation requirements of this document to the examining licensed physician. (begin at Appendix 1.5)

16.30 Content of Medical Evaluations:

Medical examinations conducted initially and at the intervals specified in (Appendix 1.5) must contain the following: *Diving physical examination (see above appendix 1.6) Modifications or omissions of required tests are not permitted.*

A. Applicant agreement for release of medical information to the Diving Safety Officer. (Appendix 1.6)

B. Medical history (Appendix 1.6)

16.40 Licensed Physician's Written Report:

- A Medical Evaluation of Fitness for SCUBA Diving Report (or SOP/SOG equivalent) signed by the examining licensed physician stating the individual's fitness to dive,

including any recommended restrictions or limitations will be submitted to the DSO for the diver's record after the examination is completed.

- The Medical Evaluation of Fitness for SCUBA Diving Report will be reviewed by the DSO or designee and the diver's record and authorizations will be updated accordingly.
- A copy of any licensed physician's written reports will be made available to the individual.
- It is the diver's responsibility to provide to the DSO 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 DSO or designee and the diver's record and authorizations will be updated accordingly.

Section 17.00 SPECIALIZED and ADVANCED DIVING

17.1 Diving Modes and Technologies

Diving modes and technologies not addressed in the standards above require the approval of the individual agency, municipality or AHJ. Proper training for EACH mode is required.

17.2 Specialty Diving

Specialty Diving includes but is not limited to:

- **A.** Diving below 60feet
- **B.** Decompression Diving – Diving beyond no decompression limits\
- **C.** Staged Decompression Dives
- **D.** Altitude Diving
- **E.** Ice Diving
- **F.** Overhead Environments – Cave, Cavern and manmade structures.
- **G.** Penetration / Overhead Environments – Wrecks
- **H.** Mixed Gas Dives
- **I.** Rebreathers
- **J.** Lifting over 100 lbs.
- **K.** Hull Clearing
- **L.** Underwater Threat Assessment
- **M.** Explosives of any sort

***Any advanced skills that are not listed in this document will require additional training.**

Each team performing these skills will be responsible for identifying the training needs, providing the necessary training and identify and insert the correct procedures in their team SOG / SOP.

Section 18: DEFINITION and TERMS

Able, Capable Diver – Certified diver with the immediate ability to descend to depth and perform specific tasks.

Absolute Pressure - The sum of atmospheric pressure plus hydrostatic pressure is called the "absolute pressure." Absolute pressure can be expressed in many ways, including "pounds per square inch absolute" (psia), "atmospheres absolute" (ata), feet of seawater absolute (fswa), feet of freshwater absolute (ffwa) or millimeters of mercury absolute (mmHga) and **ACFM -** Actual cubic feet per minute.

Advanced / 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.
- **Ice and Polar Diving**: Any dive conducted under ice or in cold water/weather conditions.
    - *Note: An Ice Dive is also be classified as an Overhead Environment dive.*

AHJ - Agency Having Jurisdiction

Air sharing - The sharing of an air supply between divers.

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

Alternate Air Source – Equipment (usually a second stage regulator) necessary for a diver to access an air / gas supply.

ASME Code or equivalent - ASME (American Society of Mechanical Engineers) Boiler and Pressure Vessel Code, Section VIII or an equivalent code that the employer can demonstrate to be equally effective.

ATA - Atmospheres absolute.

ATM – Atmospheres

Atmospheric Pressure - Atmospheric pressure is the pressure exerted by the earth's atmosphere; it decreases with altitude above sea level. At sea level, atmospheric pressure is equal to 14.7 pounds per square inch (psi) or one atmosphere (atm). The higher the altitude above sea level, the lower the atmospheric pressure. For example, at 18,000 ft. (5,486 m), atmospheric pressure is 7.35 psi or half that at sea level (see Figure 2.1). At sea level, atmospheric pressure is considered constant and universal; that is, anywhere on the earth at sea level, the pressure is 14.7 psi. The pressure inside a person's lungs is the same as the pressure outside.

Backup Diver – The diver who is fully dressed and ready to instantly respond to a Primary diver in need of assistance.

Boat operator - The person controlling a vessel during boating operations.

Bottom time **-** The total elapsed time measured in minutes from the time when the diver leaves the surface in descent to the time that the diver breaks the surface.

Bounce dive **-** A dive to a maximum depth with an immediate return to the surface.

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

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.

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

Buddy Line / Contingency Strap / Tag Line **–** A short piece of strapping or line with a method of securing a diver on one end and a search line on the other. The device is intended to be used to physically connect the user to another object or diver.

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

Buoyancy control device (BCD) **-** An inflatable flotation device capable of maintaining the diver at the surface, having a manually activated inflation source independent of the breathing supply, an oral inflation device and an exhaust valve should be used for SCUBA diving. A floatation type device that will allow the diver to establish neutral buoyancy in the water column.

Burst disk **-** Part of the valve, this safety device releases air from a cylinder if it becomes over pressurized.

Bursting pressure **-** The pressure at which a pressure containment device would fail structurally.

CERCLA **-** Comprehensive Environmental Response, Compensation and Liability Act. Commonly known as Superfund Act, was enacted by Congress on December 11, 1980. This law created a tax on the chemical and petroleum industries and provided broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. Over five years, $1.6 billion was collected and the tax went to a trust fund for cleaning up abandoned or uncontrolled hazardous waste sites. CERCLA was amended by the Superfund Amendments and Reauthorization Act (SARA) on October 17, 1986.

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 performed inside the cavern zone and within direct sight of the surface entrance conducted in daylight hours only and permitting emergency ascent (40 linear meters) of the surface.

Certified Diver **-** A diver who holds a recognized valid certification from an internationally recognized SCUBA training agency.

Certified dive equipment technician - A person capable of inspecting, repairing and overhauling diving equipment and is skilled, trained and certified to the manufacturer's specifications.

Closed circuit diving - Diving in which the breathing air is recirculated, scrubbed and rebreathed.

Confined space entry or dive - This is **not** recognized as a Public Safety Dive and **if** performed, must be performed by certified divers with the training and experience to perform the job(s).

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

***Contingency Strap / Tag Line / Buddy* Line –** A short piece of strapping or line with a method of securing a diver on one end and a search line on the other. The device is intended to be used to physically connect the user to another object or diver.

Controlled ascent - A method used by divers to return to the surface. In zero visibility, this is usually performed following a search line back to the tender. In clear water with the ability to see overhead, this is usually performed vertically. Controlled also implies the diver has the ability to change position in the water either by stopping or pausing, descending or moving horizontally at will.

CNS - Central Nervous System consisting of the brain and spinal cord

Cutting tool - A handheld cutting device; may include, but is not limited to, a dive knife, wire cutters, seatbelt cutters or shears.

Cylinder - A pressure vessel for the storage of gas.

Decompression chamber - A surface pressure vessel for human occupancy used to treat pressure related injuries. To be used by divers it MUST have passenger and patient occupancy and capability AND qualified staff to operate it.

Decompression sickness - A condition with a variety of symptoms that may result from gas or bubbles in the tissues of divers after exiting the water or moving to a lesser depth.

Decompression Planning and Calculation Method -

- Dive Tables
- Dive Computer
- PC Based Decompression Software

Decompression Table - Used to calculate repetitive diver and theoretical gas absorption using a square dive profile using the deepest depth attained and bottom time and subsequent surface intervals.

Delta P – A potentially fatal diving hazard. The change in pressure from one area to another, usually connected with culverts, pipes or drains. This change in pressure can trap a diver or pull them into equipment.S

Depth Ranges - Depth ranges for sorting logged dives are: 0-30, 31-60, 61-100, 101-130. Depths are in feet seawater (when measured in meters: 0-10, >10-30, >30-40, >40-45. A dive is logged to the maximum depth reached during the dive.

Dive - A descent under water utilizing compressed air, ascent and return to the surface. Repetitive dives

with less than a 10-minute surface interval are considered a single dive. A logged dive will be considered any dive lasting more than 5 minutes. Successful mission dives lasting less than 5 minutes will be logged in real time.

Dive boat **-** is a boat that recreational divers or professional SCUBA divers use to reach a dive site which they could not conveniently reach by swimming from the shore.

Dive briefing **-** A quick description of the events that led to the team mission. It can include a risk assessment, special notices, special instructions and delegation of responsibilities enabling the team members to prepare for the task at hand.

Dive computer **-** A device that computes a diver's theoretical gas absorption and decompression status, in real time.

Dive Officer (DS) **–** Assumes the role of DSO in temporary capacity when the4 DSO is unavailable. The DO should be a trained public safety diver and have the experience to conduct a diver operations or training.

Dive plan **-** A prearranged sequence of underwater events constituting the anticipated dive. The dive plan must incorporate emergency planning.

Dive Safety Officer (DSO) – The dive team leader. A person in charge of the dive team and dive operations.

Dive site **-** the area where a diving operation is conducted.

Dive tables **-** See "Decompression Table".

Dive team **-** Divers and support team members involved in a diving operation, including the designated person-in-charge.

Dive Team Leader **–** See Dive Safety Officer (DSO)

Diver-In-Training **(DIT) -** A probationary diver. An individual gaining experience and training in additional diving activities under the supervision of a dive team member experienced in those activities.

Diver to Diver Communication **-** Two comparably equipped SCUBA divers in the water in constant communication. IE, hand signals, hand squeezes, voice communication, line tugs or any other agreed upon communication system that can relay at least the following: I am OK, I am in trouble, I am out of air, stop, go, go up / back.

Diving Mode **-** *Usually refers to either Rescue Mode or Recovery Mode.*

Diving Type **-**

- **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.

Emergency ascent - An ascent made under emergency conditions where the diver exceeds the recommended normal ascent rate of 30 feet per minute.

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

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

FFW - Feet of freshwater

FSW - Feet of seawater

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.

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 switch block - A switch block allows a diver to change between two separate air tanks without having to remove his or her full face mask (FFM).

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.

Harness - A diver harness is worn under the BCD by a diver and it allows the diver a secure connection to the tether / search line when the diver is in the water. These connections are not intended to lift a diver from the water.

**** Buoyancy compensation device D-rings are inadequate strength members for this task and may not be able to support the diver's entire weight and dynamic load.***

Hazardous substance - Any substance designated or listed under A through D of this definition, exposure to which results or may result in adverse effects on the health or safety of employees:

A. Any substance defined under section 101(14) of CERCLA;

B. Any biologic agent or other disease-causing agent that after release into the environment and upon exposure

C. Inhalation, injection, absorption or assimilation into any person, either directly from the environment or indirectly by ingestion

D. Through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities

E. Cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations

F. In such individuals or their offspring

G. Any substance listed by the U.S. Department of Transportation as hazardous materials under 49 CFR 172.101 and Appendixes; and

H. Hazardous waste as herein defined.

Hazardous waste **-** waste or combination of wastes as defined in 40 CFR 261.3 or those substances defined as hazardous wastes in 49 CFR 171.8.

Health hazard **-** A chemical, mixture of chemicals or a biological pathogen for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals that are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins and neurotoxins, agents that act on the hematopoietic system and agents that damage the lungs, skin, eyes or mucous membranes. It also includes bacterial, viral or other human or animal exposure where contact with exposed skin, wounds, ingestion, inhalation, absorption or other contact could infect the diver as well as stress due to temperature extremes. Further definition of the terms used above can be found in Appendix A to 29 CFR §1910.1200.

Hookah diving **-** A type of shallow water recreational surface-supplied diving system where the diver uses the second stage of a SCUBA regulator and hose connected to a surface air source. Not recommended for Public Safety Diving.

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

Immersion pulmonary edema **-** (IPE) is a condition in which fluid fills the lungs during diving or swimming, particularly in cold water.

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.

Incident Classification Rating Scale **-**

- **Minor**: Injuries that the PSDTC 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 PSDTC 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 PSDTC considers being serious in nature. Examples of this classification would include, but not be limited to:
    - Arterial Gas Embolism.
    - Immersion Pulmonary Edema
    - DCS symptoms requiring multiple hyperbaric treatments.
    - Non-fatal or near drowning.
    - Oxygen Toxicity.
    - Hypercapnia.
    - Spinal injuries.
    - Heart attack.
    - Fatality.

Incident Commander: The individual responsible for the overall management of the scene.

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.
- **Non-Fatal or Near Drowning/ Hypoxia:** An incident where a person asphyxiates to the minimum point of unconsciousness during a dive involving a compressed gas but the person recovers.
- **Hyperoxic / Oxygen Toxicity:** An incident that can be attributed to the diver being exposed to too high a partial pressure of oxygen.

- **Hypercapnia:** An incident that can be attributed to the diver being exposed to an excess of carbon dioxide.
- **Fatality:** Any death accruing during a dive or resulting from the diving exposure.
- **Other:** An incident that does not fit one of the listed incident types

In-water staging **-** Usually refers to additional cylinders of breathing gas being suspended at various depths for use when diving beyond no decompression limits. This type of diving is NOT recommended for Public Safety Diving and requires much additional training.

Lift bag **-** An airtight bag with straps used to lift heavy objects underwater by means of increasing the bag's buoyancy using compressed air.

Limited / Low visibility **-** Water conditions that cause objects, features, hazards or other divers to not be clearly discernible due to insufficient light or unfavorable conditions. In-water visibility of 10 feet (3 meters) or less.

Line-tended **-** The diver is physically connected to the search line or umbilical and directed by a line tender.

Live Boating – maintaining a mobile vessel in support of dive operations. This method of dive tending is preferred in instances where anchoring is difficult, under conditions with high currents, when the dive plan makes it likely that divers will move away from the initial dive location and in locations where divers may need to be shielded from other vessel traffic.

Logged Dive **-** A logged dive will be considered any dive lasting more than 5 minutes. Successful mission dives lasting less than 5 minutes will be logged in real time.

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.

Maximum working pressure **-** The maximum pressure to which a pressure vessel may be exposed under standard operating conditions as per manufacturers specifications.

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.

NIOSH **-** National Institute for Occupational Safety and Health.

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

No-decompression limits **-** The theoretical depth-time limits of a dive, specified by a table or model, from which a diver can return directly to the surface at a control rate without being required to spend time at shallower depths to allow excess nitrogen gas to be eliminated from the body.

Normal ascent **-** An ascent made with an adequate air supply at a rate of 60 feet per minute or less.

Open circuit SCUBA **-** Standard SCUBA diving equipment where the user breathes from the set and

then exhales to the surroundings without recycling the exhaled air.

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.

Permissible exposure limit - The exposure, inhalation or dermal permissible exposure limit specified in 29 CFR Part 1910, Subparts G (Occupational Health and Environmental Control) and Z (Toxic and Hazardous Substances).

Pony Cylinder - A small independently filled diving cylinder which forms an extended SCUBA set and is fitted with its own independent regulator. In an emergency, such as depletion of the diver's main air supply, it can be used as an alternate air source or bailout bottle to allow a normal ascent in place of a controlled emergency swimming ascent. The key attribute of a pony bottle is that it provides a totally independent and redundant source of breathing gas for the diver.

Pressure-related injury - Any injury obtained as the result of hyperbaric exposure such as decompression sickness, pneumothorax, mediastinal emphysema, air embolism or subcutaneous emphysema.

Primary diver - A qualified public safety diver performing initial underwater activities relating to a search and / or recovery dive request.

PSI - Pounds per square inch

PSIG - Unit of pressure, pounds per square inch gauge.

Public Safety Diver - A person performing public safety diving.

Public safety diving - Public safety diving is the underwater work conducted by law enforcement, fire rescue, and search and rescue / recovery dive teams. Public safety divers differ from recreational, scientific and commercial divers who can generally plan the date, time and location of a dive and dive only if the conditions are conducive to the task. Public safety divers respond to emergencies 24 hours a day, 7 days a week and may be required to dive in the middle of the night, during inclement weather, in zero visibility “black water” or in waters polluted by chemicals and biohazards. The public safety dive team is a group of divers who perform underwater functions, including search and recovery for evidence and human remains.

Qualified person - A person who by possession of a recognized degree, certificate or professional standing or who by extensive knowledge, training and experience has successfully demonstrated his or her ability to solve or resolve problems relating to the subject matter, the work or the project.

Redundant Air System – A system composed of a compressed breathing gas source, pressure gauge, first and second stage regulator and a means of affixing the system to the diver so that it will not be dropped or dislodged; is completely independent of the diver’s primary air

system and is configured to be accessed without delay when the diver is under duress; and of sufficient capacity to permit the diver to ascend to the surface from the maximum recognized operational depth while complying with a prescribed ascent rate and any necessary safety stops.

Repetitive dive - Any dive made within six hours of a previous dive.

Rescue diver - A fully suited diver ready on the surface able and capable of immediately responding to the rescue of a working diver.

Rule of Thirds - The safest rule of management for gas supply is to use the rule of thirds in any situation where it is preferable to come back to a set ascent point, such as the anchor line of a dive boat. The rule of thirds means that the diver uses one-third of his air supply for the descent and the swim away from the exit point and one-third for the swim back to the exit point, leaving one-third for any delays or emergencies.

Safety / Standby diver - A 90% equipped diver at the dive location capable of rendering assistance to a diver(s) performing assigned tasks.

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

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

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

Scuba certified diver - A diver who holds a recognized and valid recreational SCUBA certification from a recognized certifying recreational SCUBA training agency.

Superfund Amendments and Reauthorization Act (SARA) - amended the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) on October 17, 1986. SARA reflected EPA's experience in administering the complex Superfund program during its first six years and made several important changes and additions to the program. SARA:

- stressed the importance of permanent remedies and innovative treatment technologies in cleaning up hazardous waste sites;
- required Superfund actions to consider the standards and requirements found in other State and Federal environmental laws and regulations;
- provided new enforcement authorities and settlement tools;
- increased State involvement in every phase of the Superfund program;
- increased the focus on human health problems posed by hazardous waste sites;
- encouraged greater citizen participation in making decisions on how sites should be cleaned up

Surface-supplied air diving - 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.

Tag Line / Contingency Strap / Buddy Line – A short piece of strapping or line with a method of securing a diver on one end and a search line on the other. The device is intended to be used to physically connect the user to another object or diver.

Tender - Used in Surface supplied and tethered diving A surface support person responsible for handling a diver's umbilical and for maintaining voice or standard line signal communications. 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.

Tether - A physically connected line attached to the diver that connects the diver to a tender on the surface.

Time keeping - A method to document the duration of a diver beginning at the descent to arrival back on the surface where the diver begins to breathe atmospheric air through normal means. This documentation will include depth, time and amount of air consumed during the dive.

Two-way communication - Communication between the diver(s) and the topside support personnel by either a hardwired or wireless system. Can also be accomplished using pull or tug signals over a tethered search line.

Umbilical - The composite hose bundle between a dive location and a diver that supplies the diver with breathing air, communications, power or heat as appropriate to the diving mode or conditions and includes a safety line between the diver and the dive tender.

Underwater Threat Assessment – Assessments below the waterline to inspect, examine or investigate for threats or actual incidents of explosives/ IEDs, structural instability or any other potential hazards.

Visibility – The ability of a public safety diver to see and be seen.

Working pressure - The maximum pressure to which a pressure containment device may be exposed under standard operating conditions.

Zero Visibility – The inability to see 1 foot or less underwater due to excessive turbidity or suspended particulates, the absence of ambient light and the inability of artificial light to increase visibility. An inability to read hand held gauges with or without a light source.

Appendices

APPENDIX 1.0 MEDICAL

APPENDIX 1.20 Divers Alert Network – Neurological Exam:

In 2016, the American Heart Association reported 5.5 million deaths from stroke worldwide[1] and more than half of the calls to the DAN Emergency Hotline in 2016 involved possible neurological decompression illness[2]. Strokes and neurological decompression sickness (DCS) can manifest almost identically and prudent response can make a huge difference for someone suffering from either condition.

The following material is informational only.

To ensure proper use of the field neurological exam, those administering this exam should be qualified to do so by completing the DAN Neurological Assessment course. This is currently a stand-alone course or part of DAN's Diving Emergency Management Provider (DEMP) or Diving First Aid for Professional Divers (DFA Pro) courses.

To obtain proper training in this valuable tool, visit dan.org and locate a DAN instructor near you.

DAN's Neurological Assessment course teaches you how to properly manage injuries with neurological implications. You will learn to recognize these injuries and properly perform a neurological assessment. You'll also learn what information to collect and relay to emergency medical services. Recognizing symptoms and responding quickly can shorten recovery times and improve long-term outcomes.

The F-A-S-T survey is just that, a fast survey to determine if there are any gross abnormalities with the injured/ill person. The F-A-S-T survey consists of four (4) steps.

1. **F**acial Symmetry
    - Have the person smile and note any non-symmetrical abnormalities
2. **A**rms
    - Have the person close their eyes and hold out their arms. Note any drooping of one arm or the other or both
3. **S**peech/Sudden Headache.
    - Is the person's speech slurred or incoherent?
4. **T**ime
    - Note the time of the F-A-S-T assessment and notify EMS IMMEDATELY if any abnormalities are detected.

A brief medial history can also be obtained by asking questions using the **S.A.M.P.L.E** acronym.

S. **S**igns and **S**ymptoms
- Signs are what you can see, Symptoms are what the person reports to you

A. **A**llergies

- Is the person allergic to anything?

M. Medications
- Are they on any medications? This is also a good opportunity to determine if they have any alcohol or illegal drugs in their system.

P. Preexisting conditions.
- Does the person have any pre-existing conditions that may be contributing to the issue at hand? Asthma is a relevant pre-existing condition, but a tonsillectomy from 30 years ago is not (unless there is trauma to the throat).

L. Last oral intake.
- What they had to eat or drink and when.

E. Events leading up to the incident.

The Neurological Assessment is actually comprised of several individual assessments that target specific areas of the neurological system.

The Neurological Assessment is actually comprised of several individual assessments that target specific areas of the neurological system.

1. Vital Signs

While there are other vital signs that can be observed or measured, this assessment focuses on two critical signs: Pulse and Respiration Rate

2. Mental function

A. What is the injured/ill person's level of responsiveness?
   i. Alert
   ii. Verbal
   iii. Pain
   iv. Unresponsive

B. What is their Orientation
   i. Person (do they know their name?)
   ii. Place (do they know where they are?)
   iii. Time (do they know the day and time?)
   iv. Event (do they know what happened?)

C. Ability to Follow Commands
   i. "Stick out your tongue and close your eye".

D. Ability to repeat a simple phrase
   i. "Repeat the phrase, "no ifs, ands, or buts".

E. Name three (3) common objects
   i. "Cell phone, pen, and a water bottle".

F. Abstract Reasoning
   i. Can they explain a relationship between a father/son, student/teacher, pencil/paper

G. Calculations
   i. Counting backwards from 100 by 7s.

H. Memory recall

i. Have the person tell you (without showing them again) what those three objects were.

3. Cranial Nerves
   - **A.** Can the injured/ill person track an object with just their eyes
   - **B.** Facial Symmetry
     i. Have them close their eyes and smile – note any abnormalities
   - **C.** Hearing
     i. Is their hearing symmetrical

4. Motor Function
   - **A.** Upper Body
     i. Shoulders
     ii. Biceps
     iii. Triceps
     iv. Finger Spread
     v. Grip Strength
   - **B.** Lower Body
     i. Hip-Flexors
     ii. Quadriceps
     iii. Hamstrings
     iv. Foot-up
     v. Foot-down

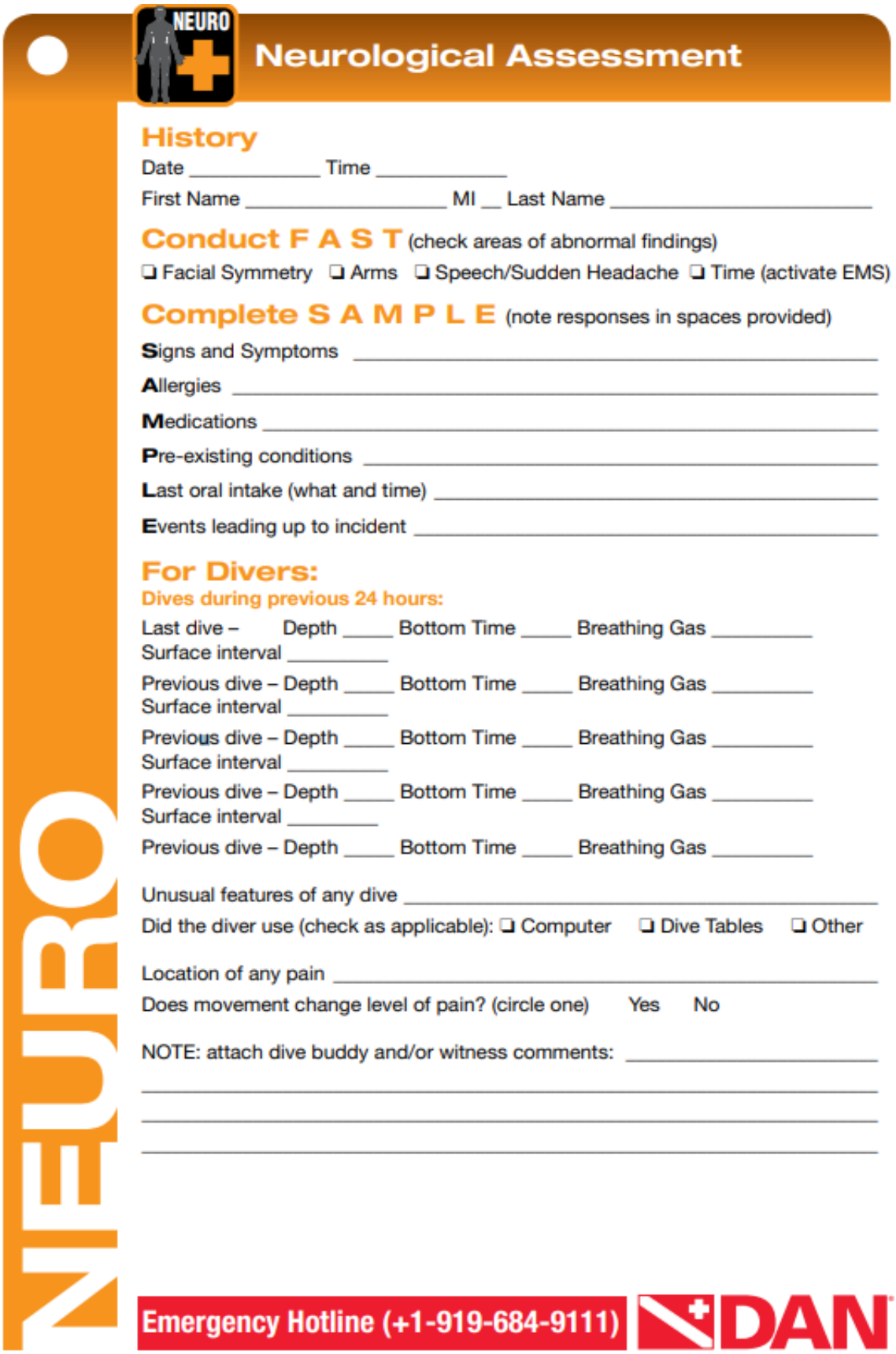
5. Coordination and Balance
   - **A.** Can they complete the 'finger-nose-finger' exercise with both hand, eyes open and eyes closed?
   - **B.** Are they able to walk steadily?
   - **C.** Romberg

The Neurological Exam should be repeated every hour, unless there is a marked change in the injured/ill person then the assessment can be run again.

When this assessment is conducted, please note your findings on a piece of paper or the DAN Neurological Assessment slate. Pass those findings to EMS when they arrive. This information is essential for the EMS personnel and physicians to help them better treat the person.

[1] https://professional.heart.org/idc/groups/ahamah-public/@wcm/@sop/@smd/documents/downloadable/ucm_503396.pdf
[2] Buzzacott P, Denoble PJ (editors). DAN Annual Diving Report 2018 Edition – A report on 2016 diving fatalities, injuries and incidents. Durham, NC: Divers Alert Network, 2018; pp. 112.

APPENDIX 1.3 DAN Neurological Slate



Neurological Assessment

NEURO

Vital Signs

Pulse _____ Respiration rate _____

Mental Function

Consciousness (check one):

- ❑ Alert
- ❑ Verbal
- ❑ Pain
- ❑ Unresponsive

Orientation (check erroneous answers):

- ❑ What is your name?
- ❑ Where are you?
- ❑ What is the day and time?
- ❑ Why are you here?

Ability to follow commands (check one) ❑ Yes ❑ No
"Stick out your tongue and close your eyes."

Ability to repeat a simple phrase ❑ Yes ❑ No
Ex.: "no if, ands, or buts."

Name 3 objects (able to complete – check one) ❑ Yes ❑ No

Abstract reasoning (able to explain relationship): ❑ Yes ❑ No
Ex.: Father/Son Student/Teacher Pencil/Paper

Calculations - count backwards from 100 by 7s (circle misses):
93 86 79 72 65 58 51 44 37 30 23 16 9 2

Memory - recall of 3 items identified earlier (check one): ❑ Yes ❑ No

Cranial Nerves

Eyes (circle any direction unable to look): Left Right Up Down

Facial Symmetry "Close your eyes and smile" ❑ Yes ❑ No

Hearing Symmetrical from about 1 foot (circle one): ❑ Yes ❑ No

Motor Function

Scale (note in blank next to area): Normal (N) Weak (W) Paralysis (P)

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

Coordination and Balance

Able to complete: Finger – Nose – Finger (check one) ❑ Yes ❑ No

Walk (check one) ❑ Normal ❑ Wobbly ❑ Unable

Romberg (check one) ❑ Yes ❑ No

Exam Repeated

Time _____ Comments _____

Time _____ Comments _____

Emergency Hotline (+1-919-684-9111)

DAN

Product Code: 361-3280 v2.1

APPENDIX 1.4 DAN Injury Report Summary

DAN.org

Injury Report Summary

Date and time of report ___ / ___ / _____ ; at ___ : ___ ❑ AM ❑ PM

Reporter _____ Phone number _____

Email _____ Relation to diver _____

Injured diver

Name _____ Phone number _____

Email _____ Age _____ Sex ❑ M ❑ F

Chief complaint

_____

_____

Dive history

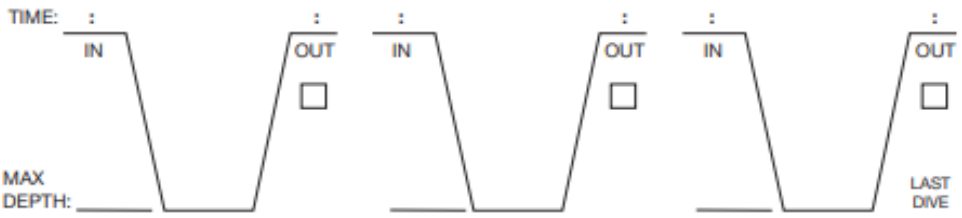
Location _____

Last dive end date ___ / ___ / _____ ; at ___ : ___ ❑ AM ❑ PM

Days in dive series _____ Breathing gas ❍ Air ❍ EANx ❍ Other _____

Dives in dive series _____ Maximum depth in dive series _____

Dive profile on day of incident: Provide time in, time out and mark symptoms onset



Describe any incidents during dive history

_____

_____

_____

_____

Oxygen first aid

Time O_2 started ___ : ___ ❑ AM ❑ PM Total time of O_2 delivery ____ hr ____ min

O_2 delivery mode ❑ Demand valve ❑ NRB (mask w/bag) ❑ Mask (no bag)

❑ Nasal cannula ❑ Other _____ ❑ Don't know (see Oxygen slate)

Regarding symptoms after O_2 initiation

After 30 min	❑ improving	❑ unchanged	❑ worsening
After 60 min	❑ improving	❑ unchanged	❑ worsening
After 90 min	❑ improving	❑ unchanged	❑ worsening
After 120 min	❑ improving	❑ unchanged	❑ worsening
After 6 hrs	❑ improving	❑ unchanged	❑ worsening

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Injury Report Summary

Neurological (see Neuro slate)

Mental function	❑ preserved	❑ altered	❑ not sure
Cranial nerves	❑ preserved	❑ altered	❑ not sure
Motor function (weakness)	❑ preserved	❑ altered	❑ not sure
Coordination and balance	❑ preserved	❑ altered	❑ not sure
Numbness / tingling	❑ preserved	❑ altered	❑ not sure

Musculoskeletal

Joint pain / discomfort	❑ none	❑ some	❑ not sure
Muscle soreness	❑ none	❑ some	❑ not sure
Back pain	❑ none	❑ some	❑ not sure
Lower back	❑ none	❑ some	❑ not sure
Mid back	❑ none	❑ some	❑ not sure
Upper back	❑ none	❑ some	❑ not sure

Cutaneous

Red rash	❑ none	❑ some	❑ not sure
Marbled / bluish skin	❑ none	❑ some	❑ not sure
Itchiness	❑ none	❑ some	❑ not sure
Tenderness	❑ none	❑ some	❑ not sure
Swelling / edema	❑ none	❑ some	❑ not sure

Other suspicious findings (please describe what you think might be relevant)

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DAN

Product Code: 381-4070 v1.0

APPENDIX 1.5 Diving Medical Guidance to the Physician

Diving Medical Guidance to the Physician

715DT_Diving_Medical_Guidance_Draft11.pdf (uhms.org)

These guidelines are typically used by physicians who have been approached by an individual wishing to take part in recreational SCUBA diving or freediving. They will usually have completed a WRSTC Diver Medical Participant Questionnaire.

Recreational SCUBA diving and freediving, hereafter – diving, is performed safely by many people. The risks associated with diving may be increased by certain physical conditions and the relationship to diving may not be readily appreciated by candidates. Thus, it is important to screen divers for such conditions.

A physical examination for diving focuses on conditions that may put a diver at increased risk for decompression sickness, pulmonary over inflation with subsequent arterial gas embolization and other conditions such as loss of consciousness, which could lead to drowning. Additionally, divers must be able to withstand some degree of thermal stress, the physiological effects of immersion and have sufficient physical and mental reserves to deal with normal diving and possible emergencies.

The history, review of systems and physical examination should include as a minimum the points listed below. The list of conditions that might adversely affect the diver is not exhaustive, but contains the most commonly encountered medical problems. The brief introductions serve as an alert to the nature of the risk posed.

The potential diver and his or her physician must weigh the benefits to be had by diving against an increased risk of injury or death due to the individual's medical condition. As with any recreational activity, there are limited data for diving with which to calculate the mathematical probability of injury. Experience and physiological principles only permit a qualitative assessment of relative risk.

For the purposes of this document:

Severe Risk implies that an individual is believed to be at substantially elevated risk of injury compared with the general population. The consultants involved in drafting this document would generally discourage a candidate with such medical problems from diving.

Relative Risk refers to a moderate increase in risk, which in some instances may be acceptable. To decide as to whether diving is contraindicated for this category of medical problems; physicians must base their judgment on an assessment of the individual candidate.

Temporary Risk refers to medical problems which may preclude diving but are temporary in nature, allowing the individual to dive after they have resolved.

Following many of the sections is a short list of references that give more information on the topic. The lists are not exhaustive, but examples that may be of particular relevance. Diagnostic studies and specialty consultations should be obtained as indicated to determine the candidate's status. A list of references is included to aid in clarifying issues that arise.

The following sections are included in this document:

Behavioral Health - Cardiovascular Systems – Gastrointestinal - Hematological Metabolic and Endocrinological – Neurological – Orthopedic – Otolaryngologic – Pulmonary

BEHAVIORAL HEALTH

Behavioral health is one of the most difficult aspects of diver candidate evaluation, because many relevant potential problems may not be apparent and are not easily assessed in an office consultation. This is also an aspect of evaluating suitability for diving in which the diving instructor, who observes the candidate in the field, must also play a part. The diving candidate must be capable of learning and applying a theoretical knowledge base for diving. Significant intellectual handicap is incompatible with independent diving.

Motivational and behavioral traits should be considered if there is obvious related history or problems become apparent during training. Candidates who appear unmotivated, irresponsible, or prone to distraction or panic should be discouraged from diving.

A history of psychiatric disease is not in and of itself disqualifying. Psychotropic medications can be problematic if they are associated with altered level of awareness or sedation, or may alter seizure threshold, (e.g., benzodiazepines, narcotics). What is of primary importance is the individual's current psychological state, and anticipated impact of their mental/psychological history relative to their ability to navigate the potential and anticipated challenges and stresses of diving. The level of baseline mental health, with or without medication, is therefore of greater importance than the theoretical effects of a given medication or class of medications while diving.

Candidates with major depression, bipolar disorder, psychoses, or current drug or alcohol abuse should not dive. Even if a candidate is well controlled on medication (see below for discussion of SSRIs), there may be risks associated with the use of potent antidepressant and antipsychotic drugs in the underwater environment. The tendency for potent psychotropic drugs to impair concentration and cause drowsiness is of particular concern, as is their potential to lower the seizure threshold, and the lack of research data evaluating potential interactions with the pressure environment.

Candidates with a past history of major psychiatric problems or drug/alcohol abuse who are stable without medication and withdrawn from drugs and alcohol can be considered on a case-by-case basis, preferably by a physician trained in diving medicine.

Perhaps the most challenging group of candidates from a behavioral perspective in the modern context is those with – mild - depression (those who have never been hospitalized for psychiatric treatment or placed on psychiatric hold or attempted self-harm) or those with mood disturbances treated with selective serotonin reuptake inhibitors (SSRIs). The general use of SSRIs has increased dramatically over recent years in many countries. There are no data describing use of SSRIs among divers, but anecdotally the numbers are significant. Concerns over diving while using SSRIs relate to the disorder being treated and to the potential interaction between the drug and diving. There are many candidates taking these drugs whose mild mood disturbance would not of itself constitute a reason to avoid diving. Evaluation of the potential for an interaction between SSRIs and diving is more difficult. There are no published reports of apparent problems despite what is almost certainly a large number of divers using them. Diving while taking an SSRI is probably acceptable provided that: the treated mood disturbance was mild prior to treatment and has been well controlled by the drug; the drug has been used for at least one month without evidence of relevant side effects; and the candidate is fully counseled about (and accepting of) the relevant risks. If the candidate is considering diving beyond the traditional recreational envelope or using gases other than air, he or she should consult an appropriate diving medicine specialist.

There are also potential risks associated with other drugs used to treat psychiatric conditions, including serotonin-norepinephrine reuptake inhibitors (SNRIs), tricyclic antidepressants (TCAs), monoamine

oxidase inhibitors (MAOIs), and atypical agents (including bupropion). Candidates on these medications should be evaluated on a case-by-case basis.

Severe Risk Conditions

- Active major depression, bipolar or psychotic disorder
- History of panic attacks
- Drug or alcohol abuse
- Severe intellectual handicap

Relative Risk Conditions

- Questionable motivation to dive – solely to please spouse, partner or family member, or to prove oneself in the face of personal fears
- Developmental delay/Cognitive impairment
- Anxiety disorder
- History of drug or alcohol abuse
- History of major depression, bipolar, or psychotic disorder
- Use of psychotropic medications
- Claustrophobia or agoraphobia

CARDIOVASCULAR SYSTEMS

Diving places increased demands on the heart. Immersion itself results in an increase in cardiac preload, as does peripheral vasoconstriction with an increase in blood pressure. These changes are typically accompanied by sustained mild to moderate exercise. Perhaps not surprisingly, almost 30% of recreational diving fatalities have a cardiac event as the disabling injury. It follows that the primary goals of evaluating the cardiovascular system in a diving candidate are to identify those who appear to be at risk of myocardial ischemic events, myocardial insufficiency, or other cardiac events (such as arrhythmias) that might disable a diver underwater, and to establish that the candidate has an adequate exercise capacity for diving.

With the above in mind, some cardiac diagnoses are considered to render a candidate unsuitable for diving, including: untreated symptomatic coronary artery disease, dilated or obstructive or previous stress cardiomyopathy, congestive heart failure, moderate or worse pulmonary hypertension, long QT syndrome or other arrhythmia-inducing channelopathies, paroxysmal arrhythmias causing unconsciousness or impairment of exercise capacity, poor exercise capacity of apparent cardiac origin, moderate to severe valvular lesions, complex congenital cardiac disease, atrial septal defect, and the presence of an implanted cardiac defibrillator.

Potential candidates with any of the following should be investigated to exclude a disqualifying condition:

- Exertional chest pain, dyspnea, palpitations, or syncope
- Unexplained syncope/near syncope
- Heart murmur

- Hypertension
- Family history of premature death (sudden/unexpected or cardiac) before age 50, cardiac disease before age 50, cardiomyopathy, arrhythmia, or channelopathy

It is strongly recommended that these candidates be evaluated in consultation with a physician trained in diving medicine and possibly a cardiologist. Successful treatment of disqualifying cardiac disorders may result in a candidate becoming suitable for diving. For example, a candidate with coronary artery disease (including previous myocardial infarction) who has been successfully revascularized may be suitable for diving if inducible ischemia can be excluded and adequate exercise capacity demonstrated (for example, in an exercise stress test). The capacity to sustain exercise at 6 MET (metabolic equivalent of task; 1 MET approximates resting metabolic rate, assumed to approximate an oxygen consumption of 3.5 mL/kg/min; 6 MET approximates an effort of six times resting metabolic rate, approximating an oxygen consumption of 21 mL/kg/min is a pragmatic expectation for a recreational diver, but there may be an occasional need to exercise transiently at higher levels during diving. Similarly, a candidate with a history of paroxysmal arrhythmia who has undergone successful pathway ablation may be suitable for diving. Candidates with any of the above diagnoses who wish to consider diving after appropriate treatment are best referred to a physician trained in diving medicine for evaluation.

Asymptomatic candidates over 45 years of age with risk factors for coronary artery disease should undergo evaluation by a physician. Individuals with a predicted 5-10-year risk of a cardiovascular event >10% using a cardiac risk calculator should be investigated for coronary disease unless they provide a credible history of exercise capacity which renders significant coronary disease very unlikely. A coronary calcium score is a suitable initial investigation, and a myocardial perfusion scan, stress echocardiogram, or CT coronary angiogram should be considered in following up a positive calcium score. Consideration of a tailored investigation pathway for the individual diving candidate is ideally undertaken by a cardiologist in consultation with a physician trained in diving medicine. Candidates who prove to have inducible ischemia or obstructive lesions justifying intervention should not dive until completion of the intervention and demonstration of its success. Candidates with non-obstructive coronary disease not requiring invasive intervention should have aggressive management of risk factors and may be suitable for diving if adequate exercise capacity can be demonstrated. Although an exercise ECG is relatively insensitive to early coronary disease, it has the advantage of demonstrating exercise capacity and can be modified to test sustained exercise at 6 MET.

Left ventricular hypertrophy (LVH) is a risk factor for arrhythmias, which may be induced by exercise or immersion. Candidates for diving with this condition should be counseled about the risks of diving.

A patent foramen ovale (PFO) that exhibits right-to-left shunting with no or minimal provocation is a risk factor for serious neurological decompression sickness. In established divers, such lesions are usually discovered by bubble contrast echocardiography conducted after a relevant episode of decompression sickness. These divers are usually advised either to cease diving, modify their diving to reduce venous bubble formation (venous bubbles crossing from right to left are almost certainly the vectors of harm in this setting), or to have the PFO repaired. Occasionally, new diver candidates have a previously discovered PFO, and in such cases an objective assessment of the shunting behavior of the lesion is required in order to adequately counsel the candidate about the implied risks in diving. If not already done, this is best achieved using bubble contrast transthoracic echocardiography at rest and with provocative maneuvers. It is strongly recommended that the results of such tests are discussed with a physician trained in diving medicine. Routine screening of all diving candidates for PFO is not recommended.

In relation to some specific cardiovascular diagnoses: Treated hypertension with adequate control is

acceptable in diving in the absence of other risk factors that would meet a risk threshold indicating screening for coronary artery disease.

Atrial Fibrillation that is adequately rate-controlled in a candidate without inducible myocardial ischemia and who exhibits adequate exercise capacity is acceptable in diving. However, many such candidates are anticoagulated and the risks of diving whilst anticoagulated would need to be understood and carefully considered by the candidate. This is best achieved through discussion with a physician trained in diving medicine.

Immersion pulmonary edema is a problem that has been seen in swimmers, compressed gas divers, and free divers.

The condition may be under-diagnosed. Risk factors include hypertension, valvular disease, diastolic dysfunction, cardiomyopathies, pulmonary hypertension, hyperhydration, immersion, cold stress, constrictive garments, exercise, and for compressed gas divers, increased breathing resistance (affected by equipment, gas density, and body position), and for free divers, pulmonary squeeze due to compression during descent. A single episode of immersion pulmonary edema may contra-indicate further diving if no modifiable risk factors are found. Repetitive cases represent a strong contra-indication. A diver or new diving candidate with such a history should be referred to a physician trained in diving medicine for discussion of the relevant issues.

Candidates with pacemakers may be able to dive, though pacemaker-dependent candidates should consider the risk carefully. The pathologic process that necessitated the pacemaker should be considered as should the candidate's functional capacity (see above). Pacemakers must be certified by the manufacturer as able to withstand the pressure changes involved in recreational diving. Devices vary in this regard, but diving beyond 30 meters/100 feet with any of them is unwise.

Severe Risk Conditions

- Untreated symptomatic coronary artery disease
- Dilated or obstructive cardiomyopathy
- Heart failure
- Pulmonary hypertension
- Long QT syndrome or other arrhythmia-inducing channelopathies
- Paroxysmal arrhythmias causing unconsciousness or impairment of exercise capacity
- Poor exercise capacity of apparent cardiac origin
- Moderate to severe valvular lesions
- Complex congenital cardiac disease
- Atrial septal defect
- Presence of an implanted cardiac defibrillator
- Multiple episodes of immersion pulmonary edema

Relative Risk Conditions

- Treated coronary artery disease

• Collectively, risk factors such as age >45 years, hypertension, smoking, elevated cholesterol and a positive family history may indicate investigation for coronary artery disease

• History of dysrhythmias requiring medication for suppression

• Mild valvular lesions (need periodic re-evaluation)

• Cardiac prostheses or arrhythmias requiring anticoagulation

• Pacemakers

• Single previous episode of immersion pulmonary edema

• Marfan syndrome or other connective tissue disorder (severe risk if there is a history of dissection)

• Left ventricular hypertrophy

References

Denoble PJ, Holm JR, eds. Patent Foramen Ovale and Fitness to Dive Consensus Workshop Proceedings. Durham, NC: Divers Alert Network, 2015; 160 pp.

Kumar M, Thompson PD. A literature review of immersion pulmonary edema. Physic Sportsmed. 2018; 47(2):148-151.

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Smart D, Mitchell SJ, Wilmshurst P, Turner M, Banham N. Joint position statement on persistent (patent) foramen ovale and diving. South

Pacific Underwater Medicine Society (SPUMS) and the United Kingdom Sports Diving Medical Committee (UKSDMC). Diving Hyperb Med.2015; 45(2), 129-131.

GASTROINTESTINAL

In general terms, there should be no gastrointestinal conditions present that increase the likelihood of vomiting, reflux, bleeding, perforation, diarrhea, or pain. Altered anatomical relationships secondary to surgery or malformations that lead to gas trapping may cause serious problems. Trapped gas expands as the diver surfaces and can lead to rupture or, in the case of the upper GI tract, emesis. Emesis underwater may lead to drowning. Dive activities may take place in areas remote from medical care, and the possibility of acute recurrences of disease must be considered.

Severe Risk Conditions

• Active inflammatory bowel disease

• Gastric outlet obstruction of a degree sufficient to produce recurrent vomiting

• Chronic or recurrent small bowel obstruction

• Severe gastroesophageal reflux

• Achalasia

- Paraesophageal hernia
- Gastroparesis

Relative Risk Conditions

- Inflammatory bowel disease when quiescent
- Functional bowel disorders

Temporary Risk Conditions

- Peptic ulcer disease associated with pyloric obstruction or severe reflux
- Unrepaired hernias of the abdominal wall large enough to contain bowel within the hernia sac could incarcerate

References

Bennett PB, Cronje FJ, Campbell E, Marroni A, Pollock NW. Assessment of Diving Medical Fitness for SCUBA Divers and Instructors. Flagstaff, AZ: Best Publishing. 2006; 241 pp.

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US Navy Diving Manual, Volume 2, Revision 7. Gastrointestinal distension.NAVSEA 0910-LP-115-1921. Naval Sea Systems Command: Washington, DC, 2016: 3-31-3-32.

HEMATOLOGICAL

Abnormalities resulting in altered rheological properties may theoretically increase the risk of decompression sickness.

Bleeding disorders could worsen the effects of otic or sinus barotrauma and exacerbate the injury associated with inner ear or spinal cord decompression sickness. Spontaneous bleeding into the joints (e.g., in hemophilia) may be difficult to distinguish from decompression illness. Thrombophilic disorders (hereditary or acquired) may facilitate vascular thrombosis and susceptibility to DCS.

Relative Risk Conditions

- Sickle cell disease
- Polycythemia vera
- Leukemia
- Hemophilia/Impaired coagulation
- Recent blood transfusion
- Recent thrombotic episodes
- Hereditary hypercoagulability conditions
  - Factor V Leiden
  - Prothrombinficiency
  - Protein S deficiency
  - Antithrombin deficiency

Temporary Risk Conditions

• Prescription of anti-coagulant drugs of any kind, including platelet aggregation inhibitors

References

Bennett PB, Cronje FJ, Campbell E, Marroni A, Pollock NW. Assessment of Diving Medical Fitness for SCUBA Divers and Instructors. Flagstaff, AZ: Best Publishing. 2006; pp 97-104.

Parker J. Haematology. In: The Sports Diving Medical, 2nd Edition. JL Publications, Melbourne 2002, pp 100-102.

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METABOLIC AND ENDOCRINOLOGICAL

States of altered hormonal or metabolic function should be assessed according to their impact on the individual's ability to tolerate the moderate exercise requirement and environmental stress of sport diving. Obesity may predispose the individual to decompression sickness, can impair exercise tolerance and is a risk factor for coronary artery disease.

Severe Risk Conditions

• The potentially rapid change in level of consciousness associated with hypoglycemia in diabetics on insulin therapy or certain oral hypoglycemic medications can result in drowning. Diving is therefore generally contraindicated, except when conducted according to the consensus guidelines for recreational diving with diabetes.

• Pregnancy: The effect of venous emboli formed during decompression on the fetus has been proven to be potentially detrimental to fetus health. Diving is therefore not recommended during any stage of pregnancy or for women actively seeking to become pregnant. (Note that in cases where pregnancy is discovered after diving, it is not considered grounds for termination.)

Relative Risk Conditions

• Hormonal excess or deficiency

• Obesity

• Renal insufficiency

References

Damnon F, de Rham M, Baud D. Should a pregnancy test be required before SCUBA diving? Br J Sports Med. 2016; 50(18): 1159-1160.

Dear GdeL, Pollock NW, Uguccioni DM, Dovenbarger J, Feinglos MN, Moon RE. Plasma glucose response to recreational diving in divers with insulin-requiring diabetes. Undersea Hyperb Med. 2004; 31(3): 291-301.

Held HE, Pollock NW. The risks of diving while pregnant - reviewing the research. Alert Diver. 2007; Mar/Apr: 48-51.

Pollock NW, Uguccioni DM, Dear GdeL. Diabetes and recreational diving: guidelines for the future. Diving Hyperb Med 2006; 36(1): 29-34.

NEUROLOGICAL

Neurological illnesses, especially those affecting the spinal cord and peripheral nerves, should be assessed according to the degree of functional compromise present. Any condition that diminishes the reserve capacity of the spinal cord may reduce the likelihood of a full functional recovery, should an episode of spinal decompression sickness occur. Conditions in which there can be a waxing and waning of neurological symptoms and signs, such as migraine or demyelinating disease, may contraindicate

diving, because an exacerbation or attack of the pre-existing disease (e.g., migraine headache with aura) may be difficult to distinguish from neurological decompression sickness. A history of head injury resulting in unconsciousness should be evaluated for risk of seizure. A diagnosis of epilepsy is considered an absolute contraindication for diving.

Severe Risk Conditions

Any abnormalities where there is a significant probability of unconsciousness, hence putting the diver at increased risk of drowning. Divers with spinal cord or brain abnormalities where perfusion is impaired may be at increased risk of decompression sickness.

Some conditions are as follows:

- Epilepsy or history of seizures, other than childhood febrile seizures
- History of transient ischemic attack (TIA) or cerebrovascular accident (CVA)
- History of serious (central nervous system, cerebral or inner ear) decompression sickness with residual deficits
- Recurrent episodes of loss of consciousness or fainting

Relative Risk Conditions

Complicated migraine headaches, particularly if severe, frequent or presenting with neurological manifestations e.g., motor, sensory or cognitive disturbance.

- History of head injury with sequelae other than seizure
- Herniated nucleus pulposus
- Intracranial tumor or aneurysm
- Peripheral neuropathy
- Multiple sclerosis
- Trigeminal neuralgia
- History of spinal cord or brain injury
- Parkinson's disease

References

Bennett PB, Cronje FJ, Campbell E, Marroni A, Pollock NW. Assessment of Diving Medical Fitness for SCUBA Divers and Instructors. Flagstaff, AZ: Best Publishing. 2006; 241 pp. 173-188.

Burkett JG, Nahas-Geiger SJ. Diving Headache. Curr Pain Headache Rep. 2019;23(7):46.

Massey EW, Moon RE. Neurology and Diving. Handb Clin Neurol. 2014;120:959-969.

Rosinska J, Łukasik M, Kozubski W. Neurological complications of underwater diving. Neurol Neurochir Pol. 2015;49(1):45-51.

UK Diving Medical Committee, Neurological disease. http://www.ukdmc.org/medical-conditions/neurological-disease/

ORTHOPEDIC

Mobility above and under the water is an essential requirement for any sport or recreational diver. Entering the water from shore or a dive boat, underwater propulsion and exiting into a dive boat or onto shore should be possible without great difficulty.

Relative impairment of mobility, particularly on a boat or ashore with equipment weighing up to 30

kg/66 lbs. (or significantly more in the case of cold water or for more equipment intensive activities, for example), must be assessed. Orthopedic conditions of a degree sufficient to impair exercise performance may increase the risk.

In some cases, like amputations resulting in various degrees of disability, it would be advisable to judge case by case by a physician trained in diving medicine.

Relative Risk Conditions

- Amputation
- Scoliosis: must also assess impact on respiratory function and exercise performance
- Aseptic necrosis: possible risk of accelerated progression due to the effects of decompression
- Disc prolapses
- Habitual luxation (e.g., shoulder, hip, patella)
- Degenerative joint diseases

Temporary Risk Conditions

- Back pain
- Fractures until complete healing of bone and soft tissue and positive weight bearing tests taking into consideration

  the weight of the used dive gear on land
- Muscle-tendon and ligament injuries
- Completion of physiotherapy/rehabilitation regimes

References

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OTOLARYNGOLOGIC

Equalization of pressure must take place during ascent and descent between ambient water pressure and the external auditory canal, middle ear, and paranasal sinuses. Failure of this to occur results at least in pain and in the worst-case rupture of the occluded space with disabling and possible lethal consequences. The inner ear is fluid filled and therefore not compressible. The flexible interfaces between the middle and inner ear, the round and oval windows are, however, subject to pressure changes.

Previously ruptured but healed round or oval window membranes may be prone to reinjury with marked overpressurization during vigorous or explosive Valsalva maneuvers. The larynx and pharynx must be free of obstruction to airflow. The laryngeal and epiglottic structures must function normally to prevent aspiration. Mandibular and maxillary function must be capable of allowing the candidate to hold a SCUBA regulator mouthpiece. Individuals who have had mid-face fractures may be prone to barotrauma and rupture of the air-filled cavities involved.

Severe Risk Conditions

- Monomeric tympanic membrane (TM)
- Open TM perforation

- Tube myringotomy
- History of stapedectomy
- History of ossicular chain surgery
- History of inner ear surgery
- Facial nerve paralysis secondary to barotrauma
- Inner ear disease other than presbycusis
- Uncorrected upper airway obstruction
- Laryngectomy or status post partial laryngectomy
- Tracheostomy
- Uncorrected laryngocele
- History of vestibular decompression sickness
- Symptomatic nasal or sinus polyps
- Ménière's disease

Relative Risk Conditions

- Recurrent otitis externa
- Significant obstruction of external auditory canal
- History of significant cold injury to pinna
- Eustachian tube dysfunction
- Recurrent otitis media or sinusitis
- History of TM perforation
- History of tympanoplasty
- History of mastoidectomy
- Significant conductive or sensorineural hearing impairment
- Facial nerve paralysis not associated with barotrauma
- Full prosthodontic devices
- History of mid-face fracture
- Unhealed oral surgery sites
- History of head and/or neck therapeutic radiation
- History of temporomandibular joint dysfunction
- History of round window rupture
- Symptomatic nasal septum deviation
- Recurrent benign positional vertigo
- Otosclerosis

References

Lechner M, Sutton L, Fishman JM, Kaylie DM, Moon RE, Masterson L, et al. Otorhinolaryngology and diving - part 1: otorhinolaryngological hazards related to compressed gas SCUBA diving: a review. JAMA Otolaryngology Head Neck Surg. 2018;144(3):252-258.

Lechner M, Sutton L, Fishman JM, Kaylie DM, Moon RE, Masterson L, et al. Otorhinolaryngology and diving – part 2: otorhinolaryngological fitness for compressed gas SCUBA diving: a review. JAMA Otolaryngology Head Neck Surg. 2018;144(3):259-263.

Molvaer OI. Otorhinolaryngological aspects of diving. In: Bennett PB, Elliott DH, eds. Physiology and Medicine of Diving, 5th ed. Saunders,Edinburgh, 2003. P227-P264.

Wendling J, et al. Otorhinolaryngology. In: Medical Assessment of Fitness to Dive. International Edition. Hyperbaric Editions CH 2502 Biel,2001. Pp25-48. ISBN 3-9522284-1-9.

PULMONARY

Any process or lesion that impedes airflow from the lungs places the diver at risk for pulmonary over inflation with alveolar rupture and the possibility of cerebral air embolization. Many interstitial diseases predispose to spontaneous pneumothorax: asthma, chronic obstructive pulmonary disease (COPD), cystic or cavitating lung diseases may all cause air trapping.

Undersea and Hyperbaric Medical Society and British Thoracic Society guidelines recommend that asthmatics should be advised not to dive if they have wheeze precipitated by exercise, cold, or emotion. Asthmatic individuals who are currently well controlled and have normal pulmonary function tests may dive if they have a negative exercise test. Many people with asthma have well controlled disease and are physically fit. They may, however, show minor abnormalities on spirometry at rest or after exercise. Those with a history of severe or unpredictable acute exacerbations are not fit to dive. For those without such a history, the overriding consideration is that the candidate must be physically fit and not impaired after exercise or cold air breathing, which is the normal case of gas expanding from within a SCUBA cylinder.

The best way to assess fitness is with an exercise test. Inhalation challenge tests (e.g., using histamine, hypertonic saline

or methacholine) are not sufficiently standardized to be interpreted in the context of SCUBA diving. If persons with breathing issues are cleared to dive, they need to take their regular inhalers and should not dive if suffering symptoms suggestive of exacerbation. Note that the FEV1/FVC ratio may be reduced below predicted, but provided there is no deterioration after exercise and the person performs well on the exercise test, a mildly obstructed spirometric tracing on its own is not a contraindication to diving.

A pneumothorax that occurs while diving may be catastrophic. As the diver ascends, trapped gas expands and could produce a tension pneumothorax. In addition to the risk of pulmonary barotrauma, respiratory disease due to either structural disorders of the lung or chest wall or neuromuscular disease may impair exercise performance. Individuals who have experienced spontaneous pneumothorax are at risk of recurrence, and should avoid diving, even after a surgical procedure designed to prevent recurrence (such as pleurodesis). Surgical procedures either do not correct the underlying lung abnormality (e.g., pleurodesis, apical pleurectomy) or may not totally correct it (e.g., resection of blebs or bullae). A high-resolution CT (HRCT) scan of the lungs may reveal cysts or blebs that represent a risk. Persons who have no parenchymal abnormality on HRCT and have had bilateral surgical pleurodesis (including VATS pleurodesis) may be cleared to dive. However, in most cases, a history of spontaneous pneumothorax will be an absolute contraindication to diving. Traumatic pneumothorax is

not a problem as the likelihood of subsequent spontaneous pneumothorax is vanishingly low.

Structural disorders of the chest or abdominal wall or neuromuscular disorders may impair cough, which could be life threatening if water is aspirated. Respiratory limitation due to disease is compounded by the combined effects of immersion (causing a restrictive deficit) and the increase in gas density, which increases in proportion to the ambient pressure (causing increased airway resistance). Formal exercise testing may be helpful.

The emergence of COVID-19 has placed an additional layer of complexity related to fitness to dive evaluations. It is beyond the scope of this document to prescribe or mandate specific tests or timelines related to fitness to dive determinations. What is of importance is awareness of the potential body systems effected by COVID-19, and to take a thoughtful and thorough history related to disease course, time since the infection resolved, and state of physical and mental health at the time of the examination.

Clinical factors that are important to consider include symptom severity during the infection and need for intensive care (e.g., ventilator support). Disease severity likely correlates with the extent of pulmonary injury and potential cardiac involvement, and in the case of intubation, may be associated with severe deconditioning, muscle atrophy and even post-traumatic stress. As such, assessment of the diver with a history of COVID-19, may require more than just a pulmonary evaluation. At the time of this publication, the medical community does not have sufficient data to support arbitrary requirements for specific testing, nor duration of post-infection convalescence after which individuals can be considered safe to return to diving.

The following documents provide current guidance on investigation of COVID-19 patients prior to diving. This is an area that is evolving and updated often; please see these resources for more current information and considerations regarding these issues.

UC San Diego Guidelines for Evaluation of Divers during COVID-19 pandemic

(https://health.ucsd.edu/coronavirus/Documents/UC%20San%20Diego%20Guidelines%20for%20Evaluation%20of%20Divers%20during%20COVID-19%20pandemic.pdf)

Centers for Disease Control and Prevention, People Who Are at Higher Risk for Severe Illness

(https://www.cdc.gov/coronavirus/2019-ncov/downloads/COVID19-What-You-Can-Do-High-Risk.pdf)

European Committee for Hyperbaric Medicine and European Underwater and Baromedical Society, COVID-19 Pandemic – Position Statements

(http://www.echm.org/documents/English-EUBS-ECHM-position-on-diving-and-COVID-19-26th-March-2020.pdf)

For those looking for aseptic practices, the following resources may be useful:

Divers Alert Network Americas / www.DAN.org

Divers Alert Network Europe / www.DANEurope.org

Severe Risk Conditions

- History of spontaneous pneumothorax (see notes)
- Impaired exercise performance due to respiratory disease
- Respiratory impairment secondary to cold gas breathing

• Pulmonary hypertension

Relative Risk Conditions

• Asthma, reactive airway disease (RAD), exercise-induced bronchospasm (EIB) or COPD (see notes)

• Solid, cystic or cavitating lesion

• Pneumothorax secondary to:

– Thoracic surgery

– Trauma or pleural penetration (see notes)

– Previous overinflating injury

• Obesity

• History of immersion pulmonary edema or restrictive disease

• Interstitial lung disease: may increase the risk of pneumothorax and likely to limit exertion

• Sleep apnea

References

Godden D, Currie G, Denison D, Farrell P, Ross J, Stephenson R, Watt S, Wilmshurst P. British Thoracic Society guidelines on respiratory aspects of fitness for diving. Thorax. 2003;58:3-13.

APPENDIX 1.60 RECREATIONAL DIVING MEDICAL SCREENING SYSTEM

Recreational Diving Medical Screening System:

Information, questionnaire and evaluation form can be downloaded here:
https://www.uhms.org/resources/recreational-diving-medical-screening-system.html

In 2020, the international Diver Medical Screen Committee (DMSC) released a new diver medical screening system and guidance to the physician. The following is an overview of that system.

Three-Part System

1. **Diver Medical Participant Questionnaire** is completed by the diving candidate.
2. **Diver Medical Physician's Evaluation Form** is completed by the physician evaluating the diving candidate for diving suitability when a physician's approval to dive is necessary.
3. **Diving Medical Guidance** is a peer reference for physicians seeking additional information regarding how specific conditions relate to diving.

Diver Medical Participant Questionnaire / Diver Medical Physician's Evaluation Form:

Diving Medical Guidance From UHMS

System Goals/Purposes

1. Reflect current medical thinking and evidence-based screening criteria.
2. Allow as many individuals to dive as reasonably possible.
3. Be user-friendly for diving participants, supervising diving professionals and physicians.
4. Identify and inform potential participants who may be at significant risk if they dive, that they need to secure medical evaluation of that risk.
5. Assist Doctors of Medicine evaluating diving candidates as to whether or not they can appropriately take part in the anticipated activity with medical decision support and references provided, where a physician's involvement is indicated.

Development and Endorsement

Beyond the endorsement by its developers, the DMSC, the new screening system reflects input from the Undersea & Hyperbaric Medical Society Diving Committee (James Chimiak, Co-chair, Charlotte Sadler, Co-chair and Nicholas Bird, UHMS President), the Divers Alert Network and the Hyperbaric Medicine Division, University of California, San Diego. It is endorsed by the UHMS.

The UHMS provides global access to the Diving Medical Guidance document via the UHMS website. The guidance document also includes references to medical journals and additional sources of related information to help medical professionals make informed decisions about a candidate's medical suitability for recreational diving.

History

The Recreational SCUBA Training Council (RSTC) diving medical screening system was first published in 1989. This screening questionnaire was a collaborative project orchestrated by and through

the UHMS Diving Committee and subsequently endorsed by the RSTC. Since then, this tool has been the most frequently-used method of efficiently and effectively screening SCUBA divers and free divers for training or diving activity participation.

After almost 30 years, there was sufficient evidence to support a revision and an independent international group of diving medical experts, the Diver Medical Screen Committee (DMSC), was brought together in 2017 to initiate an evidence-based review. The DMSC is independent from the UHMS, but the final version of the 2020 diver medical screening system includes significant input from the UHMS, DAN and other experts. The updated diver screening questionnaire underwent field testing for efficacy and screening sensitivity and was published in June 2020.

Copyright Notice

Diver Medical Screen Committee

The Diver Medical Screen Committee (DMSC) consists of international diving medicine experts, that worked independently but collaboratively with the UHMS Diving Committee as well as other experts in the field. The DMSC brings to bear a wealth of expertise in diving medicine. Facilitators of the diver medical screening system and related documents meet on a periodic basis to review and refresh the diver questionnaire and diving medical guidance in concert with the UHMS Diving Committee to ensure the system's currency and appropriateness.

Diver Medical | Participant Questionnaire

Recreational scuba diving and freediving requires good physical and mental health. There are a few medical conditions which can be hazardous while diving, listed below. Those who have, or are predisposed to, any of these conditions, should be evaluated by a physician. This Diver Medical Participant Questionnaire provides a basis to determine if you should seek out that evaluation. If you have any concerns about your diving fitness not represented on this form, consult with your physician before diving. If you are feeling ill, avoid diving. If you think you may have a contagious disease, protect yourself and others by not participating in dive training and/or dive activities. References to "diving" on this form encompass both recreational scuba diving and freediving. This form is principally designed as an initial medical screen for new divers, but is also appropriate for divers taking continuing education. For your safety, and that of others who may dive with you, answer all questions honestly.

Directions

Complete this questionnaire as a prerequisite to a recreational scuba diving or freediving course.
Note to women: If you are pregnant, or attempting to become pregnant, *do not dive*.

1	I have had problems with my lungs/breathing, heart, blood, or have been diagnosed with COVID-19.	Yes ☐ Go to box **A**	No ☐
2	I am over 45 years of age.	Yes ☐ Go to box **B**	No ☐
3	I struggle to perform moderate exercise (for example, walk 1.6 kilometer/one mile in 14 minutes or swim 200 meters/yards without resting), OR I have been unable to participate in a normal physical activity due to fitness or health reasons within the past 12 months.	Yes ☐*	No ☐
4	I have had problems with my eyes, ears, or nasal passages/sinuses.	Yes ☐ Go to box **C**	No ☐
5	I have had surgery within the last 12 months, OR I have ongoing problems related to past surgery.	Yes ☐*	No ☐
6	I have lost consciousness, had migraine headaches, seizures, stroke, significant head injury, or suffer from persistent neurologic injury or disease.	Yes ☐ Go to box **D**	No ☐
7	I am currently undergoing treatment (or have required treatment within the last five years) for psychological problems, personality disorder, panic attacks, or an addiction to drugs or alcohol; or, I have been diagnosed with a learning disability.	Yes ☐ Go to box **E**	No ☐
8	I have had back problems, hernia, ulcers, or diabetes.	Yes ☐ Go to box **F**	No ☐
9	I have had stomach or intestine problems, including recent diarrhea.	Yes ☐ Go to box **G**	No ☐
10	I am taking prescription medications (with the exception of birth control or or anti-malarial drugs other than mefloquine (Lariam).	Yes ☐*	No ☐

Participant Signature

If you answered NO to all 10 questions above, a medical evaluation is not required. Please read and agree to the participant statement below by signing and dating it.

Participant Statement: I have answered all questions honestly, and understand that I accept responsibility for any consequences resulting from any questions I may have answered inaccurately or for my failure to disclose any existing or past health conditions.

Participant Signature (or, if a minor, participant's parent/guardian signature required.) | Date (dd/mm/yyyy)

Participant Name (Print) | Birthdate (dd/mm/yyyy)

Instructor Name (Print) | Facility Name (Print)

* **If you answered YES** to questions 3, 5 or 10 above **OR** to any of the questions on page 2, please read and agree to the statement above by signing and dating it A**ND take all three pages of this form (Participant Questionnaire and the Physician's Evaluation Form) to your physician** for a medical evaluation. Participation in a diving course requires your physician's approval.

Participant Name _____ **Birthdate** _____

(Print) Date (dd/mm/yyyy)

Diver Medical | Participant Questionnaire Continued

BOX A – I HAVE/HAVE HAD:		
Chest surgery, heart surgery, heart valve surgery, stent placement, or a pneumothorax (collapsed lung).	Yes ☐*	No ☐
Asthma, wheezing, severe allergies, hay fever or congested airways within the last 12 months that limits my physical activity/exercise.	Yes ☐*	No ☐
A problem or illness involving my heart such as: angina, chest pain on exertion, heart failure, immersion pulmonary edema, heart attack or stroke, OR am taking medication for any heart condition.	Yes ☐*	No ☐
Recurrent bronchitis and currently coughing within the past 12 months, OR have been diagnosed with emphysema.	Yes ☐*	No ☐
A diagnosis of COVID-19.	Yes ☐*	No ☐

BOX B – I AM OVER 45 YEARS OF AGE AND:		
I currently smoke or inhale nicotine by other means.	Yes ☐*	No ☐
I have a high cholesterol level.	Yes ☐*	No ☐
I have high blood pressure.	Yes ☐*	No ☐
I have had a close blood relative die suddenly or of cardiac disease or stroke before the age of 50, OR have a family history of heart disease before age 50 (including abnormal heart rhythms, coronary artery disease or cardiomyopathy).	Yes ☐*	No ☐

BOX C – I HAVE/HAVE HAD:		
Sinus surgery within the last 6 months.	Yes ☐*	No ☐
Ear disease or ear surgery, hearing loss, or problems with balance.	Yes ☐*	No ☐
Recurrent sinusitis within the past 12 months.	Yes ☐*	No ☐
Eye surgery within the past 3 months.	Yes ☐*	No ☐

BOX D – I HAVE/HAVE HAD:		
Head injury with loss of consciousness within the past 5 years.	Yes ☐*	No ☐
Persistent neurologic injury or disease.	Yes ☐*	No ☐
Recurring migraine headaches within the past 12 months, or take medications to prevent them.	Yes ☐*	No ☐
Blackouts or fainting (full/partial loss of consciousness) within the last 5 years.	Yes ☐*	No ☐
Epilepsy, seizures, or convulsions, OR take medications to prevent them.	Yes ☐*	No ☐

BOX E – I HAVE/HAVE HAD:		
Behavioral health, mental or psychological problems requiring medical/psychiatric treatment.	Yes ☐*	No ☐
Major depression, suicidal ideation, panic attacks, uncontrolled bipolar disorder requiring medication/psychiatric treatment.	Yes ☐*	No ☐
Been diagnosed with a mental health condition or a learning/developmental disorder that requires ongoing care.	Yes ☐*	No ☐
An addiction to drugs or alcohol requiring treatment within the last 5 years.	Yes ☐*	No ☐

BOX F – I HAVE/HAVE HAD:		
Recurrent back problems in the last 6 months that limit my everyday activity.	Yes ☐*	No ☐
Back or spinal surgery within the last 12 months.	Yes ☐*	No ☐
Diabetes, either drug or diet controlled, OR gestational diabetes within the last 12 months.	Yes ☐*	No ☐
An uncorrected hernia that limits my physical abilities.	Yes ☐*	No ☐
Active or untreated ulcers, problem wounds, or ulcer surgery within the last 6 months.	Yes ☐*	No ☐

BOX G – I HAVE HAD:		
Ostomy surgery and do not have medical clearance to swim or engage in physical activity.	Yes ☐*	No ☐
Dehydration requiring medical intervention within the last 7 days.	Yes ☐*	No ☐
Active or untreated stomach or intestinal ulcers or ulcer surgery within the last 6 months.	Yes ☐*	No ☐
Frequent heartburn, regurgitation, or gastroesophageal reflux disease (GERD).	Yes ☐*	No ☐
Active or uncontrolled ulcerative colitis or Crohn's disease.	Yes ☐*	No ☐
Bariatric surgery within the last 12 months.	Yes ☐*	No ☐

Diver Medical | Physician's Evaluation Form

Participant Name _____ **Birthdate** _____

(Print) Date (dd/mm/yyyy)

The above-named person requests your opinion of his/her medical suitability to participate in recreational scuba diving or freediving training or activity. Please visit uhms.org for medical guidance on medical conditions as they relate to diving. Review the areas relevant to your patient as part of your evaluation.

Evaluation Result

☐ Approved – I find no conditions that I consider incompatible with recreational scuba diving or freediving.

☐ Not approved – I find conditions that I consider incompatible with recreational scuba diving or freediving.

_____ _____

Physician's Signature Date (dd/mm/yyyy)

Physician's Name _____ **Specialty** _____

(Print)

Clinic/Hospital _____

Address _____

Phone _____ **Email** _____

Physician/Clinic Stamp (optional)

Created by the Diver Medical Screen Committee in association with the following bodies:

The Undersea & Hyperbaric Medical Society

DAN (US)

DAN Europe

Hyperbaric Medicine Division, University of California, San Diego

APPENDIX 1.70 DIVERS ALERT NETWORK (DAN)

Divers Alert Network (DAN), a non-profit organization, provides medical information and advice for the benefit of the diving public. DAN is not a regulatory agency and does not set physical standards or guidelines for SCUBA diving. The responsibility for the decision of whether or not to dive is generally left up to the individual, the physician, as well as the dive provider. This decision, however, should be based on the most current diving medical information available.

DAN may be able to provide current medical literature and information that can be used to assist in this decision-making process.

If desired, DAN may also provide referrals to local physicians who are knowledgeable in dive medicine and physiology. However, DAN cannot and does not decide whether an individual may or may not participate in the sport of SCUBA diving. For more information, please feel free to contact one of the DAN offices listed below.

DAN (US)
Physicians and other medical professionals associated with DAN are available for consultation by phone, during normal business hours Monday through Friday, 8:30 AM to 5:00 PM Eastern Time US.
+1-919-684-2948 ext. 6222
www.DAN.org

DAN Europe (Italy)
+39-085-8930333
www.DANEurope.org

DAN World (Australia)
+61-3-9886-9166
www.DANAP.org

DAN Southern Africa (South Africa)
+27-11-266-4900
www.DANSA.org

DAN Japan (Yokohama)
+045-228-3066 Medical Information Line service is provided in Japanese only.
www.danjapan.gr.jp

These guidelines were created by the Diver Medical Screen Committee (DMSC). The DMSC periodically reviews them to ensure they continue to represent current best practice in hyperbaric medicine.

APPENDIX 2.0 RECIPROCITY

RECIPROCITY

PSDTC 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 *PSDiver / Diver in Training (DIT)* as established by the *(PSDTC / Organizational Member)* Diving Safety Standards and has demonstrated competency in the indicated areas. PSDTC Organizational Member is a PSDTC Organizational Member and meets or exceeds all PSDTC training requirements.

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

Date

_____ Original diving authorization
_____ Written Public Safety Diving examination
_____ Last diving medical examination Medical examination expiration date_____
_____ Most recent checkout dive
_____ SCUBA regulator/equipment service/test
_____ Date of last dive. Location / Down Time _____/_____ Depth _____

Number of dives completed within previous 12 months._____ Depth Authorization_____ feet
Total number of career dives? _____

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

Please indicate any pertinent authorizations or training:

Date Certified:

_____ CPR training (Agency) _____
_____ Oxygen administration (Agency) _____
_____ First aid for diving _____

Emergency Information:

Name:_____ Relationship: _____

Telephone: _____(work) Mobile: _____ Home _____

Address _____

I verify that the above information is complete and correct to the best of my ability.

Diving Safety Officer:

_____ _____

(Signature) (Date)

_____ _____

(Print)

APPENDIX 3.0 EMERGENCY ACTION PLAN

EMERGENCY ACTION PLAN

Introduction

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

General Procedures

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

1. Make appropriate contact with victim or rescue as required.
2. Establish (A)irway (B)reathing (C)irculation or (C)irculation (A)irway (B)reathing as appropriate
3. Stabilize the victim
3. Administer 100% oxygen, if appropriate (in cases of Decompression Illness or Near Drowning).
4. Call local Emergency Medical System (EMS) for transport to nearest medical treatment facility. Explain the circumstances of the dive incident to the evacuation teams, medics and physicians. Do not assume that they understand why 100% oxygen may be required for the diving accident victim or that recompression treatment may be necessary.
5. Call appropriate Diving Accident Coordinator for contact with diving physician and recompression chamber, etc. **DAN Emergency Number: +1-919-681-9111**
6. Notify DSO or designee according to the Emergency Action Plan of the team SOP/SOG.
7. Complete and submit Incident Report Form to the Organizational Member Agency and the PSDTC (Section 12.30 Required Incident Reporting).

List of Emergency Contacts and Phone Numbers Appropriate for Dive Location

Available Procedures

- Emergency care
- Recompression
- Evacuation

Emergency Plan Content

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

DAN.org

Emergency Action Plan

Diving Emergency Preparedness

Dive site

Name _____ Location _____

Dive Operator _____

First Aid Equipment at dive site/boat

Name of qualified, on-site first aid provider _____

Oxygen

Type of oxygen delivery _____

Available quantity _____

Location/storage _____

First Aid Kit

❑ Available ❑ Not Available

Type _____

Location/storage _____

AED

❑ Available ❑ Not Available

Location/storage _____

Local Information

(Include directions to dive site that can be provided to EMS)

_____

_____

_____

Nearest emergency department

(Include distance, name, address and phone number)

_____

_____

_____

Alternative medical facility

(Include distance, name, address and phone number)

_____

_____

_____

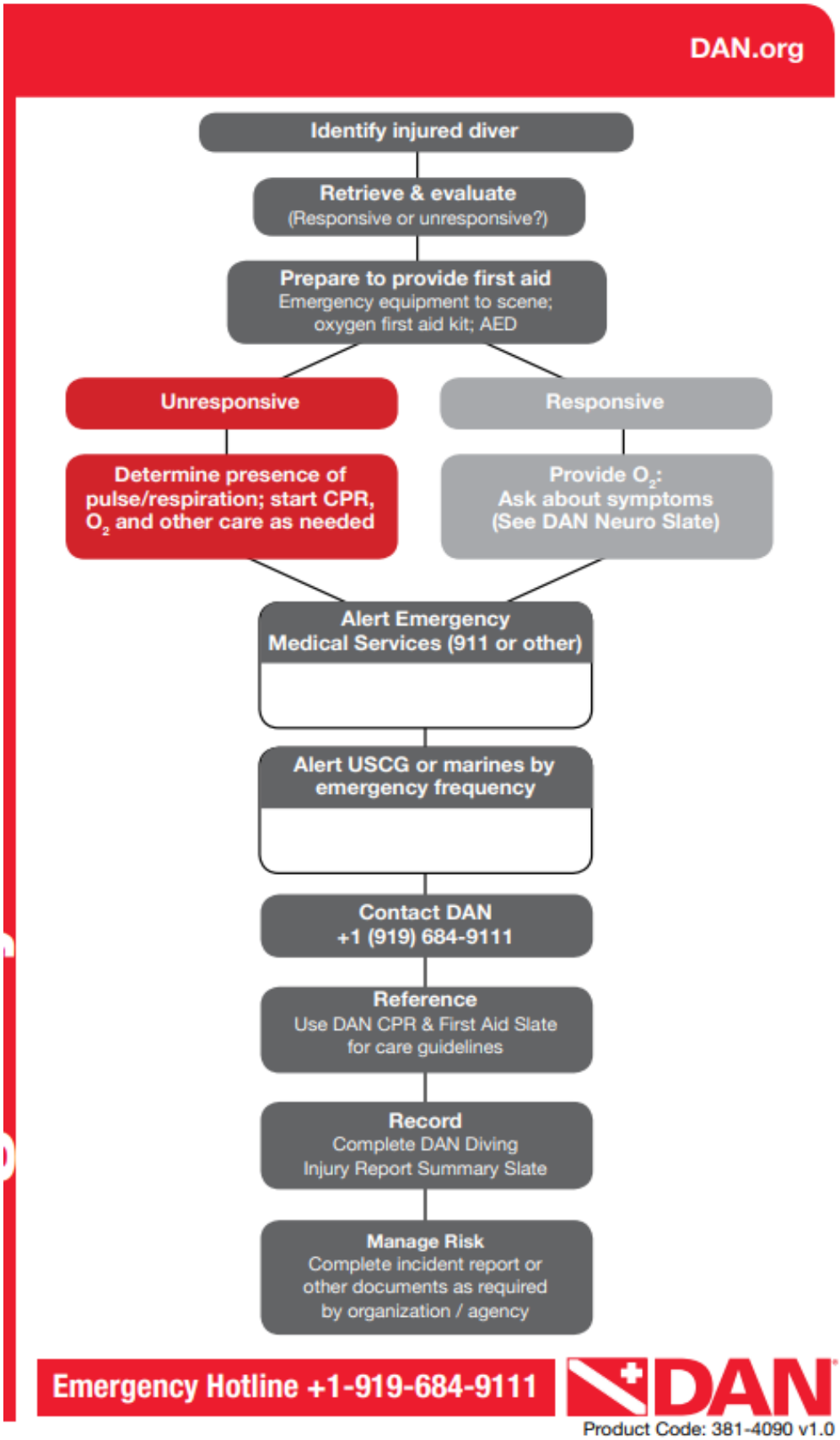
Local law enforcement (other than 911)

Name _____ Phone number _____

Local transportation (taxi service, etc.)

Name _____ Phone number _____

Emergency Hotline +1-919-684-9111 DAN


DAN.org
Identify injured diver
Retrieve & evaluate
(Responsive or unresponsive?)
Prepare to provide first aid
Emergency equipment to scene;
oxygen first aid kit; AED
Unresponsive
Responsive
Determine presence of pulse/respiration; start CPR, O_2 and other care as needed
Provide O_2:
Ask about symptoms
(See DAN Neuro Slate)
Alert Emergency Medical Services (911 or other)
Alert USCG or marines by emergency frequency
Contact DAN
+1 (919) 684-9111
Reference
Use DAN CPR & First Aid Slate for care guidelines
Record
Complete DAN Diving Injury Report Summary Slate
Manage Risk
Complete incident report or other documents as required by organization / agency
Emergency Hotline +1-919-684-9111
DAN
Product Code: 381-4090 v1.0

APPENDIX 4 INCIDENT REPORTING

PSDTC 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- the surface-to-surface time including any safety or required decompression stops.

A Dive - descent under water utilizing compressed air, ascent and return to the surface (surface to surface). Repetitive dives with less than a 10-minute surface interval are considered a single dive. A logged dive will be considered any dive lasting more than 5 minutes. Successful mission dives lasting less than 5 minutes will be logged in real time.

Dives will not be differentiated as open water or confined water dives, open water and confined water dives will be logged and submitted for PSDTC statistics classified as either mission related or training/proficiency.

Diver Logging a Dive – is a person who is diving under the auspices of their Public Safety Diving organization. Dives logged by divers from another PSDTC 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.

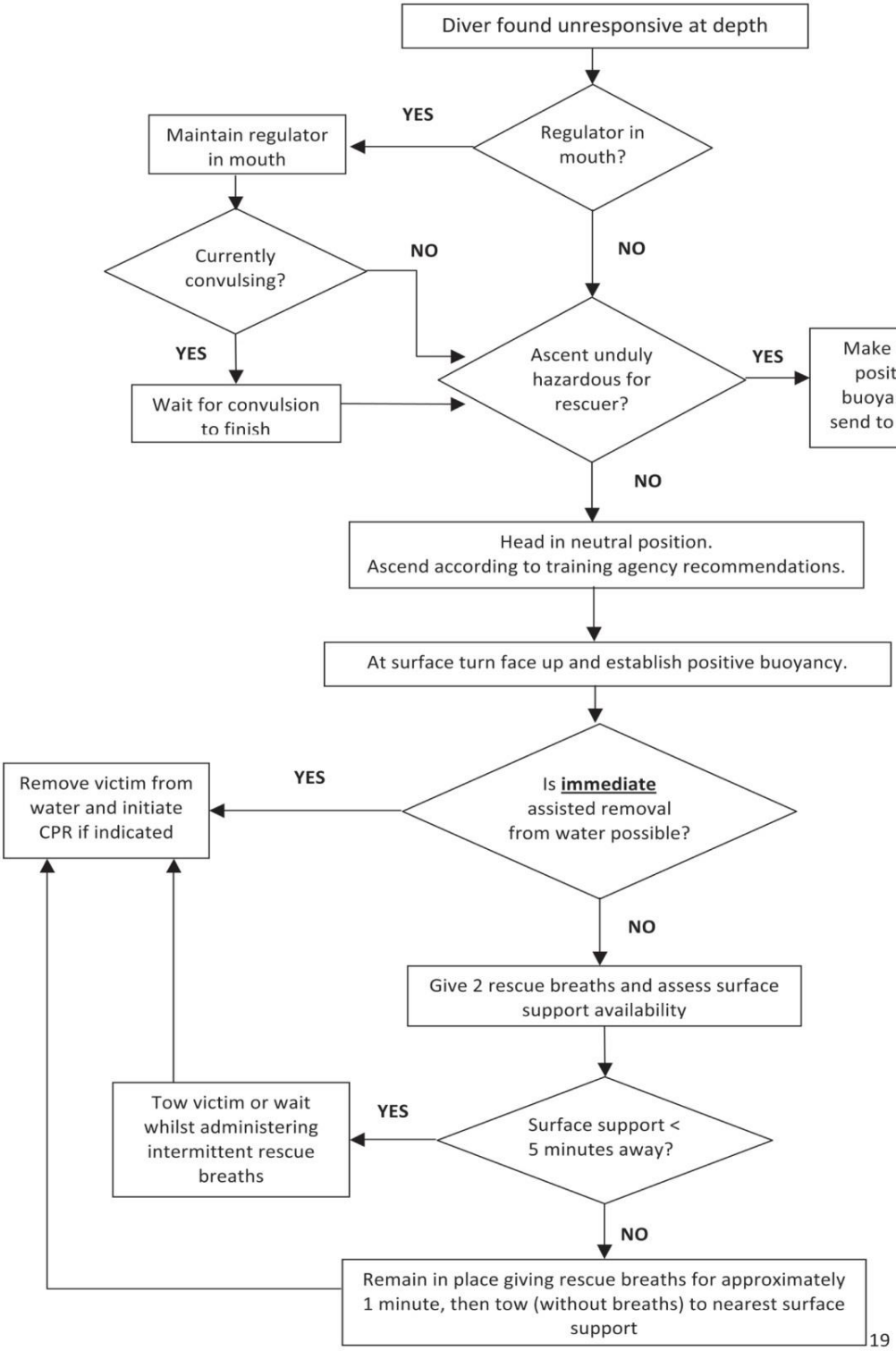
Incident(s) that occur during the collection cycle:

Only incidents that occurred during or resulting from, a dive where the diver is breathing a compressed gas will be submitted to PSDTC.

APPENDIX 5 – RESCUE OF UNRESPONSIVE DIVER

Recommendations for Rescue of a Submerged Unresponsive Compressed-Gas Diver

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



APPENDIX 6 - THEORETICAL DEPTH AT ALTITUDE

Theoretical Depths At Altitude <all depths in feet>										
Actual Depth	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
10	10	11	11	12	12	12	13	13	14	15
20	21	21	22	23	24	25	26	27	28	29
30	31	32	33	35	36	37	39	40	42	44
40	41	43	45	46	48	50	52	54	56	58
50	52	54	56	58	60	62	65	67	70	73
60	62	64	67	69	72	75	78	81	84	87
70	72	75	78	81	84	87	91	94	98	102
80	83	86	89	92	96	100	103	108	112	116
90	93	97	100	104	108	112	116	121	126	131
100	103	107	111	116	120	124	129	134	140	
110	114	118	122	127	132	137				
120	124	129	134	139						
130	135	140								
Safety Stop	14	14	13	13	12	12	12	11	11	10

Directions for Altitude Table: Use the adjusted depths on the table above when using dive tables at sites above 1000 ft elevation. Select the column that best represents your dive site elevation and the row that shows your actual (or planned) dive depth. Round both to the next higher number for safety. The resulting adjusted depth should be used when making dive table calculations.

Why do we need altitude tables? Because the air pressure at altitude is lower than the air pressure at sea level, leading to faster offgassing following dives. Dive tables are based on sea level, so adjustments need to be made when diving at higher elevations.

Note: many dive computers correct for altitude automatically when turned on at the high-elevation dive site. Check your manual for details.

TABLE 4.1
Sea Level Equivalent Depth (fsw)

Actual Depth	Altitude (feet)									
(fsw)	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000
10	10	15	15	15	15	15	15	15	15	15
15	15	20	20	20	20	20	20	25	25	25
20	20	25	25	25	25	25	30	30	30	30
25	25	30	30	30	35	35	35	35	35	40
30	30	35	35	35	40	40	40	50	50	50
35	35	40	40	50	50	50	50	50	50	60
40	40	50	50	50	50	50	60	60	60	60
45	45	50	60	60	60	60	60	70	70	70
50	50	60	60	60	70	70	70	70	70	80
55	55	60	70	70	70	70	80	80	80	80
60	60	70	70	70	80	80	80	90	90	90
65	65	70	80	80	80	90	90	90	100	100
70	70	80	80	90	90	90	100	100	100	110
75	75	90	90	90	100	100	100	110	110	110
80	80	90	90	100	100	100	110	110	120	120
85	85	100	100	100	110	110	120	120	120	130
90	90	100	110	110	110	120	120	130	130	140
95	95	110	110	110	120	120	130	130	140	140
100	100	110	120	120	130	130	130	140	140	150
105	105	120	120	130	130	140	140	150	150	160
110	110	120	130	130	140	140	150	150	160	160
115	115	130	130	140	140	150	150	160	170	170
120	120	130	140	140	150	150	160	170	170	180
125	125	140	140	150	160	160	170	170	180	190
130	130	140	150	160	160	170	170	180	190	190
135	135	150	160	160	170	170	180	190	190	**200**
140	140	160	160	170	170	180	190	190	**200**	**210**
145	145	160	170	170	180	190	190	**200**	**210**	
150	160	170	170	180	190	190	**200**	**210**		
155	170	170	180	180	190	200	**210**			
160	170	180	180	190	**200**	**200**				
165	180	180	190	200	**200**					
170	180	190	190	**200**						
175	190	190	**200**							
180	190	**200**	**210**							
185	**200**	**200**								
190	**200**									

Note: Numbers below this bar ⌐ are Exceptional Exposure Limits

Table Water Stops	Equivalent Stop Depths (fsw)									
10	10	9	9	9	8	8	8	7	7	7
20	19	19	18	17	17	16	15	15	14	14
30	29	28	27	26	25	24	23	22	21	21
40	39	37	36	35	33	32	31	30	29	28
50	48	47	45	43	42	40	39	37	36	34
60	58	56	54	52	50	48	46	45	43	41

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TABLE 4.2
Pressure Variations with Altitude

Altitude, ft	Pressure, mmHg	Pressure, psi	Pressure, atm*	Repetitive Group	Oil-filled Gauge Correction, ft
0	760.0	14.70	1.000		0
1000	732.9	14.17	0.964	A	1.22
2000	706.7	13.67	0.930	B	2.37
3000	681.2	13.17	0.896	B	3.53
4000	656.4	12.70	0.864	C	4.61
5000	632.4	12.23	0.832	D	5.70
6000	609.1	11.78	0.801	E	6.75
7000	586.5	11.35	0.772	E	7.73
8000	584.6	10.92	0.743	F	8.72
9000	543.3	10.51	0.715	G	9.67
10000	522.8	10.11	0.588	H	10.58
11000	502.8	9.73	0.662		11.47
12000	483.5	9.35	0.636		12.35
13000	464.8	8.99	0.612		13.15
14000	446.6	8.64	0.588		13.98
15000	429.1	8.31	0.565		14.76
16000	412.1	7.97	0.542		15.54
17000	395.7	7.66	0.521		16.25
18000	379.8	7.35	0.500		16.96
19000	364.4	7.04	0.479		17.67
20000	349.5	6.76	0.461		18.28

* U.S. standard atmosphere.

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Altitude diving involves information and skills beyond the scope of this page.

You cannot learn altitude diving from this table only.

<u>Formal training is necessary.</u>

TABLE 4

Locate the diver's repetitive group designation from his previous dive along the diagonal line above the table. Read horizontally to the interval in which the diver's surface interval lies.

Next read vertically downward to the new repetitive group designation. Continue downward in this same column to the row which represents the depth of the repetitive dive. The time given at the intersection is residual nitrogen time, in minutes, to be applied to the repetitive dive.

* Dives following surface intervals of more than 12 hours are not repetitive dives. Use actual bottom times in the Standard Air Decompression Tables to compute decompression for such dives.

** If no Residual Nitrogen Time is given, then the repetitive group does not change.

Repetitive group at the beginning of the surface interval

Repetitive Dive Depth feet /meters		NEW GROUP DESIGNATION															
		Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
10	3.0	**	**	**	**	**	**	**	**	**	**	**	797	279	159	88	39
20	6.1	**	**	**	**	**	**	917	399	279	208	159	120	88	62	39	18
30	9.1	**	**	469	349	279	229	190	159	132	109	88	70	54	39	25	12
40	12.2	257	241	213	187	161	138	116	101	87	73	61	49	37	25	17	7
50	15.2	169	160	142	124	111	99	87	76	66	56	47	38	29	21	13	6
60	18.2	122	117	107	97	88	79	70	61	52	44	36	30	24	17	11	5
70	21.3	100	96	87	80	72	64	57	50	43	37	31	26	20	15	9	4
80	24.4	84	80	73	68	61	54	48	43	38	32	28	23	18	13	8	4
90	27.4	73	70	64	58	53	47	43	38	33	29	24	20	16	11	7	3
100	30.5	64	62	57	52	48	43	38	34	30	26	22	18	14	10	7	3
110	33.5	57	55	51	47	42	38	34	31	27	24	20	16	13	10	6	3
120	36.6	52	50	46	43	39	35	32	28	25	21	18	15	12	9	6	3
130	39.6	46	44	40	38	35	31	28	25	22	19	16	13	11	8	6	3
140	42.7	42	40	38	35	32	29	26	23	20	18	15	12	10	7	5	2
150	45.7	40	38	35	32	30	27	24	22	19	17	14	12	9	7	5	2
160	48.8	37	36	33	31	28	26	23	20	18	16	13	11	9	6	4	2
170	51.8	35	34	31	29	26	24	22	19	17	15	13	10	8	6	4	2
180	54.8	32	31	29	27	25	22	20	18	16	14	12	10	8	6	4	2
190	59.9	31	30	28	26	24	21	19	17	15	13	11	10	8	6	4	2

FIGURE 4.10
Residual Nitrogen Timetable for Repetitive Air Dives

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Appendix 7 – Dive Tables

Table 5. U.S. Navy Standard Air Decompression Table – 1999

Depth feet/meters	Bottom time (min)	Time first stop (min:sec)	Decompression stops (feet/meters) 50 15.2	40 12.1	30 9.1	20 6.0	10 3.0	Total decompression time (min:sec)	Repetitive group
40 12.1	200						0	1:20	*
	210	1:00					2	3:20	N
	230	1:00					7	8:20	N
	250	1:00					11	12:20	O
	270	1:00					15	16:20	O
	300	1:00					19	20:20	Z
				Exceptional Exposure					
	360	1:00					23	24:20	**
	480	1:00					41	42:20	**
	720	1:00					69	70:20	**
50 15.2	100						0	1:40	*
	110	1:20					3	4:40	L
	120	1:20					5	6:40	M
	140	1:20					10	11:40	M
	160	1:20					21	22:40	N
	180	1:20					29	30:40	O
	200	1:20					35	36:40	O
	220	1:20					40	41:40	Z
	240	1:20					47	48:40	Z
60 18.2	60						0	2:00	*
	70	1:40					2	4:00	K
	80	1:40					7	9:00	L
	100	1:40					14	16:00	M
	120	1:40					26	28:00	N
	140	1:40					39	41:00	O
	160	1:40					48	50:00	Z
	180	1:40					56	58:00	Z
	200	1:20				1	69	72:00	Z
				Exceptional Exposure					
	240	1:20				2	79	83:00	**
	360	1:20				20	119	141:00	**
	480	1:20				44	148	194:00	**
	720	1:20				78	187	267:00	**
70 21.3	50						0	2:20	*
	60	2:00					8	10:20	K
	70	2:00					14	16:20	L
	80	2:00					18	20:20	M
	90	2:00					23	25:20	N
	100	2:00					33	35:20	N
	110	1:40				2	41	45:20	O
	120	1:40				4	47	53:20	O
	130	1:40				6	52	60:20	O
	140	1:40				8	56	66:20	Z
	150	1:40				9	61	72:20	Z
	160	1:40				13	72	87:20	Z
	170	1:40				19	79	100:20	Z

* See No-Decompression Table 3 for Repetitive Groups
** Repetitive Dives may not follow Exceptional Exposure Dives

FIGURE 4.25
U.S. Navy Dive Table 5ÑDepth 40 to 70 fsw

https://tecvault.t101.ro/NOAA%20Diving%20Manual.pdf

Table 5. U.S. Navy Standard Air Decompression Table – 1999 (Continued)

Depth feet/meters	Bottom time (min)	Time first stop (min:sec)	Decompression stops (feet/meters) 50 15.2	40 12.1	30 9.1	20 6.0	10 3.0	Total decompression time (min:sec)	Repetitive group
80 24.3	40						0	2:40	*
	50	2:20					10	12:40	K
	60	2:20					17	19:40	L
	70	2:20					23	25:40	M
	80	2:00				2	31	35:40	N
	90	2:00				7	39	48:40	N
	100	2:00				11	46	59:40	O
	110	2:00				13	53	68:40	O
	120	2:00				17	56	75:40	Z
	130	2:00				19	63	84:40	Z
	140	2:00				26	69	97:40	Z
	150	2:00				32	77	111:40	Z
				Exceptional Exposure					
	180	2:00				35	85	122:40	**
	240	1:40			6	52	120	180:40	**
	360	1:40			29	90	160	281:40	**
	480	1:40			59	107	187	355:40	**
	720	1:20		17	108	142	187	456:40	**
90 28.7	30						0	3:00	*
	40	2:40					7	10:00	J
	50	2:40					18	21:00	L
	60	2:40					25	28:00	M
	70	2:20				7	30	40:00	N
	80	2:20				13	40	56:00	N
	90	2:20				18	48	69:00	O
	100	2:20				21	54	78:00	Z
	110	2:20				24	61	88:00	Z
	120	2:20				32	68	103:00	Z
	130	2:00			5	36	74	118:00	Z
100 30.4	25						0	3:20	*
	30	3:00					3	6:20	I
	40	3:00					15	18:20	K
	50	2:40				2	24	29:20	L
	60	2:40				9	28	40:20	N
	70	2:40				17	39	59:20	O
	80	2:40				23	48	74:20	O
	90	2:20			3	23	57	86:20	Z
	100	2:20			7	23	66	99:20	Z
	110	2:20			10	34	72	119:20	Z
	120	2:20			12	41	78	134:20	Z
				Exceptional Exposure					
	180	2:00		1	29	53	118	204:20	**
	240	2:00		14	42	84	142	285:20	**
	360	1:40	2	42	73	111	187	418:20	**
	480	1:40	21	61	91	142	187	505:20	**
	720	1:40	55	106	122	142	187	615:20	**

* See No-Decompression Table 3 for Repetitive Groups
** Repetitive Dives may not follow Exceptional Exposure Dives

FIGURE 4.25
U.S. Navy Dive Table 5ÑDepth 80 to 100 fsw

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Flying After Diving

TABLE 4.3

Required Surface Interval Before Ascent to Altitude After Diving

Repetitive Group Designator	Altitude 1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000
A	0:00	0:00	0:00	0:00	0:00	0:00	0:00	**0:00**	0:00	0:00
B	0:00	0:00	0:00	0:00	0:00	0:00	0:00	**0:00**	0:00	2:11
C	0:00	0:00	0:00	0:00	0:00	0:00	0:00	**0:00**	3:06	8:26
D	0:00	0:00	0:00	0:00	0:00	0:00	0:09	**3:28**	7:33	12:52
E	0:00	0:00	0:00	0:00	0:00	0:51	3:35	**6:54**	10:59	16:18
F	0:00	0:00	0:00	0:00	1:12	3:40	6:23	**9:43**	13:47	19:07
G	0:00	0:00	0:00	1:23	3:34	6:02	8:46	**12:05**	16:10	21:29
H	0:00	0:00	1:31	3:26	5:37	8:05	10:49	**14:09**	18:13	23:33
I	0:00	1:32	3:20	5:15	7:26	9:54	12:38	**15:58**	20:02	24:00
J	1:32	3:09	4:57	6:52	9:04	11:32	14:16	**17:35**	21:39	24:00
K	3:00	4:37	6:25	8:20	10:32	13:00	15:44	**19:03**	23:07	24:00
L	4:21	5:57	7:46	9:41	11:52	14:20	17:04	**20:23**	24:00	24:00
M	5:35	7:11	9:00	10:55	13:06	15:34	18:18	**21:37**	24:00	24:00
N	6:43	8:20	10:08	12:03	14:14	16:42	19:26	**22:46**	24:00	24:00
O	7:47	9:24	11:12	13:07	15:18	17:46	20:30	**23:49**	24:00	24:00
Z	8:17	9:54	11:42	13:37	15:49	18:17	21:01	**24:00**	24:00	24:00

Exceptional Exposure — Wait 48 hours before flying

NOTE 1 When using Table 4-3, use the highest repetitive group designator obtained in the previous 24-hour period.

NOTE 2 Table 4-3 may only be used when the maximum altitude achieved is 10,000 ft. or less. For ascents above 10,000 ft., consult NOAA Diving Program for guidance.

NOTE 3 The cabin pressure in commercial aircraft is maintained at a constant value regardless of the actual altitude of the flight. Though cabin pressure varies somewhat with aircraft type, the nominal value is 8,000 feet to compute the required surface interval before flying.

NOTE 4 No surface interval is required before taking a commercial flight if the dive site is at 8,000 ft. or higher. In this case, flying results in an increase in atmospheric pressure rather than a decrease.

NOTE 5 No repetitive group is given for air dives with surface decompression on oxygen or air. For these surface decompression dives, enter the standard air table with the sea level equivalent depth and bottom time of the dive to obtain the appropriate repetitive group designator to be used.

NOTE 6 For ascent to altitude following a non-saturation helium-oxygen dive, wait 12 hours if the dive was a no-decompression dive. Wait 24 hours if the dive was a decompression dive.

https://tecvault.t101.ro/NOAA%20Diving%20Manual.pdf

ANNEX SECTIONS 1-9

ANNEX 1.0 PRIMARY / REDUNDANT AIR, Re: 13.20 SCUBA CYLINDERS

NFPA 1670 – A.3.3.84, A18.4.8(1)/NFPA 1006 – A.3.3.115

Minimum Primary Reserve Pressure

For the purposes of this document, *minimum pressure* is one third of the rated capacity of breathing gas available to the diver. In no case should the established minimum reserve pressure for the primary source of breathing gas be less than 500psi.

Dive operations involve work in an IDLH environment. To ensure safe dive operations all divers must plan their dives to maintain an adequate reserve to manage unforeseen circumstances.

The one-third reserve should be calculated in advance for specific sizes of the cylinders used by the team by using the total volume of air including any redundant air systems, adjusted for the rated working reserve pressure of the cylinders associated with the breathing gas systems. From that calculation, determine the primary system pressure that would leave the diver with approximately one-third the total volume in reserve. It is not the intent to calculate the reserve pressure based on the actual pressure of the cylinder at the start of the dive but always with the rated working pressure of the cylinder.

A diver equipped with only a standard 80 aluminum cylinder gets 80 ft^3 (2.27 m^3) at 3000 psi. Because there is no redundant air supply, the entire one-third volume of 36.6 ft^3 (0.74 ^{m3}) must be carried in the primary system. (26.36 ft^3 x 3000 psi) /80 ft^3 = 1000 psi.

A diver equipped with an 80 ft^3 primary HP Steel and a Pony cylinder with a working pressure of 3500 psi and 21 ft^3 (0.59 m^3) redundant air system cylinder has a total of 101 ft^3 (2.86 m^3). The diver needs to be on the surface with approximately 33.6 ^{ft3} (0.93 ^{m3}) to meet the one-third. Subtract the 21 ft^3 (0.59 m^3) provided in the redundant air system cylinder to leave 12.6 ft^3 (0.34 m^3) in the primary for the required reserve. (12.6 ft^3) x 3500 psi) / 80 ft^3 = 472 psi.

Even though the calculated minimum surface reserve pressure is 472 psi, the minimum permissible breathing gas pressure is 500 psi. In this case the diver's minimum primary reserve pressure is 500 psi.

Ensuring that divers comply with the required minimum reserve pressure is often a challenge to agencies that perform public safety diving. Ensuring that divers get adequate training using the established limits, including calculating additional air required to perform the ascent and relevant safety stops, is a key element to ensuring compliance. Training should be conducted at depths and under conditions that simulate an actual rescue or recovery environment while performing mission specific work as often as possible so that divers can set proper expectations about air consumption and exertion levels. Instances where divers violate the minimum reserve pressure should be treated as a breach of policy and the contributing factors should be document to prevent recurrence. The AHJ is responsible for holding divers and supervisors accountable for compliance with established limits.

NFPA 1670 - A.3.3.107 / NFPA 1006 A.3.3.115

Redundant Air Systems

This breathing gas system is typically configured with a “pony” cylinder connected to a first and second stage regulator which is then attached to a buoyancy compensator or strapped to the primary cylinder. It is intended to provide a source of air that is independent from any failure in the primary delivery system. As such, it is not typically intended to be connected to the primary system by a block or other device unless one of the following occurs:

1. The device is constructed with a feature that prevents the contents of the reserve cylinder from free flowing out a breach in the primary delivery system such as a full face mask (FFM).
2. The device is in addition to a conventional second stage.

ANNEX 2.0 COVID (updated 12/17/2020)

Additional and Updated information concerning COVID-19 by the Dive Alert Network can be found here: COVID-19 Information from Divers Alert Network

COVID-19: Surface Survival Times

COVID-19: Surface Survival Times (diversalertnetwork.org)

The COVID-19 outbreak and subsequent pandemic has altered the way we approach the world. By learning about how long the virus that causes this disease can survive on various surfaces, divers can better understand and control their risk of infection. In this article we will examine survival of the virus on surfaces of interest to divers such as equipment, workbenches and countertops as well as the role of equipment disinfection moving forward.

Cleaning rental equipment especially that which comes in contact with the mouth and face has always been an important practice to ensure cleanliness and safety. Because of the highly transmissible nature of COVID-19, the act of disinfection is now more essential than ever. Experts expect that COVID-19 will continue to spread, even after resumption of business as usual, until a vaccine is developed and/or a large portion of the population has been infected. The dive community must now integrate the best available data on novel coronavirus survival times into its routine disinfection procedures.
Survival times of the virus are particularly important to consider on surfaces that cannot easily be decontaminated, such as fabrics. Research on the virus that causes COVID-19 is still developing, forcing researchers to apply knowledge about similar viruses to the novel coronavirus for answers. Because they are closely related, the coronavirus responsible for the 2003 SARS epidemic has been studied as a surrogate for the current virus. Other surrogate coronaviruses, such as human coronavirus 229E, have also been analyzed.

Human coronavirus 229E was found to survive for 2-6 days on plastic, 5 days on steel, glass, PVC, silicone, Teflon™ and ceramic, up to 8 hours on latex, and 2-8 hours on aluminum.[1] The SARS virus was found to survive up to 9 days on plastic, 5 days on metal, 4-5 days on paper, and 4 days on wood and glass.[1] Studies of the virus that causes COVID-19, SARS-CoV-2, found that it can survive for 2-3 days on plastic and steel, up to 4 hours on copper, up to 3 hours in aerosols (from a cough or sneeze) and 24 hours on cardboard.[2]

Little data exists on the survivability of SARS-CoV-2 on fabrics. Best practices are derived based on available information about infectious agents of similar structure. The novel coronavirus is an enveloped virus, which means the virion, or the form the virus takes when outside the body, is wrapped in a fatty layer to protect it during transmission. If the envelope is damaged or dries out, the virus will die. The Aujeszky's Disease virus has been shown to survive for less than one day on denim.[3] However, the only similarity between that virus and SARS-CoV-2 is that both are enveloped. Experts postulate that the survival of the virus depends on porosity of the fabric. More porous fibers may trap, dry and break apart virus particles more easily. Others have said that viruses may survive for shorter times on natural fibers and longer on synthetics.[4] Due to the lack of data about survival times on fabrics, there is unfortunately insufficient evidence to assess how long SARS-CoV-2 might survive on equipment made of synthetic fabrics, such as BCDs and wetsuits.

Definitive timeframes for the survivability of viruses on various surfaces are not collectively agreed upon at this time. For this reason, disinfection — in conjunction with additional practices such as social

distancing — remains a vital part of reducing the risk of viral transmission between divers using rental equipment.

1. Kampf G, Todt D, Pfaender S, Steinmann E. Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents. Journal of Hospital Infection. 2020Feb6;104(3):246–51.

2. New coronavirus stable for hours on surfaces [Internet]. National Institutes of Health. U.S. Department of Health and Human Services; 2020 [cited 2020Apr17]. Available from: https://www.nih.gov/news-events/news-releases/new-coronavirus-stable-hours-surfaces

3. Pirtle E, Beran G. Virus survival in the environment. Revue Scientifique et Technique de lOIE. 1991Jan;10(3):733–48.

4. Leiva C. How Long Coronavirus Lives on Clothes, And How to Wash Them [Internet]. HuffPost. HuffPost; 2020 [cited 2020Apr20]. Available from: https://www.huffpost.com/entry/how-long-coronavirus-live-clothing-washing_l_5e724927c5b6eab779409e74

DISINFECTION OF SCUBA EQUIPMENT AND COVID-19

Disinfection of Scuba Equipment and COVID-19 (diversalertnetwork.org)

Updated June 10, 2020

Information on COVID-19 has been ever changing. The information included here may not be the most relevant or current information.

The novel coronavirus, also known as SARS-CoV-2, is the cause of the disease COVID-19, which has killed 408,025 people worldwide as of this article's most recent update[1]. SARS-CoV-2 is part of the viral group known as – corona - (Latin for crown or halo) because of the pattern of proteins that stud its surface[2]. It is estimated that this group of viruses is responsible for 15%-30% of acute respiratory infections each year[3]. These numbers, however, are subject to rapid change as a result of the current pandemic.

COVID-19 spreads via respiratory secretions in a variety of ways including aerosolized droplets expelled by coughing or sneezing, touching surfaces contaminated with the virus, or close contact with someone who has the virus[2]. The incubation period of the virus ranges from 2-14 days[2]. One study identified the median incubation as 5.1 days with 97.5% of patients showing symptoms within 11.5 days[3].

Coronaviruses belong to a group of enveloped viruses, which means the virion (the form that the virus takes while outside the host cell) is protected by an oily lipid layer[4]. As with most enveloped viruses, damaging or destroying this lipid layer will inactivate the virus. Studies of other coronaviruses have shown their infectivity can be reduced by heat, UV light and alkaline or acidic conditions[5]. Because of this, and the fact that enveloped viruses are generally easily inactivated, surfaces can be disinfected using household cleaning products[6].

Because research into SARS-CoV-2 is ongoing, there is debate about how long it can survive on surfaces. Recent studies have shown that it can survive up to 3 hours in an aerosol droplet (such as from a sneeze), 4 hours on copper, 24 hours on cardboard, and 2-3 days on plastic and stainless steel[7]. In water, however, it is unclear how long SARS-CoV-2 survives. Studies on the SARS virus, called SARS-CoV-1 and the cause of an epidemic in 2003, have shown that it remained infectious for long periods in surface water (lakes, rivers, wetlands, etc.) and previously pasteurized sewage at both low and ambient temperatures[8]. In chlorinated or bromated pools and hot tubs, the CDC specifies that SARS-CoV-2 would be inactivated[9].

HEAT

There is relatively little data on SARS-CoV-2, and much of it is preliminary. Studies have shown that infectivity of the virus is reduced as temperature increases. It is very stable at 40°F (4°C) but is inactivated in 5 minutes at 158°F (70°C) [10].

When additional information is needed, scientists will sometimes look to related but slightly harder-to-kill viruses. In the case of the novel coronavirus, some data reports are based on the SARS-CoV-1 virus because it is more difficult to kill than the novel coronavirus. One study found that the SARS-CoV-1 virus loses infectivity after being heated to 133°F (56°C) for 15 minutes[5] and the World Health Organization specifies this temperature and timing as well[11]. Another study found that the SARS-CoV-1 virus remains stable between 40°F (4°C) and 98°F (37°C) and would lose infectivity after 30 minutes at 133°F (56°C) [11].

Divers Alert Network has received questions about the virus entering a SCUBA cylinder as a result of

contaminated air being drawn into the compressor. Calculations show that a four-stage compressor with 1 ATA inlet pressure and an 80°F environment pumping air up to 29 ATA or around 4000 psi, would have an inter-stage temperature inside the cylinder of 225 °F. This calculation is very basic and does not account for anything outside of ideal conditions. However, it does indicate the instantaneous temperature at the moment of peak pressure.

In reality, the outlet valve temperature will likely be 170°F-190°F, and the gas temperature around 150°F, occurring during each stage of the compressor (i.e. four cycles for a four-stage compressor assuming each stage's outlet temperature is the same). Because this is hot enough to kill SARS-CoV-2, it is therefore unlikely that the virus would survive this process should an infected individual cough into the compressor intake.

It is important to note that infected droplets exhaled by a person can be as small as 0.5 micron; the filter systems alone would not remove these, but the virus should no longer be infectious at that stage.
In fact, there is a series of barriers, each of which could potentially prevent infectious viral particles from entering the SCUBA cylinder on its own. These include the inlet filer, 3 or 4 stages of adiabatic heat of compression, inter-stage and final stage drains, in which almost all the moisture is removed, the breathing air filter, the SCUBA first stage regulator filter and the adiabatic heat generated when the cylinder is being filled.

It should be noted, however, that if an individual carried the virus on their hands, either as a result of being infected or unknowingly touching an infected surface, and touches the cylinder valve or fill whip, the virus could potentially enter the cylinder through this route. It has been shown that some viruses are extremely pressure resistant — an order of magnitude above diving gas storage pressures. These studies, however, were conducted on noroviruses, a non-enveloped group of viruses that are generally harder to kill than enveloped viruses[13, 14]. Other studies conducted on enveloped viruses such as the flu only explored the efficacy of high hydrostatic pressure at around 290 MPa (42,000 PSI)[15]. It is therefore very important to practice hand washing and disinfection of high-touch areas including cylinders and fill stations, as it is likely that a virus could survive at diving gas storage pressures.

QUATERNARY AMMONIUM COMPOUNDS

Quaternary ammonium compounds, or quats, are a group of chemicals that are exceedingly common as active ingredients in cleaning solutions. These agents are hydrophobic and as such are effective against enveloped viruses. Quats are thought to react with the viral envelope and – disorganize - it, leading to the contents of the virus leaking out and degrading. In addition, little evidence exists to support viral resistance against these compounds[16]. Studies have shown that quats are effective against SARS-CoV-1[17], and the World Health Organization (WHO) recommends the use of cleaning products containing these compounds in their laboratory biosafety guidance related to coronavirus disease 2019[18].

There are quaternary ammonium-containing products commonly used in the SCUBA industry to disinfect equipment. However, these compounds are harmful to the environment, so care must be taken in their use and disposal[19].

BLEACH

Bleach, or sodium hypochlorite, has been studied in many different concentrations, and its effectiveness against viruses has been proven. It is a strong oxidant that works by damaging the viral genome[20]. In a study that examined SARS-CoV-2 specifically, it was found that a sodium hypochlorite concentration of 0.1% or 1,000 ppm in water was needed to reduce infectivity when sprayed onto a hard-non-porous surface[21]. A second study on the same virus found that 0.1% sodium hypochlorite would inactivate the

virus within 1 minute. A study on SARS-CoV-1 found that bleach: water concentrations of 1:50 (0.1% sodium hypochlorite) and 1:100 (0.05% sodium hypochlorite) inactivated the virus after an immersion of 5 minutes[22].

When using bleach, the use of gloves, a mask, and eye protection is encouraged. Mix the solutions in well-ventilated areas, and use cold water, as hot water will decompose the active ingredient. It is important to never mix bleach with other chemicals and to remove all organic matter from items to be disinfected, as this too will inactivate the active ingredient[21]. Items disinfected with bleach must be thoroughly rinsed with fresh water and allowed to dry before use, as it is corrosive to stainless steel (in higher concentrations) and irritating to mucous membranes, skin and eyes[23,24]. Highly concentrated bleach solutions have also been found to be harmful to life-support equipment, causing metal fatigue and in some cases hose failure during the Hart building anthrax attack. As such these solutions are not used by EPA units for dive equipment when effective alternatives exist.

The CDC recommends a solution of 1/3 cup bleach per gallon of water (22mL bleach per L water) with a soaking time of 1 minute for hard, nonporous surfaces. This relatively weak 2% bleach solution and short contact time should not cause damage to SCUBA regulators.[25]

SOAP AND WATER

Washing hands and surfaces with soap and water is one of the most effective ways to protect against the virus. The type of soap used is not important. Washing with soap and water does not necessarily kill microorganisms but physically removes them from a surface. Running water by itself can be effective in removing some unwanted material from surfaces; however, soap will physically pull material from the skin and into the water[26].

Divers Alert Network was asked why soap and water will not work for SCUBA equipment if it is recommended for hands. Soap and water, as stated above, must be combined with mechanical action to be completely effective. Soaking SCUBA equipment in soapy water alone is not an effective disinfection method. If soapy water were combined with mechanical action, it would theoretically prove to be more efficient. However, there are some parts of SCUBA equipment that are not easily reached without disassembly, such as the inside of a regulator. Since an exhaled breath will travel through the inside of a regulator and contact the diaphragm, lever arm, and other internal surfaces, soaking the regulator in a disinfectant solution may be a better option.

ALCOHOL

According to the CDC, to combat COVID-19, an alcohol solution of at least 60% isopropanol or ethanol should be used on the hands and at least 70% should be used to disinfect surfaces[25]. Evidence suggests that benzalkonium chloride hand sanitizers are less reliable than alcohol-based sanitizers[27]. Repeated use of alcohol can harm certain types of plastic and rubber by causing swelling, hardening, and cracking of these materials[23], so it is most likely not the best disinfectant to use on SCUBA equipment.

Alcohol is flammable and should not be used in the presence of any type of compressed gas, including air, and especially oxygen-enriched gasses. If hand sanitizer has been applied to hands, and the alcohol has not evaporated completely, alcohol vapors may enter the regulator first stage or fill whip and present a high risk of fire and explosion.

If using an alcohol-based hand sanitizer, ensure that hands are completely dry before assembling equipment or filling cylinders. Due to the risks of using alcohol near compressed gas, consider providing alcohol-based hand sanitizer only to employees trained in its use and associated risks.

EPA GUIDELINES

No matter the active ingredient or method of disinfecting SCUBA equipment, proven efficacy against the novel coronavirus is of utmost importance. The EPA's "List N" is a compilation of products that work against SARS-CoV-2. Outside of the United States, local governing bodies may also have registered disinfectants. Following the directions for use for each individual product will ensure its efficacy.

When product manufacturers register their products with the EPA, they must submit a list of uses for the product. It is uncommon for registered products on List N to contain - SCUBA - ; more likely to be listed are respirators or full-face breathing apparatuses. When choosing a disinfectant solution from List N it is important to check that the product's EPA registration specifies its use for the equipment in question.

Some products commonly recommended by underwater breathing equipment manufacturers are classified as quaternary ammonium sanitizers registered with the EPA for use in food service only, and are not currently on the EPA's List N. The EPA does not consider them to be effective against SARS-CoV-2 when applied to materials and surfaces outside of food service.

BEST PRACTICES

When selecting a disinfectant, consult your local governing body's pesticide registration system for its list of registered disinfectants if the products specified in the EPA's List N are unavailable in your area. When using these products, be sure to follow the directions and use the specified personal protective equipment (such as gloves or eye protection) when disinfecting. If registered products cannot be found, be sure to use disinfection protocols outlined by the CDC.

After disinfecting, one must take care not to contaminate the equipment, such as by handling it when storing. Dive shop employees should maintain good hygiene by washing hands frequently and regularly disinfecting high-touch areas, including fill stations (as outlined in the – heat - section of this article). Finally, consider updating your existing emergency action plan to include a potential COVID-19 infection by staff or customers. Be sure to outline all disinfection protocols and ensure that they are being diligently followed by all staff. The most important consideration is the health and safety of your staff and customers.

If you have any questions, please email us at RiskMitigation@DAN.org.

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ANNEX 3.0 DELTA P

8.0(K)(9) **Guideline for Diving Operations at Dams And Other Work Sites Where Delta P Hazards May Exist**

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DELTA P

2.1.1 Visual Signs

One indicator of a potential ΔP hazard is excessive water leakage from the downstream side of a structure. If possible, examine the spillway, stop logs and structure for any visible or audible signs of water leakage and the upstream side of the dam for any signs of suction (vortex), on the surface, before conducting any other surveys. If excessive water leakage is evident then it is imperative that the area around the source of the leakage is surveyed, on the upstream side of the structure, in order to evaluate the severity of ΔP, its location and options to either control it or avoid it. If additional tests indicate that the source of leakage cannot be controlled then the area around it should be identified as a hazardous area and declared unsafe for diving. Hydro Electric dams may not always offer good visual indicators because of the design of the structure however downstream boils may be indicative of ground faults or leakage through the structure.

2.1.2 Downstream Approaches

Diving on the downstream side of some types of dams, where turbulence does not pose a hazard to the diver and safe access is available, is worth considering as a safe means of detecting sources of hazardous water flow. Downstream Apron Sill Spillway Deck Stop-Logs Bull nose ELECTONICALLY DISTRIBUTED BY THE CANADIAN ASSOCIATION OF DIVING CONTRACTORS AS AN INDUSTRY PUBLIC SAFETY SERVICE: WWW.CADC.CA: Disclaimer: Guidelines may not be complete or accurate. Guideline contributors disclaim all liability for the accuracy or completeness of the guideline, and disclaim all warranties, express or implied to their incorrect use. Guidelines users always are urged to seek out newer information that might impact recommendations contained within the guideline. Revised Oct 17, 2011

2.1.3 Flow Indicator Devices

2.1.3(i) Bag Test

A bag test involves the use of a sand bag that is loaded with enough material to make the bag just heavy enough for the circumstances worked in (approximately 3-5lbs). It should be secured to a 3/8” rope that is long enough to reach the entire upstream portion of the structure where the diver will be working plus a control area of at least 5m around the proposed work

site. (Note – the rope should not exceed 3/8" diameter because the diver's feel might be affected it)

It can be a very effective means of detecting ΔP hazards if performed by a person who has had the appropriate training and experience. It will also serve as an effective means of sealing off some ΔP hazards and the rope, if tied off, will assist with the identifying the location of the hazard.

In order to be effective, the bag must be lowered and raised slowly across the entire structure at approximately 1 to 2 feet per second and as close as possible to the structure and river bed, (within 10 inches). A vessel should be used to perform the bag test in situations where access to the work site is difficult to reach from the deck of the structure.

A severe draw on the bag and rope or anytime where the bag is trapped and cannot be pulled free are indicators of a serious ΔP hazard; the amount of force to pull the bag free of a ΔP hazard is indicative of the water flow hazard.

Note* The person performing the bag test, must ensure that he is wearing gloves to protect against rope burns and that all persons are free from being entangled by the rope in the case that the bag is caught and pulled through a ΔP source. In addition, the person conducting the test should also be protected by an adequate fall protection Any Significant hazard detected must be effectively controlled before commencing a recognition dive.

Finally, although the bag is an effective means of detecting any existing ΔP hazards it must not in itself be the sole indicator used to declare a site free from hazardous water flows. Its purpose is only to determine if it is safe to commence a recognition dive.

2.1.3 (ii) Mop Test

A mop can be an effective tool to use during a recognition dive because its strands will react to any water flow while the mop handle allows the diver to remain clear of any ΔP hazards. It may be used to verify that ΔP does not exist at a structure that has not shown any indication of hazardous water flow by a bag test. Nonetheless, it must only be used in good visibility and the diver and diving umbilical must be provided with an independent restraint system until the survey confirms the area is free from hazardous water flow hazards. (See - ΔP restraint system)

2.1.3 (iii) Pole & Ribbon Test

Another means for performing the recognition dive as it allows the diver to remain clear of any hazardous water flows. Nonetheless, it must only be used in circumstances where there is good visibility and the diver and diving umbilical are restrained by an independent restraint system until the survey is completed and the work site is declared safe from hazardous water flows.

2.1.3 (iv) Pole Camera Survey

A pole camera combined with a surveyor's ribbon is useful for detecting gaps and signs of a hazardous water flow in relatively shallow water where there is good visibility. The ribbon is a good indicator of hazardous water flow and may aid in preventing the loss of the camera The person performing the survey with the pole camera must ensure that all persons are clear of any entanglement with the pole camera system while it is being maneuvered around the

structure. In addition, the person performing the survey must use fall protection.

2.1.3 (vi) ROV Survey

In some circumstances a remote-controlled vehicle is the only safe means of performing a survey of a dam for potential ΔP hazards. Although potentially costly, if the ROV encounters ΔP, it is certainly more preferable than a person being injured.

2.2 Recognition Dive

Its purpose is to establish a safety zone. This dive is performed in order to identify any signs of a potential ΔP hazard, such as: structural damage, accumulation of debris, cracks, holes and gaps\after the successful completion of a bag test.

First it is essential that both the diver and diving supervisor review the drawings of the structure with the Dam operator prior to the commencement of a "recognition dive" because of the necessity to familiarize themselves with the structure its dimensions and any service pipes. (Note that drawings are not always a true representation of what may exist, so caution is always recommended)

Secondly the diver must use a ΔP travel restraint system as per clause 2.5.9 while performing a recognition dive, and finally a rescue plan shall always be written and understood by all persons participating in the diving operation.

2.3 Safety Zone

A work site that has been declared safe to dive after the satisfactory completion of a bag test and recognition dive. The boundaries of the safe zone may be identified by features such as bull nose gates or with other indicators such as chain, rope etc. A 5m buffer is the minimum boundary when in open water. Once the safety zone has been established, there should be a restraint placed on the umbilical that would prevent the diver from exiting the zone.

ANNEX 4.0 ANNUAL REVIEWS / BASIC SKILLS EVALUATION

Annual Review - Top Water Mastery Skills
(Mask, Fins and Snorkel)
The following are presented here as an example of skills mastery

To be performed continuously until complete

_____- 800 yard / 725 meters Mask, Fins and Snorkel swim. **Completed in under 17 *minutes***

_____- 300 yard / 275 meters **Inert Victim Tow** (Life jackets must be used by at least one) using Mask, Fins and Snorkel. Victim should be face up and able to breath at all times. **Completed in under 12 minutes**

_____- 500 / 450 meters yard **continuous forward stroke** swim – no swim aids – **TO COMPLETION**

_____- 45 minute survival tread. **Participant will maintain their head above water at all times.**

Skills -

_____- On a single breath of air, in 8 feet – 15 feet of clear water using Mask, Fins, Snorkel and at least a 5 lb. weight belt, the participant will tread water, release and hold the weight belt out to the side with arm extended.

When participant is at roughly a 45degree angle, they will drop their weight belt.

The participant will free dive to the bottom, recover and don the weight belt, fully flood their mask once, **(twice is preferred)** clear it and ascend. At the surface the participant will clear their snorkel without lifting their head out of the water.

REPEAT 5 times

_____- On a single breath of air, in 8 feet – 15 feet of clear water using Mask, Fins, Snorkel and at least a 5 lb. weight belt, the participant will submerge at least 5' and clear a fully flooded mask no less than 4 times **(6 is preferable)** and ascend. At the surface the participant will clear their snorkel without lifting their head out of the water.

REPEAT 5 Times or as necessary to complete skill a minimum of 3 times.

****

None of the above is intended to be a pass / fail.
The skills are intended to set a mark of achievement that can measure mastery of those particular skills.

Annual Review – Basic SCUBA Skills
Basic SCUBA Equipment and Depth less than 30 feet

To be performed continuously until complete

- **Controlled descent.**

  Establish and HOLD neutral buoyancy near the bottom. (The expectation is to stay neutral). When applicable, underwater skills should be conducted while maintaining neutral buoyancy.

- **No mask breathing** from a regulator for no less than two minutes.
- **Mask exchange on the surface.**
- **Mask exchange underwater.**
- **Regulator Recovery** – successfully perform no less than two different regulator recovery techniques.
- **Alternate Air buddy breath** and swim horizontally the length of the pool and back or at least 25 yards. To be done both as donor and recipient.
- **Slipped Tank** - Tank band will be loosened. Diver must remove gear, correct the problem and don gear underwater.
- **Lost fin swim** – While underwater, participants will remove one fin and swim the length of the pool and back or at least 25 yards.
- **Simulated free flowing regulator** for no less than 30 seconds. (To facilitate this drill, a separate cylinder and regulator may be used for all participants.)
- Controlled ascent and manually inflate BCD at the surface.
- **ON THE SURFACE -** Remove BCD and fix loosened tank band. Don BCD at the surface.
- **ON THE SURFACE -** Remove and replace weight belt or weight pockets.

ANNEX 5.0 ADDITIONAL INFORMATION;

Continuing Education and Recommended Additional Training Topics (as appropriate)

Diver Equipment Checklist

DIVER'S NAME:_____ DATE INSPECTED ____/____/____

Basic Scuba Equipment

- ☐ Gear Bag
- ☐ Mask
- ☐ Full Face Mask
- ☐ Fins
- ☐ Snorkel
- **Wet Suit:**
  - ☐ Jacket
  - ☐ Pants
  - ☐ Vest
  - ☐ Hood
  - ☐ Gloves
  - ☐ Boots
- ☐ Dry Suit
- ☐ Weight Belt
- ☐ Buoyancy Control Device (BCD)
- ☐ Tank (s) #_____ (Filled)
- ☐ Backpack
- ☐ Regulator (with SPG & Alternate Air Source)
- ☐ Compass
- ☐ Depth Gauge
- ☐ Bottom Timer
- ☐ Knife
- ☐ Wire Cutters
- ☐ Emergency Medical Shears
- ☐ Dive Table
- ☐ Nylon Search Rope
- ☐ Diver Communication
- ☐ Pony Bottle

Accessory Equipment

- ☐ Dive Light
- ☐ Slate & Pencil
- ☐ Lift Bag
- ☐ Goody Bag
- ☐ Camera, Film
- ☐ Marker Buoy
- ☐ Down Weight
- ☐ Dive Flag

Spare Equipment

- ☐ Nylon Line
- ☐ Tanks
- ☐ Weights
- ☐ Straps
- ☐ O-Rings
- ☐ Tools
- ☐ Suit Cement
- ☐ Regulator Plugs
- ☐ Bulbs, Batteries

Personal Items

- ☐ Food & Water
- ☐ Swimsuit & Towel
- ☐ Sun Block/Lotion
- ☐ Jacket
- ☐ Medications

Regulator's Last Service Date____/____/____ Technician's Name:_____

Dive Shop:_____ Phone Number: (_____)_____-_____

Tanks Last VIP: #1 - ____/____/____ #2 - ____/____/____ #3 - ____/____/____

Tanks Last Hydro: #1 - ____/____ #2 - ____/____ #3 - ____/____

Notes:_____

_____

_____

DIVE SUPERVISOR_____ DATE____/____/____

Dive credit and hours diving conducted in zero visibility as approved by the DSO

1. Hazardous Materials Training for HP Cylinder Handling (and Filling if team operates a fill station). – 1 hour
2. Diving Rescue – to include procedures relevant to team specific protocols. – 10 hours
3. Diving Physics (beyond entry-level scuba training)
5. Diving Physiology (beyond entry-level scuba training) - 2 hours
6. Diving Environments germane to those experienced by the PSD team - 2 hours
7. Decompression Theory and its Application – 2 hours
8. Decompression Management (Dive tables, dive computers, software & databases if used) – 2 hours
9. Public Safety Diving Regulations and History
    - Public Safety Dive Planning – 2 hours
    - Coordination with other Agencies or dive teams – 2 hours
    - Appropriate Governmental Regulations – 2 hours
10. Site Location and Re-location – 4 hours

    Inclusive of:

    - Dive Site Risk Assessment
    - Locating an object ins zero vis
    - Marking and diagraming the location
    - Relocating the object based on written materials
11. In-Water Evidence Recovery (Body and Weapon) – 10 hours, 2 dives
12. Specialized Diving Equipment
    - Underwater Communications
    - Lift bags and Procedures
    - Line Reels
    - Photography
    - Remote sensing (sonar/ magnetometer / ROV)

Suggested Topics (include, but are not limited to):

1. Specific Dive Modes (methods of gas delivery)
    - Open Circuit Scuba
    - Surface Supplied Diving
    - Rebreathers
2. Specialized Breathing Gases
    - Nitrox
    - Mixed Gas

3. Small Boat Operation
4. Specialized Environments and Conditions
    - Altitude Diving
    - Cold Water Diving
    - Zero Visibility Diving
    - Contaminated Water Diving
    - Decompression Diving
    - Overhead Environments
    - Night Diving
    - Strong Current Diving
    - Potential Entanglement/Entrapment
    - Delta P issues
    - Handling human remains

Feet to Meters Conversion Table

Feet (ft)	Meters (m)	Feet (ft)	Meters (m)	Feet (ft)	Meters (m)
1 ft	0.3048 m	7 ft	2.1336 m	40 ft	12.1920 m
2 ft	0.6096 m	8 ft	2.4384 m	50 ft	15.2400 m
3 ft	0.9144 m	9 ft	2.7432 m	60 ft	18.2880 m
4 ft	1.2192 m	10 ft	3.0480 m	70 ft	21.3360 m
5 ft	1.5240 m	20 ft	6.0960 m	80 ft	24.3840 m
6 ft	1.8288 m	30 ft	9.1440 m	90 ft	27.4320 m
100 ft		30.4800 m			

Section 3.30(G) SAC RATE / RMV CALCULATIONS

http://www.alertdiver.com/?articleNo=259

Determine Your SAC Rate

Surface air consumption (SAC), sometimes called surface gas consumption (SGC), is a measure of your rate of gas usage expressed in pounds per square inch (psi) or, for metric divers, in bars of pressure. It's the first thing you need to know to calculate your gas needs for any given dive.

You can determine your SAC on your next dive. When you enter the water, descend to a depth where you have a large set reference point like a smooth section of ocean bottom or the deck of a ship. Fine-tune your buoyancy, then record your bottom time, the depth and the pressure reading on your submersible pressure gauge (SPG). Swim at a comfortable pace for 10 minutes, maintaining a stable depth. At the end of your timed swim, record the pressure reading on your SPG again.

After your dive, get a sheet of paper, pencil and a calculator. The first step in determining your SAC is

calculating how much gas you used for each minute of your timed swim. For example, let's assume your dive was at 33 feet or 10 meters; that your test segment was 10 minutes in duration and that you used 600 psi or 40 bars of pressure. [*Author's note: 600 psi actually equals 41.38 bars. We use 40 bars to simplify the math examples.*] So, we start by dividing the total gas used by the number of minutes in the segment:

- Imperial: 600 ÷ 10 = 60 psi per minute
- Metric: 40 ÷ 10 = 4 bar per minute

We now know how much gas you used per minute during the timed swim. But that measurement was taken at depth. To know your SAC rate, we need to bring that measurement to the surface by adjusting for the absolute pressure of the dive. The formula for determining absolute pressure is:

- Imperial: Depth (in feet of sea water) ÷ 33 + 1 = atmospheres absolute of pressure (ATA)
- Metric: Depth (in meters of sea water) ÷ 10 + 1 = atmospheres absolute of pressure (ATA)

So, for our example:

- 33 feet ÷ 33 + 1 = 2 ATA. If you use metric: 10 meters ÷ 10 + 1 = 2 ATA

Now we simply divide our usage in pressure by the absolute pressure at depth and we have reached the first stop in our calculations, an accurate SAC rate.

- Imperial: 60 psi ÷ 2 ATA = 30; so, our SAC is 30 psi per minute
- Metric: 4 bars ÷ 2 ATA = 2; so, our SAC is 2 bars per minute

Determining Gas Needs

As long as you use a tank that has both the same volume and the same pressure rating as the one used in the timed swim, your SAC rate will tell you approximately how much gas you'll breathe each minute at a given depth. Simply multiply your SAC by the atmospheres of pressure at your planned depth. For example: You're planning a dive to 99 feet or 30 meters. That's 4 atmospheres of pressure (99 feet ÷ 33 + 1 = 4 ATA or 30 meters ÷ 10 + 1 = 4 ATA).

- Imperial: 30 psi x 4 ATA = 120 psi per minute at depth
- Metric: 2 bar x 4 ATA = 8 bars per minute at depth

To estimate your total gas needs for the dive, take the starting pressure of your cylinder, subtract a reserve amount of gas and then divide the remainder by the consumption rate to find out how many minutes of dive time you can expect. The safest rule of management for gas supply is to use the rule of thirds in any situation where it is preferable to come back to a set ascent point, such as the anchor line of a dive boat. The rule of thirds means that the diver uses one-third of his air supply for the descent and the swim away from the exit point and one-third for the swim back to the exit point, leaving one-third for any delays or emergencies. Most divers think of this emergency as sharing gas with a buddy, but in reality, it could be used for getting lost, getting snagged in monofilament line or even something as simple as retrieving a lost piece of equipment.

So, if you start the dive with a full cylinder at 3,000 psi, or 206 bars, the planning math looks like this:

- Imperial: 3,000 psi ÷ 3 = 1,000 psi as 1/3 of our cylinder. 3,000 – 1,000 = 2,000 psi of useable gas. A rate of 120 psi per minute means you'll have approximately 16.6 minutes of gas at depth (2,000 ÷ 120 = 16.6).
- Metric: 206 bars ÷ 3 = 68.7 bars as 1/3 of our cylinder. 206 – 69 = 137 bars of useable gas. 137 ÷ 8 = 17.1 minutes of dive time.

Calculating an RMV

In the event that you are diving a tank of a different size or operating pressure, you will need to take two more steps to make your calculations useful. Because pressure ratings on cylinders can vary dramatically — from 2,400 psi to 3,500 psi or 165 bars to 240 bars — we have to convert cylinder pressures into equivalent volumes of gas and then modify our SAC into a measurement called a Respiratory Minute Volume (RMV). The method of converting these pressures varies depending on whether the diver is using the imperial or metric measurement. For simplicity we will demonstrate each method separately starting with the imperial system.

The first step is to find out how much gas volume is contained in each psi of gas in the cylinder used to determine our SAC. We call this number a cylinder conversion factor (CF). To calculate the CF, divide the rated volume of the cylinder in cubic feet by the rated pressure of the cylinder (CF volume ÷ rated psi).

So for an aluminum 80 (the cylinder used in our test dive scenario) the CF is .0267 (80 ÷ 3,000 = .0267).

To convert our SAC (30 psi per minute) to an RMV we need to multiply the pressure of gas used by the CF of the cylinder.

- RMV = 30 x 0.0267 = 0.8 cubic feet per minute

For divers using the metric system, there is no need to find a conversion factor because the rating on metric cylinders is the volume at 1 bar of pressure. To convert a SAC in bar to an RMV, simply multiply the rated volume by the SAC. In our example, the diver's SAC was 2 bars and he was using an 11-liter cylinder.

- RMV = 2 x 11 = 22 liters per minute

With these numbers a diver can select any cylinder and estimate how many minutes of dive time the cylinder will yield for his personal RMV. To calculate dive duration for our sample divers, we take the rated cylinder volume, take away the one-third of the volume for our reserve and then divide the remainder by the RMV of the diver at depth.
Let's assume a 108-cubic-foot (17-liter) cylinder rated at 2,640 psi (180 bars) on our same dive to 99 feet (30 meters) or 4 ATA of pressure.

Imperial System

- 108 cubic feet ÷ 3 = 36 cf. 108 – 36 = 72 cubic feet of useable gas volume
- 0.8 x 4 = 3.2 RMV in cubic feet
- 72 ÷ 3.2 = 22.5 minutes of available dive time

Metric System

- 17 ÷ 3 = 5.6; 17 – 5.6 = 11.3 liters of useable water volume
- 11.3 x 180 bars of rated pressure = 2,034 liters of usable gas
- 22 x 4 = 88 RMV in liters
- 2,034 ÷ 88 = 23 minutes of available dive time

Estimates vs. Reality

Using these calculations, you can estimate your available bottom time. However, this does not absolve a diver of the responsibility to monitor gauges and manage the dive based on actual air consumption (not

to mention decompression obligations). If you find yourself swimming into a current, for example, your air consumption rate will be higher than that used in your calculations. On a drift dive where you barely move a muscle, your gas consumption may be lower. To more accurately estimate gas supply needs for high- and low-exertion dives, repeat the SAC process swimming at a faster pace and again at a slower pace.

Use Less Air

These simple steps may significantly improve your gas consumption rates and make your dives more enjoyable.

Streamline Your Gear

When moving through a medium that is 800 times denser than air, even small efficiencies can reap big benefits. Avoid "danglies" by eliminating all unnecessary gear and tucking what you do need inside pockets. Secure gauges and your octopus regulator to your BCD and route hoses close to your body. When you fin through the water, fold your arms together or clasp your hands behind your back while keeping your fins inside the slipstream created by your tank and torso.

Fine Tune Your Buoyancy and Trim

The air cell in most BCDs is located at or near the diver's shoulders and the weight is located at or near the diver's waist. This alignment of forces pulls the shoulders toward the surface and pushes the lower body toward the bottom, giving the diver the swimming profile of a Mack truck. The more weight you carry, the more this effect is exaggerated. Take a buoyancy course or work with an instructor to fine-tune your weighting and redistribute your ballast load to achieve a proper horizontal swimming position. Bonus: You'll be adding less air to your BCD to offset ballast, which means you'll have more in the tank to breathe.

Stop the Leaks

On every dive, scan your gear for air leaks. Small leaks from your octopus, gauge console or BCD inflator can add up over the course of a dive and, as a matter of safety, indicate gear long overdue for service. Another hidden air thief: a leaky mask. Every time you stop to clear water from your mask, you're wasting breathing gas.

TABLE 8.6
Air Consumption Table at Depth

SURFACE AIR CONSUMPTION RATE (PSI PER MINUTE)	DEPTH (FEET)														
Surface	10	15	20	25	30	40	50	60	70	80	90	100	120	140	160
15	19	21	24	27	28	33	37	42	46	51	55	60	69	78	87
16	20	23	25	28	30	35	40	44	49	54	59	64	73	83	92
17	22	24	27	30	32	37	42	47	52	57	62	68	78	88	98
18	23	26	28	32	34	39	45	50	55	61	66	72	82	93	104
19	24	27	30	34	36	41	47	53	58	64	70	76	87	98	110
20	26	29	32	36	38	44	50	56	62	68	74	80	92	104	116
21	27	30	33	37	39	46	52	58	65	71	77	84	96	109	121
22	28	31	35	39	41	48	55	61	68	74	81	88	101	114	127
23	29	33	36	41	43	50	57	64	71	78	85	92	105	119	133
24	31	34	38	43	45	52	60	67	74	81	88	96	110	124	139
25	32	36	40	45	47	55	62	70	77	85	92	100	115	130	145
26	33	37	41	46	49	57	65	72	80	88	96	104	119	135	150
27	35	39	43	48	51	59	67	75	83	91	99	108	124	140	156
28	36	40	44	50	53	61	70	78	86	95	103	112	128	145	162
29	37	42	46	52	55	63	72	81	89	98	107	116	133	150	168
30	39	43	48	54	57	66	75	84	93	102	111	120	138	156	174
31	40	45	49	55	58	68	77	86	96	105	114	124	142	161	179
32	41	46	51	57	60	70	80	89	99	108	118	128	147	166	185
33	42	47	52	59	62	72	82	92	102	112	122	132	151	171	191
34	44	49	54	61	64	74	85	95	105	115	125	136	156	176	197
35	45	50	56	63	66	77	87	98	108	119	129	140	161	182	203
36	46	52	57	64	68	79	90	100	111	122	133	144	165	187	208
37	48	53	59	66	70	81	92	103	114	125	136	148	170	192	214
38	49	55	60	68	72	83	95	106	117	129	140	152	174	197	220
39	50	56	62	70	74	85	97	109	120	132	144	156	179	202	226
40	52	58	64	72	76	88	100	112	124	136	148	160	184	208	232

https://tecvault.t101.ro/NOAA%20Diving%20Manual.pdf

Aluminum Cylinders

Aluminum Cylinders							
Manufacturer & Nominal Capacity	Service pressure, psi	Actual air capacity, ft3	Outer diameter, in	Length without valve, in	Empty weight, lbs (w/o valve)	Buoyancy Empty, lbs (w/valve)	Buoyancy Full, lbs (w/valve)
Catalina S6	3000	6	3.21	10.8	2.6	-1.1	-1.5
Luxfer 6	3000	6	3.21	10.87	2.72	-1.03	-1.49
Catalina S13	3000	13	4.38	12.8	5.7	-0.8	-1.7
Luxfer 13	3000	13.2	4.37	12.87	5.94	-0.72	-1.71
Luxfer 14	2015	13.7	4.4	16.5	5.4	1.7	0.7
Catalina S19	3000	19	4.38	17.4	7.8	0	-1.3
Luxfer 19	3000	19.9	4.37	18.56	8.09	0.12	-1.37
Luxfer 27	3000	27.9	5.3	18	11.4	0.6	-1.5
Catalina S30	3000	30	5.25	20	13.7	-0.2	-2.4
Luxfer 30	3000	30	4.87	21.85	11.61	1.2	-1
Catalina S40	3000	40	5.25	24.9	15.9	1.7	-2.6
Luxfer 40	3000	39.9	5.25	24.75	15.3	2.2	-0.8
Catalina S45	3000	45	6.89	17.7	20.3	1.3	-2
Luxfer 50	3000	48.4	6.89	19	21.2	1.3	-2.4
Catalina S53	3000	53	7.25	19.2	25.6	-0.2	-4.1
Catalina C60	3300	60	7.25	19.9	27.3	-0.4	-4.9
Catalina S63	3000	63	7.25	21.6	27.2	2	-2.6
Luxfer 63	3000	63	7.25	21.85	26.6	2.6	-2.1
Luxfer 72	3000	69.6	6.9	26	28.4	3.6	-1.6
Luxfer 80	3000	77.4	7.25	26.06	31.38	4.4	-1.4
Luxfer S80	3000	78.2	8	22.93	35.12	2.26	-3.6
Catalina S80	3000	77.4	7.25	25.8	31.6	4	-1.8
Catalina C80	3300	77.4	7.25	25.1	34.4	-0.2	-5.9
Luxfer 92	3200	90.3	8	24.8	37.6	3.1	-3.6
Luxfer 100	3300	99.3	8	26.21	40.86	3.11	-4.34
Catalina C100	3300	100	8	27.3	46.1	-0.4	-7.8

Steel Cylinders

Manufacturer & Nominal Capacity	Service pressure, psi	Actual air capacity, cu. Ft. (at +10%)	Outer diameter, in	Length without valve, in	Empty weight, lbs	Buoyancy Empty, lbs (w/valve)	Buoyancy Full, lbs (w/valve)
OMS 13	2400 +10%	13	3.9	14	5.9	-2.25	-3.31
OMS 20	2400 +10%	20	3.9	19.5	7.5	-1.5	-3
Heiser 45	2400 +10%	45	5.5	25.79	20.3	0.8	-2.575
PST LP 45	2400 +10%	45	5.5	23	19	-0.5	-3.7
OMS 45	2400 +10%	46	5.5	23	17.6	0	-4
OMS 50	2400 +10%	50	5.5	25.2	19.92	-1.5	-4.8
OMS 66	2400 +10%	66	7	21	25	-1.67	-5.15
PST 65	3500	67	7.25	16.75	26.2	-1.5	-6.4
PST MP 72	3300	72	6.9	20.75	30	-6	-11.4
Faber 72	3000+10%	72	6.75	20.5	28.7	-3.7	-8.45
Faber 80	2400 +10%	78	7.25	24	30	-1.7	-7.55
Faber 80	3180 +10%	80	7.25	19.88	32.5	-7.22	-13.22
PST E7-80	3442 PSI	80	7.25	20	28	-2.5	-8.5
Worth. X7-80	3442	80	7.25	19.7	27.7	-3	-9
PST LP-80	2400 +10%	80.6	7.25	24	34	-1	-7
PST 80	3500	82	7.25	19.75	28.6	-3.3	-9.3
OMS 85	2400 +10%	85	7	26	31	0	-6.7
Faber 95	2400 +10%	95	8	23.8	37.2	-1.2	-8.325
PST 95	2400 +10%	96.6	8	24.75	43.8	-3.3	-10.4
OMS 98	2400 +10%	98	8	24	38	0	-7.73
Faber 100	3180 +10%	100	7.25	24.01	38.7	-7.26	-14.76
PST E7-100	3442 PSI	100	7.25	24.12	33	-1	-8.5
Worth X7-100	3442	100	7.25	24	33	-2.5	-10
PST 100	3500	102	7.25	23.94	34.1	-1.3	-8.8
Heiser 104	2400 +10%	104	8	27.36	47.4	-7.46	-15.26
PST 104	2400 +10%	106.2	8	26.88	46.4	-3.3	-11.27
OMS 108 (112)	2400 +10%	112	8	26	41	-1	-8
PST E8-119	3442 PSI	119	8	24	41	-2	-10.5
Worth X8-119	3442	119	8	24	42	-2	10.9
Heiser 120	3190	120	8.03	25.8	55	-17.82	-26.4
Faber 120	3180 +10%	120	7.25	28.64	48.3	-7.22	-16.22
PST E7-120	3442 PSI	120	7.25	28.25	38	0	-10.5
Worth X7-120	3442	120	7.25	28	38	-2	-11
PST 120	3500	122.5	7.25	27.87	39.2	-1.3	-10.3
PST 120	2400 +10%	122.5	8	29.37	51.3	-1.7	-10.7
OMS 121 (125)	2400 +10%	125	8	29	45	0	-9.5
PST E8-130	3442 PSI	130	8	26.12	43	-1	-10.5
Worth X8-130	3442	130	8	25.5	43	-2	-11.7
OMS 135 (131)	2400 +10%	131	8	30.7	47	0.75	-10.31
Heiser 140	3190	140	8.03	29.9	63	-18.04	-28.4
E8-149	3442 PSI	149	8	29.37	47.5	-1.7	-12.8
Heiser 190	4400	190	8.03	31.3	87	-46.86	-62.3

Section 8.0(K)(I) CALCULATING CURRENT SPEED

Current Speed Chart*

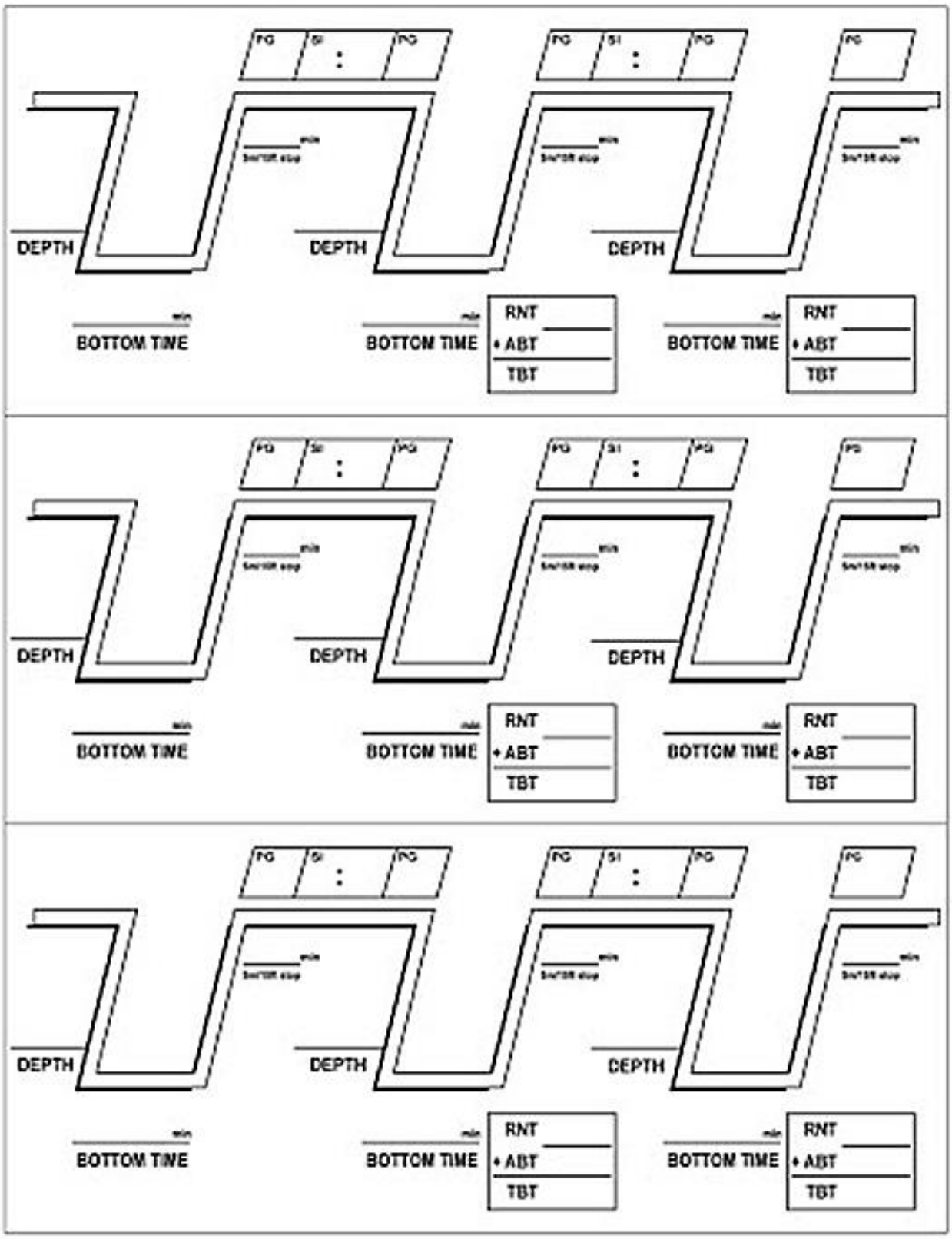
Current speed should be evaluated prior to diving in moving water.

Measure 100 feet parallel to the water or lay out a 100 foot or measured line. Toss an object that will float upstream of your line and note the amount of time it takes for the object to travel the line distance measured out.

CURRENT SPEED			
Time (seconds)	**Feet Per Second**	**Miles Per Hour**	**Knots**
90	**1.1**	**.76**	**0.66**
80	**1.25**	**.85**	**0.74**
70	**1.43**	**.97**	**.84**
60	**1.66**	**1.14**	**1.0**
55	**1.8**	**1.24**	**1.1**
50	**2**	**1.4**	**1.2**
40	**2.5**	**1.7**	**1.5**
30	**3.33**	**2.27**	**2.0**
20	**5**	**3.4**	**3.0**
10	**10**	**6.8**	**6.0**

Public safety diving should not be conducted in currents exceeding 1 knot on SCUBA or 2 knots utilizing surface supplied air.

Section 9.0 (E) REPETITIVE DIVE TABLES



Section 9.0(N) NITROX IS NOT RECOMMENDED

For the purposes of this consensus standard, nitrox is not recommended. Time and depth limitations for diving in zero or low visibility should negate the potential benefits of using nitrox. The potential to need an emergency supply of gas lends itself to compressed air. Compressed air should be easily obtained and used by all dive team members. Nitrox can be used but teams must allow for emergency breathing gas needs and have the ability to stockpile and supply additional gas on site before beginning a dive.

Section 10.10 Communication Between Diver and Surface – Line Signals

Whatever signals you use, they must provide adequate communication between the diver and the dive tender. Below are examples of line signals.

OATH

Many public safety dive teams use the acronym *OATH* to identify line signals.

- 1 Tug: ***O****kay* (can be a question or answer)
- *2 Tugs: **A**dvance or Give me rope*
- 3 Tugs: ***T****ake up rope* or *I'm coming back*
- 4 Tugs: ***H****elp*

CIVIL DEFENSE uses similar lifeline signals as a method of communication for rescue workers working off a lifeline. They identify a lifeline as "A means of communication for members of a rescue party who must enter hazardous enclosures or toxic atmosphere. It enables them to keep in contact with persons outside by sending rope signals." **Their standard lifeline signals include:**

- One pull: *Stop* (if moving), *Okay* (If at rest)
- Two pulls: *Advance*
- Three Pulls: *Come out at once*
- Four Pulls: *Distress – come at once*

NOAA DIVING PROGRAM 11/27/17

LINE PULL SIGNALS FROM THE TENDER TO THE DIVER

1 - Pull stop or are you OK
2 - Pulls go down
3 - Pulls standby to come up
4 - Pulls come up

FROM THE DIVER TO THE TENDER

1 - Pull I'm OK or stop
2 - Pulls lower me (give slack)
3 - Pulls take up slack
4 - Pulls haul me up

EMERGENCY LINE-PULL SIGNALS

2-2-2 - Pulls I'm fouled, send help ("I need you")
3-3-3 - Pulls I'm fouled but don't need help
4-4-4 - Pulls haul me up immediately

ALL EMERGENCY SIGNALS WILL BE ANSWERED AS GIVEN EXCEPT 4-4-4
SEARCH SIGNALS

7 - Pulls go on (or off) search signals
1 - Pull stop and search where you are
2 - Pulls adjust distance (move directly away from tender if given slack; move toward the tender if tension is increased)
3-Pulls Face tender, maintain tension and move right
4-Pulls Face tender, maintain tension and move left

Dive Tender Line-Pull Signals

Tender-To-Diver Signals

1 Tug = Are you OK?
2 Tugs = Stop. Advance search line and change direction
3 Tugs = Come to surface
4 Tugs = DANGER! Stop, search and wait for directions

Diver-To-Tender Signals

1 Tug = Diver is OK
2 Tugs = Allow diver more line to advance
3 Tugs = Have found object to search
4 Tugs = NEED IMMEDIATE HELP! Send Safety Diver to assist

T**eam Life Guard Systems**, also uses and teaches these line signals:
Dive to Tender Tender to Diver

1 - Dive is OK 1 stop, face the line, tighten line
2 - Make a notation 3 - go right (diver's)
2+2+2 problem but ok, alert back up 4 - go left (diver's)
3+3+3 problem need help 2+2 Search Immediate area
4+4+4 need immediate help! 3+3 Stand By
6+6 Found Object

REGARDLESS OF WHICH SIGNALS YOU USE,
ADD THIS:

ANY TIME THE SEARCH LINE GOES SLACK AND A SMALL, STEADY PULL DOES NOT FIND RESISTANCE, AN IMMEDIATE EMERGENCY IS TO BE DECLARED AND ACTED ON.

STANDARD LINE SIGNALS

FROM TENDER TO DIVER

- 1 Pull - *"Are You All Right?"* While moving one pull means - *"Stop"*
- 2 Pulls - *"Going Down" or "Going Out"* While ascending or coming in toward shore 2 Pulls mean - *"You Have Moved Too Far, Go back Until I Stop You."*
- 3 Pulls - *"Stop and Stand by, Instructions To Follow"*
- 4 Pulls - *"Come Up"*
- 2 Pulls pause 1 Pull - *"I Understand"*

FROM DIVER TO TENDER

- 1 Pull - *"I Am All Right"* While moving means *"I'm Stopping"* or *"I'm On The Bottom"*
- 2 Pulls - *"Give Me Slack"*
- 3 Pulls - *"Take Up The Slack"*
- 4 Pulls - *"Coming Up"*
- 2 Pulls pause 1 Pull - *"I Understand"*
- 1 Pull pause 2 Pulls - *"I've Found The Object"*

SEARCH SIGNALS

- 7 Pulls - *"Go On (or Off) Search Signals"*
- 1 Pull - *"Stop"* or *"Stop and Search Where You Are"*
- 2 Pulls - *"Go"*
- 3 Pulls - *"Go Right"*
- 4 Pulls - *"Go Left*"

EMERGENCY SIGNALS FROM DIVER

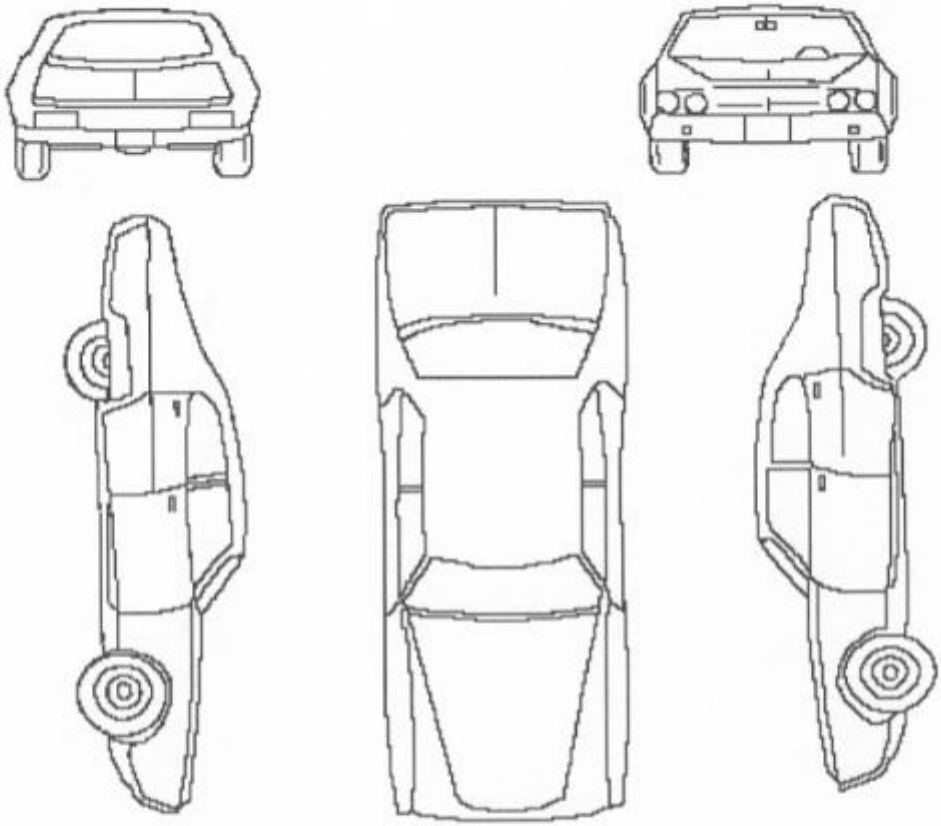
- 2 Pulls pause 2 Pulls pause 2 Pulls - *"I Need Assistance"*
- 3 Pulls pause 3 Pulls pause 3 Pulls - *"I Am Fouled But Can Get Out"*
- 4 Pulls pause 4 Pulls pause 4 Pulls - *"Haul Me Up Immediately'*

REGARDLESS OF WHICH SIGNALS YOU USE,ADD THIS:

***ANY TIME THE SEARCH LINE GOES SLACK AND A SMALL, STEADY PULL DOES NOT FIND RESISTANCE, AN IMMEDIATE EMERGENCY IS TO BE DECLARED AND ACTED ON*!**

ANNEX 6.0 FORMS

DESCRIPTION OF VEHICLE WHEN FOUND



DIVER'S EXAMINATION: **BI**=Body Inside, **BP**=Body Partially (inside/outside), **DP**=Damage Present, **OD**=Open Door, **PE**=Paint Exchange, **RD**=Recovery Damage, **TD**=Tire Deflated, **WB**=Window Broken, **WO**=Window open,

OTHER/EXPLAIN:_____

_____

ANY ARTIFACTS OR DAMAGE DONE TO VEHICLE DURING RECOVERY? ☐ **YES** ☐ **NO**

IF YES, EXPLAIN:_____

_____

INVENTORY:_____

_____

_____

DIVER MAKING REPORT:_____ DATE OF REPORT_____/_____/_____

VEHICLE RECOVERY WORKSHEET Page_____of_____

DATE SUBMERGED:_____/_____/_____ ☐ UNKNOWN TIME:_____:_____ ☐ AM ☐ PM

WITNESS TO SUBMERSION:_____
Last First MI

ADDRESS:_____STATE_____ZIP_____

PHONE NUMBER: (_____)_____-_____ FAX:(_____)_____-_____

NOT WITNESSED ☐

DATE RECOVERED:_____/_____/_____ TIME RECOVERED_____:_____ ☐ AM ☐ PM

RECOVERY LOCATION:_____

DIVE TEAM'S NAME:_____

ADDRESS:_____STATE_____ZIP_____

PHONE NUMBER: (_____)_____-_____ FAX: (_____)_____-_____

WERE PHOTOGRAPHS TAKEN DURING RECOVERY? ☐ YES ☐NO, IF YES, WHO HAS POSSESSION?

NAME: _____ NUMBER: (_____)_____-_____

DRIVER:_____ ☐ NO DRIVER
Last First MI

VEHICLE YEAR: _____ MAKE:_____ MODEL:_____ BODY:_____ COLOR:_____

REGISTRATION:_____ STATE:_____ VIN:_____

EVIDENCE OF VEHICLE'S LOCATION

☐ TIRE TRACKS ☐ SCRAP MARKS ☐ GAS SLICK ☐ FLOATING DEBRIS ☐ OTHER

NOTES:_____

VEHICLE'S POSITION IN THE WATER ☐ **TOTALLY SUBMERGED** ☐ **PARTIALLY SUBMERGED**

☐ ON ALL FOUR TIRE ☐ OVERTURNED ☐ ON ITS SIDE ☐ DRIVER'S SIDE ☐ PASSENGER'S SIDE

NOTES:_____

EVIDENCE VEHICLE WAS STOLEN/PLACED IN WATER

☐ LIGHTS SWITCH ON ☐ KEY IN IGNITION ☐ HOT WIRED ☐ ITEM HOLDING GAS PEDDLE DOWN
☐ IN NEUTRAL ☐ IN GEAR, EXPL._____ ☐ RADIO ON, WHAT STATION?_____

NOTES:_____

NAME OF WRECKER SERVICE:_____
That made the recovery

ADDRESS:_____STATE_____ZIP_____

PHONE NUMBER:(_____)_____-_____ FAX: (_____)_____-_____

BODY RECOVERY WORKSHEET

Page____of____

NAME OF DECEASED: _____
Last First MI

ADDRESS: _____ STATE_____ ZIP_____

DOB: _____/_____/_____ **SSN:** _____-_____-_____ ☐ MALE ☐ FEMALE

RACE: ☐BLACK ☐WHITE ☐HISPANIC ☐ASIAN ☐NATIVE AMERICAN ☐UNKN. ☐OTHER _____

DATE SUBMERGED: _____/_____/_____ ☐ UNKNOWN TIME: _____:_____ ☐ AM ☐ PM

WITNESS TO SUBMERSION: _____
Last First MI

ADDRESS:_____STATE_____ZIP_____

PHONE NUMBER: (_____)_____-_____ FAX: (_____)_____-_____

NOT WITNESSED ☐

DATE RECOVERED: _____/_____/_____ TIME RECOVERED: _____:_____ ☐ AM ☐ PM

DIVE TEAM'S NAME: _____

ADDRESS: _____STATE_____ZIP_____

PHONE NUMBER: (_____)_____-_____ FAX: (_____)_____-_____

RECOVERING DIVERS NAME: _____

WERE PHOTOGRAPHS TAKEN DURING RECOVERY? ☐ YES ☐ NO, IF YES, WHO HAS POSSESSION?

NAME: _____ NUMBER: (_____)_____-_____

RECOVERED IN: ☐ FRESH WATER ☐ SALT WATER WATER TYPE: CLEAN 1 2 3 4 5 6 7 8 9 POLLUTED

DEPTH IN FEET: _____ BOTTOM COMPOSITION: _____

RECOVERED WATER TEMPERATURE: SURFACE _____°F BOTTOM _____°F

RECOVERED AIR TEMPERATURE THAT DAY: HIGH _____°F LOW _____°F

BODY POSITION WHEN FOUND:

ON BOTTOM	☐	ON SURFACE	☐	UNDERCUT	☐
FACE UP	☐	FLOATING	☐	ON SHORE	☐
FACE DOWN	☐	SNAGGED	☐	CONTAINER	☐
LEFT SIDE	☐	STRAINER	☐	WEIGHTED	☐
RIGHT SIDE	☐	EDDY	☐	TIED/CHAINED	☐

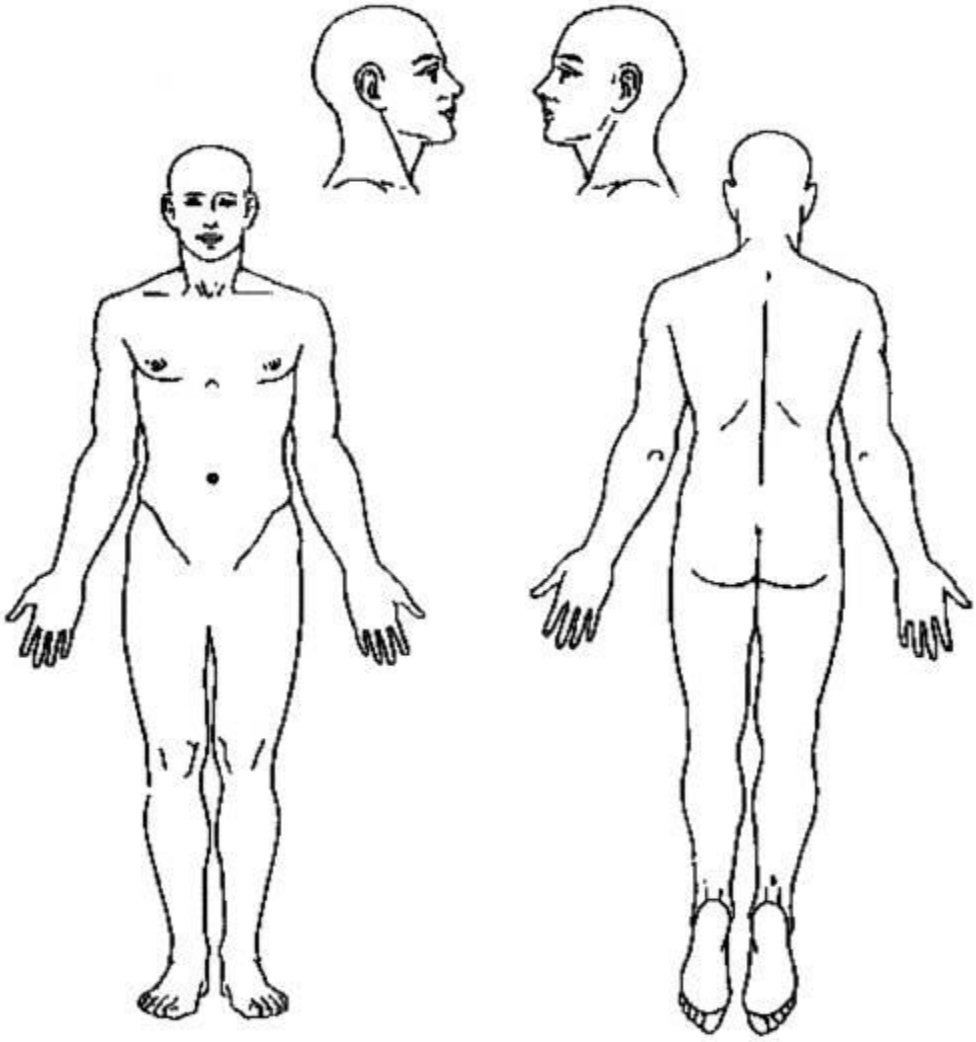
OTHER/EXPLAIN: _____

NAME OF FUNERAL HOME/MORTICIAN:_____
That recovered victim from the scene

ADDRESS:_____STATE_____ZIP_____

PHONE NUMBER:(_____)_____-_____ FAX:(_____)_____-_____

DESCRIPTION OF BODY WHEN FOUND



DESCRIPTION OF BODY: ☐ Clothed ☐ Unclothed ☐ Partly Clothed,

Explain_____

LIST CLOTHING: _____

Height_____in. ☐ estimated **Weight**_____lb. ☐ estimated
Hair color_____ **Eye color**_____ R_____L_____ Beard ☐ Mustache ☐

RIGOR: ☐ Jaw ☐ Neck ☐ Arms ☐ Legs ☐ Passing ☐Absent ☐ Other
LIVOR: ☐ Blanches ☐ Fixed Color ☐ Purple ☐ Pink/Red ☐ Indeterminant ☐ Other
LIVOR LOCATION: ☐ Anterior ☐ Posterior ☐ Left ☐ Right ☐ Regional
(specify)_____

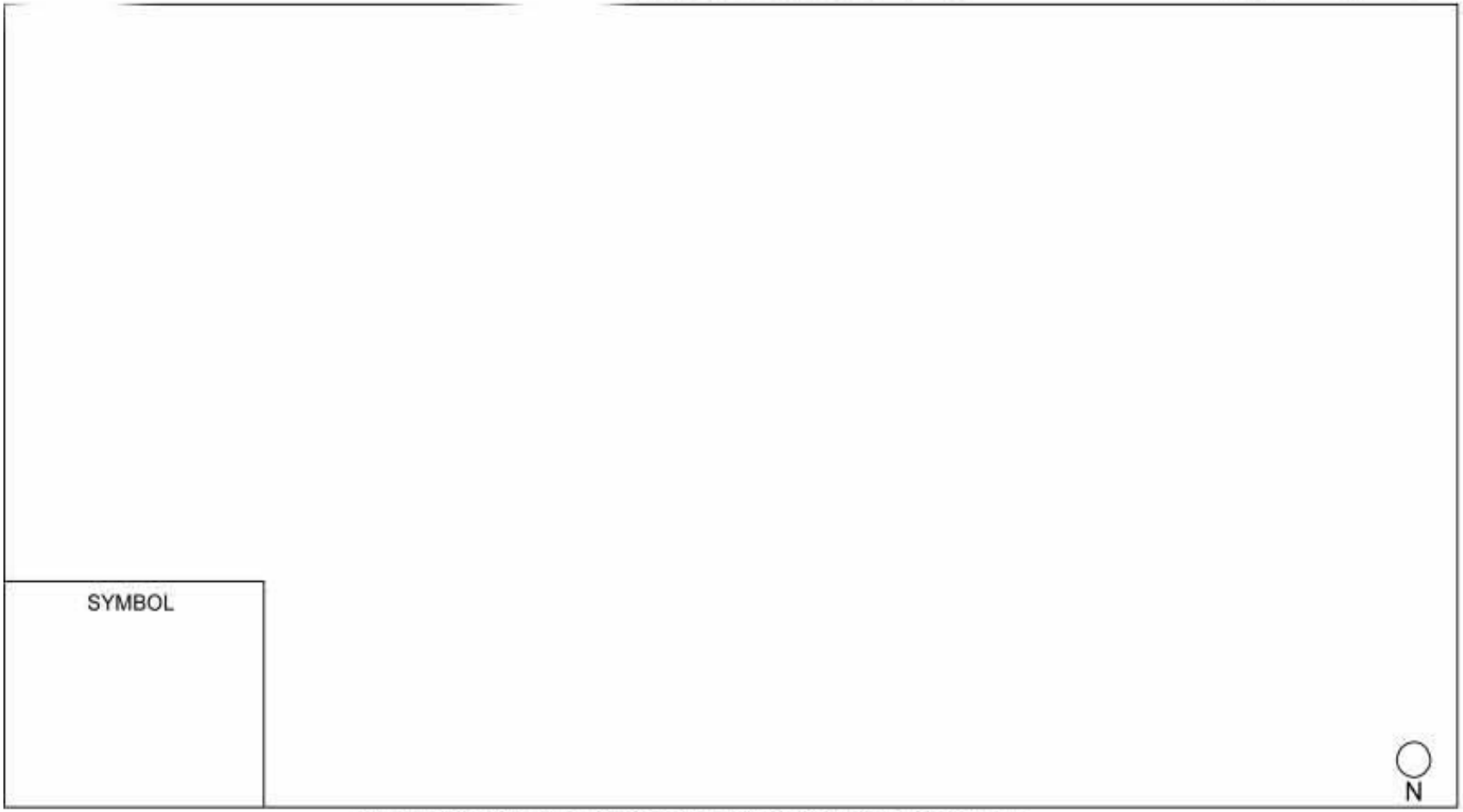
DIVER'S EXAMINATION: **A**=Abrasion/Contusion, **AF**=Animal/Fish Feeding, **BR**=Broke Rigor (diver), **DH**= Drag Hook, **FM**=Foam, **GB**=Goose Bumps, **LM**= Line Mark (diver's marker buoy mark), **OI**=Other Injury

ANY ARTIFACTS OR DAMAGE DONE TO BODY DURING RECOVERY ? ☐ **YES** ☐ **NO**

IF YES, EXPLAIN: _____

CRIME SCENE SKETCH

Page _____ of _____



ATTENTION: THIS SKETCH IS NOT DRAWN TO SCALE

LEGEND:

Date ____/____/____ Time _____:_____ ☐AM ☐PM **KEY:**_____

Diver_____ _____

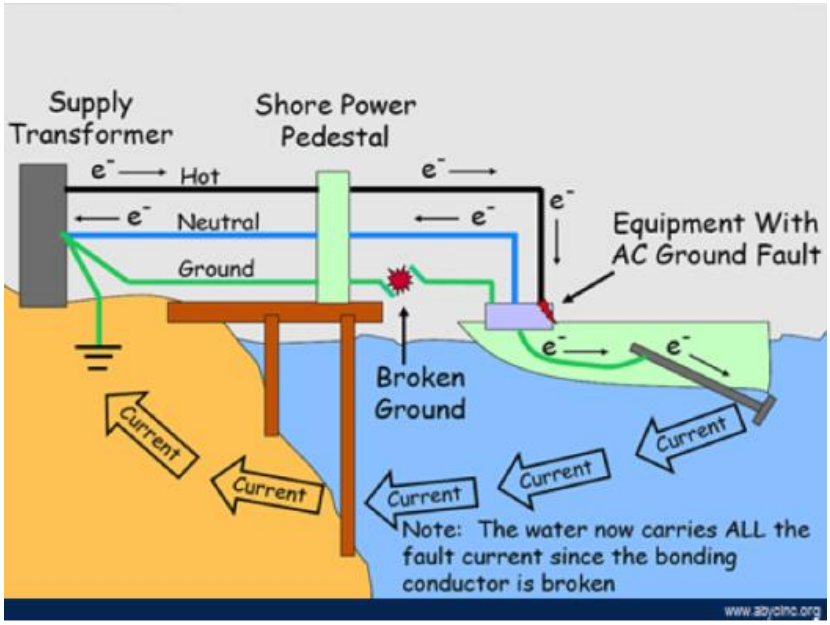
Location_____ _____

_____ _____

ANNEX 7.0: ELECTRICAL SHOCK DROWNING (ESD) PROTOCOLS

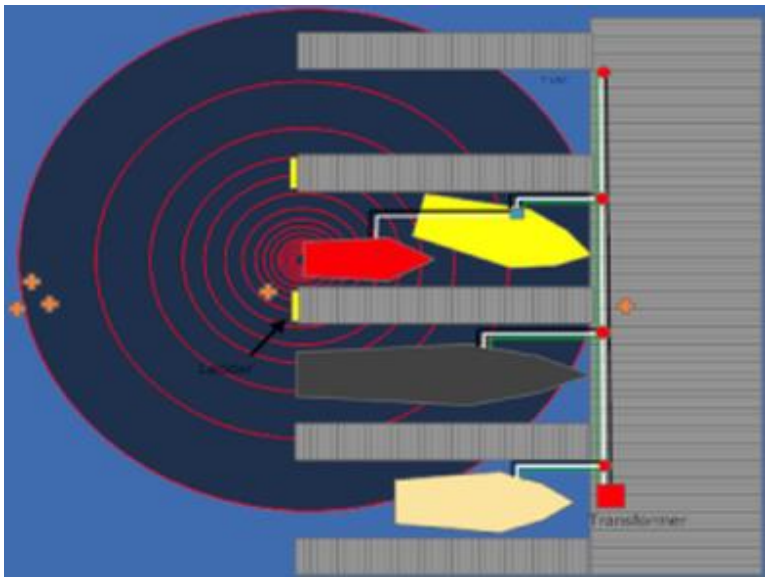
WHAT IS ELECTRIC SHOCK DROWNING?

Electric Shock Drowning (ESD) is the result of the passage of a typically low-level AC current through the body with sufficient force to cause skeletal muscular paralysis, rendering the victim unable to help himself / herself, while immersed in fresh water, eventually resulting in drowning of the victim. Higher levels of AC current in the water will also result in electrocution. Electric Shock Drowning (ESD) has become the catch all phrase that encompasses all in-water shock casualties and fatalities.



Although Electric Shock Drowning can occur virtually in any location where electricity is provided near water, the majority of Electric Shock Drowning deaths have occurred in public and private marinas and docks. The typical victim of Electric Shock Drowning is a child swimming in or around a marina or dock where electricity is present. The electricity that enters the water and causes Electric Shock Drowning originates from the wiring of the dock or marina, or from boats that are connected to the marina's or dock's power supply.

Would you consider stepping into a bathtub or swimming pool with a hair dryer? Think of the boat as the hairdryer. If an electric fault occurs on a boat while it is connected to a marina's or dock's shore power and the boat or marina is not properly wired to meet current ABYC and NFPA standards, the water surrounding the boat will become electrified.



WHY IS ELECTRIC SHOCK DROWNING A SILENT KILLER?

- There is no visible warning or way to tell if water surrounding a boat, marina or dock is energized or within seconds will become energized with fatal levels of electricity.
- In most circumstances' victims do not immediately feel electrical current when they enter or swim in the water around a marina or dock, thus giving the victims the false impression that it is "safe"

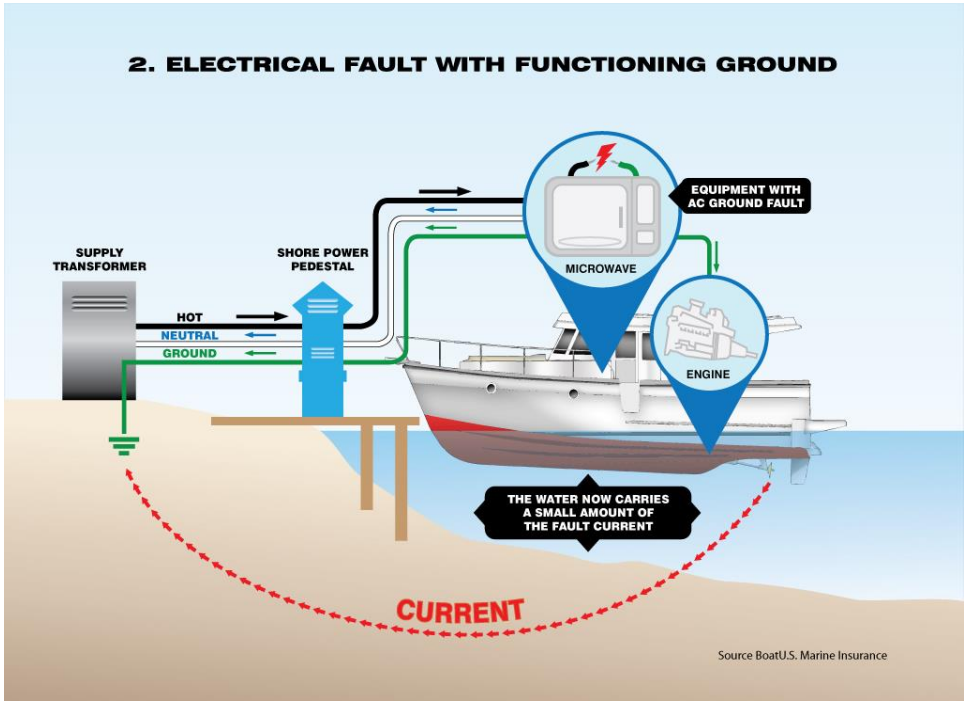
to swim. Most often, electricity enters the water when an electrical fault occurs aboard a boat. Often, the electric fault occurring aboard the boat is intermittent. For example, the fault that places deadly current into the water may only occur when a light switch is turned on, or when a hot water heater, battery charger, A/C unit or other electrical device cycles on. Water can appear and feel "safe" and in a split second become energized with deadly electricity.

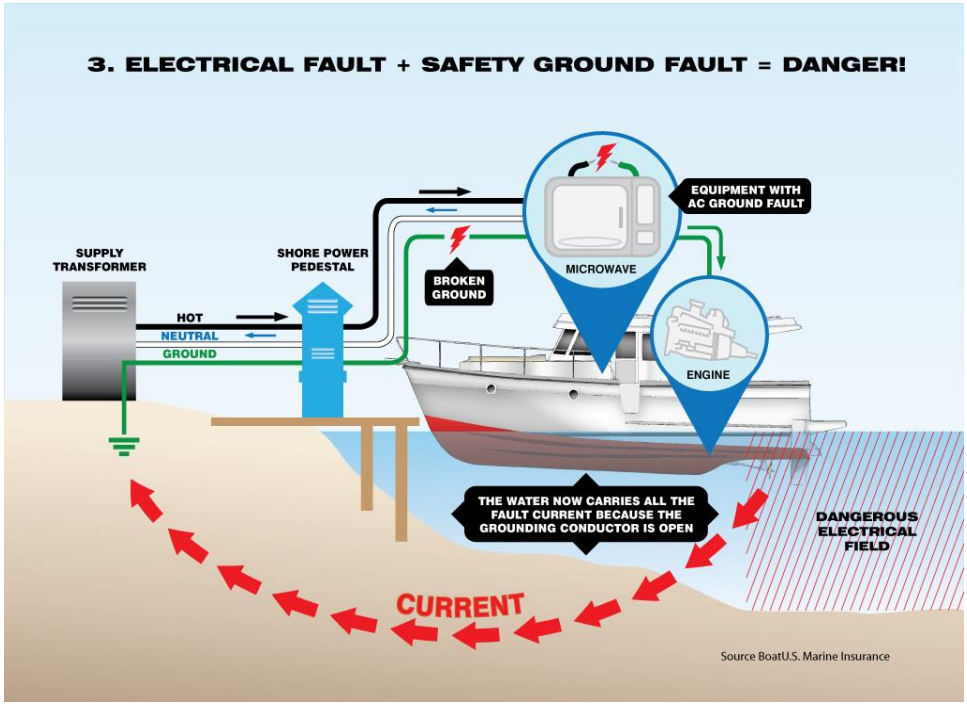
- Under the typical scenario, the victim's muscles become paralyzed by the electrical current, he or she is unable to swim, and ultimately drowns. Unless there is a witness nearby to experience and report the sensation of electric shock in the water, the victim's death is typically labeled a common drowning. In the vast majority of Electric Shock Drownings, the victim's autopsy shows no signs of electrical injury and investigators often never learn that electricity was the cause of the drowning.
- Until very recently, there has been very little public awareness about the danger of Electric Shock Drowning. As a result, Electric Shock Drowning continues to kill and new families are devastated on a yearly basis with very little public awareness.

HOW FREQUENTLY DOES THIS OCCUR?

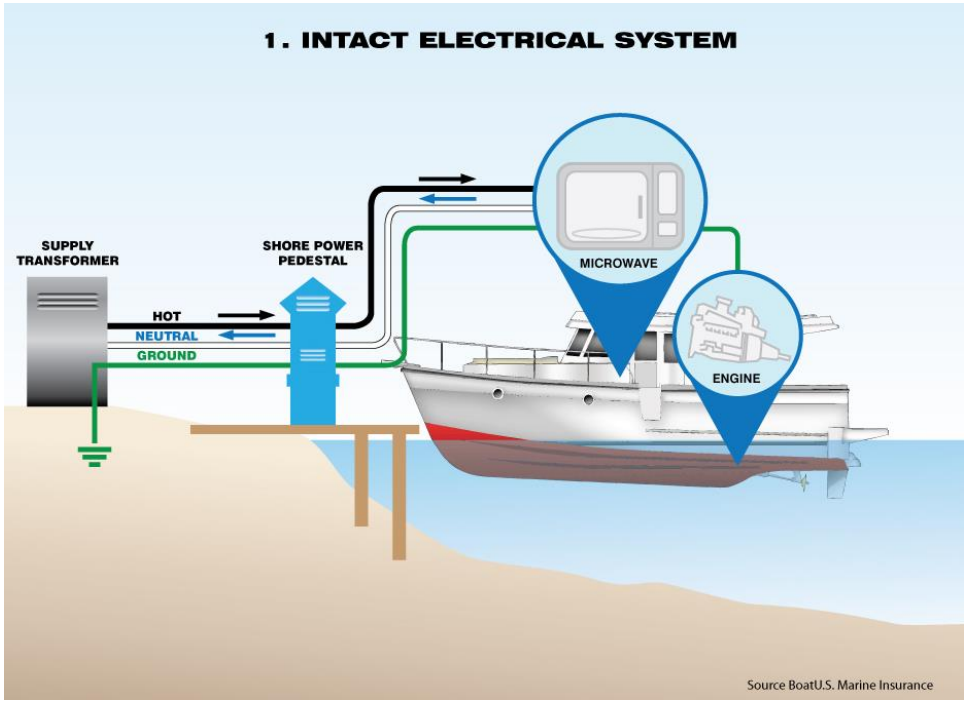
- How many unexplained drownings of healthy vibrant people around boats and marinas have there been? The answer – many.
- How many of these unexplainable drownings have likely been caused by Electric Shock Drowning instead of cramping, excessive alcohol use, or some other factor? The answer – many.
- The number of verifiable in-water deaths due to Electric Shock Drowning is, in all likelihood, just the tip of the iceberg.

ADDITIONAL DIAGRAMS:





Images courtesy of Boat U.S. **http://www.boatus.com/**



2019 ESDPA. If believe you have witnessed or have information about an Electric Shock Drowning incident or near miss, please contact: Kevin Ritz at (503)709-5649 / kevintritz@gmail.com or Capt. David Rifkin (USN, Ret) at (904)382-7868 / qualitymarinesvcs@comcast.net.

Protocol for Diving on Boats at Docks Using Electrical Power

September 2018

Source:
https://www.electricshockdrowning.org/uploads/4/8/5/6/48564375/protocol_for_diving_on_boats_at_docks_using_electrical_power_-_september_2018.pdf

Electric Shock Drowning (ESD) is a significant safety concern for anyone swimming around or near dock using electrical power for any purpose (lights, appliances, boats, etc.). The danger is associated with electrical currents that may be in the water near a person in the water.

When electrical current passes through the body, it can cause muscular paralysis or stop the heart and the breathing process. Paralysis causes the inability to swim and stay afloat, resulting in drowning.

The Electric Shock Drowning Prevention Association (ESDPA) strongly encourages NO SWIMMING around docks using electrical power. It recommends not swimming within 150 feet of such docks and is mainly concerned with recreational swimming.

Routine maintenance on boats generally includes underwater inspections and bottom cleaning. It is usually more cost efficient to do some of this maintenance waterborne, hence the need to be in the water near to and even touching the boat's underwater surfaces. This presents a potential hazard to those doing this maintenance in the presence of electricity.

There are, however, some steps that professional divers can take to reduce their risk of electric shock injury and ESD. Their safety may also include working with marina and boatyard management to properly coordinate and manage diving operations to enhance safety.

1. Marinas and boatyards should be aware of any diving operations in their facilities. They should require divers to formally check in and check out with marina staff. They should ensure that the boat involved in the diving operations is completely unplugged from any potential source of electricity ashore before permitting any diving on that boat. It is also recommended that the boats immediately adjacent to or across from the intended boat be unplugged for diver's safety.
2. Marinas and boatyards should consider the use of "diving windows" on a periodic basis (e.g. bimonthly) to facilitate diving operations. During this window, diving could be permitted on a complete dock or section of dock by turning off the feeder breakers supplying electricity to these areas. The windows could be published to enable planning for routine maintenance.
3. Marinas and boatyards should have a plan to deal with electrical shock in the water around their facilities.
    - **a.** This would include knowing precise locations and having direct access to shutting off electrical power where necessary in an emergency.
    - **b.** It would also include emergency notifications (911) and a plan to rescue anyone in the water incapacitated or being shocked.
    - **c.** A long sturdy nonconductive pole should be readily available to push a victim AWAY from the dock to get them farther from the electrical source.
    - **d.** Throwable life rings should be at the ready (but should not be used to pull a person

back to the dock or boat to avoid getting them closer to the electrical source.

e. Facilities should consider installing emergency electrical cutoff switches in key locations such as at the head of a dock.

f. Marinas and boatyards should periodically train for electric shock scenarios and include local first responders in this training. It is imperative that the staff and first responders know how to turn power off in an emergency (and before rescuers attempt to get into the water for a rescue).

4. Divers should consider taking the following steps to reduce their risk of injury or death in the presence of electricity while diving on boat in facilities using electrical power.

a. Ensure, as a minimum that the boat they are diving on is UNPLUGGED (not just turned off at the pedestal). Hang a "lockout" tag on the receptacle and breaker to preclude a passerby or the owner from plugging boat in while diving operations are in progress.

b. Unplug boats adjacent to the one(s) being worked on.

c. Wear a rubber wetsuit to include gloves and booties to improve insulation to electrical current.

d. Check into the marina or boatyard facility so somebody knows where you will be diving. Strongly consider having a buddy stationed on the dock who knows where to secure dock power, and who can call 911 if required.

e. If you feel even the slightest of tingling sensations when entering the water, STOP and leave the water. Report the situation to the facility for investigation.

5. Diving contractors and those who employ divers for their services should provide electrical safety training to personnel conducting diving services. This should include, as a minimum, the information presented above.

ANNEX 8.0: THE DROWNING MACHINE and LOW HEAD DAMS

Emergency rescues at low-head dams

https://damfailures.org/wp-content/uploads/2018/10/1996-Wright-Rescues-at-Low-Head-Dams.pdf

Abstract

Emergency rescues at low-head dams can be hazardous to rescue personnel because of the reverse roller phenomenon (hydraulic) common below many hydraulic structures. Characteristics of hydraulic jumps are discussed along with various tail water conditions. Rescue methods are described using both non-motorized and motorized boats. Emergency rescue personnel should never cross the "boil" area, otherwise they, too, may become victims. Retrofitting dangerous low-head dams is recommended so as to reduce the hazard. "Safe low-head dams' refers to those structures which are not characterized as being 'drowning machines" where the task of extraditing one's self from the 'hydraulic" ranges from very difficult to near impossible.

Introduction

Low-head dams for power production or water diversion are hazardous to recreational boaters and swimmers because of a unique hydraulic phenomenon known to the engineering profession as a "roller." (Peterka, 1978)

Boaters term this characteristic a "hydraulic." Grade control structures to protect stream beds against erosion can have similar characteristics. Even as low-head dams and grade control structures are hazardous to the general public, similarly they are hazardous to rescue personnel and have resulted in drownings among their ranks. (USBR, 1989) (Borland-Coogan, 1980)

Low-head dams are characterized for this paper as having a vertical drop of less than three meters. It is this modest drop in elevation that creates an appearance of little or no danger to the layman and rescuer. The surface appearance of the "hydraulic" immediately downstream of the dam is oftentimes tranquil which is most deceiving to the observer. (Wheat, 1989) The energy of the falling water is dissipated near the toe of the dam and, with certain flow conditions, the hydraulic forms, which represents a reversal in the flow direction back towards the falling water jet. (McLaughlin, 1986) (City of Tempe, video, undated) Even a good swimmer would find it almost impossible to swim out of the hydraulic. Rescue personnel can be caught in the hydraulic in the same way as the unwary boater or swimmer. A rescue boat carried into the path of the falling water jet by the reverse current can easily capsize, throwing the rescue personnel into the hydraulic. (Borland-Coogan, 1980)

Emergency rescue agencies must have standard operating procedures for rescues at the toe of low-head dams. Agencies with low-head dams in their jurisdictions would be well advised to have practice sessions at those locations. Of importance in rescues is that the lives of rescue personnel should not be risked to recover a body or to retrieve an overturned boat.

Low-head dams and grade control structures which exhibit these types of reverse rollers or "hydraulics" have been termed "drowning machines." (Leutheusser, 1991) (Borland-Coogan, 1980) Drowning machines can be retrofitted to reduce the hazard by reshaping the downstream face or by providing a

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1. Wright Water Engineers, Chief Engineer; former American Ski Patrol "Avalanche" Instructor; Fellow, American Society of Civil Engineers.
2. Wright Water Engineers, Project Engineer, Denver, Colorado.
3. Wright Water Engineers, Senior Hydraulic Consultant; "Visiting Professor" from Rose-Hulman Institute of Technology, Terre Haute, Indiana. Member, American Society of Civil Engineers.
4. Wright Water Engineers, Project Engineer, Denver, Colorado.

boat chute. (Wright, 1995) (USBR, 1989) However, it is best to incorporate protective features into the design of new facilities. (USBR, 1974)

Experienced rafters and kayakers believe that one can dive to the bottom of the flowing water to escape a reverse roller or a deep hole in order to be carried free by the submerged jet.

Hydraulics of low-head dams

Significant energy exists in the flowing body of water at the crest of a low-head dam as a result of its elevation. This potential (positional) energy transforms into kinetic (velocity) energy as the water passes over the crest of the structure and as it gains velocity when it falls. A hydraulic jump typically forms at the structure base to dissipate the excess kinetic energy and to return the flow to normal downstream subcritical conditions. (Hwang &. Houghtalen, 1995)

Various types of hydraulic jumps occur depending on the character and height of the structure, the depth of the tailwater, and the magnitude of the flow. (USBR, 1987) The four common types of hydraulic jump conditions that form below low-head dams are depicted in Figure 1.

Case I represents a fairly well-defined hydraulic jump with a low tailwater depth. The flow immediately upstream of the jump is characterized by low depths and high velocities (supercritical flow). The flow downstream of the jump is characterized by high depths and low velocities (subcritical flow). The jump itself is relatively unstable, turbulent, and short in length. No unusual hazard exists in this scenario; swimmers and boaters tend to be swept downstream by the high velocity waters preceding the jump. The jump is known to rafters as a standing wave.

As the tailwater depth rises, a Case II scenario occurs. The jump moves upstream towards the downstream face of the dam. In this case, the hydraulic jump is more well defined and stable, though the turbulence in the jump increases. Small floating debris can get trapped between the jump and the nappe; however, the danger is modest to swimmers and boaters as the strong current tends to sweep them downstream. Boaters and rafters are likely to bounce over the hydraulic jump. The abrupt bounce may cause rafters to be thrown into the water.

Case II occurs with an additional increase in tailwater depth. The jump is now submerged and not apparent. Therein lays the danger! Velocities are still high, much energy is still being dissipated, and significant amounts of air entrainment occur. Even a strong swimmer would find it difficult to get out of the reverse roller. A detailed discussion of the dangers associated with this case follows in the next section.

Finally, Case IV represents the hydraulic conditions associated with high tailwater depths. The drop structure is inundated and no hydraulic jump occurs. Standing surface waves are present. Because energy loss and velocities are modest (i.e., very little elevation difference between headwater and tailwater), little unusual hazard exists to swimmers and boaters.

Drowning hazards

Although the hazards to boaters a low-head dams are understood (Smalley, 1987) the potential danger to volunteer rescue personnel is not widely recognized. This may stem from a misconception of where the hazard occurs within the drop structure. Intuition may say that going over the crest of the dam would cause the greatest concern for safety. However, the real danger exists immediately downstream of the structure when there is a moderately high tailwater created by downstream river characteristics and the shape of structure (Case III, Figure1).

As the water travels over the crest of the dam, the flow becomes a supercritical jet as shown in Figure 2. The supercritical flow transitions itself into subcritical flow downstream. This transition usually occurs in the form of a hydraulic jump, where the energy is dissipated through turbulence and an increase in depth resulting from the lower velocity.

In a given range of flows, the hydraulic jump will become submerged. The submerged jump results in a reverse rolling current in the direction toward the face of the dam. As Figure 2 shows, the point where the flow separates into a downstream component and an upstream reverse current is often called the boil. Between the face of the dam and the boil, the direction of the surface flow is upstream, into the plunging jet. It is this phenomenon that creates the hazard to boaters and rescue personnel.

Boaters typically experience problems when their downstream momentum is not enough to escape the reverse current or if the boat capsizes. Once the boat is trapped in the hydraulic, the reverse current carries the boat back into the plunging jet. The force of the jet is sufficient to capsize a boat, especially once the boat gets turned sideways. As the boaters are thrown from the boat, they too become trapped in the reverse roller. The velocity of the upstream current is in excess of the swimming ability of most persons. Hence, a rescue situation arises.

If the structure is located in an urbanized area, there is a chance that rescue personnel will arrive at the site before the victims have drowned. However, in their zeal to rescue the trapped boaters, the rescue personnel often put themselves in extreme danger. The hazard potential is often less apparent since the rescue boat approaches the drop structure from downstream and, thus, never travels over the crest of the dam. As discussed above, danger exists if the rescue boat travels too far upstream and crosses the boil.

With the rescue personnel traveling in a motorized boat upstream toward the dam, they are initially fighting the current of the stream as they approach the boil. As they pass over the boil, the boat surges forward due to both the force of the motor and the upstream current. Because of extreme turbulence within the submerged jump, the water is highly aerated. The aerated water provides less resistance to the propellers, making the motor less efficient. So, when the boat operator reverses the propeller direction, the motor no longer has sufficient thrust to allow the boat to escape the hydraulic. The current then continues to move the boat into the plunging jet, where the boat will likely be capsized, increasing the number of potential victims.

Emergency rescue precautions

There are two basic scenarios at low-head dams that would necessitate action by emergency rescue personnel. The first is when an accident occurs and a victim is caught in the hydraulic who is thought to still be alive. The other occurs after a drowning has occurred and the body has to be recovered. The primary difference between the two scenarios is the sense of urgency inherent in a rescue attempt. Both operations should take full precautions to ensure that emergency rescue personnel are not endangered. The fundamental rule in rescues is that the rescuers must not be exposed to unusual danger.

Approach from Downstream. All boat-based rescue attempts at low-head dams should approach the drop structure from the downstream side. The victim is often trapped near the face of the dam. Approaching from the downstream side allows the boat operator to better control the velocity and positioning towards the dam, since the boat is working against the stream's normal current.

Don't Cross the Boil. Although approaching the dam from the downstream side is critical, this is not where most emergency rescue personnel recognize the need for an upstream approach to the victim. However, many are not aware of the hazard of the boil area. The boil is the location (downstream of the

dam) where the surface direction of the water separates into a downstream component and an upstream component. The location of the boil dictates where the reverse, upstream current begins. Don't cross the boil!

Power Boats. Even during the excitement of a rescue, emergency rescue personnel must never allow their boat to cross over the boil. Seeing a person drowning in the hydraulic, the inclination of rescue personnel may be to get as close to the victim as possible. Once a boat crosses the boil, rescue personnel face the same danger as the original boaters. The boat will surge forward as it moves into the upstream current. The ability to escape from the hydraulic is hampered by the effect of the highly-aerated water on the boat propeller. The entrained air reduces the efficiency of the propeller and may not allow the boat's power to overcome the reverse current of the hydraulic.

Rescue Boat Capsizing. As the boat continues to be forced upstream, the plunging wall of water over the crest of the dam becomes a factor. As the boat approaches the face of the dam, the plunging jet hits the bow, often causing the boat to capsize. Even if the initial force of the failing water does not result in the boat capsizing, the boat may be turned sideways by the upstream current and begin to fill with water. The end result is usually the same; that is, by crossing the boil, the emergency rescue personnel have become victims of the hydraulic. Too many rescue personnel have become victims.

Provide Anchoring. Even if a boat stays downstream of the boil on approach, it still must be able to hold its position during the rescue attempt. A method of anchoring the boat should be employed so that the boat does not cross the boil or, if it does, it may be retrieved.

A line should be carried across the stream and anchored on both banks. A rescue may be attempted without using a boat if a rope is stretched across the stream. This method entails attaching a floatation device to the rope and dragging it across the lower face of the dam. Another method is to use an air-inflated fire hose pushed out from shore. (City of Tempe, 1993) The hose will ride at the base of the falling jet. In many cases, the victim is disoriented and weakened from being submerged and from the tumbling effect of the reverse roller. In such cases, the victim is likely to be unable to grab or hold onto the floatation device or fire hose.

A boat must be used if the victim is unable to significantly assist in the rescue. The boat should be anchored by a rope secured on both banks. From downstream of the boil, a flotation device is thrown to the drowning victim until the victim is able to grab the device. As the rescue personnel begin to pull the victim from the hydraulic, it is important that the safety lines keep the boat a safe distance from the boil. If the victim is unconscious or too weak to hold onto a floatation device, a hooked device (grappling hook) can be used.

Use of Two Boats. Emergency rescue personnel attempting rescues on large rivers may not be able to reasonably span the river with safety lines. On wide rivers, a second boat may need to be used to anchor the first. As Figure 3 shows, the second boat is located further downstream from the first and is not directly involved in the rescue attempt. The sole purpose of the second boat is to keep the rescue boat from crossing the boil. The rescue proceeds from the first boat in the same manner as described above.

Shore Rigged Non-Motorized Boat. Highly-experienced emergency rescue teams may opt for use of rigging to shore-based personnel so as to provide better control over the boat location as shown in Figure 4. A general rule of such teams is not to cross the boil. (Denver Fire Department, 1995)

Use of Helicopter. Some rescue organizations have helicopters available from the sheriff or police department. If weather conditions are satisfactory, the helicopter can hover over the "hydraulic," a life

preserver can be lowered, and the victim can be extricated by pulling the victim downstream out of the hazard zone. Under no conditions should a frogman jump into the hydraulic for the rescue.

Adverse Time Element. Unfortunately, in most low-head dam accidents involving the reverse rollers, a normal victim's chances of surviving more than ten minutes is low because of hypothermia, excitement, thrashing about and because becoming submerged each minute or so quickly drains energy.

Training. Since low-head dam rescues are not easily performed, emergency rescue personnel with such dams in their jurisdiction should be specially trained. Simulated rescues should be practiced on a periodic basis at the local hazardous dams. Education of both the public and the emergency rescue personnel as to the dangers associated with low-head dams is key. Persons unfamiliar with the proper techniques should not attempt to rescue victims as they may become victims themselves.

Alternatives. The retrofit of hazardous low-head dams and check structures is recommended whenever recreational boating may exist and where members of the public may reasonably become involved. (USBR Center Line, 1992) Retrofits generally require changing the downstream shape and character of the low-head dam or grade control structure or constructing a user-friendly boat chute with adequate upstream signing and carefully- placed pilot rocks.

While no retrofitted low-head dam or grade control structure can be declared strictly "safe" and "non-hazardous" because of inherent dangers around flowing water bodies, the objective is to eliminate the "drowning machines" where unsuspecting individuals and rescue personnel are caught unaware in a hydraulic trap from which self- extrication is unlikely.

Diving Down. A victim may be able to escape by diving down so as to be carried downstream by the submerged jet. This technique is used by experienced boaters in "deep holes" formed in river rapids.

Conclusions

When tailwater depth at low-head dams or drop structures reaches certain levels, a reverse roller can be created which can trap swimmers and boaters and potentially drown them. The danger of this situation is compounded by the fact that unwary rescue workers can fall victim to the same phenomenon. Rescue personnel who may be involved in rescues at low-head dams need to be properly trained to execute emergency rescues without endangering themselves.

Dangerous reverse rollers (hydraulics) do not always occur at a given dangerous low-head dam. The reverse roller phenomenon is a result of a combination of flow rate and tailwater depth--the problem being that, when the conditions are most dangerous, the hydraulic may appear tranquil.
Rescue operations are best carried out with maximum control of the rescue boat. This may entail four shoreline stationed personnel with four ropes to the boat which is non-motorized. Care is needed when using motorized boats.

Retrofitting dangerous structures is recommended using either a reshaped downstream dam face condition, a stair-stepped series of dams or a suitable boat chute with adequate upstream signing and a good portage. (Leutheusser 1991) (Wright, 1994)

Existing dams should be reanalyzed periodically to ensure that they meet the test of safety by current standards. (Jansen, 1980)

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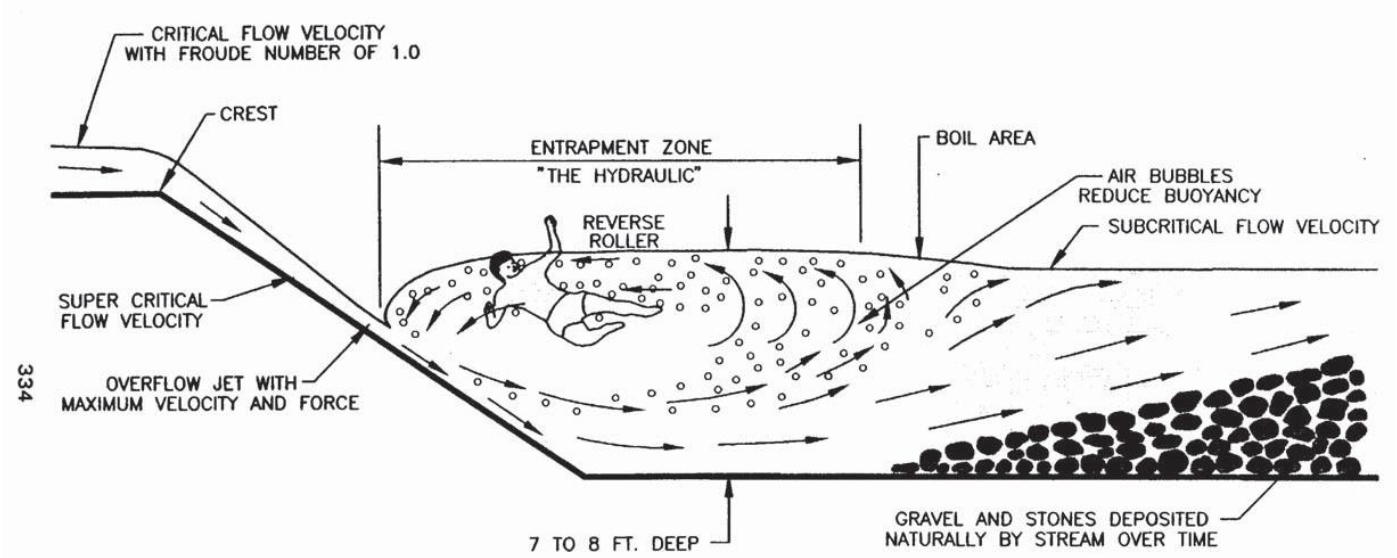
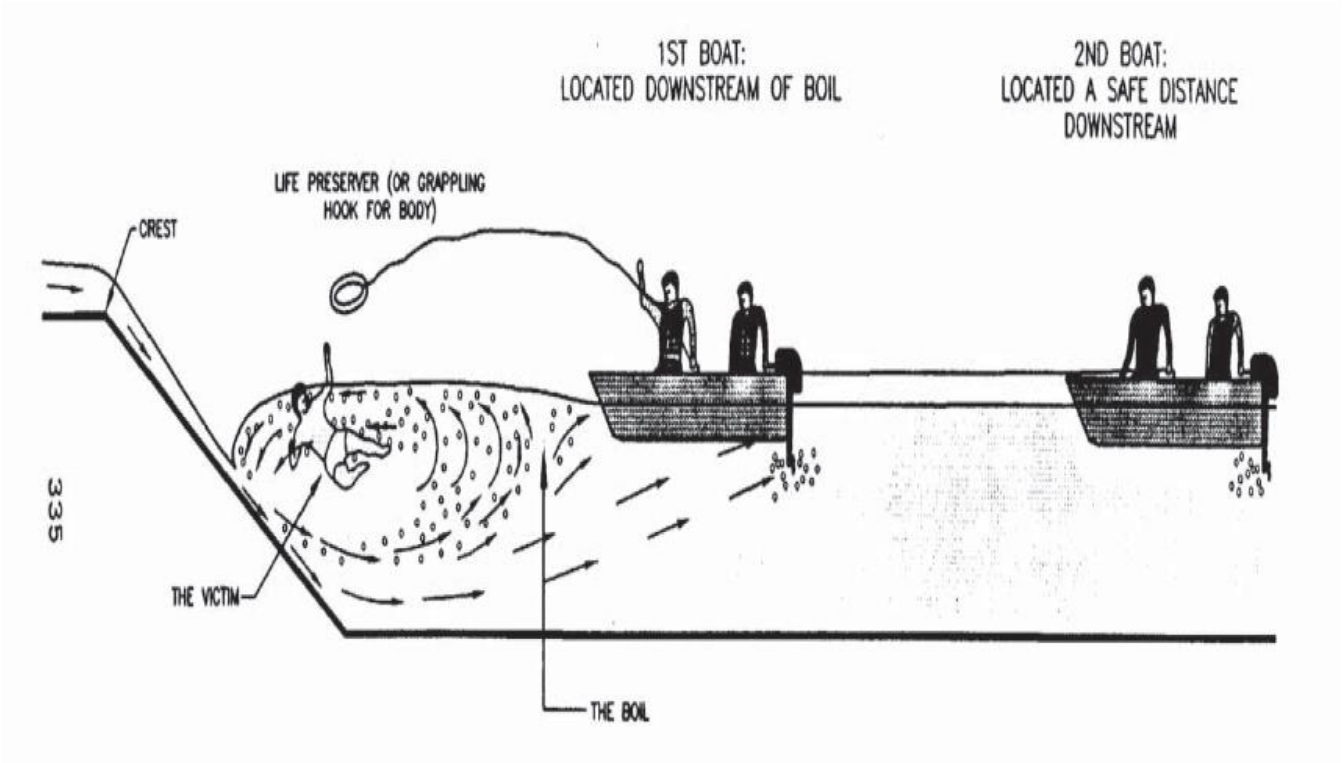
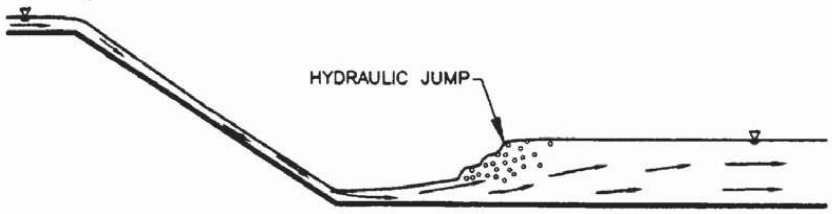


FIGURE 2

LOW-HEAD DAM OR DROP STRUCTURE WITH HIGH TAILWATER WHICH SUBMERGES THE HYDRAULIC JUMP. VICTIM MAY ESCAPE BY DIVING DOWN TO NEAR BOTTOM IN HOPE OF BEING CARRIED DOWNSTREAM BY LOWER REMNANTS OF JET.

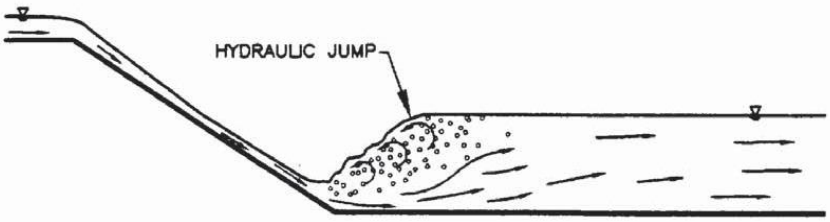




LITTLE ENTRAPMENT POTENTIAL

CASE I

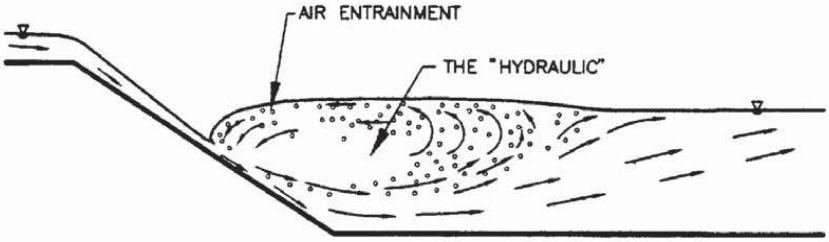
- LOW TAILWATER WITH SWEPT-OUT JUMP
- PERSONS WILL USUALLY BE SWEPT DOWNSTREAM



MODEST ENTRAPMENT POTENTIAL

CASE II

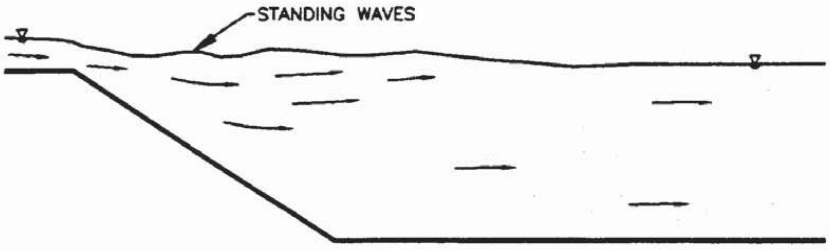
- NORMAL TAILWATER WITH OPTIMUM JUMP.
- MODEST ENTRAPMENT FOR PERSONS, ALTHOUGH LOGS AND SIDEWAYS CANOES CAN GET TRAPPED IN SMALL "HOLE".



HIGH ENTRAPMENT POTENTIAL
EXTREME HAZARD WITH TRANQUIL APPEARENCE

CASE III

- HIGH TAILWATER WITH SUBMERGED HYDRAULIC JUMP
- THE RESULTING "HYDRAULIC" WILL TRAP A PERSON IN THE REVERSE ROLLING CURRENT
- RESCUE BOATS WILL BE "SUCKED" TOWARDS FALLING JET
- DIVING TO THE BOTTOM MAY CAUSE THE PERSON TO BE CARRIED DOWNSTREAM



NO UNUSUAL HAZARD

CASE IV

- VERY HIGH TAILWATER ASSOCIATED WITH HIGH FLOWS INUNDATES THE DROP STRUCTURE
- NO HYDRAULIC JUMP OCCURS
- NO UNUSUAL HAZARD TO PERSONS OR BOATS

FIGURE 1

TYPICAL TAILWATER EFFECTS ON THE HYDRAULIC JUMP
AT LOW-HEAD DAMS OR DROP STRUCTURES.

333

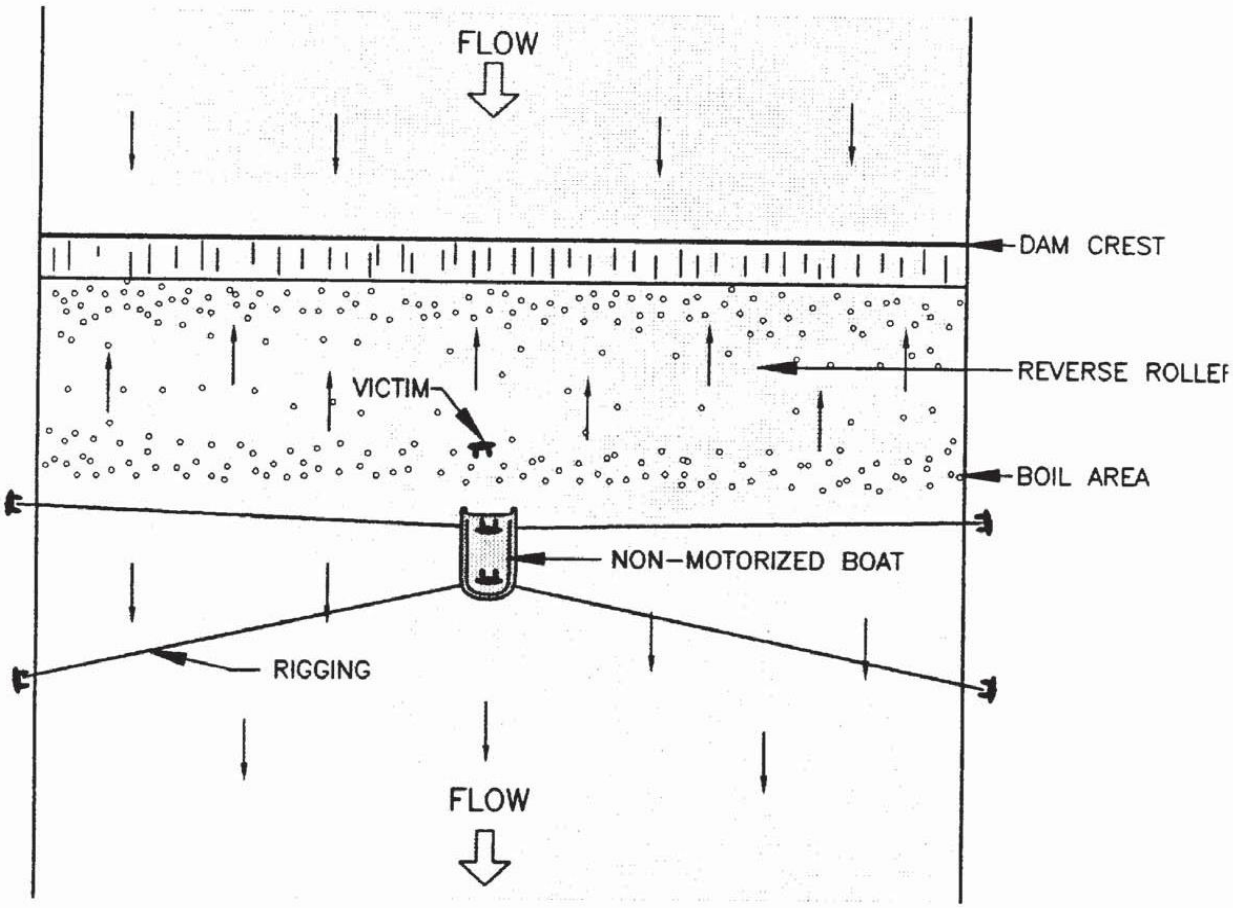


FIGURE 4

RESCUE WITH SHORE RIGGED, NON–MOTORIZED BOAT FOR MAXIMUM STABILITY. BOAT MUST NOT CROSS BOIL. VICTIM EXTRICATED AS HE RISES TO SURFACE AT BOIL.

336

Annex 9.0
Public Safety Diver Equipment and Training Examples

Changes Highlighted in this color:

Comments in this Color

The NIMS typing seems to go in both directions depending on which resource you are looking at. Let's decide if the BEST is 1. If so, we have no way to build upward without reconfiguring all the levels. If we go the other way, BEST is open ended and the LEAST would always be 1.

		Best - Type I to Entry Level - Type V				
INDIVIDUAL	**EQUIPMENT**					
Individual equipment should be the requirement for each working diver on a dive scene. This equipment should be available for EACH diver and backup. This is not a list of required, ISSUED dive gear for each individual diver. Each team will need to equip their team with sizes etc; keeping within the minimum requirements.						
Individual Dive Equipment	**Minimum**	**Type**	**Type**	**Type**	**Type**	**Type**
SCUBA	**Component**	**I**	**II**	**III**	**IV**	**V**
	Scuba Cylinder (team availability)	2 - 80	2 - 80	1 - 80	1 - 80	1 - 80
	Contingency Cylinder with regulator and SPG (team Availability) Minimum 60 cf	x	x	x	x	x
	Scuba Regulator with Octopus and SPG	x	x	x	x	x
	Timing Device	x	x	x	x	x
	Depth Gauge	x	x	x	x	x
	Redundant Air Supply	x	x	x	x	x
	Recreational Mask	x	x	x	x	x
	Redundant Recreational Mask	x	x	x	x	x
	Snorkel	x	x	x	x	x
	Personal Floatation Device	x	x	x	x	x
	Whistle or surface noise making device	x	x	x	x	x
	Weights One Hand Release - Mounted	x	x	x	x	x
	Two (2) Different Cutting Tools	x	x	x	x	x
	Environmental Protection Suitable for Basic Water Conditions	x	x	x	x	x
	Gloves Suitable for the Environment	x	x	x	x	x
	Tag or Contingency Line	x	x	x	x	x
	Wet Suit	x	x	x	x	
" Training for particular equipment must accompany usage prior to recognition of Level.						
	Dry suit"	x	x	x		
	Full Face Mask / Comms Wireless"	x	x	x		
	Full Face Mask / Comms Hard Wire"	x				
	Hard Helmet"	x				

TEAM	EQUIPMENT					
* Training for the particular equipment must accompany usage prior to recognition of Level.						
By recognizing TEAM equipment, a team will be able to stay within the standard without the burden of providing each piece of equipment for each individual diver. Individual equipment should be available TO the diver, not necessarily ISSUED to the diver.						
Team Dive Equipment	Minimum	Type	Type	Type	Type	Type
SCUBA	Component	I	II	III	IV	V
	Dive Flag	x	x	x	x	x
	Assorted Buoy Markers	x	x	x	x	
	Ability to Fill Cylinders on-site.	x				
	Air Compressor	x	x	x	x	x
	Assorted ropes and throw bags	x	x	x	x	x
	Body Bag	x	x	x	x	x
	Assortment of Evidence Containers	x	x	x	x	x
	1) 80 cf (@ 3000 psi) Cylinder for each diver in the water plus 1 extra for each diver in the water at any given time.	x	x	x	x	x
	Contingency Cylinder with regulator and SPG (Team Availability) Minimum 60cf	x	x	x	x	x
	First Aid / O2 kit	x	x	x	x	x
	Lift Bags 10-50 lb	x	x	x	x	x
* Training for particular equipment must accompany usage prior to recognition of Level.						
	Lift Bags 50-250 lbs*	x	x	x	x	
	AED	x	x	x		
	Lift Bags 250 -1000 lbs*	x	x	x		
	Dedicated Lift Harness systems for each diver in the water	x	x			
	GPS Tracking / Marking Device	x	x			
	Surface Supplied Air*	x	x			
	Side Scan / Vector Scan Sonar*	x				
	ROV*	x				
	Lift Bags > 1000 lbs *	x				

TEAM	BOATS / MOTORIZED WATER CRAFT					
Boats should not be a requirement for any team. However, if boats ARE utilized by a team, proper training, safety equipment and usage must be employed.						
**** Training for the particular equipment must accompany usage prior to recognition of Level.**						
	Minimum	**Type**	**Type**	**Type**	**Type**	**Type**
	Component	**I**	**II**	**III**	**IV**	**V**
BOATS **	Inflatable					
	PWC (Personal Watercraft)					
	Rigid Hull					
	Sonar Systems					
	Marine GPS and Navigations					
SONAR **	Top Scan Sonar Operations Where applicable					
	Boat Operations - Where applicable					
	Side Scan / Vector Scan Sonar Operations					
	Side Scan / Vector Scan Sonar Operations					
ROV **						
Qualification Prerequisites	**Training**					
Prerequisite hours should be obtainable even by new teams. We must resist making the time requirements too great and allow new teams to build. Entry level hours may be too much. Remember, most teams restrict a zero vis dive to 15 or 20 minutes.						
Logged dive time should be the criteria instead of recognition of recreation certifications. Hours should be maintained by the individual and possibly by the team training officer or record keeper.						
	Minimum	**Type**	**Type**	**Type**	**Type**	**Type**
	Conditions	**I**	**II**	**III**	**IV**	**V**
INDIVIDUAL	Logged Open Water (hours)	> 60	60	48	24	12
	Zero Visibility/ Low Visibility (where applicable) (hours)	24	12	9	6	3
	Open Water	x	x	x	x	x
	CPR / First Aid / O2 / AED	x	x	x	x	x
*** These requirements may be met within the PSD Basic Specialty Training.**	* Recreational Rescue Diver Equivalent	x	x	x	x	x
	* Recreational SAR Diver Equivalent	x	x	x	x	x
	* Haz - Mat Awareness	x	x	x	x	x
	PSD Basic - Specialty Training With Certificate of Completion	x	x	x	x	x
	NIM's ICS 100, 200, 700, 800	x	x	x	x	x
	Lift Bag Operations	x	x	x	x	
	PSD Certification	x	x	x		
	Haz-Mat Operations	x	x			
	PSD Advanced Specialty	x				
	Haz-Mat Technician	x				

Qualification Prerequisites	Advanced Training					
Logged dive time should be the criteria instead of recognition of recreation certifications. Hours should be maintained by the individual and possibly by the team training officer or record keeper.						
Prerequisite hours should be obtainable even by new teams. We must resist making the time requirements too great and allow new teams to build. Entry level hours may be too much. Remember, most teams restrict a zero visibility dive to 15 or 20 minutes. Obtaining 180 minutes is not going to be nearly as easy as it is to write the number.						
Zero visibility training should be the hard focus, not logged open water hours. Training is required – even if simulated.						
	Minimum	**Type**	**Type**	**Type**	**Type**	**Type**
	Diving Criteria/Limits	**I**	**II**	**III**	**IV**	**V**
ALL TEAM MEMBERS	Logged Open Water (hours)	> 60	60	48	24	12
DIVING	Zero Vis/ Low Vis (where applicable) (hours)	**24**	**12**	**9**	**6**	**3**
	Clear Water (vis >10')	x	x	x	x	x
	Still Water (No Current)	x	x	x	x	x
	Tidal Water NOT Effected by Tidal Current	x	x	x	x	x
	Depth < 40'	x	x	x	x	x
	Limited Vis > 2' <10' and <20' depth NO current	x	x	x	x	x
	Current < 1Knot	x	x	x	x	x
	Depth < 60'	x	x	x	x	
	Zero Vis and <20' depth NO current	x	x	x	x	
	Tidal Water Effected by Tidal Current	x	x	x		
	Limited Vis > 2' <10'	x	x	x		
	Zero Vis <2'	x	x	x		
	Depth > 60' < 100	x	x			
	Depth < 132'	x				
Qualification Prerequisites	**ADVANCED SPECIALTIES**					
Advanced specialties represent skill sets beyond basic PSDiving						
	Minimum	**Type**	**Type**	**Type**	**Type**	**Type**
	Diving Criteria/Limits	**I**	**II**	**III**	**IV**	**V**
DIVING	Current > 1knot*	x				
ICE	**Ice Diving Certification** by a recognized training agency is mandatory.	x	x	x		
SWIFT WATER DIVING	**ALL responding team members** must meet ~~or exceed~~ qualifications for Swift Water Rescue (surface). **ALL responding diving team members,** who will be diving, must have successfully completed specialty training in swift	x				
SURF	Provided dive is within training and capability of diver and team.	x	x	x	x	
	Because surf diving will be up to local teams, decisions to dive must be based on their own assessment of the conditions and their training.					
CONFINED SPACE / CAVE	Confined Space / CAVE Diving Certification by a recognized training agency is mandatory.	x	x			
SURFACE RESPONSE	**SURFACE RESPONSE AND OTHER WATER RESPONSE CAPABILITIES**					
TOP WATER	**Still, Current, Flood Conditions**					
FLOOD RESPONSE	**These categories will need to be addressed separately and may need to be separated completely from DIVE OPERATIONS.**					
SWIFT WATER - TOP WATER RESPONSE	**Water Rescue and Response is a function of a Water Response Team. It is possible for a team to have the need and ability to perform just surface response and NOT have a dive component.**					

Required PSD and Related Training Courses	
Open Water SCUBA (4 Dives Minimum)	
Minimum)	
Minimum Number of Dives Beyond Open Water for Qualification at this Level	25
Successfully Complete an Annual Swim (Watermanship Type) Test	
Annual Medical Statement (RSTC)	
Annual Dive Physical (35 +) (Physician Approval to Dive)	
Diving Injury Recognition and Field Treatment	
CPR for the Professional Rescuer	
Oxygen Administration	
AED	
Basic First Aid	
Spinal Immobilization	
water)	
Basic Equipment Decontamination and Maintenance	
Basic Ropes and Knots	
Report Writing and Scene Documentation	
NIM's (100, 200, 700, 800)	
Basic Search Patterns	
Small Object Recovery	
Public Safety Diving (PSD-1) Awareness Level	
Level 5	
Minimum Number of Dives Beyond Open Water for Qualification at this Level	50
Full Face Mask	
Dry Suit	
Crime Scene Recognition and Protection	
Hazmat Awareness	
Public Safety Diving (PSD-2) Operations Level	
Level 4	
Minimum Number of Dives Beyond Open Water for Qualification at this Level	100
Underwater Communications (Wireless and Hardwired Operations)	
Light Salvage and Rigging (250 lbs or less)	
Underwater Photography and Video Graphic Operation	
Evidence Recovery and Documentation	
Contaminated Water Diving (Level 2 Water)	
Confined Space Awareness	
Public Safety Diving (PSD-3) Technician Level (Supervisor)	
Level 3	

Minimum Number of Dives Beyond Open Water for Qualification at this Level	150
Decompression Theory and Operations	
Deep Diving Operations (tailored to PSD 60 to 100 feet)	
Hazmat Operations	
Surface Supplied Air Diving Operations	
Confined Space Operations	
Level 2	
Minimum Number of Dives Beyond Open Water for Qualification at this Level	250
Very Deep Diving Operations (tailored to PSD > 100 feet)	
Hazmat Technician	
Hazmat Diving Operations	
Confined Space Technician/Rescue Operations	
Confined Space Diving (Full Cave is Acceptable)	
Level 1	
Some Suggested Specialty Operations	
ROV Operations	
Side Scan Sonar Operations	
Sector Scanning Sonar Operations	
Explosives Recognition	
Post Blast Analysis	
Small Water Craft Operations	
Underwater Metal Detector Operations	
Hydraulic Tool and Safety Operations	
Pneumatic Tool and Safety Operations	
Heavy Rigging Technician	
Underwater Cave Recovery Technician	
DPV Operations	
Bridge Inspector	
Underwater Burning and Cutting Operations	
Kirby Morgan Operations	

ANNEX 10.0: FEMA TYPING CHARTS

https://rtlt.preptoolkit.fema.gov/Public/Resource/View/6-508-1005?p=16

FEMA

Position Qualification for On-scene Security, Protection and Law Enforcement
Law Enforcement Operations

DIVER

RESOURCE CATEGORY	Law Enforcement Operations
RESOURCE KIND	Personnel
OVERALL FUNCTION	The Diver performs underwater functions, including evidence collection and remains search and recovery
COMPOSITION AND ORDERING SPECIFICATIONS	1. This position can be ordered as a single resource or in conjunction with a NIIMS typed team (Public Safety Dive Team). 2. Discuss logistics for deploying this position, such as working conditions, length of deployment, security, lodging, transportation, and meals, prior to deployment

Each type of resource builds on the qualifications of the type below it. For example, Type 1 qualifications include the qualifications in Type 2, plus an increase in capability. Type 1 is the highest qualification level.

COMPONENT	TYPE 1	TYPE 2	TYPE 3	TYPE 4	NOTES
DESCRIPTION	Same as Type 2, PLUS: Performs specialty dives, such as: 1. Confined space/cave dives 2. Hazardous materials and contaminated water dives 3. Ice dives 4. Dives in depths greater than 130 feet	Same as Type 3, PLUS: 1. Dives up to 130 feet 2. Performs technical lifting of objects up to 4,000 lbs. 3. Uses underwater metal detectors 4. Performs grid searches 5. Uses side-scan sonar equipment 6. Performs boat-based search patterns	Same as Type 4, PLUS: 1. Dives up to 100 feet 2. Marks and recovers evidence 3. Performs technical lifting of objects up to 2,000 lbs. 4. Maps floor of water body 5. Records underwater scene	The Diver: 1. Dives up to 60 feet 2. Performs basic search patterns 3. Performs tethered dives 4. Operates in black water conditions 5. Performs victim rescue and body recovery 6. May possess other specialty certifications and can use specialty skills based on incident needs	Not Specified
EDUCATION	Same as Type 2	Same as Type 3	Same as Type 4	High school diploma or equivalent	Not Specified

COMPONENT	TYPE 1	TYPE 2	TYPE 3	TYPE 4	NOTES
TRAINING	Same as Type 2, PLUS: Completion of the following: 1. Training in specialty dives, such as: a. Contaminated Water Operations b. Confined Space/Cave Diving c. Ice Diving 2. Training in accordance with Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) Part 1910.120: Hazardous Waste Operations and Emergency Response 3. Enriched air or rebreather certification 4. Training in accordance with National Fire Protection Association (NFPA) 1006: Swiftwater Rescue Operations, or equivalent	Same as Type 3, PLUS: Completion of the following: 1. Training on Authority Having Jurisdiction (AHJ) approved underwater metal detectors 2. Training on AHJ-approved side-scan sonar equipment 3. AHJ-determined grid search training	Same as Type 4, PLUS: Completion of the following: 1. Advanced underwater evidence collection training that meets or exceeds PADI Master Underwater Criminal Investigator training standards or DRI Underwater Crime Scene Investigator II training standards 2. Search and recovery diver certification through PADI, DRI, or other nationally recognized curriculum 3. Underwater videographer training through PADI, DRI, or other nationally recognized curriculum 4. Deep diver certification through PADI, DRI, or other nationally recognized curriculum	Completion of the following: 1.IS-100: Introduction to the Incident Command System, ICS-100 2. IS-200: Basic Incident Command System for Initial Response, ICS-200 3. IS-700: National Incident Management System, An Introduction 4. IS-800: National Response Framework, An Introduction 5. Public Safety Diver training through Professional Association of Diving Instructors (PADI), Dive Rescue International (DRI), or other nationally recognized curriculum 6. Basic underwater evidence collection training that meets or exceeds PADI Underwater Criminal Investigator or DRI Underwater Crime Scene Investigator I training standards 7. U.S. Coast Guard-approved boating safety course 8. Training in accordance with accordance with OSHA 29 CFR Part 1910.120: Hazardous Materials Awareness	Underwater evidence collection includes: 1. Locating evidence 2. Marking evidence 3. Attaching markers to bodies, guns, and vehicles 4. Documenting diver's involvement 5. Measuring using triangulation on the surface 6. Recording the item's depth 7. Recovering evidence 8. Handling evidence 9. Maintaining chain of custody and records 10. Scribing the evidence container

COMPONENT	TYPE 1	TYPE 2	TYPE 3	TYPE 4	NOTES
EXPERIENCE	Same as Type 2, PLUS: Knowledge of support needs for advanced dive and search patterns, including: 1. Knowledge of contamination and decontamination procedures related to the underwater environment 2. Knowledge of dive-related health at depths greater than 130 feet 3. Knowledge and skills related to confined space and cave diving operations Experience: Same as Type 2	Same as Type 3, PLUS: Knowledge, Skills, and Abilities: 1. Ability to operate underwater metal detector 2. Ability to operate side scan sonar 3. Ability to design and execute a grid search based on given parameters Experience: Same as Type 3	Same as Type 4, PLUS: Knowledge, Skills, and Abilities: 1. Ability to operate AHJ-provided lifting equipment 2. Ability to operate AHJ equipment to map the floor of the water body 3. Ability to use the AHJ-provided underwater scene recording equipment Experience: Performed at least four dives a year over a five-year period in conditions similar to those of the mission	Knowledge, Skills, and Abilities: 1. Ability to use proper dive-related Personal Protective Equipment (PPE) 2. Ability to plan and chart the dive mission based on parameters 3. Knowledge of standard operating procedures, divers' hand signals, equipment limitations, and alternate communication and entanglement procedures 4. Ability to determine victim survivability 5. Ability to apply dive patterns and victim search patterns based on requestor-provided information 6. Ability to apply dive reference materials and witness interviews to develop a dive plan 7. Knowledge of local, state, and Federal laws related to evidence collection 8. Knowledge of health emergencies related to diving Experience: Performed at least four dives a year over a two-year period in conditions similar to those of the mission	Not Specified

COMPONENT	TYPE 1	TYPE 2	TYPE 3	TYPE 4	NOTES
PHYSICAL/MEDICAL FITNESS	Same as Type 2	Same as Type 3	Same as Type 4	1. Arduous 2. Passes Watermanship Test and Basic Scuba Skills Evaluation as prescribed by International Association of Dive Rescue Specialists (IADRS) at least every year 3. Maintains AHJ-determined physical fitness standards suitable for the environment and typing through annual physicals with a physician that has knowledge of hyperbaric and dive-related illnesses; a PADI medical statement, a National Association of Underwater Instructors (NAUI) medical evaluation, and the NFPA 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments all meet or exceed this physical fitness standard	The NIMS Guideline for the National Qualification System (NQS) defines Physical/Medical Fitness levels for NIMS positions.
CURRENCY	Same as Type 2	Same as Type 3	Same as Type 4	1. Functions in this position during an operational incident, planned event, exercise, drill, or simulation at least once every year 2. Passes the IADRS Watermanship Test and Basic Scuba Skills Evaluation at least annually 3. Performs at least four dives annually that are similar to those expected to be performed on a deployment	Not Specified
PROFESSIONAL AND TECHNICAL LICENSES AND CERTIFICATIONS	Same as Type 2	Same as Type 3	Same as Type 4	Public Safety Diver certification through PADI, DRI, or other nationally recognized curriculum	Not Specified

NOTES

Nationally typed resources represent the minimum criteria for the associated component and capability.

REFERENCES

1. FEMA, NIMS 508: Public Safety Dive Team
2. FEMA, NIMS 509: Dive Team Leader
3. FEMA, NIMS 509: Tender
4. FEMA, National Incident Management System (NIMS), October 2017
5. FEMA, NIMS Guideline for the National Qualification System, November 2017
6. FEMA, National Response Framework, June 2016
7. Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) Part 1910.120: Hazardous Waste Operations and Emergency Response, latest edition adopted
8. National Fire Protection Association (NFPA) 1006: Swiftwater Rescue Operations, 2017
9. NFPA 1582: Standard on Comprehensive Occupational Medical Program for Fire Departments, 2013
10. International Association of Dive Rescue Specialists (IADRS), Annual Watermanship Test, 2011
11. IADRS, Annual Basic Scuba Skills Evaluation
12. Professional Association of Diving Instructors (PADI), Public Safety Diver certification
13. Dive Rescue International (DRI), Public Safety Diver certification

DIVE TEAM LEADER

RESOURCE CATEGORY	Law Enforcement Operations
RESOURCE KIND	Personnel
OVERALL FUNCTION	The Dive Team Leader manages and directs all aspects of dive operations
COMPOSITION AND ORDERING SPECIFICATIONS	1. This position can be ordered as a single resource or in conjunction with a NIMS typed team (Public Safety Dive Team). 2. Discuss logistics for deploying this position, such as working conditions, length of deployment, security, lodging, transportation, and meals, prior to deployment

Each type of resource builds on the qualifications of the type below it. For example, Type 1 qualifications include the qualifications in Type 2, plus an increase in capability. Type 1 is the highest qualification level.

COMPONENT	TYPE 1	TYPE 2	NOTES
DESCRIPTION	Same as Type 2, PLUS: 1. Plans and directs specialty dive operations, such as: a. Confined space dives b. Contaminated water dives c. Ice dives d. Dives in depths greater than 130 feet	The Dive Team Leader: 1. Defines search parameters for a dive rescue incident 2. Coordinates with the Incident Commander (IC), Operations Section Chief, Branch Director, or Division/Group Supervisor to meet objectives for an operational period related to diving activities 3. Ensures team members follow all applicable laws, standards, and best practices for dive activities 4. Develops tactical action plan for dive operations, to fulfill the Incident Action Plan 5. Provides Incident Action Plan documentation as the incident requires 6. Ensures chain of custody is fulfilled related to any evidence preservation 7. Manages divers in depths up 130 feet and without obstructions	Not Specified
EDUCATION	Same as Type 2	High school diploma or GED	Not Specified

COMPONENT	TYPE 1	TYPE 2	NOTES
TRAINING	Same as Type 2, PLUS: 1. Training in specialty dives, such as: a. Contaminated Water Operations b. Confined Space/Cave Diving c. Ice Diving 2. Training in accordance with Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) Part 1910.120: Hazardous Waste Operations and Emergency Response 3. Enriched air or rebreather certification 4. Training in accordance with National Fire Protection Association (NFPA) 1006: Swiftwater Rescue Operations, or equivalent	Completion of the following: 1. IS-100: Introduction to the Incident Command System, ICS-100 2. IS-200: Basic Incident Command System for Initial Response, ICS-200 3. ICS-300: Intermediate Incident Command System for Expanding Incidents 4. IS-700: National Incident Management System, An Introduction 5. IS-800: National Response Framework, An Introduction 6. Supervisory course through the NFPA, International Association of Chiefs of Police (IACP), or equivalent 7. U.S. Coast Guard-approved boating safety course 8. Training in accordance with OSHA 29 CFR Part 1910.120: Hazardous Materials Awareness	Not Specified
EXPERIENCE	Type 2, PLUS: 1. Knowledge of support needs for advanced dive and search patterns, including: a. Ability to research chemicals and create a decontamination plan for divers and support personnel b. Ability to plan a contaminated water, confined space, or ice dive tactical action plan Experience: Supervised at least four dives a year over a five-year period in conditions similar to those of the mission	Knowledge, Skills, and Abilities: 1. Knowledge of the capabilities and limitations of their Public Safety Dive Team 2. Ability to perform an adequate risk/benefits analysis and make a dive/no-dive decision 3. Knowledge and ability to create a tactical action plan that fulfills the Incident Action Plan 4. Ability to properly document all information related to the dive, evidence collection, and recording of the scene, based on nationally accepted practices Experience: Supervised at least four dives a year over a two-year period in conditions similar to those of the mission	Dives include mission dives or training dives.
PHYSICAL/MEDICAL FITNESS	Same as Type 2	1. Moderate 2. Maintains Authority Having Jurisdiction (AHJ) determined physical fitness standards suitable for the environment and typing through annual physicals; a Professional Association of Diving Instructors (PADI) medical statement, a National Association of Underwater Instructors (NAUI) medical evaluation, and the NFPA 1582: Standard on Comprehensive Occupational Medical Program for Fire Departments all meet or exceed this physical fitness standard	The NIMS Guideline for the National Qualification System (NQS) defines Physical/Medical Fitness levels for NIMS positions.
CURRENCY	Same as Type 2	Functions in this position during an operational incident, planned event, exercise, drill, or simulation at least once every year	Not Specified

COMPONENT	TYPE 1	TYPE 2	NOTES
PROFESSIONAL AND TECHNICAL LICENSES AND CERTIFICATIONS	Same as Type 2	Certified in cardiopulmonary resuscitation (CPR)	Not Specified

NOTES

Nationally typed resources represent the minimum criteria for the associated component and capability.

REFERENCES

1. FEMA, NIMS 508: Public Safety Dive Team
2. FEMA, NIMS 509: Diver
3. FEMA, NIMS 509: Tender
4. FEMA, National Incident Management System (NIMS), October 2017
5. FEMA, NIMS Guideline for the National Qualification System, November 2017
6. FEMA, National Response Framework, June 2016
7. National Fire Protection Association (NFPA) 1006: Swiftwater Rescue Operations, 2017
8. NFPA 1582: Standard on Comprehensive Occupational Medical Program for Fire Departments, 2013
9. Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) Part 1910.120: Hazardous Waste Operations and Emergency Response, latest edition adopted

FEMA

Position Qualification for On-scene Security, Protection and Law Enforcement
Law Enforcement Operations

TENDER

RESOURCE CATEGORY	Law Enforcement Operations
RESOURCE KIND	Personnel
OVERALL FUNCTION	The Tender helps create a dive plan and assists divers in all aspects of a dive
COMPOSITION AND ORDERING SPECIFICATIONS	1. This position can be ordered as a single resource or in conjunction with a NIMS typed team (Public Safety Dive Team). 2. Discuss logistics for deploying this position, such as security, lodging, transportation, and meals, prior to deployment 3. This position typically works 12 hours per shift, is self-sustainable for 72 hours, and is deployable for up to 14 days

Each type of resource builds on the qualifications of the type below it. For example, Type 1 qualifications include the qualifications in Type 2, plus an increase in capability. Type 1 is the highest qualification level.

COMPONENT	TYPE 1	TYPE 2	NOTES
DESCRIPTION	Same as Type 2, PLUS: Supports divers on advanced dives, including: 1. Working with diving equipment for dives in depths greater than 130 feet 2. Working with advanced evidence collection equipment 3. Assisting divers in confined spaces, contaminated waters, and ice diving conditions 4. Setting up a hazardous materials decontamination process	The Tender: 1. Works with divers to perform basic dive patterns 2. Helps divers assemble, put on, and take off Personal Protective Equipment (PPE) 3. Monitors divers' air consumption 4. Maintains communication with divers while they are on the surface and submerged 5. Documents the dive operation on dive charts 6. Works with diving equipment for dives in depths up to 130 feet 7. Helps create the dive plan and ensures that it is followed	Not Specified
EDUCATION	Same as Type 2	High school diploma or equivalent	Not Specified
TRAINING	Same as Type 2, PLUS: Training on techniques for advanced dives, such as: 1. Ice Rescue Operations Technician 2. Training in accordance with the Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) Part 1910.120: Hazardous Waste Operations and Emergency Response 3. Training in the use of Authority Having Jurisdiction (AHJ) provided detection capabilities	Completion of the following: 1. IS-100: Introduction to the Incident Command System, ICS-100 2. IS-200: Incident Command System for Single Resource and Initial Action Incidents 3. IS-700: National Incident Management System, An Introduction 4. IS-800: National Response Framework, An Introduction 5. Emergency Medical Responder training 6. U.S. Coast Guard-approved boating safety course 7. Training in accordance with National Fire Protection Association (NFPA) 1006: Swiftwater Rescue Operations, or equivalent	Not Specified

COMPONENT	TYPE 1	TYPE 2	NOTES
EXPERIENCE	Same as Type 2, PLUS: Knowledge of support needs for advanced dive and search patterns, including: 1. Ability to support AHJ's advanced evidence collection equipment 2. Knowledge and ability to assist divers in confined space and ice diving situations 3. Knowledge and ability to research chemical data and devise a decontamination plan for divers exiting contaminated waters Experience: Tendered at least four dives a year over a five-year period in conditions similar to those of the mission	Knowledge, Skills, and Abilities: 1. Understanding of the AHJ's various dive patterns 2. Familiarity with the dive environment 3. Familiarity with the team's dive equipment and PPE 4. Understanding of the physiological effects of diving 5. Ability to self-rescue from the water 6. Ability to perform minor repairs on dive equipment and PPE 7. Ability to record evidence collection information Experience: Tendered at least four dives a year over a two-year period in conditions similar to those of the mission	Not Specified
PHYSICAL/MEDICAL FITNESS	Same as Type 2	1. Performs duties under arduous circumstances characterized by working consecutive 12-hour days under physical and emotional stress for sustained periods of time 2. Maintains AHJ-determined physical fitness standards suitable for the environment and typing through annual physicals; a Professional Association of Diving Instructors (PADI) medical statement, a National Association of Underwater Instructors (NAUI) medical evaluation, and the NFPA 1582: Standard on Comprehensive Occupational Medical Program for Fire Departments all meet or exceed this physical fitness standard 3. Passes an annual surface swim test: a. 100-yard swim, no time limit b. Tread water for 10 minutes without a personal floatation device (PFD) c. While wearing a PFD, tow an unconscious person 100 yards	Not Specified
CURRENCY	Same as Type 2	Functions in this position during an operational incident, exercise, drill, or simulation at least once annually	Not Specified
PROFESSIONAL AND TECHNICAL LICENSES AND CERTIFICATIONS	Not Specified	Not Specified	Not Specified

NOTES

Nationally typed resources represent the minimum criteria for the associated component and capability.

REFERENCES

1. FEMA, NIMS 508: Public Safety Dive Team
2. FEMA, NIMS 509: Dive Team Leader
3. FEMA, NIMS 509: Diver
4. FEMA, NIMS Guideline for the National Qualification System, November 2017
5. Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) Part 1910.120: Hazardous Waste Operations and Emergency Response, latest edition adopted
6. National Fire Protection Association (NFPA) 1006: Swiftwater Rescue Operations, 2017
7. NFPA 1582: Standard on Comprehensive Occupational Medical Program for Fire Departments, 2013

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