

Lummi Natural Resources Department Lummi Indian Business Council





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#### ACKNOWLEDGEMENTS AND DEDICATION

This is the third edition of the Lummi Natural Resources Department (LNR) Commercial Harvest Diving Standards (hereafter, standards). The first edition was adopted in 1996, the second, in 2013. The development of any standards is generally the result of long hours spent talking one-on-one, in small groups, or in formal committee with the persons responsible for administering new guidelines and rules and with those people for whom the standards are intended. Like its predecessors, the third edition benefitted from many such conversations over the past five years. I especially thank Dr. Justin Iwasaki and Dr. Dakotah Lane of the Lummi Tribal Health Center for recognizing the contribution these standards might make toward improved community health. To this end, Dr. Lane took the necessary steps in attaining credentials to properly administer to the fitness needs of the Lummi commercial harvest diving fleet while the clinic staff kept pace with the changes. Dr. Lane also played an integral role in updating the medical requirements in Chapter 3. I also thank Merle Jefferson, Sr. and Ben Starkhouse of LNR, and the Lummi Fisheries and Natural Resources Commission, including Steve Solomon, Elden Hillaire, Bobby Dennis, Jr., and Gerald I. James, who provided me with a "sound" sounding board when adopting the standards. Finally, I thank the participants of the May 2016 diving safety workshop which ultimately led to this volume. In alphabetical order, these were: Michael Alexander, James Ballew, Ed Conway, Cliff Cultee, Shannon Cultee, Robert George IV, Tracy Ginn, Aaron Hillaire, Elden Hillaire, James C. Jefferson, Phillip Jefferson, Randal Jefferson, Ray Jefferson, Sr., Rob Jefferson, Anthony Jeffries, Matt Jeffries, Tremaine Lawrence, Thomas Olsen, Malcolm Owings, Brandon Revey, Eugene Revey, Valentino Revey III, George Thomas, Jr., Roque Tapuro, and James Wade. It should be noted that Randal Jefferson, Lummi Indian Business Council's Workplace Safety Officer, has been instrumental in keeping the fleet's emergency response training "in-house" recently. This work is dedicated to the memories of David Hillaire, Albert Hillaire, Hank Hoskins, Sr., and Robert Davis III and to the current and future Lummi fishers participating in commercial harvest diving operations under the auspices of the Lummi Nation.

Karl W. Mueller

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## **1.0 GENERAL PROVISIONS**

# 1.1 REGULATORY HISTORY OF THE LUMMI NATURAL RESOURCES DEPARTMENT COMMERCIAL HARVEST DIVING STANDARDS

In 1995, new harvest opportunities arose for treaty fishers after Federal District Court Judge Edward Rafeedie reaffirmed the Boldt Decision and ruled that Washington's Treaty Tribes would share half of all fish, including shellfish, with non-treaty fishers and non-tribal citizens inside their usual and accustomed fishing areas. In the wake of the Rafeedie Decision and toward the close of the 20<sup>th</sup> century, a few intrepid Lummi fishers began commercial harvest diving for sea cucumbers, sea urchins, and geoduck clams. Shortly thereafter, the Lummi Fisheries and Natural Resources Commission (LFNRC) recognized that specialized training and experience were required to participate in the emerging tribal dive fisheries. In 1996, the LFNRC approved Lummi Natural Resources Department (LNR) regulations designed to minimize the risks associated with working underwater. Regulation 96-03 outlined the minimum training requirements for Lummi fishers wanting to participate in commercial harvest diving activities and Regulation 96-04 summarized the safety standards that Lummi diving operations were required to follow. Given the limits and management restrictions placed on traditional fisheries such as those targeting Pacific salmon and Dungeness crab, the new dive fisheries were poised to become a small but bright spot in the Lummi Nation's economy.

In the ensuing years, despite having a reasonable, albeit minimal, set of commercial harvest diving requirements (Regulation 96-04 drew heavily from the federal Occupational Safety and Health Administration's [OSHA] standard, 29 CFR 1910 Subpart T, Commercial Diving Operations), diving accidents within the Lummi commercial harvest diving community were not uncommon. Several incidents of decompression sickness, barotraumas, one near-drowning, and a diving-related fatality prompted the LFNRC to exercise its authority (10.05.070 Fish Vessel Safety Regulations) to prioritize diving safety on the Lummi Reservation. In February 2012, the LFNRC charged LNR staff with reviewing the 1990s-era diving regulations and recommending ways in which Lummi's commercial harvest diving safety record might be improved. The LNR staff recommendations included (in no particular order):

- 1) Designating a dive-qualified professional to administer diving safety for the fleet;
- 2) Creating a peer oversight body or process for qualified and experienced Lummi divers to review safety matters;
- 3) Re-writing or developing new commercial harvest diving standards and regulations;
- 4) Reconciling the Lummi Nation Natural Resources Code of Laws (Title 10) with existing commercial harvest diving regulations and associated fisheries;
- 5) Adopting new standards for medical requirements including drug testing;
- 6) Requiring more rigorous training for personnel new to the dive fisheries and requiring diving safety refresher training for existing personnel;
- 7) Outfitting the Lummi commercial harvest diving fleet with emergency oxygen administration kits;
- 8) Introducing routine equipment/dive vessel inspections; and
- 9) Investigating the possibility of using the local hyperbaric oxygen chamber for diving-related emergencies, including suspected cases of decompression sickness.

The following month (March), the Director of LNR, through the LFNRC, appointed an LNR staff member to administer a new diving safety initiative for the department. In August 2012, the LFNRC updated LNR regulations 96-03 and 96-04 with respect to medical and training requirements for divers and hose tenders, and a third regulation (2012-40 Dive Vessel Registration) was passed outlining dive vessel owner responsibilities. After consulting with members of the Lummi commercial harvest diving fleet, the LFNRC, Lummi legal and law enforcement personnel, and local medical professionals, the new LNR Diving Safety Administrator (DSA) then drafted an updated set of standards for use by the commercial harvest diving fleet. In June 2013, the LFNRC approved and adopted an earlier version of this document, the July 2013 Commercial Harvest Diving Standards, as

the official guidelines for all commercial harvest diving-related activities permitted under the auspices of the Lummi Nation. Regulation 2013-24 Lummi Nation Commercial Harvest Diving Standards soon followed, and superseded all previous commercial harvest diving regulations. Since a set of safety standards is considered to be a "living document" subject to periodic update(s), a review of Lummi's standards was scheduled for the spring of 2016. In May of that year, the DSA met with members of the Lummi commercial harvest diving community, the LFNRC, the Natural Resources Enforcement Patrol, and the director of the Lummi Health Clinic to review the 2013 version of the standards. The current document is a direct result of those meetings (Figures 2 and 3), and was adopted by the LFNRC (a quorum being present) on January 11, 2019 (Regulation 2019-09 Commercial Harvest Diving Standards).

#### **1.2 SCOPE AND APPLICATION**

The LNR Commercial Harvest Diving Standards were adapted from the 2011 version of the Association of Diving Contractors International (ADCI) Consensus Standards for Commercial Diving and Underwater Operations and, to a lesser degree, from the 2017 version of the National Oceanic and Atmospheric Administration (NOAA) Diving Manual – Diving for Science and Technology (6<sup>th</sup> edition), and selected training materials from Technical Diving International (TDI) and the Divers Alert Network (DAN). The 2017 version of the Hoodsport'N Dive Surface Supplied Air Diving for the Commercial Harvester Manual is appended (Appendix V) with permission for reference purposes only.

<u>These standards apply to all Lummi fishers approved to participate in commercial harvest diving activities under</u> <u>the auspices of the Lummi Nation</u>. These standards are intended for internal use only by LNR and for personal use by members of the Lummi commercial harvest diving community when working aboard LNR-registered fishing vessels approved for diving operations; hence, this document must not be sold, lent, or given to any other person(s), institution, or organization outside of the jurisdiction of the Lummi Nation without permission from the Director of LNR or the LFNRC.

#### **1.3 AUTHORITY**

The Lummi Nation Natural Resources Code of Laws, Title 10, establishes the institutional framework to govern and regulate Lummi commercial harvest diving activities (10.01.050 Purpose). The LFNRC is the governing body charged with implementing the objectives of Title 10 (10.01.040 Lummi Fisheries and Natural Resources Commission). It is the elected group (11 members) of eligible Lummi citizens that is co-authorized with the Director of LNR to issue fishing and safety regulations concerning Lummi commercial harvest diving activities (10.06.010 Season; 10.06.030 Pre-Season Fishing Regulation; 10.06.040 In-Season Fishing Regulation; 10.05.070 Fish Vessel Safety Regulations). Commercial harvest diving operations targeting sea cucumbers, sea urchins, geoduck clams, or pink and spiny scallops are subject to regulation by the Director of LNR and the LFNRC (10.16.020 Miscellaneous Commercial Fisheries). The rules and regulations promulgated under Title 10 apply to all Lummi fishers exercising their treaty rights to harvest under the auspices of the Lummi Nation (10.01.030 Jurisdiction). Lummi fishers, including those who wish to participate in the tribe's commercial dive fisheries, must have in their possession general fishing identification cards with current validation stickers (10.04.030 Lummi Nation Treaty Indian Fishing Identification Card Validations). In addition, Title 10 stipulates that it is illegal to possess, consume, or be under the influence of drugs or alcohol when fishing under the auspices of the Lummi Nation (10.07.090 Prohibited Behavior; 10.07.140 Fishing or Hunting While Intoxicated or Under the Influence of a Controlled Substance). In June 2017, the Lummi Indian Business Council (LIBC) reaffirmed its long-held position concerning the perils of drug and alcohol abuse within the Lummi community by passing a resolution recognizing that substance abuse threatens, both directly and indirectly, the Lummi People's traditional way of life and the natural resources on which they depend (LIBC Resolution No. 2017-070). Subsequently, the LFNRC approved of a new mandate, the Fisheries Alcohol and Controlled Substance Testing Regulation (no. 2017-001) which requires Lummi citizens be drug-tested before being issued their annual general fishing identification cards and validations through LNR. Accordingly, divers and hose tenders applying to participate in Lummi's commercial dive fisheries must receive negative test results to warrant

further consideration by the department. Finally, the Natural Resources Enforcement Patrol is authorized to enforce all rules and regulations governing Lummi commercial harvest diving activities (10.01.060 Enforcement).

Workplace safety aboard commercial fishing vessels operating within the territorial seas of the United States of America may also be regulated by OSHA and the United States Coast Guard (USCG). Both agencies have their own (albeit similar) commercial diving standards (OSHA 29 CFR Part 1910, Subpart T – Commercial Diving Operations and USCG 46 CFR Part 197, Subpart B – Commercial Diving Operations) that apply to workers both onshore and offshore. By and large, the OSHA regulations do not apply to diving operations and vessels over which the USCG exercises inspection authority (e.g., certain sizes of commercial fishing vessels). Most of the time, the commercial enterprises of federally-recognized treaty tribal members are covered under OSHA [29 CFR 1975.4 (b) (3) – Coverage]. Indeed, the LNR Commercial Harvest Diving Standards generally meet or exceed those identified in the OSHA guidelines for commercial diving operations (29 CFR Part 1910, Subpart T) involving surface supplied air diving (29 CFR 1910.425). In practice, however, the USCG has responded to and investigated many, but not all, diving accidents involving Lummi fishers since the late 1990s. Local authorities, including qualified staff from the LIBC, have taken the lead on the others.

#### **1.4 DIVING SAFETY ADMINISTRATION**

The Lummi commercial harvest diving fleet collectively conducts hundreds of dives each year when fishing. According to the Bureau of Labor Statistics (U.S. Department of Labor), in terms of workplace safety, commercial fishing is generally considered a dangerous way to earn a living. Commercial harvest diving is arguably the Lummi Nation's most dangerous fishing occupation. Indeed, there have been three fatalities associated with the tribe's commercial harvest diving activities since the mid-1990s. Furthermore, there have been two or three emergency medical service responses (EMS) and/or hospitalizations related to diving accidents annually since 2011 (Figure 1). It should be noted that the 2013 peak in the number of divers participating in Lummi's dive fisheries (Figure 1) coincided with an increase in the ex-vessel price paid for landed sea cucumber and the development of the San Juan Islands/Strait of Georgia Region harvest management plan for subtidal geoduck clam. However, despite the commercial harvest diving fleet nearly doubling in size over the past five years, both in terms of number of divers and number of vessels participating in the dive fisheries, the number of EMS responses and/or hospitalizations related to diving accidents and their rate of occurrence (# of incidents per 100 commercial landings, all species combined) have remained relatively static or have declined, especially since 2016 (Figure 1). This suggests that LNR's diving safety initiative has had a positive impact on Lummi's commercial harvest diving activities by improving diver safety since being implemented in 2012; therefore, for the foreseeable future, the department will continue its efforts, emphasizing safe and healthful practices within the Lummi commercial harvest diving fleet.

Three key elements lie at the core of the LNR diving safety initiative: 1) tracking the qualifications and experience of Lummi fishers participating in commercial harvest diving activities, 2) maintaining regular communications between the department and the participants in the dive fisheries, and 3) the willingness of the participants themselves to adopt safer practices. Participants in the Lummi Nation dive fisheries must meet a minimum set of requirements related to their physical fitness, training, and experience in commercial harvest diving operations. These requirements are mandated by regulation (Regulation 2019-09 Commercial Harvest Diving Standards), authorized and promulgated by the Director of LNR in consultation with the LFNRC, concerning the safe operation of Lummi fishing vessels (10.05.070 Fish Vessel Safety Regulations). To improve compliance with the regulation(s), the DSA not only communicates with individual members of the commercial harvest diving fleet on a routine basis, but also in a peer group setting during periodic management meetings. In this way, the Director of LNR and the LFNRC disseminate information to, and receive feedback from, the commercial harvest diving fleet, through the DSA, on matters related to diving safety.



Figure 1. Relationship between expansion of the Lummi Nation commercial harvest diving fleet (number of divers, red line; number of dive vessels, green line) and the annual frequency or rate of emergency medical system (EMS) responses or hospitalizations due to Lummi diving accidents [number of incidents, blue line; number of incidents/100 commercial landings in the dive fisheries (all species combined), purple line]. Only those incidents officially documented during an eight-year period (2011–2018) are shown.

#### 1.4.1 DIVING SAFETY ADMINISTRATOR

The DSA shall mean the dive-qualified safety professional who is the primary contact between the Director of LNR, the LFNRC, and the Lummi commercial harvest diving community. The DSA shall have a minimum set of qualifications to serve in that capacity including, but not limited to, certification as a divemaster or underwater instructor from a widely-recognized training agency, several years experience in the field, and familiarity and experience with diving safety practices. The DSA may have the same qualifications as a Diving Safety Officer (DSO) as defined by the National Oceanic and Atmospheric Administration (NOAA) in that agency's Working Diving Standards and Safety Manual dated July 2011; however, in practice, the DSA has overlapping duties and responsibilities of a NOAA Diving Program Manager and DSO, as outlined in the NOAA standards manual, but without the DSO requirement of being a certified instructor. The DSA should be an employee of the LIBC, appointed through the Director of LNR, with approval from the LFNRC. If the DSA is an employee of the LIBC, he or she is subject to that organization's personnel policies. The primary responsibility of the DSA is administering diving safety for the fleet, on behalf of the Director of LNR and the LFNRC, to satisfy the requirements of the LNR Commercial Harvest Diving Standards. The DSA's duties may include, but are not limited to, the following:

- 1) Developing and maintaining as necessary the LNR Commercial Harvest Diving Standards to be used by the Lummi Nation commercial harvest diving fleet as a safe practices manual (e.g., Figures 2 and 3);
- Reviewing and verifying initial training and certification for members of the commercial harvest diving fleet;
- 3) Issuing or revoking LNR classification cards, through the Director of LNR and/or the Chair of the LFNRC;
- Organizing or conducting diving safety refresher trainings for the Lummi commercial harvest diving community;

- 5) Conducting, monitoring, or reviewing results from inspections of compressed air equipment aboard LNRregistered fishing vessels approved for diving operations;
- 6) Maintaining the LNR diving safety database including but not limited to individual records for Lummi fishers permitted to dive commercially under the auspices of the Lummi Nation, and records for LNRregistered fishing vessels approved for diving operations;
- 7) Reviewing diving incidents and diving accidents, and participating in formal investigations of these as required;
- Assembling qualified and experienced members of the Lummi commercial harvest diving fleet, as requested by the Director of LNR and/or the LFNRC, to review specific diving safety matters and incidents, and to report the group's safety recommendations back to the administrative requestor(s) (see expanded description in following section);
- 9) Preparing formal reports of diving incidents and diving accidents for review by the Director of LNR, the LFNRC, and Lummi law enforcement;
- Working with Lummi law enforcement, the Director of LNR, the LFNRC, local healthcare providers, and the Lummi commercial harvest diving community to ensure compliance with the LNR Commercial Harvest Diving Standards;
- 11) Alerting the Director of LNR, the LFNRC, and the Lummi commercial harvest diving community of possible breaches of applicable diving policies and standards;
- 12) Alerting the Lummi commercial harvest diving community of updates on issues, policies, regulations, or equipment standards affecting diving safety;
- Supporting any suspensions or revocations of privileges administered by the Director of LNR, the LFNRC, or the Lummi Tribal Court for violations of the diving standards and procedures adopted by the Lummi Nation;
- 14) Assembling the commercial harvest diving fleet on a periodic basis to address dive fishery management issues; and
- 15) Procuring, maintaining, and scheduling service of diving equipment used by LNR staff in managing the Lummi Nation's dive fisheries.

#### 1.4.2 DIVE FLEET MEETINGS

Besides arranging periodic meetings to discuss dive fishery management issues, the DSA will assemble qualified and experienced members of the Lummi commercial harvest diving fleet, as requested by the Director of LNR and the LFNRC, to review specific diving safety matters and/or incidents. In this way, the latter assembly will serve as a de facto Diving Control Board (DCB) as defined in NOAA's Working Diving Standards and Safety Manual dated July 2011. The dive fleet meeting will strive for consensus on issues and recommendations to be lifted up to the Director of LNR and the LFNRC, but unlike NOAA's DCB, the group lacks the authority to make policy, take formal action, or provide binding oversight of diving activities on a fleet-wide basis. Furthermore, any discussion or assessment of protected health information related to a Lummi fisher's fitness to participate in commercial harvest diving activities is subject to federal rules under the Health Insurance Portability and Accountability Act of 1996, or HIPAA. An important contribution of the dive fleet meetings will be to collaborate with the DSA in developing safe diving practices and to assist in developing the standards to be included in a safe practices manual (e.g., the LNR Commercial Harvest Diving Standards). The group will meet these goals by:

- 1) Reviewing and recommending revisions or edits to the LNR Commercial Harvest Diving Standards used by the Lummi dive fleet, at least of this writing, as a safe practices manual;
- 2) Establishing processes to effectively review or monitor working diving operations permitted under the auspices of the Lummi Nation;
- 3) Recommending training and certification programs required for participants of Lummi Nation-approved commercial harvest diving activities;
- 4) Reviewing and adopting the physical conditioning and medical standards required to promote diver safety;

- 5) Instructing and reminding fellow participants in the Lummi dive fisheries to adhere to all diving regulations, standards, policies, and procedures;
- 6) Participating in safety assessments and safety refreshers as required;
- 7) Serving as a board of review for inquiries into the nature and cause of diving incidents (e.g., "nearmisses") and accidents, if requested by the Director of LNR and the LFNRC;
- 8) Serving as a board of review for breaches of applicable diving policies and standards, if requested by the Director of LNR and the LFNRC;
- 9) Recommending to the Director of LNR and the LFNRC, through the DSA, any action(s) needed to address unsafe, unwise, or noncompliant practices/diving operations;
- 10) Recommending to the Director of LNR and the LFNRC, through the DSA, the appropriate measures to mitigate reoccurrence of diving incidents; and
- 11) Supporting any suspensions or revocations of privileges administered by the Director of LNR and the LFNRC for violations of the diving standards and procedures adopted by the Lummi Nation.

### Lummi Natural Resources Harvest Management

To	Lummi Fishering and Natural Bedourcos Commission
From:	Karl Mueller
CC:	Merle Jefferson, Sr., Leroy Deardorff, Sr., Ben Starkhouse, the Natura Resources Enforcement Patrol, Victor Johnson, and Steven Toby
Date:	9/6/2018
Re:	Summary of major changes to the Lummi Natural Resource Department's (LNR) 2013 Commercial Harvest Diving Standards
Commercial to periodic re- reviews and necessary). of the LNR (bereafter #	Harvest Diving Standards (hereafter, the standards), is a living document subje- eview and updating. In jurisdictions outside of the Lummi Nation, diving standard d updates typically occur every five to eight years (or more frequently, Over the past two years, I have been opportunistically updating the 2013 versic standards after receiving input from the Lummi commercial harvest diving fleue feat) the LNB Enforcement Patrol (hereafter, the officer), physicians from the
Commercial to periodic re- reviews and necessary). of the LNR (hereafter, th Lummi heal Commission posted on-li- participants commission and finalize standards to facilitate this standards:	Harvest Diving Standards (hereafter, the standards), is a living document subjective and updating. In jurisdictions outside of the Lummi Nation, diving standards dupdates typically occur every five to eight years (or more frequently, Over the past two years, I have been opportunistically updating the 2013 version standards after receiving input from the Lummi commercial harvest diving fleme fleet), the LNR Enforcement Patrol (hereafter, the officers), physicians from the clinic, and various members of the Lummi Fisheries and Natural Resource (hereafter, the commission). The final draft of the updated standards has been be since mid-July with periodic text reminders sent out to the fleet reminding to review the document prior to a separate review and adoption by the Next steps include meeting with both the fleet and the commission to revier the lefet and the officers, as well as to management and policy-level parties. To process, I have prepared the following summary of the major changes to the second to the fleet the following summary of the major changes to the second text previous and for more intuitive second to the fleet of the fleet and the officers as well as to management and policy-level parties.



<ul> <li>b) Minimum guidelines/requirements for dive vessel owners specified and detailed</li> </ul>	
<ul> <li>c) Temporary permits and variance for no-shows included.</li> <li>d) General approval and incident review processes clarified with respect to roles of Lummi Fisheries and Natural Resources Commission, Diving Safety Administrator, and use of peer-review group (formally</li> </ul>	
the "diving control board").	
<ul> <li>Fisheries Alcohol and Controlled Substance Testing Regulation (no. 2017-001)</li> <li>incorporated into standards.</li> </ul>	
<ol> <li>Medical guidelines and "fitness to dive" requirements consolidated into single chapter.</li> </ol>	
<ul> <li>Lummi clinic physician trained in both diving medicine and conducting proper dive physicals.</li> </ul>	
<ul> <li>b) New Lummi diving physician provided review of medical guidelines and physical examination forms to ensure conformity with training and service capabilities of clinic.</li> </ul>	
<ul> <li>c) Clinic director and new Lummi diving physician clarify services that will be provided by clinic ("rubber-stamping" fitness to participate no longer acceptable).</li> </ul>	
<ul> <li>d) Provisions for opioid replacement therapy included; "grandfather" clause language added.</li> <li>a) Second opinion referred endowed by the test in the test in the test in the test in test in the test in test i</li></ul>	
<ul> <li>7) Technical material irrelevant to a typical commercial harvest diving operation removed.</li> </ul>	
<ul> <li>a) Planned decompression elements removed.</li> <li>b) Number of dive tables reduced to reflect removal of planned decompression.</li> <li>c) Remaining tables edited to maximum depth of 130 ft.</li> </ul>	
d) NITROX requirements retained for future reference.	
8) Emergency preparedness and response consolidated into single chapter and streamlined for efficiency of use in field, especially as relates to emergency oxygen administration	
9) Contacts and resources lists updated.	
10) Glossary edited and all non-relevant terms removed.	
<ol> <li>Addition of updated version of an example surface supplied air training manual used with permission from training vendor.</li> </ol>	
Page 2	

Figure 3. Summary of the major changes to the 2013 version of LNR's Commercial Harvest Diving Standards.



In memory of Albert Hillaire (at left, back row)







## 2.0 ENTRY REQUIREMENTS and CLASSIFICATION

#### **2.1 OVERVIEW**

Everyone participating in Lummi commercial harvest diving operations shall possess a minimum set of qualifications for the job assigned to him or her. The classifications outlined in these standards are based on four elements: a) medical fitness, b) technical training, c) field experience, and d) demonstrated proficiency. To this end, persons participating in commercial harvest diving operations shall possess the following knowledge and skills gained through a combination of formal training and experience:

- 1) Familiarity with harvest diving procedures and proficiency in the use of equipment, tools, devices and systems associated with assigned tasks;
- 2) Physiology and physics related to diving;
- 3) Emergency procedures; and
- 4) First aid, CPR, and emergency oxygen administration.

#### 2.1.1 ADDITIONAL SURFACE SUPPLIED AIR TRAINING REQUIRED

It should be noted that a sport diving certification alone does not qualify an individual to participate as a diver in Lummi commercial harvest diving operations. Likewise, a current first aid/CPR certification alone does not qualify an individual to tend a diver's umbilical. Diving personnel certified by widely-recognized recreational training agencies [e.g., National Association of Underwater Instructors (NAUI), the Professional Association of Diving Instructors (PADI), Scuba Schools International (SSI), or Scuba Diving International (SDI)] are not sufficiently trained to participate in or conduct a commercial harvest diving operation without additional training in surface supplied air (SSA) diving techniques commonly used for such activity. This training must be completed in order to demonstrate competency in the field and to obtain the proficiency/experience required to perform aboard a Lummi commercial harvest diving vessel. Additional SSA training is required and will be recognized only from accredited sources (Appendix II). Alternatively, the person may receive documented and verifiable on-the-job training under the direct supervision of a qualified and experienced individual as classified by LNR. <u>The additional SSA training requirement applies to all positions held aboard a Lummi commercial harvest diving vessel</u>. Examples of the forms used to document the required additional SSA training can be found at the end of this chapter.

#### 2.1.2 MEDICAL FITNESS EVALUATION REQUIRED

Besides meeting the requirements for a drug- and alcohol-free workplace (see Section 1.3), all LNR-classified crew members, but especially those exposed to hyperbaric conditions, must have their physical, mental, and emotional state evaluated thoroughly by a medical professional prior to participating in Lummi commercial harvest diving operations. The procedures and guidelines for determining fitness to participate in the Lummi Nation's commercial dive fisheries are outlined in the following chapter. <u>Medical evaluations will be documented on LNR medical history and physical examination forms or their equivalents</u>. Examples of these forms can be found following the main text of Chapter 3.

#### 2.2 LNR COMMERCIAL HARVEST DIVING CLASSIFICATION PROCESS

With these standards, the Director of LNR and the LFNRC establish an approval process whereby a properly-trained Lummi fisher can obtain a classification card that indicates his or her diving qualification and competency level as defined in the LNR Commercial Harvest Diving Standards. The Director of LNR, the LFNRC, and the DSA will recognize commercial harvest diving personnel in four classification categories:

- 1) Hose Tender (HT);
- 2) Trainee Diver (TD);
- 3) Experienced Diver (ED); and
- 4) Experienced Dive Operator (EDO).

These individuals must be properly trained in accordance with the current edition of the LNR Commercial Harvest Diving Standards, progressing in their careers through continued formal training and on-the-job training, and demonstrated field and leadership experience. To reiterate, prospective diving personnel can use the forms found at the end of this chapter to document their early on-the-job training in the equipment/systems used during LNRapproved commercial harvest diving operations and their knowledge of the LNR standards.

Finally, a note concerning the dive vessel owner or DVO: <u>While a formal classification for DVOs is not available as</u> of this writing, minimum sets of expectations for DVOs are outlined in sections 2.5 and 4.1. Furthermore, all DVOs must follow the Lummi Nation Natural Resources Code of Laws concerning vessel registration and safety (i.e., Title 10, Chapter 10.05 Vessel Registration).

#### **2.3 REQUIREMENTS FOR HOSE TENDER AND TRAINEE DIVER**

The entry-level minimum skill designation/classification on a commercial harvest diving crew is HT. The HT must be at least 15 years old. All Title 10 rules related to employing minors (10.07.110 Minors) apply if the HT is younger than 18 years old. The next skill designation/classification is TD. The TD must be at least 18 years old and must satisfy the minimum entry-level qualifications of diving proficiency, technical proficiency and experience by successfully completing a formal course of study and by obtaining the experience and level of proficiency required under the direct supervision of a qualified and experienced individual as classified by LNR.

#### 2.3.1. HOSE TENDER

At a minimum, HTs must satisfy the following requirements:

- General tribal fishing identification card with current validation and negative drug screening (see Section 1.3);
- Current approval by an appropriate healthcare provider (physician or medical staff under direction of a physician) after passing a medical examination of the HT sufficient to identify factors which prohibit or restrict assisting with commercial harvest diving activities;
- 3) Current certification in first aid, CPR, and emergency oxygen administration by a widely-recognized training agency;
- 4) Four hours of training in the operation and maintenance of equipment used in commercial harvest diving operations and the procedures to be followed by each member of a crew verified by a qualified and experienced individual as classified by LNR (e.g., ED or EDO). In general, this training will take up to two working days to complete whereby the HT tends (with supervision) four to eight dives of 30 to 60 min duration each; and
- 5) Review and understand the current LNR Commercial Harvest Diving Standards verified by the DSA or a qualified and experienced individual as classified by LNR (e.g., ED or EDO).

Upon completion of the requirements outlined above (examples of the forms used to document the required additional SSA training can be found at the end of this chapter), the HT may serve in that role aboard an LNR-registered fishing vessel engaged in no-decompression, commercial harvest diving operations under the direct supervision of a qualified and experienced individual as classified by LNR (e.g., ED or EDO).

#### 2.3.2. TRAINEE DIVER

At a minimum, TDs must satisfy the following requirements:

- General tribal fishing identification card with current validation and negative drug screening (see Section 1.3);
- Current approval by an appropriate healthcare provider (physician or medical staff under direction of a physician) after passing a medical examination of the TD sufficient to identify factors which prohibit or restrict diving activity or assisting with commercial harvest diving activities;
- 3) Open Water Certification from a widely-recognized scuba training program (e.g., NAUI, PADI, SSI, or SDI);

- 4) Current certification in first aid, CPR, and emergency oxygen administration by a widely-recognized training agency;
- 5) Four (4) non-harvest dives of at least 15 min duration in open water at depths of 20 to 40 ft, with the equipment to be used in commercial harvest diving operations, including practice in recovering from loss of air supply, loss of mask, emergency ascent, retrieving/extracting injured diver, and other situations likely to be met in working dives logged by the TD and verified by a qualified and experienced individual as classified by LNR (e.g., ED or EDO);
- 6) Four hours of training in the operation and maintenance of equipment used in commercial harvest diving operations and the procedures to be followed by each member of a crew verified by a qualified and experienced individual as classified by LNR (e.g., ED or EDO). In general, this training will take up to two working days to complete whereby the TD tends (with supervision) four to eight dives of 30 to 60 min duration each;
- 7) Proof of annual servicing and maintenance of personal bailout systems and associated cylinders (see sections 5.3.5, 5.7.2, and 5.7.3); and
- 8) Review and understand the current LNR Commercial Harvest Diving Standards verified by the DSA or a qualified and experienced individual as classified by LNR (e.g., ED or EDO).

Upon completion of the requirements outlined above, the TD may participate in no-decompression, commercial harvest diving operations aboard an LNR-registered fishing vessel as a member of the crew under the direct supervision of a qualified and experienced individual as classified by LNR (e.g., ED or EDO). The TD may participate in no more than three dives per day, and must complete 90 logged dives in waters shallower than the maximum depth limit of the TD's initial diving certification (typically less than 60 ft) under safe conditions. Work must be performed during each dive with proper supervision. All dives logged while in TD status must have a minimum of 15 min bottom time. Two or three shorter-duration dives (e.g., five to 10 min) may be combined to equal one dive of the required 15 min bottom time. Training dives will be verified by a qualified and experienced individual as classified by LNR (e.g., ED or EDO). Examples of the forms used to document the required training for the TD can be found at the end of this chapter.

#### 2.4 REQUIREMENTS FOR EXPERIENCED DIVER AND EXPERIENCED DIVE OPERATOR

Advancement beyond the HT or TD levels requires additional training and demonstrated proficiency during commercial harvest diving operations in the field. Field experience is defined as those days spent participating as a crew member aboard a commercial harvest diving vessel. <u>Advancement to higher designations (e.g., ED or EDO)</u> requires completion of training and documented experience for all lower designations.

#### 2.4.1. EXPERIENCED DIVER

The ED participates in a no-decompression, commercial harvest diving operation as a member of the crew, but may also supervise the activities of the HT and TD if designated as the person-in-charge in the absence of a higherqualified or more experienced individual as classified by LNR (e.g., DVO, EDO, or another ED). At a minimum, EDs must satisfy the following requirements:

- General tribal fishing identification card with current validation and negative drug screening (see Section 1.3);
- Completion of the HT and TD requirements above, including at least 90 logged dives under normal working conditions which have been verified through records maintained by the ED candidate and by a qualified and experienced individual as classified by LNR (e.g., ED or EDO);
- Current approval by an appropriate healthcare provider (physician or medical staff under direction of a physician) after passing a medical examination of the ED sufficient to identify factors which prohibit or restrict diving activity or assisting with commercial harvest diving activities;
- 4) Current certification in first aid, CPR, and emergency oxygen administration by a widely-recognized training agency; and

5) Proof of annual servicing and maintenance of personal bailout systems and associated cylinders (see sections 5.3.5, 5.7.2, and 5.7.3).

#### 2.4.2. EXPERIENCED DIVE OPERATOR

The EDO (which may also be a DVO) safely conducts all aspects of commercial harvest diving operations and supervises the activities of all crew members; hence, by default, the EDO serves as the designated person-in-charge. At a minimum, the EDO must satisfy the following requirements:

- General tribal fishing identification card with current validation and negative drug screening (see Section 1.3);
- 2) Completion of all training requirements outlined above for HT, TD, and ED, including at least 1000 logged dives under normal working conditions which can be verified through records maintained by the EDO candidate or by signed declaration of a qualified and experienced individual as classified by LNR (e.g., DVO or EDO) with possible review by a group of his or her peers in the industry;
- Current approval by an appropriate healthcare provider (physician or medical staff under direction of a physician) after passing a medical examination of the EDO sufficient to identify factors which prohibit or restrict diving activity or assisting with commercial harvest diving activities;
- 4) Current certification in first aid, CPR, and emergency oxygen administration by a widely-recognized training agency; and
- 5) Proof of annual servicing and maintenance of personal bailout systems and associated cylinders and onboard emergency gas supplies (see sections 5.3.5, 5.7.2, and 5.7.3).

#### **2.5 REQUIREMENTS FOR DIVE VESSEL OWNER**

The DVO and his or her fishing activities are governed by the Lummi Nation's Natural Resources Code of Laws. DVOs must follow all rules and safety regulations promulgated under Title 10, Chapter 10.05 Vessel Registration. For example, these standards are considered integral to the safe operation of a commercial harvest diving vessel. Familiarity with them is just one responsibility of a DVO. If the DVO has no commercial harvest diving experience, he or she must gain on-the-job training from a qualified and experienced individual as classified by LNR (e.g., EDO or another experienced DVO). Training should include, but is not limited to, safety procedures and emergency response, proper operation and maintenance of diving equipment, troubleshooting problems, the effects of hyperbaric conditions on divers, and the potential impacts of environmental conditions (e.g., wind, temperature, and tides) on diving operations. His or her understanding of and proficiency in commercial harvest diving operations will be reviewed and verified by a group of the DVO's peers from within the Lummi commercial harvest diving fleet and by the LFNRC. In practice, the DVO should be an active member of his or her commercial harvest diving crew.

#### 2.6 DOCUMENTATION ACCEPTED

Lummi fishers possessing the training and certificates identified above are entitled to apply for the privilege of participating in commercial harvest diving operations permitted under the auspices of the Lummi Nation. Certificates and verification of training will be evaluated by the DSA together with other documentation such as dive logs, supervisor logs, letters of reference from other diving safety professionals, etc., to determine whether the individual is eligible in all respects to participate in commercial harvest diving activities (Figure 4).

#### 2.6.1 LNR CLASSIFICATION CARD ISSUE

All diving personnel permitted to participate in commercial harvest diving activities under the auspices of the Lummi Nation must hold a current LNR classification card reflective of the assigned tasks to be performed (e.g., HT or ED). The LNR classification card must be obtained before fishing aboard an LNR-registered DSV and shall be renewed annually (Title 10, Chapter 10.04 Lummi Fishing and Hunting Identification Cards). The LNR classification of acceptable documentation to the DSA that the individual for whom the card is intended has recorded evidence of having successfully completed the medical approval, training, and

on-the-job experience necessary to support card issue at the appropriate level of LNR classification. <u>The eligible</u> <u>Lummi fisher shall carry a current classification card on his or her person whenever he or she is participating in</u> <u>commercial harvest diving activities under the auspices of the Lummi Nation</u> (10.04.050 Fishing without Proper Identification).

The LNR classification card shall be a  $2\frac{1}{8}$  inch x  $3\frac{3}{8}$  inch (5.5 cm x 8.5 cm) plastic laminated card issued annually by the department and signed by the Director of LNR, the Chair of the LFNRC, and/or his or her designee (Figure 5). Classification cards issued under this program are valid from July 1 of the year of issuance until June 30 of the following year (10.04.030 Lummi Nation Treaty Indian Fishing Identification Card Validations) unless otherwise specified by LNR. For example, in recent years, for the sake of administrative convenience, the validation period for LNR classification cards matched the management year for the commercial sea cucumber fishery (August 1 through July 31).



Figure 4. General approval process for fishers wanting to participate in Lummi commercial harvest diving activities.

This Certificate is issued pursuant to Title 10 of the Lummi Code of Laws, and applicable regulations	This Certificate is issued pursuant to Title 10 of the Lummi Code of Laws, and applicable regulations
Name: FishID:	Name:     FishID:       I     I
has met the qualifications to be classified as a	has met the qualifications to be classified as a
Hose Tender	Trainee Diver
Issuer: KLMR Issued: 7/28/2017 Expiry: 7/31/2017	Issuer: KLMR Issued: 7/28/2017 Expiry: 7/31/2017
Authorized Signature Lummi Natural Resources Department	Authorized Signature Lummi Natural Resources Department
This Certificate is issued pursuant to Title 10 of the Lummi Code of Laws, and applicable regulations	This Certificate is issued pursuant to Title 10 of the Lummi Code of Laws, and applicable regulations
Name: FishID:	Name: FishID:
has met the qualifications to be classified as an	has met the qualifications to be classified as an
Experienced Diver	Experienced Dive Operator
Issuer: KLMR Issued: 7/28/2017 Expiry: 7/31/2017	Issuer: KLMR Issued: 7/28/2017 Expiry: 7/31/2017
Authorized Signature Lummi Natural Resources Department	Authorized Signature Lummi Natural Resources Department

Figure 5. Examples of laminated cards used by the Lummi Natural Resources Department (LNR) to classify Lummi fishers in one of four jobs (hose tender, trainee diver, experienced diver, and experienced dive operator) aboard an LNR-registered commercial harvest diving vessel. The color of the LNR classification cards changes annually to match other registration and validation documentation issued by the department. Typically, the Director of LNR or the Chair of the Lummi Fisheries and Natural Resources Commission signs the LNR classification cards.

#### 2.6.2 CONDITIONAL APPROVAL AND TEMPORARY PERMIT

According to the Lummi Nation Natural Resources Code of Laws, the Director of LNR in consultation with the LFNRC may issue permits for fishing activities not otherwise opened in accordance with the provisions of Title 10 (10.07.040 Permitted Fisheries). For qualified and experienced Lummi fishers (e.g., those persons having previously met all requirements of these standards), a temporary permit may be issued to "bridge the gap" between qualifying events (e.g., a delay in scheduling an annual physical examination through no fault of the previously qualified and experienced Lummi fisher); or, a temporary permit may be issued for exploratory fisheries such as those targeting pink and spiny scallops. A temporary permit may be issued by the DSA or other authorized LNR staff, with notice sent to the Lummi Natural Resources Enforcement Patrol, and will be valid for a period not exceeding two weeks. If the temporary permit is used to bridge the gap in completing the requirements of these standards, it is expected that the qualified and experienced Lummi fisher will fulfill his or her responsibility in a timely fashion. A temporary permit shall not be used as a substitute for a proper LNR classification card (Section 2.6.1). Furthermore, temporary permits shall not be issued to fishers who are applying to participate in Lummi commercial harvest diving activities for the first time except as provided in the next section.

#### 2.6.3 VARIANCE FOR "NO-SHOW" HOSE TENDER

On rare occasions, a qualified, LNR-classified hose tender may not report for duty as planned for a given fishery opening. In the event of an untimely "no-show" occurring, the DVO or designated person-in-charge (DPIC) may contact the DSA, or other appropriate LNR staff, to seek conditional approval (i.e., temporary permit) for an

unqualified yet trusted Lummi fisher to participate on his or her commercial harvest diving crew for the day. The DSA or LNR staff will then alert the LNR enforcement patrol of the change in personnel aboard the affected commercial harvest diving vessel. The duties assigned to the unqualified crew member shall be commensurate with the replacement's training and level of experience aboard a commercial harvest diving vessel. For example, the replacement shall not be asked to trouble-shoot the air compressor if he or she has previously never done so. Furthermore, all crew members must acknowledge the risks, liabilities, and limitations associated with exercising the variance for a "no-show" hose tender. Indeed, the unqualified fisher may not be able to perform routine tasks associated with a typical commercial harvest diving operation nor may the unqualified fisher respond appropriately during a diving emergency. Therefore, as per a consensus vote of the LFNRC at its January 11, 2019 meeting (a quorum being present), all participating crew members, including the unqualified fisher, shall be issued temporary permits with waivers associated with exercising the variance for a "no-show" hose tender (see example at the end of Chapter 7). In this way, by signing the temporary permits and waivers, the crew acknowledges yet still freely chooses, without coercion by the DPIC, to participate in this activity. Finally, it is expected that the DVO or DPIC keep such variance requests to an absolute minimum (e.g., one or two occasions per season).

#### 2.6.4 OTHER DOCUMENTATION

Proof of classification, certification, or qualification may be requested by LNR representatives, Natural Resources Enforcement Patrol, DVOs, or dive safety professionals from other Treaty Tribes to verify that the Lummi fisher for whom LNR permission was granted is fully qualified to perform duties in the classification requested (i.e., HT, TD, ED, or EDO). LNR will have on file, and may retain for a period of at least five years, hard copies of information that show evidence that the individual for whom the LNR classification card is requested does, in fact, possess the necessary training, field experience or required number of working dives, and medical approval to perform in that capacity. To reiterate, protected health information will be processed and stored according to HIPAA rules. Other forms of acceptable documentation include:

- 1) A properly maintained commercial harvest diver's log book;
- Verifiable endorsements from certification authorities recognized by LNR or legitimate records from an established commercial diving operation;
- 3) Proof of successfully completing a formal course of study at any accredited school, military school, or equivalent whose curriculum satisfies elements of the American National Standards Institute (ANSI) technical document ANSI/ACDE-01-2009 relevant to surface supplied air diving; or
- Proof of successfully completing a course of instruction/training that meets or exceeds the contents of the LNR Commercial Harvest Diving Standards with respect to education, proficiency, and experience.

#### **2.7 LNR DATABASE**

The DSA will maintain an electronic diving safety database containing a listing of all LNR-classified card recipients (i.e., past and present members of the Lummi commercial harvest diving fleet) and new applicants to the Lummi dive fisheries. Records will include the name of the Lummi fisher, a unique identifier provided by the applicant (i.e., Lummi fisher identification number), as well as the dates of medical approval (HIPAA rules apply) and dates of issue for all training cards/validations received by the individual. The database information will be maintained as confidential and used for LNR management purposes only. Its existence will be used as a verification tool for determining legal participation in Lummi commercial harvest diving operations, replacement of lost cards, renewal of cards, and generally, as a means to track the number of qualified personnel within the Lummi commercial harvest diving fleet. The format and content of the database will not be changed without approval from the DSA and the LNR Database Manager.

#### 2.8 RECIPROCITY AND DOCUMENTATION REQUIRED BY NON-LUMMI TRIBAL FISHERS

Non-Lummi fishers currently approved to dive under the auspices of another Treaty Tribe may be authorized to participate as a crew member aboard a Lummi commercial harvest diving vessel during a fishery as long as the commercial harvest diving activities involving the non-Lummi tribal member are lawful and comply with all tribal

codes and federal court rulings related to treaty fishing rights in Washington State. Furthermore, the qualifications and requirements for hose tender and diver classifications within the other Treaty Tribe's standards must be equivalent to or exceed those stated in this manual. The Director of LNR, in conjunction with the LFNRC, shall have the final approval of determining whether the harvest diving activity is acceptable and whether to authorize reciprocity between a Lummi commercial harvest diving operation and a qualified member of another Treaty Tribe. The DSA will review all dive qualifications and/or documentation and confer with the appropriate diving safety professional from the other Treaty Tribe(s). Finally, an LNR-classified Lummi diver or hose tender may participate in the diving operation of another Treaty Tribe only if authorized to do so by that organization and as long as the commercial harvest diving activities involving the Lummi tribal member are lawful and comply with all tribal codes and federal court rulings related to treaty fishing rights in Washington State.



## Hose Tender and Trainee Diver Training Log

As per the Lummi Natural Resources Department (LNR) Commercial Harvest Diving Standards (hereafter, standards), <u>Trainee Divers (TD) and Hose Tenders (HT) must complete at least four (4) hours training in the operation and maintenance of equipment used in harvest diving operations and the procedures to be followed by each crew member. Furthermore, TDs and HTs must be familiar with and understand the standards. Training must be verified by the designated person-in-charge (DPIC; e.g., the Experienced Dive Operator) or the LNR-registered dive vessel owner (DVO) and logged in the table provided below. The completed table must be returned to the LNR office before receiving your LNR classification card.</u>

Date	Hours	Activities Completed	Supervisor's Name

(Printed name of Trainee Diver or
Phone


# LUMMI INDIAN BUSINESS COUNCIL 2665 kwina road bellingham, washington 98226 (360) 312-2000

DEPARTMENT LUMMI NATURAL RESOURCES

DIRECT NO.

# Confirmation of Commercial Harvest Diving Training Requirements

l,	(Designated-Person-in-Charge or Dive Vessel
Owner), confirm that	
	(print name of Trainee Diver/Hose Tender)
has completed four (4) hours of training operations and the procedures to be follo	in the operation and maintenance of equipment used in diving owed by each crew member aboard my fishing vessel(s),
	and/or
I further confirm that the Trainee Diver/H	Hose Tender named above is familiar with and understands the
Lummi Natural Resources Department (LI	NR) Commercial Harvest Diving Standards.
Signature	Date
Phone	

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# COMMERCIAL HARVEST DIVING STANDARDS





# **3.0 MEDICAL REQUIREMENTS**

# **3.1 OVERVIEW**

The availability of medical literature concerning commercial diving is limited. Because of this, ADCI-associated diving physicians consensually developed a set of medical requirements for working divers among ADCI's member organizations that are commonly used throughout the commercial diving industry (refer to the ADCI Consensus Standards for Commercial Diving and Underwater Operations). The following medical requirements were adapted from the 2011 version of the ADCI medical standards and are intended to be used with the LNR medical history/physical examination form located at the end of this chapter. These standards concern specific aspects of an applicant's physical, mental, and emotional fitness to participate in the Lummi Nation's commercial dive fisheries and are considered to be the minimum requirements for medical approval by the director of LNR, the LFNRC, the Lummi Tribal Health Center, and by the applicant's peers within the Lummi commercial harvest diving community.

## **3.2 PHYSICAL EXAMINATION STANDARDS FOR DIVERS AND HOSE TENDERS**

Every person approved to participate in commercial harvest diving operations under the auspices of the Lummi Nation shall undergo periodic physical examination. For participants under the age of 30 years, a physical examination must be completed every three years; for participants aged 30 years and older, the physical examination must be completed every two years. More frequent or extensive examination(s), including a complete medical re-examination, may be required if there is an illness or diving accident that affects a person's fitness or ability to participate in commercial harvest diving operations. For the sake of procedural and administrative efficiencies, no distinction will be made between diver and hose tender physicals since the HT is typically the entrylevel position into the diver ranks. In this way, should an HT desire to become a trainee diver, the applicant will have already had a thorough baseline fitness evaluation that potentially reveals a disqualifying medical condition precluding him or her from diving duty. Ultimately, this will save the HT (and DVO or designated person-in-charge) time and resources spent on preparing the individual for naught. In summary, the following medical examination schedule will be followed by all participants:

- 1) An initial, baseline examination including work history and pre-fishing season drug screening (see LNR medical history/physical examination form located at end of chapter, Table 1, and Section 3.5);
- 2) At a minimum, the tests outlined in Table 2 as appropriate;
- 3) Any additional tests, including ones the examining physician deems necessary to establish the presence/absence of a potentially disqualifying condition (see Section 3.5);
- 4) Periodic re-examination, every two or three years, depending on the participant's age and annual prefishing season drug screening; and
- 5) Re-examination (and possible drug screening) after a serious illness or diving-related injury that functions as a return-to-work order (see Section 3.9).

<u>The department will not issue commercial harvest diver classification cards to persons younger than 18 years of age; similarly, LNR-classified hose tenders cannot be younger than 15 years of age (refer also to Section 2.3). While there are no gender- and maximum age-related limits for participation in the Lummi Nation's commercial dive fisheries, serious consideration must be given to the need for adequate reserves of physical, pulmonary, and cardiovascular fitness to complete assigned tasks and for use in emergency situations. Obviously, the lack of these reserves, especially as a crew member ages beyond 50 years, compromises the health and safety of the individual and his or her crewmates.</u>

# **3.3 PHYSICIAN AND HEALTHCARE PROVIDER REQUIREMENTS**

As per a 2018 consensus vote of the LFNRC (a quorum being present), all Lummi fishers participating in the tribe's commercial dive fisheries shall have their preliminary medical evaluations conducted at the Lummi Tribal Health

Center. If an individual chooses to, he or she may elect to seek medical approval outside of the Lummi Nation, at which point, Section 3.10 applies. The medical examination must be performed by a healthcare provider (physician or medical staff under direction of a physician) that is trained as a Level I Medical Examiner of Divers through the Undersea and Hyperbaric Medical Society (UHMS) or its equivalent. Examining physicians should be familiar with the roles and responsibilities of diving personnel in the Lummi commercial harvest diving fleet. Indeed, the spectrum of commercial harvest diving activities ranges from menial tasks at the surface to mentally- and physically-challenging operations at depths exceeding 60 ft seawater (fsw); hence, job descriptions (see Chapter 4) and job-limiting medical disabilities can vary widely. An examination should not be performed by a non-physician unless directed to do so with review and approval from an eligible supervising physician. Furthermore, the examining physician may deviate from these standards on an individual basis, at his or her discretion, should circumstances warrant such a deviation. Finally, the use of these standards is intended to be tempered with the good judgment of the examining physician or healthcare provider.

## **3.4 PHYSICAL EXAMINATION PROCESS**

The numbered items in Table 1 coincide with those of the LNR medical history/physical examination form located at the end of this chapter. Paper and electronic copies of this form are available also from the DSA. A patient's history is recorded on the first two pages of the LNR medical history/physical examination form and, ideally, should be completed in advance of his or her appointment. The third and fourth pages are used to record specific findings from the physical examination. Together, Table 1 and the physical examination form ensure standardization of medical services provided to members of the Lummi commercial harvest diving community, and provide a way for the examining physician to contrast his or her findings with others in the industry. For example, where there is doubt about the medical fitness of an applicant, the examining physician should seek further opinion(s) and recommendation(s) from an appropriate specialist in the field of concern. Appendix II lists a number of diving medicine resources throughout Puget Sound.

#### 3.4.1 PROVISIONAL APPROVAL WITH RESTRICTION

The examining physician may recommend reasonable accommodation for an applicant to meet these standards. Upon application by a Lummi fisher, and with agreement by the examining physician, his or her medical condition(s) may justify a variance or provisional approval to participate in Lummi's commercial dive fisheries until a follow-up examination occurs or until the applicant's next periodic physical examination is scheduled, whichever comes first. At that time, the approved variance will be subject to the examining physician's review and comment (see physician approval form at end of this chapter). If reasonable accommodation cannot be made, disqualification for an inability to meet the medical requirements of these standards will be determined on a caseby-case basis, and related only to specific duties or functions of the LNR-classified position being applied for. For example, a previously-approved diver may not qualify to work under hyperbaric conditions due to medical reasons, but his or her condition(s) might not preclude him or her from working topside as a hose tender.

## **3.5 POTENTIALLY DISQUALIFYING MEDICAL CONDITIONS**

Certain medical conditions are potentially disqualifying based on the excessive risk to the participant, his or her crew members, or the commercial harvest diving operation itself. Below are examples of medical conditions that may affect the ability to dive or participate in commercial harvest diving operations in a safe manner. The list is not intended to be all-inclusive; failure to specify a particular condition under this section does not imply the condition is compatible with diving. If an applicant has one or more of the following conditions at the time of his or her physical examination, he or she may not be permitted to participate in the Lummi Nation's commercial dive fisheries until LNR receives confirmation from a Level I Medical Examiner of Divers (UHMS or its equivalent) that the medical issue is resolved and that the Lummi fisher is medically fit to participate in the department-approved commercial harvest diving operation.

1) History of lung diseases [e.g., chronic obstructive pulmonary disease (COPD), asthma, and recurrent or spontaneous pneumothorax];

- 2) Significant cardiovascular abnormalities (e.g., hypertension and long QT syndrome);
- 3) History of seizure disorder other than early childhood febrile conditions;
- 4) Diagnosis or history of type 2 diabetes;
- 5) Chronic inability to equalize sinus and middle ear pressure;
- 6) Morbid obesity; or
- 7) Grossly impaired hearing.

#### 3.5.1 EVIDENCE OF DRUG, ALCOHOL, OR CONTROLLED SUBSTANCE ABUSE

Commercial harvest diving is the most dangerous work activity pursued by Lummi fishers. It is imperative that crew members be alert and unimpaired by drugs, alcohol, or controlled substances. According to Title 10, the Natural Resources Code of Laws, it is illegal to possess, consume, or be under the influence of drugs or alcohol when fishing under the auspices of the Lummi Nation (10.07.090 Prohibited Behavior; 10.07.140 Fishing or Hunting While Intoxicated or Under the Influence of a Controlled Substance). In June 2017, LIBC reaffirmed its long-held position concerning the perils of drug and alcohol abuse within the Lummi community by passing a resolution recognizing that substance abuse threatens, both directly and indirectly, the Lummi People's traditional way of life and the natural resources on which they depend (LIBC Resolution No. 2017-070). Subsequently, the LFNRC approved of a new mandate, the Fisheries Alcohol and Controlled Substance Testing Regulation (no. 2017-001) which requires Lummi citizens be drug-tested before being issued their annual general fishing validations through LNR. Accordingly, divers and hose tenders applying to participate in Lummi's commercial dive fisheries must receive negative test results to warrant further consideration by the department. Fishers with negative test results are then allowed to exercise their treaty-reserved fishing rights for the management year (July 1 – June 30) in which they were tested. A fisher testing non-negative (i.e., a "positive" result) is not eligible to receive his or her general fishing validation from LNR, and therefore will not be approved to participate in Lummi's commercial dive fisheries, until further evaluation and clearance are received from local healthcare authorities, including chemical dependency experts, working on behalf of LIBC.

#### 3.5.2 OPIOID REPLACEMENT THERAPY OR OPIOID MAINTENANCE THERAPY

In recent years, the misuse or abuse of opiates (e.g., heroin) has reached catastrophic proportions in many areas of the United States. As a result, opioid maintenance therapies (e.g., Suboxone® treatment) as means of recovery from addiction have become commonplace in affected communities. Since replacement drugs like buprenorphine and methadone are classified as opiates or narcotics with side effects (e.g., impaired judgment or altered behavior) that may be incompatible with safe diving practices, their use is generally disqualifying under most working diver standards. Many Lummi fishers have undergone treatment with opioid replacements and have been declared "fit to dive" by a variety of healthcare providers. Still, there are no scientific studies showing data that confirm the relative safety or danger of taking these medications in a commercial diving environment. Until such data exists, Lummi fishers who were approved to participate as divers and hose tenders prior to January 1, 2018 and who were also undergoing opioid maintenance therapies at the time of their approvals, may be approved with restrictions to participate in the tribe's commercial dive fisheries after this date on a case-by-case basis only. At a minimum, an opioid replacement user will be subject to annual physical evaluation to ensure compliance with, and normal progression of, his or her treatment plan. It is fully expected that, under the care of an appropriate healthcare provider, an applicant will wean him- or herself off of the opioid replacement over a period of time that is consistent with a successful treatment plan.

Starting January 1, 2018, all new applicants to the Lummi Nation's commercial dive fisheries who are also undergoing opioid maintenance therapies will not receive approval to participate from Lummi Tribal Health Center (LTHC) staff until completing a successful treatment plan by weaning him- or herself off of the opioid replacement (e.g., Suboxone<sup>®</sup> or methadone) under the care of an appropriate healthcare provider. A new applicant undergoing opioid maintenance therapy who does not agree with LTHC's policy may seek a second opinion as per Section 3.10.

#### 3.5.3 MENTAL HEALTH CONSIDERATIONS

Given the nature of the work and duties assigned aboard a DSV, an applicant's emotional state and temperamental fitness must be thoroughly appraised. Intelligence should be at least normal. Past or present evidence of mental illness is generally disqualifying unless the examining physician can be confident that the condition is reasonably inconsequential and unlikely to (re)occur. Speech impediments (e.g., stammering) that might become more pronounced or debilitating under stress or excitement may be disqualifying. Personality disorders, bipolar disorders, psychosis, instability, and anti-social traits are generally disqualifying; so, too, are neurotic trends and a lack of emotional adjustment. Mental health conditions requiring medication may also be disqualifying and should be carefully evaluated. For example, a person diagnosed with temporary situational depression may be approved to participate in commercial harvest diving activities provided he or she is prescribed low-dose antidepressants that do not affect seizure thresholds or have any side effects of central nervous system depression. Finally, any abnormalities should be noted in block # 51 of the physical examination form located at the end of this chapter.

#### **3.6 PHYSICIAN'S WRITTEN REPORT**

The examining physician will prepare a written summary of his or her findings to be shared with the DSA. Prior to disseminating these results, however, the Lummi fisher must complete and sign an authorization to release his or her health information (a sample release form is located at the end of this chapter; but see also Chapter 10). The *Physician Approval Form* and the *Medical Review Officer Report of Drug Screening Results* (also located at the end of this chapter) are intended to be used as compliance tools that minimize the amount of protected health information being shared between the examining physician and LNR in accordance with the Health Insurance Portability and Accountability Act of 1996 (see Section 3.7.1). By completing and signing these forms, the Lummi fisher authorizes the examining physician (e.g., Lummi Tribal Health Center or Virginia Mason Medical Center) to furnish LNR, specifically the DSA, with a transcript of the medical record related to the physical examination and/or drug screening. The forms and subsequent transcripts will be used only when requested by the applicant for purposes of processing his or her physical examination, which is required for participation in the Lummi Nation's commercial dive fisheries (see Section 2.1.2).

## **3.7 MEDICAL RECORD KEEPING**

Each crew member should establish and maintain an accurate medical record of his or her own health status with respect to participating in the Lummi Nation's commercial dive fisheries. The medical record should include those physical examinations specified herein, including the LNR medical history/physical examination forms, and the physician's written report (located at the end of this chapter). The DSA and LNR shall also maintain a record of the examining physician's recommendation on the crew member's fitness to participate in commercial harvest diving activities. All medical records maintained by the DSA and LNR shall be confidential, secured (e.g., stored in lockable filing cabinet), and maintained for a period of up to five years or more from the date of the physical examination unless otherwise prescribed by law.

#### 3.7.1 HIPAA RULES APPLY

All medical records related to granting Lummi fishers permission to participate in commercial harvest diving operations under the auspices of the Lummi Nation shall be processed and stored according to the federal Health Insurance Portability and Accountability Act of 1996 (HIPAA). Two components of this act are particularly relevant: the HIPAA Privacy Rule and the HIPAA Security Rule. The HIPAA Privacy Rule regulates the use and disclosure of protected health information (PHI) held by "covered entities" (e.g., medical service providers, LNR, and the DSA). For example, covered entities must make a reasonable effort to disclose only the minimum necessary information required to achieve its purpose. Covered entities must also take reasonable steps to ensure the confidentiality of communications with individuals. Furthermore, covered entities are required to notify individuals of uses of their PHI. Finally, the HIPAA Privacy Rule gives individuals the right to request that a covered entity correct any inaccurate PHI. The HIPAA Security Rule lays out three types of security safeguards required for compliance with the act: administrative, physical, and technical. In general, this rule governs how and where an individual's PHI will

be stored, substantially limiting access to the information. The DSA shall be required to successfully complete HIPAA training offered by LIBC and shall confer with its HIPAA Officer and the LIBC legal department to ensure compliance with the act.

## **3.8 WITHDRAWAL FROM HYPERBARIC CONDITIONS FOR DIVERS**

The determination of whether a diver's health and wellbeing will be negatively impacted by continued exposure to hyperbaric conditions shall be based on the professional judgment of the physician and his or her thorough examination of the applicant. The physician will indicate in his or her report any limitations or restrictions that may apply to the diver's work activities. Recommending withdrawal from working under hyperbaric conditions due to medical conditions, advancing age or other related factors, or for personal reasons (e.g., voluntary retirement), does not necessarily preclude a previously-classified ED or EDO from working topside as the designated person-in-charge aboard a commercial harvest diving vessel so long as he or she is fit for duty.

#### **3.9 RE-EXAMINATION AFTER INJURY OR ILLNESS**

A diver must be examined by a Level I Medical Examiner of Divers (UHMS or equivalent) following a known decompression sickness (DCS) or DCS with audiovestibular (hearing and balance), central nervous system dysfunction, or arterial gas embolism. Moreover, a crew member must have a medical examination following a known diving-related injury or illness that requires hospitalization of 72 hours or more (unless national or local laws dictate otherwise). The physician will adjust the scope of his or her physical examination appropriately in light of the nature of the injury or illness. The results of the re-examination must be submitted to the DSA for reauthorizing the individual for returning to work in the Lummi Nation's commercial dive fisheries.

## **3.10 SECOND OPINION, REFERRAL, AND APPEAL PROCESS**

The privilege to participate in commercial harvest diving operations under the auspices of the Lummi Nation may be revoked for medical, legal, or other reasons. Should a Lummi fisher lose that privilege (or not be granted approval in the first place), he or she may seek a second opinion (in the case of a medical issue) or the applicant may seek an appeal through the Director of LNR and/or the Chair of the LFNRC (in the case of a legal issue or other than medical).

#### 3.10.1 SECOND OPINION AND REFERRAL TO NON-LUMMI MEDICAL PROVIDER

Clinic staff from the Lummi Tribal Health Center can facilitate a second opinion from or a referral to the Hyperbaric Medicine Unit at the Virginia Mason Medical Center in Seattle, Washington. Alternatively, clinic staff can facilitate a second opinion from or a referral to a non-Lummi provider on the most recent list of Level I Medical Examiner of Divers for Washington State maintained by the UHMS.

#### 3.10.2 APPEAL PROCESS

A Lummi fisher denied the privilege to participate in commercial harvest diving operations under the auspices of the Lummi Nation for a reason other than a medical issue, can make an appeal using the following protocol: After contacting the DSA with his or her intent, the DSA will consult with the Director of LNR and/or Chair of the LFNRC who may convene a meeting of a peer-review group of experienced, dive-qualified Lummi fishers to deliberate the case. If a peer-review group of experienced, dive-qualified Lummi fishers is convened, the DSA will meet with that group and present its findings or recommendations to the Director of LNR and/or the Chair of the LFNRC, who have signatory authority over the affected crew member's participation in commercial harvest diving activities (Figures 4 and 5). The Director of LNR and/or the Chair of the LFNRC, who majority) of the LFNRC to deliberate the case, can then determine whether the affected crew member poses a risk to his or her fellow fishers, the harvested resource, or the general public pursuant to Title 10, the Lummi Natural Resources Code of Laws (10.05.070 Fish Vessel Safety Regulations) and whether conditional approval of the applicant is warranted or not.

No.	Exam	Results, indication, or action
1	Name	Record.
	Tribal ID, Lummi	
2	Fisher ID, or Social	Record.
	Security Number	
3	Height	No set limits.
4	Weight	Excessive weight that cannot be attributed to muscular build or a high level of physical fitness should be noted. The applicant should be aware that obesity can increase the risk of developing heart disease (including strokes), diabetes, cancer, and depression, all of which are potentially disqualifying. Individuals who present with excessive fatty tissue should be strongly encouraged to lose weight and possibly discouraged from participating in commercial harvest diving activities until his or her excess weight is reduced.
5	Body Fat	Optional. According to U. S. Navy, body fat percentages above 25% for males and 31% for females are considered very high and are generally disqualifying for its diving personnel. These standards can be used as an educational guideline for applicants.
6	Body Mass Index (BMI)	BMI > 28 is not disqualifying for commercial harvest diving, but may require further consultation with examining physician concerning the long-term health effects of BMI > 28 if due to excessive fatty tissue [BMI is calculated as: (weight in pounds x 703)/(height in inches <sup>2</sup> )].
7	Temperature	The applicant should be free of any infection or disease that causes an abnormal temperature.
8	Blood Pressure	Ideally, resting blood pressure should not exceed 140/90 mm Hg. In cases of apparent hypertension, repeated daily blood pressure determinations should be made before a final decision is made. Blood pressure should be controlled without target organ damage. Beta blockers are not acceptable, whereas low-dose diuretics are acceptable. Medications required to control blood pressure should be noted on the physical exam form. Finally, sleep apnea
9	Pulse/Rhythm	Persistent tachycardia, marked arrhythmia (except of the sinus type), or other significant disturbance of the heart or vascular system are generally disqualifying.
10	General Appearance and Hygiene	Should be reasonable without raising any medical concerns.
11	Build	Record.
12	Distant Vision	Corrected to 20/40 OU (oculi uterque; Latin for both eyes). Monocular vision is not necessarily disqualifying for commercial harvest diving. A diver whose vision has been recently corrected via surgery should be restricted from diving until cleared by the physician to work under hyperbaric conditions.
13	Near Vision	Corrected to 20/40 OU.
14	Color Vision	Optional. Color blindness does not disqualify an applicant from participating in commercial harvest diving; however, an applicant should be made aware that color vision may be required for some tasks associated with commercial harvest diving (e.g., distinguishing between harvested species underwater or color-coding the umbilical).
15	Field of Vision	Should be normal with any discrepancies documented. A field of vision < 85 degrees is generally disqualifying.
16	Contact Lenses	Record if used. Appropriate lenses for diving may be used (e.g., gas permeable or

No.	Exam	Results, indication, or action
		fenestrated hard lens).
		Causes for rejection or further evaluation may include:
	Used Freedowed	a) Deformities of the skull associated with disease of the brain, spinal cord, or
17	Scalp	peripheral nerves, or that would prevent the individual from wearing required
	Scalp	equipment (e.g., pronounced depressions or exostosis); and
		b) Loss or congenital absence of the bony substance of the skull.
		Conditions affecting the neck should not impair or cause insufficient range of motion in
		the applicant. Causes for rejection may be:
		a) Cervical ribs if symptomatic;
		b) Congenital cysts of bronchial cleft origin or those developing from the remnants of
18	Neck	the thyroglossal duct, with or without fistulous tracts;
		c) Fistula, chronic draining, of any type;
		d) Spastic contraction of the muscles of the neck of a persistent and chronic nature;
		and
		e) Neural impingement.
		Active pathology or previous eye surgery may be cause for restriction or rejection. A
10	Eves	diver whose vision has been recently corrected via surgery should be restricted from
15	Lyes	diving until cleared by the physician to work under hyperbaric conditions. History of
		cataract surgery with intraocular lens implant is not disqualifying.
		If Eustachian tube dysfunction is suspected, then referral or testing should be ordered.
		Round window ruptures that have been adequately repaired with no significant
		residual deficits may be approved for diving. Conditions that are generally disqualifying
		or that may need further evaluation include:
		a) Acute disease including vestibular disease;
		b) Chronic serious otitis;
	Ears – internal	c) Otitis media;
	and external canal	d) Perforation of the tympanic membrane;
	(20-24)	e) Presence of Pressure Equalizer (PE) tubes;
	()	f) Any significant nasal or pharyngeal respiratory obstruction;
		g) Chronic sinusitis if not readily controlled;
		h) Debilitating speech impediments due to organic defects;
		i) Inability to equalize pressure due to any cause;
		j) Meniere's disease;
		k) Recurrent or persistent vertigo; or
		I) Recent unhealed or infected piercings.
		Sleep apnea should be addressed and/or treated to ensure adequate rest and
		alertness are achieved, and to reduce the risk of developing heart disease.
		Furthermore, applicant should have normal to high degree of dental fitness. Other
25		conditions that are generally disqualifying for divers include:
25	Nouth and Throat	a) Any appormalities of dentition or malformation of the mandible that are likely to
		impair the diver's ability to securely and easily retain any standard mouthpiece
		equipment;
		b) Dentures that cannot be removed prior to diving; and
L		c) Unrepaired, severe dental caries.
26	Chest/Breast	Note any chest deformities, breast abnormalities, or masses.

No.	Exam	Results, indication, or action							
		Obstructive or restrictive pulmonary function requires further evaluation (see # 54							
		below). Conditions that are generally disgualifying or that may need further evaluation							
		include:							
		a) Congenital and acquired defects that restrict pulmonary function, cause air							
		entrapment, or affect the ventilation-perfusion or balance:							
27	Lungs	b) Pulmonary diseases requiring medication:							
		c) Chronic obstructive pulmonary disease (COPD), an umbrella term used to describe							
		progressive lung diseases including emphysema, chronic bronchitis, refractory (non-							
		reversible) asthma, and some forms of bronchiectasis: and							
		d) History of spontaneous or recurrent pneumothorax.							
		There should be no evidence of heart disease: the cardiovascular system should be							
		without significant abnormality in all respects. Any arrhythmias must be fully							
		investigated. Persistent tachycardia or arrhythmias other than sinus arrhythmias must							
	Heart (thrust	he fully investigated. Fiertion fractions must be at least 40%. For evaluation nurnoses							
28	size rRhythm	Bruce protocol functional stress testing must be to at least 13 estimated Metabolic							
20	sounds)	Equivalents of Task (METs) without evidence of ischemia. Pacemakers and implantable							
	soundsj	cardiac defibrillators are disqualifying. Evidence or presence of patent foramen ovale							
		(PEQ) must be fully evaluated PEQ repairs are not necessarily disqualifying Coumadin							
		or any anticoagulants are generally disqualifying							
29	Pulse	Record. Peripheral pulses should be regular, full and symmetric.							
	Vascular System	Evidence of severe varicose veins, symptomatic arteriosclerosis, or marked							
30	(e.g., varicosities)	symptomatic hemorrhoids may be disqualifying.							
	, ,	History of gastrointestinal bleeding may be disqualifying. Other potentially							
	Abdomen and Viscera	disqualifying gastrointestinal diseases include:							
		a) Active peptic ulceration unless treated and healed;							
31		b) Ulcerative colitis or cholelithiasis;							
		c) Crohn's disease; and							
		d) Hepatitis.							
22		All inguinal or femoral hernias are disqualifying until repaired. Ventral hernias > 1 cm							
32	Hernia (all types)	must be repaired prior to diving.							
	Endocrino System	Endocrine disorders requiring medication may be disqualifying. Thyroid disease that is							
33	end Disketss	adequately controlled with medication is acceptable for diving. Diabetics controlled							
	and Diabetes	with diet and exercise and with Hgb A1C < 7.0 are acceptable.							
		Only as medically indicated. Evidence or history of urinary dysfunction and retention							
		must be fully investigated and treated. Other conditions that are generally							
24	G-U System	disqualifying or that may need further evaluation include:							
34	(Genital-Urinary)	a) Untreated venereal disease;							
		b) Renal insufficiency or chronic renal disease; and							
		d) History of nephrolithiasis or kidney stones.							
		Impairment of musculoskeletal function that interferes with an individual's							
25	Upper Extremities	performance aboard a DSV should be carefully assessed. Amputations are not							
35	(strength, ROM)	necessarily disqualifying, and orthopedic internal fixation hardware is not disqualifying							
		if the fracture site is healed.							
20	Lower								
36	Extremities.	See # 35 above.							

No.	Exam	Results, indication, or action									
	Except Feet										
37	Feet	See # 35 above.									
38	Spine	Neural impingement is generally disqualifying; and, see also # 35 above.									
20	Skin and	Active, acute, or chronic disease of the skin or lymphatic system may be disqualifying.									
39	Lymphatic System	Tattoos should be fully healed prior to diving.									
		Only as medically indicated. Any conditions that interfere with normal function (e.g.,									
40	Anus and Rectum	stricture, prolapse, severe hemorrhoids) should be discussed with applicant and could									
		be disqualifying.									
41	Sphincter Tone	Only as medically indicated.									
		Only as medically indicated; however, menstrual disorders manifested by abnormal or									
42	Pelvic Exam	prolonged bleeding, as well as excessive pain, may be disqualifying. Furthermore,									
		pregnancy at any stage is generally disqualifying for divers.									
		All neurodegenerative conditions are disqualifying. Examination of the central and									
		peripheral nervous system should show normal function, but localized minor									
		abnormalities, such as patches of anesthesia, are allowable provided generalized and									
	Neurological	organic disease of the nervous system can be excluded. History of epilepsy or seizures									
	Exam	(apart from childhood febrile convulsions, oxygen toxicity, or withdrawal types) is									
	(43-50)	disqualifying. Intracranial surgery, loss of consciousness, and severe head injury									
		involving concussion or more than momentary unconsciousness may also be									
		disqualifying. If the severity of head injury is in doubt, further evaluation and									
		treatment should be considered.									
43	Cranial Nerves	Examine, evaluate, and record.									
44	Reflexes	Should be symmetrical and free from pathology. Document any abnormalities.									
	Пелехев	Pathological reflexes should be evaluated.									
45	Cerebellar	Test and record									
	Function										
	Strength and										
46	Tone of	Examine and record. Note any atrophy or loss of tone.									
	Muscles										
47	Propioception/	Examine and record.									
	Stereognosis										
48	Nystagmus	Test and record. Congenital nystagmus is not necessarily disqualifying. End point									
		lateral gaze nystagmus is considered normal.									
	Sensations and	Test and record. Vibration should be tested using a 128 Hz tuning fork. Two point									
49	Vibration	discrimination should be tested at the thumb (C6), 3rd finger (C7) and the 5th finger									
		(C8) and should be discernible at 4 mm.									
50	Rhomberg	Test and record. Consider performing rhomberg evaluation for up to two minutes.									
	Miscellaneous										
51	Remarks	Record findings and comments.									
	and Dermatome										
L	Diagram										
52	Urinalysis	Includes color pH, specific gravity, glucose, albumin and micro. All results should be									
		within normal limits.									
53	Blood Tests	Significant anemia or history of hemolytic disease should be evaluated. When due to a									

No.ExamResults, indication, or actionVariant hemoglobin state, it is generally disqualifying. Complete serology, sickle cell, and AIDS tests only if medically indicated. If positive, should be cause for rejection until properly treated and cleared to return to work by physician. Pregnancy test for female only if medically indicated or requested by applicant.54Pulmonary FunctionAll divers must have periodic pulmonary function tests to establish Forced Expiratory Volume at one (1) second (FEV1) and Forced Vital Capacity (FVC) recording best of three measurements using American Thoracic Society standards. FEV1 and FVC should both be over 75% using Knudson reference values. If either or both are below 75%, then the diver should be referred for functional stress testing under Bruce protocol to at least 13 estimated Metabolic Equivalents of Task (METs).55X-ray/Imaginga) 14 x 17 chest: No pathology within normal limits; b) Lumbar/sacral spine – optional or as medically indicated. For example, any lesions, especially juxta-articular, should be evaluated to determine applicant's fitness to dive; and d) MRI – optional or as medically indicated. For example, neural impingements on MRI examination are generally disqualifying.56Electrocardiogram (ECG) testsResting standard 12 lead ECG initially to establish baseline, then as medically indicated to age 35. Exercise stress ECG test should be considered after age 40 or as medically indicated.	Nie	Fuere	Desults indication or estion
54Pulmonary FunctionAll divers must have periodic pulmonary function tests to establish Forced Expiratory Volume at one (1) second (FEV1) and Forced Vital Capacity (FVC) recording best of three measurements using American Thoracic Society standards. FEV1 and FVC should both be over 75% using Knudson reference values. If either or both are below 75%, then the diver should be referred for functional stress testing under Bruce protocol to at least 13 estimated Metabolic Equivalents of Task (METs).55X-ray/Imaginga) 14 x 17 chest: No pathology within normal limits; b) Lumbar/sacral spine – optional or as medically indicated. For example, any lesions, especially juxta-articular, should be evaluated to determine applicant's fitness to dive; and d) MRI – optional or as medically indicated. For example, neural impingements on MRI examination are generally disqualifying.56Electrocardiogram (ECG) testsResting standard 12 lead ECG initially to establish baseline, then as medically indicated to age 35. Exercise stress ECG test should be considered after age 40 or as medically indicated.	NO.	Exam	Results, indication, or action
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55       X-ray/imaging       juxta-articular, should be evaluated to determine applicant's fitness to dive; and         d) MRI – optional or as medically indicated. For example, neural impingements on MRI examination are generally disqualifying.         56       Electrocardiogram (ECG) tests         Resting standard 12 lead ECG initially to establish baseline, then as medically indicated to age 35. Exercise stress ECG test should be considered after age 40 or as medically indicated.		V may /line a sin a	c) Long bones – optional or as medically indicated. For example, any lesions, especially
6       d) MRI – optional or as medically indicated. For example, neural impingements on MRI examination are generally disqualifying.         56       Electrocardiogram (ECG) tests       Resting standard 12 lead ECG initially to establish baseline, then as medically indicated to age 35. Exercise stress ECG test should be considered after age 40 or as medically indicated.		x-ray/inaging	juxta-articular, should be evaluated to determine applicant's fitness to dive; and
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56 (ECG) tests to age 35. Exercise stress ECG test should be considered after age 40 or as medically indicated.		Electrocardiogram	Resting standard 12 lead ECG initially to establish baseline, then as medically indicated
indicated.	56	(FCG) tests	to age 35. Exercise stress ECG test should be considered after age 40 or as medically
		(200) (2303	indicated.
Hearing loss (in either ear) of 40 dB in the range of 500, 1000 and 2000 Hz is an			Hearing loss (in either ear) of 40 dB in the range of 500, 1000 and 2000 Hz is an
indication for further evaluation and possible referral to a hearing specialist, unless the			indication for further evaluation and possible referral to a hearing specialist, unless the
57 Audiogram Pure examining physician is convinced that the loss will not be aggravated or increased by	57	Audiogram Pure	examining physician is convinced that the loss will not be aggravated or increased by
Tonecontinued participation in commercial harvest diving activities. Monaural hearing is not		Tone	continued participation in commercial harvest diving activities. Monaural hearing is not
disqualifying; however, doubts about function of labyrinths require specialized			disqualifying; however, doubts about function of labyrinths require specialized
examination.			examination.
58 Comprehensive As medically indicated; cholesterol and triglycerides required for divers over 40.	58	Comprehensive	As medically indicated; cholesterol and triglycerides required for divers over 40.
Mietabolic Panel		Metabolic Panel	Described on scalls, for tribel recording to entities in Lympic Notice, fishering, or co
Required annually for tribal members participating in Lummi Nation fisheries, or as			Required annually for tribal members participating in Lummi Nation Insperies, or as
Standards) Evidence of substance abuse that is generally disgualifying includes:			Standarde) Evidence of substance abuse that is generally disgualifying includes:
Statiualus). Evidence of substance abuse that is generally disqualitying includes.	50	Drug Scroon	a) Alcohol drug or chamical dopondonce is a active untreated addiction:
b) At the time of medical examination, use of any illegal or controlled substance, drug	39	Diug Scieeli	b) At the time of modical examination use of any illegal or controlled substance drug
or behavior-altering chemical, when the use cannot be accounted for as a result of a			or behavior-altering chemical, when the use cannot be accounted for as a result of a
nrescription by a physician			nrescription by a physician

Table 2. Summary of minim	um medical testing/evaluation required for prospective participants in commercial
harvest diving operations pe	ermitted under the auspices of the Lummi Nation.
Test	Comment
History & Physical Exam	Every person approved to participate in commercial harvest diving operations under the auspices of the Lummi Nation shall undergo periodic physical examination. For participants under the age of 30 years, a physical examination must be completed every three years; for participants aged 30 years and older, the physical examination must be completed every two years.
Chest X-ray	Initial PA (Projection: 14" x 17" minimum) to establish baseline, then as medically indicated for working under hyperbaric conditions. Obstructive or restrictive pulmonary function may be disqualifying.
Electrocardiogram (ECG) Tests	Resting standard 12 lead ECG initially to establish baseline, then as medically indicated to age 35. Exercise stress ECG test should be considered after age 40 or as medically indicated. There should be no evidence of heart disease; the cardiovascular system should be without significant abnormality in all respects. Any arrhythmias must be fully investigated. Persistent tachycardia or arrhythmias other than sinus arrhythmias must be fully investigated.
Pulmonary Function Test	All divers must have periodic pulmonary function tests to establish Forced Expiratory Volume at one (1) second (FEV1) and Forced Vital Capacity (FVC) recording best of three measurements using American Thoracic Society standards. FEV1 and FVC should both be over 75% using Knudson reference values. If either or both are below 75%, then the diver should be referred for functional stress testing under Bruce protocol to at least 13 estimated Metabolic Equivalents of Task (METs).
Audiogram	Initially to establish baseline, then as medically indicated or if further evaluation required (e.g., bone conduction audiogram).
Visual Acuity	Initially to establish baseline, then as medically indicated.
Complete Blood Count	Test to monitor general health of prospective participant, and to screen for a variety of disorders as indicated by hemolytic anemia.
Routine Urinalysis	Includes color pH, specific gravity, glucose, albumin and micro. All results should be within normal limits.
Drug Screen	<ul> <li>Required annually for tribal members participating in Lummi Nation fisheries, or as medically/legally indicated (see Section 3.5.1 of LNR Commercial Harvest Diving Standards). Evidence of substance abuse that is generally disqualifying includes:</li> <li>a) Alcohol-, drug-, or chemical-dependence, i.e., active, untreated addiction;</li> <li>b) At the time of medical examination, use of any illegal or controlled substance, drug, or behavior-altering chemical, when the use cannot be accounted for as a result of a prescription by a physician.</li> </ul>
Purified Protein Derivative (PPD)	Initially to establish baseline, then as medically indicated, especially following exposure to mycobacteria or tuberculosis that would affect pulmonary function.
Comprehensive Metabolic Profile	As medically indicated; cholesterol and triglycerides required for divers over 40, especially to evaluate cardiovascular health and risk of heart disease.

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## LUMMI NATURAL RESOURCES DEPARTMENT

## MEDICAL HISTORY FORM

Employer Diver or Hose Tender? Date											
1. Last Name	First Name	Middle Name		2. Date of E	Birth		3. Gender	4. Identifi	cation Nur	mber	
5. Address (Nu	mber, Street)	6. City			7. State	8. Zip	o Code	9. Are	a Code – l	Phone Number	
								(	)		
10. Emergency	Contact Person – Relationship – Addre	ss – Telephone Nu	mber					11. Ce	ell Phone N	Number	
									)		
12. MEDI	CAL HISTORY: Have	you ever ha	d or been tro	eated for (positi	ve answers	s mus	t be expla	ained l	below)	):	
Yes No	o 11 o 1	Yes No	a	FOUR	Yes	No .					
HH	Enilensy	HH	PEO Repair	ogram or ECHO	H	H	Herniated Di	isc or Sc	atica		
	Concussion or Head Injury		High Blood P	ressure	H		Elbow Injury	/			
	Disabling Headaches		Asthma or W	heezing			Arm/wrist/ha	and Inju	ry		
	Loss of Balance/Dizziness Coughing up Blood Hip/Leg/Ankle Injury										
HH	Severe Motion Sickness     D     Shorthese of Beach     Shorthese of Beach     D     Shorthese of Beach     D     Shorthese of Beach										
HH	J Unconsciousness I I Shortness of Breath I I Foot Trouble or Injuries										
	Wear Contacts/Glasses     Pneumothorax     Swollen Joints										
	Color Vision Defect		Lung Disease	or Surgery			Broken Bone	es or Fra	ctures		
	Eye Disease or Injury		Gallbladder E	bisease or Stones	님		Varicose Vei	ins	7 1	-	
HH	Eye Surgery Hearing Loss	HH	Stomach Blee	ding	H		Numbress of	r Paralys	eakness	S	
	Ear Disease or Injury		Frequent Indi	gestion	E .		Sleep Disord	lers	515		
	Ear Surgery		Jaundice				Diabetes				
	Perforated Eardrum		Liver Disease	or Hepatitis			Goiter or Th	yroid Di	isease		
HH	Nose Bleed	HH	Hemorrhoids	(Piles)	H	H	Anemia: Sicl	se kle Cell	or Other	r	
	Airway Obstruction	HH	Gas Pains	(Thes)	H		Skin Rash or	Disease	e of othe		
	Hay Fever or Allergies		Crohn's Disea	ase/Ulcerative Colitie	s 🗍		Staph Infecti	ons			
	Chest Pain Rupture or Hernia Tumor or Cancer										
HH	☐     Heart Murmur     ☐     Kidney Disease     ☐     Claustrophobia       ☐     Rheumatic Fever     ☐     Kidney Stones     ☐     Mental Illness/Depression										
HH	Kheumatic Fever     Kidney Stones     Mental Illness/Depression     Heart Attack     Protein, Sugar or Blood in Urine     Nervous Breakdown										
	Abnormal Heart Rhythm     D     Joint Pain/Arthritis     Anv Sexually Transmitte										
	Heart Disease		Back Strain o	r Injury			Contagious I	Disease			
	Cardiac Stent or Angioplasty		Spine Probler	ns			Other Illness	or Inju	ry or An	y Other	
	For Females ONLY		Painful Mens	es		1	vicultar Con	union			
	Irregular Menses		Pregnancy		Last Me	enstrua	l Period				
PLEASE EX	<b>KPLAIN THE DETAILS OF</b>	EACH ITEM	CHECKED YES	8							
										<u></u>	
12 1107 4										/E A D	
13. LIST A	LL SURGERIES									(EAR	
14. LIST A	LL HOSPTALIZATIONS								У	<b>TEAR</b>	
										/E + D	
15. LIST A	LL INJURIES									(EAR	
16. LIST A	LL MEDICATIONS, PRESC	RIPTION OR	OVER THE CO	DUNTER					16 (p. 1		
-											
17 ANSWI	ER THE FOLLOWING QUES	STIONS:									
Every Ite	em Checked Yes Must Be Fully Ex	plained Below	YES NO						YES	NO	
Do you have an	physical defects or any partial disabilitie	?		Have you ever resigned reasons?	d, been terminated,	, or chang	ed jobs for medi	ical			
Have you ever b	een rejected or rated for insurance, employ	ment, license, or		Have you ever been dis	smissed from empl	loyment b	ecause of excess	s use of			
armed forces for Have you ever h	health reasons? ad illnesses, injuries, or lost time accident	s from any work	+	drugs or alcohol? Do you have any allere	gies or reactions to	food, che	micals, drugs. ir	isect			
that you have do	ne?	lical trastment that		stings, or marine life?	w the care of a star	wigin-2 C	live physiciae '-	name			
has not been do	ne?	near treatment that		and address on the next	t page.	sician? C	sive physician's	name			
COMMENTS:											

8.	My Personal Physician is:	Name						
		Address						
		City, State						
		Phone Number						
	DIVING HISTORY Ho	w long have you been commercial diving?						
				7			-	
	Surf Maximum Denth Surface Air	ace Air Diving History				Sa	turation	Diving History Maximum Depth
	Maximum Depth Surface Mixed	Gas		Heliox	Vac 🗖	No		
	Longest Bottom Time Air			Trimix		No		Maximum Duration (Days)
	Longest Bottom Time Mixed Ga			Nitrox		No		
_	Longest Bottom Time Wixed Ga	, 		Huox		140		<u>.</u>
	DIVING EXPERIENCE (Num	ber of years experience):		21. INDICAT If None put 0	E THE N (Zero)	UMBE	R OF DI	ECOMPRESSION INCIDENTS
	Have yo	ou passed an oxygen tolerance test?		•		2.	anot any	
	Air Ye	s No		Bends, pain on	ly	-		
	Mixed Gases	(D) ( ) ( ) (		Bends, neuroio	gicai			
	Saturation Name o	f Diving School		Chokes				
				Inner ear	<u> </u>	_		
	IN DIVING HAVE YOU HAD	A HISTORY OF: (Provide details of dates a	nd seve	erity)				
	Yes No I	Details		0	Yes	No	Details	
	Gas Embolism		L	ung Squeeze				
	Oxygen Toxicity		N	ear Drowning		<u> </u>		
	$CO_2$ Toxicity		A	sphyxiation				
	CO Toxicity		V	ertigo (Dizziness)				
	Ear/Sinus Squeeze		Pı	neumothorax				
	Ear Drum Rupture		N	itrogen Narcosis				
	Deafness		L	oss of Consciousness	s 🗆			
0				City,	State			
•	Have you ever had any of the foll Yes No	owing? If so, give approximate date: Give Date	Yes	No				Give Date
	Chest X-Ray			Nerve Conditi	on Studies	e		
	Longbone Series			Pulmonary Fu	nction Stu	dies _		
	Back (Spine) X-Ray			Audiogram				
	ENG			EKG				
	EEG			Exercise (Stree	ss) EKG			
	EMG			MRI				
-								
	Physician Remarks:							
_								
_								
	RTIFY THAT I HAVE REVIEWED DERSTAND THAT LEAVING OUT ( COMMERCIAL HARVEST DI	THE FOREGOING INFORMATION SUPPLIED OR MISREPRESENTING FACTS CALLED FOR VING ACTIVITIES PERMITTED UNDEF	BY ME ABOVE R THE	E AND THAT IT IS 1 E MAY BE CAUSE F AUSPICES OF TH	rue and or refus ie lumi	O COMI SAL OI	RECEN	D THE BEST OF MY KNOWLEDGE. VING APPROVAL TO PARTICIF
at	e Signa	ture						Page 2 of

# LUMMI NATURAL RESOURCES DEPARTMENT

# PHYSICAL EXAMINATION FORM

Employer	Date		Date of Birth		Age
1. Last Name	First Name		Middle Name		2. Identification Number
3. Height (inches)	4. Weight (pounds)	5. Body Fat (%) (0	Optional)		6. BMI (Optional)
7. Temperature	8. Blood Pressure	9. Pulse/Rhythm		10. General Appearance/	Hygiene 11. Build
	/				
12. Distant Vision:	1	3. Near Vision: Jaeger	N	ear Vision Corrected	14. Color Vision (Test Performed and Resul
R. 20/ Col	rr. to 20/ F	20/	K. 20	)/	
		2. 20/	L. 20		NT-
15. Field of Vision (Degrees) K	<ul> <li>L</li> <li>eck each item in appropriate column (er</li> </ul>	16. Co nter NE for Not Evaluated	ntact Lenses	MARKS	NO
	7. Head, Face, Scalp	inter i the for i tor Evaluated	/ 142.	in nacio	
1	8. Neck				
1	9. Eyes				
2	0. Ears - General (internal and	d external canal)			
2	1. Eustachian Tube Function				
2:	<ol> <li>Tympanic Membrane</li> </ol>				
2.	<ol><li>Nose (Septal Alignment)</li></ol>				
2.	4. Sinuses				
2:	<ol><li>Mouth and Throat</li></ol>				
20	6. Chest				
2'	7. Lungs				
2	<ol><li>Heart (Thrust, Size, Rhythr</li></ol>	n, Sounds)			
2	9. Pulses (Equality, etc.)				
30	<ol> <li>Vascular System (Varicosit</li> </ol>	ies, etc.)			
3	1. Abdomen and Viscera				
33	2. H ernia (All Types)				
3.	3. Endocrine System				
34	4. G-U System	DOM			
3.	5. Upper Extremities (Strengt	n, ROM)			
31	7 Foot	reet)			
3	8 Spine				
3	9 Skin Lymphatics				
4	0 Anus and Rectum				
4	1. Sphincter Tone				

#### NEUROLOGICAL EXAMINATION

#### 43. CRANIAL NERVES

43. CI	KANIAL N	CR	V LO																				
				ſ	N	NOR	MAI		AE	3N(	ORMA	L	NE							NORMAL	ABN	ORMAL	NE
Ι	Olfactory				1									ſ	V	II	Facial						
II	Optic													1	VI	II	Audito	ry					
III	Oculomoto	or												1	Г	X	Glosso	phay	rngea	1			
IV	Trochlear													1		X	Vagus	-	-				
V	Trigeminal	1						_						ſ	Х	I	Spinal	Acce	essory				
VI	Abducens				1									ľ	X	П	Hypog	ossa	1			-	
			Let	D t	EEI	P TE	NDO	N J	Right	t	_			PATH	OLO Left	GIC	AL F	light		SUP	ERFICIAL		
	0		1 2	3	4		0	1	2	3	4			Presen	t Ał	sent	Presen	t A	bsent		Present	Absent	NE
Tricep Bicep Patell Achil	ps											Ba Ho Ai	abinski offman nkle Clonus							Upper Abdomen Lower Abdomen Cremasteric			
45. Cl	EREBELLA	AR	FUN	CT	ION	I							46. MUSC	LE		ST	RENG	ΤН		TONE			
				0		1	2		3	4				[	1	2	3	4	5	Normal	Abnormal		
Ataxi Trem	a or (intention)							$\square$				Righ Left	nt Upper Extre Upper Extrer	mity [								_	

	Norm	al Abno	rmal	Right Lower	· Extremity						
Finger to Nose	0			Left Lower H	Extremity			0			
Heel to Shin (Sliding)											
47. PROPIOCEPTI	ON					48. NYSTAGN	MUS				
		Left	R	ight	] _				Present	Absent	
	Normal	Abnormal	Normal	Abnormal	] [	End Point Latera	al Gaz	e			
Joint Position Sense					]	Pathological					
Stereognosis											
Vibratory Sensation											
49. SENSATION								50. RHC	OMBERG		
Normal	Abnormal		Normal /	Abnormal	Two Point Dis	scrimination		Absent			
Hot		Sharp			Normal			Present			
Cold		Soft			Abnormal						Page 3 of 4

#### 51. MISCELLANEOUS REMARKS

					The second secon	
<u>LAB</u> 52.	ORATORY FINDINGS Urinalysis Color Appearance Sp. Gravity Ph	0     1+       Blood	2+ 3+ 4+	53. Blood Tests CBC Normal Abnormal Sickle Cell	Attach R RPR	eports Pos Neg Pos Neg
54.	Pulmonary Function FVC FEV1 FEV1/FVC FEV1/FVC	55. X-rays Non Chest Lumbar Spine C Long Bone Series C Other	mal Abnormal (E	Describe)		
56.	Electrocardiogram Static Exercise Stress	57. Audiogram	z 500 1000 20 ft ght	000 3000 4000	6000 8000	
58.	Comprehensive Metabolic Panel     Attach Report     Lip (if       Normal Abnormal	pid Panel Comments: f done) Normal			59. Drug Screen	ts sent to LNR
	k Status: Fit for diving Cleared for supervisor Cleared for topside work only Cleared with restrictions: Further evaluation needed: Unfit for diving : Unfit mments:		Examinee Signature Examinee Name Physician Signature Physician Name			
			Address			
			Phone Number			
	Date of Examination					Page 4 of 4



# LUMMI INDIAN BUSINESS COUNCIL 2665 kwina road bellingham, washington 98226 (360) 312-2000

So wine Road Bellingham, washington 50220 (50

DEPARTMENT LUMMI NATURAL RESOURCES

FAX Number 360-380-6989

# **Physician Approval Form**

Applicant Name:

Diver or Hose Tender (circle one)

Address:

Cell phone or telephone:

TO THE PHYSICIAN: The above named person is applying for approval from the Lummi Natural Resources Department (LNR) to participate in commercial harvest diving activities permitted under the auspices of the Lummi Nation. Commercial harvest diving puts unusual stresses on individuals in many ways; therefore, your opinion of the applicant's medical fitness to participate is requested. He or she will be assigned as a commercial harvest diver or as a hose tender. Both assignments require a sound back and core musculature, a level of coordination, adequate hearing and sight, ability to read gauges and tables, and good judgment. Typically, a diver is physically engaged underwater using surface supplied air equipment, including an umbilical hose, a harness weighing in excess of 50 lb, and a full face mask or helmet. Surface supplied air diving requires heavy exertion under hyperbaric conditions. The cardiovascular and respiratory health of the applicant should be commensurate with his or her assigned duties. An absolute requirement for the diver is his or her ability to equalize the pressure in the lungs, middle ears, and sinuses. The hose tender must be capable of coordinating his/her movements in variable sea conditions while lifting over 50 lb. Any medical condition that risks the loss of consciousness should disqualify the applicant. Please consult the most recent edition of the LNR Commercial Harvest Diving Standards for additional information concerning the medical requirements for participating in the Lummi Nation's commercial dive fisheries.

- [] ELIGIBLE WITH NO RESTRICTIONS
- [] ELIGIBLE WITH RESTRICTIONS
- [] NOT ELIGIBLE

Physician's Remarks:

Physician's Signature:

Date:

Please send completed form to the LNR Diving Safety Administrator at the address or FAX number above



**JUMMI INDIAN BUSINESS COUNCIL** 

2665 KWINA ROAD BELLINGHAM, WASHINGTON 98226 (360) 312-2000

DEPARTMENT LUMMI NATURAL RESOURCES

FAX Number 360-380-6989

# **Medical Review Officer Report of Drug Screening Results**

Applicant Name:

Diver or Hose Tender (circle one)

Address:

Cell phone or telephone:

TO THE PHYSICIAN: The above named person is applying for approval from the Lummi Natural Resources Department (LNR) to participate in commercial harvest diving activities permitted under the auspices of the Lummi Nation. He or she will be participating as a commercial harvest diver or as a hose tender. Commercial harvest diving is the most dangerous work activity pursued by Lummi fishers. It is imperative that commercial harvest diving crew members be alert and unimpaired by drugs, alcohol, or controlled substances. Because of the increased risk of dereliction of duties by the crew member under the influence, that poses a risk to self, his or her fellow fishers, the harvested resource, or the general public pursuant to the Lummi Natural Resources Code (Title 10), evidence of substance abuse including, but not limited to, alcohol-, drug-, or chemical-dependence (i.e., active, untreated addiction) is a disqualifying medical condition according to the LNR Commercial Harvest Diving Standards.

## [] NEGATIVE

I found no evidence of substance abuse when reviewing the results of the applicant's drug screening or urinalysis.

## [] NON-NEGATIVE

The applicant had, at the time of his/her drug screening or urinalysis, an indication of using an illegal or controlled substance, drug, or behavior-altering chemical that could not be accounted for as a result of a prescription by a physician.

Physician Remarks:

Physician's Signature:

Date:

# COMMERCIAL HARVEST DIVING STANDARDS





# COMMERCIAL HARVEST DIVING STANDARDS





# 4.0 ROLES and RESPONSIBILITIES

Titles, duties, responsibilities and capabilities of personnel engaged in commercial harvest diving and underwater operations vary widely. The descriptions of the classification designations in this section indicate the minimum duties and responsibilities of crew members.

## **4.1 DIVE VESSEL OWNER**

The primary responsibility and role of a DVO are 1) to provide a safe, functioning work platform, or diving support vessel (DSV), that is currently registered with LNR and is capable of fully supporting the intended commercial harvest diving operation(s), and 2) to function as a "compliance safety and health officer" for commercial harvest diving operations occurring aboard his or her LNR-registered DSV. Other responsibilities of a DVO include, but are not limited to, providing the crew working aboard his or her DSV with the following:

- An understanding of all diving regulations, including a safe practices manual, governing commercial harvest diving operations permitted under the auspices of the Lummi Nation. These standards may serve as the required safe practices manual (see chapters 7 and 8);
- 2) An emergency aid list including the whereabouts of the nearest operating decompression chamber, available diving physicians, and local emergency medical services (EMS) (see Chapter 10 and Appendix II);
- 3) First aid supplies at the commercial harvest diving location, including an emergency oxygen administration kit ("O<sub>2</sub> kit") that is in working order with documentation or proof of annual visual inspection service and five-year hydrostatic testing (see Chapter 10);
- 4) A means of planning and assessing commercial harvest diving operations (see chapters 7 through 9);
- A means of evaluating hazardous activities surrounding commercial harvest diving operations such as environmental conditions (e.g., weather and tides) or vessel traffic (e.g., shipping and other marine operations) (see chapters 6 and 7);
- 6) An open dialogue between the DVO and crew concerning daily briefings related to commercial harvest diving operations aboard the DVO's DSV (see below and Chapter 8);
- 7) Pre-dive checklist(s) including records of inspecting, servicing, and/or maintaining the diving equipment used aboard the DVO's DSV (see chapters 5 and 8); and
- 8) A warning signal alerting others in the vicinity of the DSV that commercial harvest diving operations are being conducted. This must be in the form of the internationally-recognized blue-and-white code flag A or alpha. A red-and-white "diver down" flag alone does not satisfy this requirement but may be displayed with the alpha flag (see Chapter 7).

## **4.2 DESIGNATED PERSON-IN-CHARGE**

A qualified person shall be designated in charge of each commercial harvest diving operation (hereafter, designated person-in-charge or DPIC). The DPIC must be an LNR-classified ED or EDO in good standing and shall be stationed at the commercial harvest diving location. A DVO also may serve as the DPIC so long as he or she is divequalified and has experience and training in conducting commercial harvest diving operations as outlined in these standards. A qualified ED, EDO, or DVO removed from working under hyperbaric conditions (see Section 3.7) may serve as the DPIC so long as he or she left active service in good standing and is fit to serve as the DPIC as outlined in these standards. <u>LNR-classified HTs and TDs may not serve as the DPIC</u>. The DPIC is responsible for the immediate health and safety of the crew. Other responsibilities of the DPIC include, but are not limited to, the following:

- 1) Planning and coordinating operations;
- 2) Record keeping (e.g., maintaining shipboard dive log);
- 3) Proper response to any job-related emergency (see also Section 8.9.2); and

4) Knowledge of and understanding the appropriate laws in the Lummi Natural Resources Code (Title 10) and the current dive fishery regulations.

## **4.3 EXPERIENCED DIVE OPERATOR**

The LNR-classified EDO shall posses the knowledge, experience, and familiarity with all techniques, procedures, emergency procedures and operational parameters for the diving mode under his or her direct supervision. The EDO may also be the DPIC. If this is the case, he or she is in charge of planning and executing the commercial harvest diving operation, and is responsible for the safety and health of the crew. Besides the requirements summarized in Section 2.4, the EDO shares responsibilities of an HT, TD, and ED. The EDO's duties include, but are not necessarily limited to, the following:

- 1) Read, understand, and comply with all DVO policies and applicable governmental regulations (e.g., safe practices manual) as they relate to his or her qualifications or performance while engaged in commercial harvest diving operations;
- Ensure that all relevant operating instructions, manuals, decompression tables and procedures, and regulatory publications are available at the dive location and are maintained to reflect current changes and developments;
- Personally inquire if all personnel on the crew are qualified and physically able to perform tasks assigned. Make an assessment of the physical condition of the divers prior to each dive to determine if any physical impairment is present that would be detrimental to the diver's health and safety in the water or under hyperbaric conditions;
- 4) Have adequate knowledge, training and familiarization with all life-support and ancillary equipment used in the commercial harvest diving operations;
- 5) While it is the personal responsibility of each LNR-classified diver to ensure that his or her own diving equipment is properly maintained, inspected, and in good working order prior to diving, it is the responsibility of the EDO, if acting as the DPIC, to verify that the compressor, umbilical, manifold, filtrations systems, and topside emergency gas supply designated for use are:
  - a. Inspected prior to each dive and are in good working order;
  - b. Suitable for the planned diving operation; and
  - c. Compliant with regulatory requirements for the diving mode used.
- 6) Maintain and submit reports required by DVO and relevant tribal governmental regulations concerning commercial harvest diving operations and equipment maintenance, testing or repair;
- 7) Establish a dive plan ensuring that sufficient breathing gas, supplies, and proper equipment are available for safe and timely completion of the job task;
- 8) Develop, modify, or prepare pre- and post-dive checklists for the operation;
- 9) Ensure the detailed briefing of his or her diving crew and support personnel, including:
  - a. Tasks to be undertaken;
  - b. Unusual hazards or environmental conditions.
- 10) Assign the duties of all crew members and personally direct them throughout the commercial harvest diving operation;
- 11) When applicable (e.g., complex or potentially hazardous commercial harvest diving operations, Chapter 9), prepare a Job Hazard Analysis (JHA, Section 8.10.3) for each task undertaken;
- 12) Develop and implement emergency/contingency procedures;
- 13) Ensure commercial harvest diving operations are carried out from a suitable and safe location on the surface;
- 14) The EDO must also ensure that, prior to commencing a commercial harvest diving operation, all masters of craft in the vicinity of the commercial harvest diving operation and all persons responsible for anything that might affect the commercial harvest diving operation are advised that diving or underwater operations are to be undertaken;

- 15) While on duty, be in immediate control and available to implement emergency procedures. The EDO is not permitted to dive unless another qualified diver (e.g., ED or fellow EDO) is present whom may also assume the responsibilities of the DPIC;
- 16) Ensure that each diver is continuously tended while in the water;
- 17) Ensure the dive is terminated when:
  - a. The diver requests termination;
  - b. The diver fails to respond to communication or communication is lost between the diver and crew members at the dive location;
  - c. Communication is lost between the DSV operator, crew, and diver(s) during live-boating operations;
  - d. The diver begins to use his or her diver-carried reserve breathing gas supply; or
  - e. Weather or site conditions are degrading to the extent that diver safety may be compromised.
- 18) After every dive, it is recommended that:
  - a. The physical condition and wellbeing of the diver is checked by visual observation and verbal questioning;
  - b. The diver is instructed to report any physical problems or symptoms of decompression sickness or arterial gas embolism; and
  - c. The diver is advised of the location of the nearest operating decompression chamber and is acquainted with the dangers of flying after diving or traveling to altitudes higher than the dive site.
- 19) Be aware of the procedures to follow to obtain medical support in the event of an accident, either diving or non-diving related. Ensure a two-way communication system is available at the dive location to obtain emergency assistance (see also Section 8.9.2);
- 20) Report all accidents or incidents involving personnel as required by relevant government entities and by the DVO (Chapter 10);
- 21) Maintain a shipboard log of date, location, depth, bottom time, surface interval, and if needed, a breathing mix profile (e.g., NITROX operations) at the dive location for each diver during the dive;
- 22) Maintain a supervisor's log of medical treatment supervised;
- 23) When a crew member is in training or advancement mode, view and ensure accuracy of diver's personal log book and affix signature to properly record activities;
- 24) Maintain certification in first aid, CPR, and emergency oxygen administration; and
- 25) Maintain an appropriate level of physical fitness.

## **4.4 EXPERIENCED DIVER**

The LNR-classified ED must have a working knowledge of diving theory and practice, and must have a full understanding of the diving equipment in use and relevant tasks assigned aboard a DSV. To this end, the ED may occasionally be assigned as the DPIC. If this is the case, he or she is in charge of planning and executing the commercial harvest diving operation, and is responsible for the safety and health of the crew. Besides the requirements summarized in Section 2.4, and in addition to being able to carry out the responsibilities of an HT and a TD, an ED should:

- 1) Read, understand, and comply with all DVO policies and applicable governmental regulations (e.g., safe practices manual) as they relate to his or her qualifications or performance while engaged in commercial harvest diving operations;
- 2) Report to the DPIC any recent medical treatment or illness so that a proper determination can be made concerning fitness and ability to dive;
- 3) Have adequate knowledge, training and familiarization with all life-support and ancillary equipment used in the commercial harvest diving operation;
- 4) While it is the personal responsibility of each LNR-classified diver to ensure that his or her own diving equipment is properly maintained, inspected, and in good working order prior to diving, it is the

responsibility of the ED, if acting as the DPIC, to verify that the compressor, umbilical, manifold, filtration systems, and topside emergency gas supply designated for use are:

- a. Inspected prior to each dive and are in good working order;
- b. Suitable for the planned commercial harvest diving operation; and
- c. Compliant with regulatory requirements for the diving mode used;
- 5) Comply with regulations or instructions concerning the use, maintenance, repair, and testing of all diving equipment provided for the operation;
- 6) Report to the DPIC any defect or malfunction of the diving equipment provided for the commercial harvest diving operation;
- 7) Comply with regulatory requirements for the diving mode in use;
- 8) Ensure that the deepest depth attained during his or her dive has been established before ascent;
- 9) When applicable (e.g., complex or potentially hazardous commercial harvest diving operations, Chapter 9), review and be familiar with the JHA (Section 8.10.3);
- 10) Accomplish all tasks assigned by the DPIC;
- 11) Comply with all commands or instructions from the DPIC during the conduct of commercial harvest diving operations;
- 12) Follow safe diving practices at all times during the commercial harvest diving operation whether on deck or in the water. Bring to the attention of the DPIC any questionable items. Be aware of the safety of others as well as his or her own safety;
- 13) Assist in the training of new personnel (e.g., TD or HT) as directed by the DVO or DPIC;
- 14) Be capable and qualified to carry out all of the duties and responsibilities of a standby diver and act as a standby diver when directed to do so (the standby diver is the individual possessing the required training and experience to render assistance to a stricken diver). While acting as a standby diver, the ED should:
  - a. Be ready to don diving helmet or mask when directed by the DPIC;
  - b. Remain in the immediate vicinity of the stricken diver's water entry location and be ready to enter the water when directed by the DPIC;
  - c. Remain at the station throughout the entire dive to assist the stricken diver;
  - d. Constantly remain abreast of events of the dive; and
  - e. Not be assigned any tasks that might interfere with duties as a standby diver while there is a stricken diver in the water.
- 15) Immediately report all symptoms or suspected symptoms of decompression sickness to the DPIC as early and as accurately as possible;
- 16) If acting as DPIC, report all accidents or incidents involving personnel as required by relevant government entities and by the DVO (Chapter 10);
- 17) If advancing to the EDO classification, maintain a personal log book that details all dives and operations, and may include medical examinations, courses taken, certification level achieved, and personal equipment maintenance;
- 18) Maintain certification in first aid, CPR, and emergency oxygen administration; and
- 19) Maintain an appropriate level of physical fitness.

In the event an ED is assigned a task for which he or she does not feel qualified either by training and experience, he or she should immediately inform the LNR-registered DVO or DPIC.

## **4.5 TRAINEE DIVER**

The TD must be classified by LNR as such, having been cleared to dive by a physician who is familiar with diving medicine and having completed a formal course of diving instruction where he or she has gained detailed knowledge of diving theory and practice. Furthermore, the TD should have a full understanding of the diving equipment in use and of the tasks assigned by the DPIC, both in the water and topside. While carrying out his or her training, the TD should be in possession of an up-to-date personal diver's log book, which can be used to establish his or her training status. In addition to carrying out the responsibilities of an HT, the TD should:

- 1) Read, understand, and comply with all DVO policies and applicable governmental regulations (e.g., safe practices manual) as they relate to his or her qualifications or performance while engaged in commercial harvest diving operations;
- 2) Report to the DPIC any recent medical treatment or illness so that a proper determination can be made concerning fitness and ability to dive;
- 3) Have adequate knowledge, training and familiarization with all life-support and ancillary equipment used in the commercial harvest diving operations;
- 4) It is the personal responsibility of each LNR-classified diver, including TD, to ensure that his or her own diving equipment is properly maintained, inspected, and in good working order prior to diving;
- 5) Comply with regulations or instructions concerning the use, maintenance, repair, and testing of all diving equipment provided for the operation;
- 6) Report to the diving supervisor any defect or malfunction of the diving equipment provided for the commercial harvest diving operation;
- 7) Ensure that the deepest depth attained during his or her dive has been established <u>before</u> ascent;
- 8) Only when applicable (e.g., complex or potentially hazardous commercial harvest diving operations, Chapter 9), have reviewed and be familiar with the JHA (Section 8.10.3). <u>Note: While in training status, the</u> <u>TD must not participate in complex or potentially hazardous commercial harvest diving operations</u> <u>(Chapter 9) unless he or she has received training in those operations and as supervised or directed by the</u> <u>DVO or DPIC</u>;
- 9) Accomplish all tasks assigned by the DPIC;
- 10) Comply with all commands or instructions from the DPIC during the conduct of commercial harvest diving operations;
- 11) Follow safe diving practices at all times during the commercial harvest diving operation whether on deck or in the water. Bring to the attention of the DPIC any questionable items. Be alert for the safety of others as well as his/her own safety;
- 12) Assist in the training of new personnel only as directed by the DPIC;
- 13) Be capable and qualified to carry out all of the duties and responsibilities of a standby diver and act as a standby diver when directed to do so (the standby diver is the individual possessing the required training and experience to enter the water at the diving station in order to render assistance to a stricken diver). While acting as a standby diver, the TD should:
  - a. Be ready to don diving helmet or mask when directed by the DPIC;
  - b. Remain in the immediate vicinity of the diver's water entry location and be ready to enter the water when directed by the DPIC;
  - c. Remain at the station throughout the entire dive, to include all in-water decompression;
  - d. Constantly remain abreast of events of the dive; and
  - e. Not be assigned any tasks that might interfere with duties as a standby diver while there is a diver in the water.
- 14) Immediately report all symptoms or suspected symptoms of decompression sickness to the DPIC as early and accurately as possible;
- 15) Maintain a personal diver's log book that details all training dives, and may also include medical examinations, courses taken, certification level achieved and personal equipment maintenance;
- 16) Maintain certification in first aid, CPR, and emergency oxygen administration; and
- 17) Maintain an appropriate level of physical fitness.

In the event a TD is assigned a task for which he or she does not feel qualified either by training and experience, he or she should immediately inform the DVO or DPIC.

# 4.6 HOSE TENDER

The HT is assigned by the DPIC to perform various duties, which include, but may not be limited to, the following:

- 1) Read, understand, and comply with all DVO policies and applicable governmental regulations (e.g., safe practices manual) as they relate to his or her qualifications or performance while engaged in commercial harvest diving operations;
- 2) Report to the DPIC any recent medical treatment or illness so that a proper determination can be made concerning fitness and ability to participate in commercial harvest diving operations;
- 3) Set up and operate all equipment as directed by the DVO or DPIC;
- 4) Assist the diver in dressing and undressing;
- 5) Report to the DPIC any defect or malfunction of the diving equipment provided for the commercial harvest diving operation;
- 6) Confirm that the diver's equipment is functioning properly and inform the DPIC that the diver is ready;
- 7) Prepare for and support the dive until its completion;
- 8) Tend the diver's umbilical (keeping at least one hand on the umbilical at all times in the event that twoway audio-communications fail) and be aware of the diver's depth and location at all times;
- 9) Continuously tend a diver;
- 10) Assist in topside work as required or directed by the DPIC;
- 11) Be alert for and immediately report conditions that may be hazardous or unsafe;
- 12) Immediately report all symptoms or suspected symptoms of decompression sickness to the DPIC as early and accurately as possible;
- 13) Inspect and repair such equipment as he or she is qualified to inspect and repair or has been given permission to inspect and repair by the DVO or DPIC;
- 14) Maintain certification in first aid, CPR, and emergency oxygen administration; and
- 15) Maintain an appropriate level of physical fitness.

In the event an HT is assigned a task for which he or she does not feel qualified either by training and experience, he or she should immediately inform the DVO or DPIC.

# COMMERCIAL HARVEST DIVING STANDARDS





# COMMERCIAL HARVEST DIVING STANDARDS





# 5.0 DIVING EQUIPMENT: REQUIREMENTS, MAINTENANCE, and TESTING

## **5.1 GENERAL**

Due to the life-support nature of diving, personnel involved in the operation, maintenance and repair of diving systems and equipment should have appropriate training and experience in the maintenance and use of the type of equipment used. Equipment such as helmets, masks, bailout systems, and regulators that provide direct life support should be of a type familiar to the diver and subject to a planned maintenance system. It is the personal responsibility of each LNR-classified diver to ensure that his or her own diving equipment is properly maintained, inspected, and in good working order prior to diving. The DVO and the DPIC should inquire whether all diving systems and equipment have been examined and tested prior to diving to determine their condition and suitability for service. No commercial harvest diving operation should be permitted to commence until all systems and equipment have been thoroughly tested for proper functionality.

## **5.2 MAINTENANCE RECORDS**

Documentation of a preventive maintenance program for all life-support equipment is highly recommended, and in some instances, required. For example, LNR-classified divers are required to provide proof of annual servicing and maintenance of gas cylinders and first-stage regulators used for bailout purposes. Maintenance records might also include:

- 1) Suitable equipment logs that are:
  - a. Current and filled out correctly; and
  - b. Adequately descriptive, including the nature of the work performed, dates of modification, repair or test, the name of the individual performing the work or test, and the particular piece of equipment involved.
- 2) Unique identities (e.g., tags or labels) for life-support equipment traceable to the equipment/maintenance log; or
- 3) Contents and pressure of each compressed gas cylinder, quad, or bank used in a commercial harvest diving operation.
  - a. These records should be updated daily when the system is in use.

## **5.3 DIVER DRESS**

#### 5.3.1 GENERAL

The diver should be suitably dressed for the job intended taking into consideration the thermal, biological, physical, and chemical conditions that he or she will be exposed to.

## 5.3.2 DRY SUITS

Diving personnel should be familiar with dry suit use, either through dry suit certification or training received, prior to conducting dry suit operations. Dry suits shall:

- 1) Have a means of preventing over-inflation, which could result in an uncontrolled ascent; and
- 2) Be constructed of material suitable to the environment in which it is to be used:
  - a. For example, protecting the diver from cool temperatures or hazardous materials.

## 5.3.3 HARNESSES

A working diver should be equipped with an appropriate harness that:

- 1) Is intended for underwater use;
- 2) Is certified by the manufacturer as detailed below:
  - a. Certification and Testing of Diving Harnesses
    - i. Each harness is clearly marked in a durable manner with the following:
      - 1. Manufacturer's name and country of origin;
      - 2. Product model and number;
      - 3. Month and year of manufacture;
      - 4. Unique serial number for that harness; and
      - 5. Breaking strength.
    - ii. A new diving harness should be certified by the manufacturer or supplier to confirm that:
      - Each securing point intended for attaching an umbilical or lifting a diver out of the water in an emergency should withstand a tensile of at least 2,000 pounds for five minutes without sustaining damage that would render it inoperable or unsafe to use.
      - Each complete full-body harness, including adjustment systems, straps, and buckles, should withstand a tensile load of at least 2,000 pounds for five minutes – applied in the direction of lift – without sustaining damage that would render it inoperable or unsafe to use.
- 3) Provides a method to securely attach the umbilical to the diver;
- 4) Has at least one attachment point for the umbilical that is rated to at least the same breaking strength as the lifeline or strength member in the umbilical bundle;
  - a. If the harness has multiple attachment points of different strengths, those suitable for umbilical attachments should be clearly identified.
- 5) Allows for easy disconnect of the main umbilical and weights, without removal of the main bail-out harness;
  - a. This may be achieved by use of a separate or independent outer harness/jacket for the bailout system and diver's weights.
- 6) Is equipped with a positive buckling device (i.e., designed to prevent strap pull-through and accidental release by the diver) so that it is not possible to release the harness by a single action;
  - a. Releases and buckles should not be tampered with nor permanently secured (e.g., taped or ziptied in the closed position).
- 7) Is equipped with adjustable leg straps;
- 8) Is fitted with at least one lifting (recovery) ring, accessible when the diver is fully dressed, suitable for recovery of the diver from the water in an emergency using a hoisting device or other suitable means;
- 9) Lifts an unconscious or injured diver and his or her equipment from the water in an emergency;
- 10) Maintains the diver in a heads-up position during recovery (using the lifting ring) from the water in an emergency;
- 11) Has an overall breaking strength of no less than 2,000 pounds;
- 12) Is visually inspected prior to use for any signs of deterioration or damage (e.g., excessively frayed straps or webbing) and is possibly not used if there is doubt about its material condition; and
- 13) Is regularly maintained in accordance with the manufacturer's recommendations.

## 5.3.4 WEIGHT BELTS

Weight belts should:

- 1) Be of sufficient weight to maintain the diver at working depth;
- 2) Not be used as an attachment for the diving umbilical;
- 3) Be attached to the diver in a manner to avoid accidental disengagement; and

4) Be equipped with appropriate releases and buckles that are not tampered with nor permanently secured (i.e., taped or zip-tied in the closed position).

## 5.3.5 DIVER-WORN OR DIVER-CARRIED EMERGENCY GAS SUPPLY

A diver-worn or diver-carried emergency gas supply (EGS), i.e., his or her bailout system, should have a minimum calculated four-minute supply at the anticipated working depth of the diver (see discussion and calculations for various sizes of bailout cylinders in Section 8.11). The bailout system should:

- 1) Have a cylinder meeting the requirements in Section 8.11;
  - a. At a minimum, the cylinder and cylinder valve shall be inspected and, if necessary, overhauled annually by a certified technician trained in these procedures. A record of the annual maintenance of this equipment must be kept by the TD, ED, EDO, or DVO. A verifiable receipt or equipment tag will suffice as evidence of the annual maintenance of the bailout cylinder and cylinder valve.
- 2) Have a depth-compensating regulator on the cylinder capable of delivering the proper pressure and flow to the diver's helmet or mask in accordance with its manufacturer recommendations;
  - a. At a minimum, the first stage of this regulator shall be inspected and overhauled annually by a certified technician trained in these procedures. A record of the annual maintenance of this equipment must be kept by the TD, ED, EDO, or DVO. A verifiable receipt or equipment tag will suffice as evidence of the annual maintenance of the bailout's first stage regulator.
- 3) Have a means of attachment to the helmet or mask which prevents accidental detachment;
- 4) Have a positive means of isolating the bailout system from the primary gas supply; and
- 5) Be sampled or tested to verify breathing gas contents when using a breathing gas mix other than air (e.g., NITROX).
  - a. Cylinders should be clearly marked with their content, date, pressure, and name of individual performing this verification.

## **5.4 HELMETS AND MASKS**

Helmets and masks and their associated regulators are components of critical life-support systems that, if not functioning properly, can expose divers to significant hazards. All helmets and masks and their associated regulators should therefore be maintained and inspected in strict compliance with their manufacturer recommendations. Suitable logs can be maintained to record such information. Helmets and masks should be fitted to accept a diver-worn or diver-carried EGS (i.e., the bailout system); furthermore, they should be fitted to allow for positive and ready removal from the diver under all circumstances. Finally, helmets and masks used in surface supplied commercial harvest diving operations should be:

- 1) Appropriate for the task intended;
- 2) Fitted with a two-way audio communications system;
- 3) Equipped with a non-return (check) valve in the main gas supply that closes readily and positively;
- 4) Equipped with non-return valves with springs not exceeding 3 PSI cracking pressure;
- 5) Constructed of corrosion-resistant materials;
- 6) Maintained in accordance with manufacturer specifications and have all modifications that affect safety or performance documented in the equipment log; and
- 7) Equipped with second stage regulators inspected and overhauled annually by a certified technician trained in these procedures.
  - a. A record of the annual maintenance of this equipment must be kept by the TD, ED, EDO, or DVO. A verifiable receipt or equipment tag will suffice as evidence of the annual maintenance of the helmet or mask's second stage regulator.
  - b. A Lummi fisher receiving formal training in the maintenance and repair of his or her own helmet or mask, including adjusting and trouble-shooting the second stage regulator, may receive a

variance to the above requirement by submitting verifiable documentation (e.g., course certificate) to the DSA after completing such training.

## 5.5 HOSES

## 5.5.1 GENERAL

Hoses used with surface supplied air compressors and related equipment should be suitable for underwater use or rated by their manufacturers for the work or service intended. A hose should be kink-resistant and handled or arranged onboard to prevent kinking. The hose should be suitable for breathing gas service and appropriately designed to prevent collapse when used for a commercial harvest diving operation with higher external pressure compared to the internal pressure of the hose. Hoses should also have:

- 1) Minimum burst pressures equal to four times the maximum allowable working pressure (MAWP);
- 2) MAWPs and flow ratings not less than the system on which they were installed;
- 3) Connectors with pressure capabilities equal to or greater than the designed working pressure of the system on which they are installed;
- 4) Corrosion-resistant fittings that cannot break free or be accidentally detached; and
- 5) Visual examinations and pressure tests after each repair.

## 5.5.2 BREATHING GAS HOSES (LP)

Breathing gas hose assemblies should:

- 1) Meet requirements of Section 5.5.1;
- 2) Have maximum allowable working pressures equal to or greater than supply pressure plus 150 psi; and
- 3) Be subjected to periodic (e.g., yearly) pressure tests to one-and-one-half times the design working pressure of the systems on which they were installed.
  - A 200-pound axial load should be applied on fittings while initial test pressures are applied. The test pressure should be maintained without loss of pressure (when corrected for temperature) for 10 minutes.
  - b. The axial load weight may be removed after the initial test pressure has been applied, providing no leakage is evident.
  - c. If a pneumofathometer hose is incorporated into the umbilical, it should also be periodically (e.g., yearly) pressure-tested for leakage.

## 5.5.3 UMBILICALS

Diver umbilical and dive hose assemblies should:

- 1) Meet requirements of sections 5.5.1 and 5.5.2;
- 2) Ideally, be marked from the diver end at 10-foot intervals up to 100 feet, and then marked in 50-foot intervals thereafter (Table 3);
- 3) Be marked with a unique identity and be subjected to a planned maintenance program;
- 4) Consist of a breathing gas hose, communications cable, a means of determining the diver's depth (e.g., pneumofathometer), and a strength member or safety line (the strength member may be the entire hose assembly, if so designed); and
- 5) Have a minimum break strength of the hose assembly, including terminating hardware (e.g., "D" ring or attaching points), of 1,000 pounds.

A color coding scheme for umbilical lines can be used in surface supplied air commercial harvest diving operations to help monitor the position or location of a diver. Table 3 shows an example of a standardized color coding scheme that is used by many operations throughout the commercial diving industry. Finally, if a redundant
umbilical assembly is used for the standby diver, it should be of sufficient length to reach the primary diver at his or her farthest point from the DSV.

**Table 3.** Example of a standardized color coding scheme and banding pattern for umbilical lines used in surface supplied air commercial harvest diving operations (source: ADCI Standard 006). Beyond 300 feet, continue to place yellow bands after 50 feet and red bands after 100 feet.

10 feet (3.05 meters)	1 white band
20 feet (6.10 meters)	2 bands
30 feet (9.15 meters)	3 white bands
40 feet (12.2 meters)	4 white bands
50 feet (15.25 meters)	1 yellow band
60 feet (18.29 meters)	1 yellow band/1 white band
70 feet (21.34 meters)	1 yellow band/2 white bands
80 feet (24.39 meters)	1 yellow band/3 white bands
90 feet (27.44 meters)	1 yellow band/4 white bands
100 feet (30.49 meters)	1 red band
150 feet (45.73 meters)	1 red band/1 yellow band
200 feet (60.98 meters)	2 red bands
250 feet (76.22 meters)	2 red band/1 yellow band
300 feet (91.46 meters)	3 red bands

#### 5.5.4 OXYGEN HOSES

Oxygen hoses should meet the requirements of this section and be suitable for the use intended.

- 1) LP hose assemblies (less than 500 psi) used in systems containing greater than 50 percent oxygen are to be cleaned for oxygen service;
- Hoses used for oxygen (over 50 percent) service should be identified by a consistent color code or tagged "FOR OXYGEN USE ONLY"; and
- 3) Lubricants used to assemble fittings on hoses for oxygen service should be compatible with oxygen.

#### **5.6 COMPRESSOR SYSTEMS**

Compressors, boosters, gas transfer pumps, and filtration systems used in commercial harvest diving applications come in a variety of configurations. At a minimum, these systems must be manufactured and designed to be used for underwater operations with the breathing gas filtered to ensure the health and safety of the diver. All equipment used for breathing gas service should be subjected to periodic breathing gas quality testing (e.g., every six months or at discretion of DVO or DPIC, especially if concern arises over breathing gas quality).

#### 5.6.1 COMPRESSORS AND GAS PUMPS

Compressors, boosters, and gas transfer pumps should be or have:

- 1) Suitable and of the appropriate type, pressure, and flow rate for the service intended;
- 2) The necessary instrumentation to facilitate underwater operations;
- 3) Flexible pressure hoses in accordance with Section 5.5.1;
- 4) Electrical controls, wiring, and drive units, when so equipped, that meet jurisdictional requirements; and

5) Suitable personnel protection around rotating machinery that also meets applicable jurisdictional requirements.

#### 5.6.2 FILTRATION

Filters, when installed to prevent contamination, must meet or exceed the flow rate and pressure rating of the compressor or piping system in which they are installed and be able to deliver breathing gas in compliance with Compressed Gas Association, CGA (or equivalent), purity standards for extended operation. Furthermore, the air intake must be located and/or configured (e.g., filtered) to be clear of exhaust fumes and other contaminants.

#### 5.6.3 AIR PURITY REQUIREMENTS

All compressors, transfer pumps or booster pumps used for breathing air service should be subjected to periodic air quality testing (e.g., every six months or at discretion of DVO and DPIC, if concern arises over air quality). Furthermore:

- 1) Compressors with a discharge pressure of 500 psi or less shall meet the standards of the current American National Standards Institute (ANSI) CGA required for Grade D air or equivalent;
- 2) Compressors with a discharge pressure that exceeds 500 psi shall meet the requirements of the current ANSI CGA for Grade E air or equivalent;
- 3) Air purity tests should be taken at the discharge point that would normally supply the breathing gas system, the diver's hose or cylinder fill point;
- 4) Compressors used for breathing gas transfer other than atmospheric air (e.g., NITROX) should also be checked periodically (e.g., every six months) to ensure that contaminants are not being introduced into the gas being processed; and
- 5) Documentation of the latest test(s) should be kept on file and available upon request.

#### 5.6.4 TESTING

Compressors used for breathing gas should conform to design specifications and be functionally tested:

- 1) Prior to being put into service;
- 2) Periodically in accordance with manufacturer's recommendations and planned maintenance schedule;
- 3) During annual inspection;
- 4) After any repairs that may affect the compressor's performance; and
- 5) Following serious diving accidents, the air quality will be tested by the DSA or LNR Enforcement personnel.

#### **5.7 COMPRESSED GAS EQUIPMENT**

#### 5.7.1 VOLUME TANKS/AIR RECEIVERS

Volume tanks used in diving systems shall be designed, fabricated, inspected, tested and certified in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Section VIII, Division 1, Unfired Pressure Vessels), or other statutory/classification society requirements. A volume tank shall be equipped with a:

- 1) Pressure gauge;
- 2) Check valve on the inlet side;
- 3) Pressure rating to the maximum system pressure on which it is installed;
- 4) Relief valve as required by code of manufacturer;
- 5) Condensate drain valve, located at its lowest point; and
- 6) Slow-opening valves when used with design pressures exceeding 500 psi.

In addition, a volume tank should be:

- 1) Periodically (e.g., annually) pneumatically tested to MAWP utilizing the breathing gas mix normally used;
- 2) Hydrostatically tested to 1.3 MAWP (ASME 2007 UG 99) every fifth year or after any repair, modification or alteration to the pressure boundary and stamped with the test date;
- 3) Inspected internally and externally at least annually for damage or corrosion; and
- 4) Cleaned for oxygen service and have slow-opening valves when used in systems containing greater than 50 percent oxygen (e.g., NITROX).

#### 5.7.2 GAS STORAGE CYLINDERS AND TUBES

High-pressure gas cylinders or tubes shall be:

- 1) Manufactured to recognized code or standard;
- 2) Equipped with an overpressure relief device;
- 3) Visually examined annually for damage or corrosion;
- 4) If rack-mounted into banks of cylinders or tubes, have valves and regulators protected from damage caused by impact or from falling objects;
- 5) Hydrostatically tested every fifth year to the requirements of the code of the manufacturer by an authorized test facility and stamped with the date of test;
- 6) Inspected internally and externally at least annually for damage or corrosion if used underwater;
  - a. At a minimum, the cylinder and cylinder valve shall be inspected and, if necessary, overhauled annually by a certified technician trained in these procedures. A record of the annual maintenance of this equipment must be kept by the TD, ED, EDO, or DVO. A verifiable receipt or equipment tag will suffice as evidence of the annual maintenance of the bailout cylinder and cylinder valve.
- 7) Labeled as to contents (fire-hazard warning signs should be erected in the vicinity of stored oxygen); and
- 8) Stored in a well-ventilated area, protected from overheating and secured from falling.

#### 5.7.3 SCUBA AND BAILOUT CYLINDERS

High pressure tanks or cylinders used for scuba and/or bailout purposes (i.e., EGS) should be labeled with their gas contents which are easily visible on the units. Similarly, the units should be uniquely identified with results of all testing recorded in an equipment log. Finally, scuba and bailout cylinders shall be:

- 1) Manufactured to recognized codes or standards;
- 2) Equipped with an overpressure relief device;
- 3) Inspected internally and externally at least annually for damage or corrosion;
  - a. At a minimum, the cylinder and cylinder valve shall be inspected and, if necessary, overhauled annually by a certified technician trained in these procedures. A record of the annual maintenance of this equipment must be kept by the TD, ED, EDO, or DVO. A verifiable receipt or equipment tag will suffice as evidence of the annual maintenance of the bailout cylinder and cylinder valve; and
- 4) Hydrostatically tested every fifth year to the requirements of the code of the manufacturer by an authorized test facility and stamped with the date of test.

#### 5.7.4 GAUGES

Gauges utilized in diving equipment and for underwater applications shall be suitable for the purpose intended. In addition, a gauge should be cleaned for oxygen service when used in systems containing greater than 50 percent oxygen (e.g., NITROX). When used to indicate a diver's depth (e.g., pneumofathometer), the gauge should be:

- 1) Of appropriate range and graduation;
- 2) Graduated in units consistent with the diving tables to be utilized (Appendix III);
- 3) Fitted with a pressure-limiting device to avoid being over-pressurized;
- 4) Calibrated to a known standard:
  - a. Periodically, e.g., every six months;
  - b. When a discrepancy exists exceeding +/- 2 percent of full scale;
  - c. Tagged or labeled with date calibrated, amount of deviation (+/-) to the calibration standard, and due date of next calibration;
  - d. With records maintained in an equipment log.

#### **5.8 DIVER ENTRY AND EGRESS SYSTEMS**

Most commercial harvest divers in the Lummi fleet enter the water via a giant stride off a swim step located aft or over the gunwale. Upon surfacing the water, a diver egresses via a ladder attached at the stern of the DSV. Diving ladders should be:

- 1) Suitable for the purpose intended;
- 2) Constructed of corrosion-resistant material or be maintained free of corrosion;
- 3) At least three-feet below the surface when extended; and
- 4) Capable of supporting the weight of two divers plus their gear.

#### **5.9 DIVE COMPUTERS**

It is the personal responsibility of the diver to be proficient in using his or her dive computer for commercial harvest diving operations. Diving personnel may complete an appropriate practical training session through the vendor from which he or she purchased the unit, at a local dive shop, or with the DVO or DPIC, provided the latter is familiar with the dive computer used by the diver. Before commencing operations, the DPIC should inquire whether, and/or be satisfied that, a diver is proficient in the use of his or her dive computer and that he or she understands the limitations of the unit. Other guidelines and requirements include the following:

- 1) Every diver relying on a dive computer to plan harvest diving operations or to determine decompression status must have his or her own unit.
  - a. <u>At no time will divers share a single dive computer</u>.
- A diver must not dive for 18 hours before activating and using a new dive computer (this is required to clear residual nitrogen from the diver's system in order to match the zero nitrogen uptake of the new dive computer).
- 3) If a dive computer fails at any time during the dive, the dive should be terminated and appropriate surfacing procedures initiated immediately. If the failure occurs during the first dive of the day, a diver may switch over to using the appropriate dive tables (Appendix III) to plan his or her diving activities for the rest of the day.
  - a. All crew members should be proficient in using standard dive tables (Appendix III).
- 4) A Diver entering decompression mode must follow the protocols/directions displayed on his or her dive computer. At no time should a diver deviate from this standard unless the dive computer fails, then # 3 above applies.
- 5) When using a dive computer, non-emergency ascents are to be at the rate specified for the make and model of the dive computer being used.
- 6) Multiple dives below 60 fsw require special consideration. A diver must understand the effects of repeated exposure to hyperbaric conditions on his or her body and how a dive computer functions under these conditions.
- 7) During ascent, a safety stop should be made between 10 fsw and 30 fsw for three (3) to five (5) minutes, especially after dives below 60 fsw.

8) Once a dive computer is in use, it must remain on, or be capable of running its calculations, until it indicates that complete off-gassing has occurred or 18 hours have elapsed, whichever comes first.

### **5.10 TIMEKEEPING DEVICES**

Devices utilized to monitor a diver's exposure time under pressure should be suitable for that purpose and easily readable. It is highly recommended that a secondary timekeeping device be worn by a diver for use in conjunction with the appropriate dive tables (Appendix III) in the event that his or her dive computer fails.

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# COMMERCIAL HARVEST DIVING STANDARDS





# COMMERCIAL HARVEST DIVING STANDARDS





## **6.0 DIVING SUPPORT VESSELS**

#### 6.1 GENERAL

A diving support vessel (DSV) is defined in this document as the LNR-registered fishing vessel used to support commercial harvest diving operations. Due to the very diverse and variable types of diving performed throughout the commercial diving industry, DSVs vary accordingly, ranging from small craft for day-long projects (most of the Lummi commercial harvest diving fleet falls under this category) to purpose-built diving vessels with special four-point anchor systems and dynamically-positioned ships for long-term, offshore operations. The DSV should be properly outfitted and configured, taking into consideration the type(s) of diving to be performed, the tools and equipment needed to complete the work safely and successfully, and the environmental conditions that could affect commercial harvest diving operations. A DSV can be adapted, modified, or equipped to mitigate the vessel's shortcomings and therefore provide a safe working platform for commercial harvest diving operations. Indeed, the DVO or DPIC should determine whether or not to use a DSV and its associated equipment based on safety considerations for his or her crew.

When outfitting and configuring his or her DSV, the DVO or DPIC must consider the worst-case scenarios for weather, tides, and currents (e.g., wind and waves). Adequate planning is required and proper equipment should be readily available to facilitate moving the DSV away from the dive site if environmental conditions deteriorate. While some DSVs can withstand harsher environmental conditions compared to others, care should be taken not to exceed a DSV's operational limits before removing the vessel from harm's way. In general, DSVs are used to safely and efficiently provide:

- 1) Transit to and from the work site for both personnel and required equipment;
- 2) A secure, accurate position during commercial harvest diving operations;
- 3) Deck space for the life support and safety equipment required;
- 4) Deck space for the tooling required to perform the work;
- 5) Communications for commercial harvest diving operations and for emergency purposes; and
- 6) Additional services such as:
  - a. First aid and lifesaving equipment (e.g., oxygen administration kit);
  - b. Adequate fuel and power supplies;
  - c. Davits and hydraulic pot/gear pullers; and
  - d. Firefighting appliances.

#### **6.2 REGULATORY CONSIDERATIONS**

According to Title 10, Chapter 10.05 (Vessel Registration), a DVO or DPIC must register his or her DSV with LNR on an annual basis (July 1 – June 30). The DVO or DPIC must comply with all aspects of Chapter 10.05, including any regulations related to safe operation of the DSV (Chapter 10.05.070 Fish Vessel Safety Regulations). The DVO or DPIC should also be aware of the federal requirements concerning the safe operation of a commercial fishing vessel. For example, the USCG's Marine Safety Bulletin No. 18–14 dated December 1, 2014 (attached at end of chapter for reference purposes only) outlined the implementation of new requirements for commercial fishing vessel safety examinations and some new equipment standards. Most of the new USCG rules apply to vessels that are considerably larger than those used by Lummi fishers for commercial harvest diving operations. Furthermore, the new USCG rules are primarily intended for commercial fishing vessels operating beyond three nautical miles of the baseline of the United States territorial sea (Figure 6). When the three nautical mile line is overlaid upon the northern portion of the Lummi Nation's usual and accustomed fishing grounds and stations (see relevant map attached at end of chapter), it becomes abundantly clear that Lummi DSVs conducting commercial harvest diving operations in the San Juan Islands region are well within the three nautical mile line.



Figure 6. Relationship between tidal elevation (nautical chart datum), distance from shore, and uses of coastal and inland marine waters of the United States of America (source: NOAA Office of Coast Survey). Note the three nautical mile (3 n. mi.) line of the U.S. territorial sea.

#### **6.3 REQUIRED EQUIPMENT**

Besides complying with the USCG equipment requirements for a commercial fishing vessel (see checklists at end of chapter), the DSV must also be equipped with an emergency oxygen administration kit and an internationally-recognized "Alpha Flag" for display while conducting commercial harvest diving operations (see also sections 4.1, 7.5, and 10.2). The safe return of a commercial harvest diving crew is based largely on the reliability of the DSV's diving life-support equipment; therefore, this equipment must be routinely maintained and provided with adequate lashing, stowage, and protection from environmental elements and the impact(s) from long-term, continuous operation(s).



Figure 7. Minimum spacing for commercial harvest diving support vessels anchored within close proximity to each other.

#### **6.4 ANCHORING DIVING SUPPORT VESSELS**

If DSVs are anchored and engaged in commercial harvest diving operations within close proximity to each other (e.g., during a commercial geoduck clam opening), the DSVs should ideally maintain a minimum distance of no less than 600 ft apart (Figure 7). In this way, the DSVs will avoid each other's anchor spreads and "circles of operation" thereby reducing the risk of entangling their respective anchor lines, diver umbilical lines, or other related equipment (e.g., water jet hoses) which can measure up to 300 ft or more in length.

#### **6.5 LIVE-BOATING**

Surface supplied air commercial harvest diving operations are normally stationary with the DSV firmly anchored and powered down (i.e., engine off). Periodically, it may be necessary to power up the DSV to run its hydraulics or to move the vessel to avoid entangling a diver's umbilical in the DSV anchor line or a nearby kelp bed, and to avoid other hazards to the DSV and diver, such as submerged obstructions (e.g., boulders) or another anchored vessel. Should any of these occur, the commercial harvest diving operation has switched over to "live-boating" mode, and now requires a high level of alertness and strict attention to detail on behalf of the topside crew – especially considering the effects of propeller or thrust unit wash and suction on the diver's umbilical when he or she passes under the wash zone of the propeller.

#### 6.5.1 MINIMUM REQUIREMENTS

Proper pre-job planning should be conducted to ensure that the necessary personnel and equipment are available for this mode of operation. Indeed, the prudent DPIC will have developed a JHA (Section 8.10.3) for live-boating. Following are the minimum requirements for conducting a live-boating operation:

#### 1) Personnel

- a. The crew shall consist of no fewer than three LNR-qualified fishers (EDO, ED, and TD or HT);
- b. The crew should be experienced in live-boating procedures and assigned tasks that maximize the safety of the submerged diver; and
- c. A standby diver should be prepared to enter the water when directed by the DPIC.
- 2) Equipment
  - a. The DPIC and crew should be satisfied with the condition of the DSV and how well equipped the vessel is to partake in a live-boating procedure;

- Relevant support equipment (e.g., anchor assembly, cleats, boat hooks, and additional lines) should be selected to ensure the maximum safety of the diver and the crew during the operation;
- c. While live-boating, a diver-worn or diver- carried EGS shall be used by the diver;
- d. The two-way voice communication system should be in good working order;
- e. A "kill switch" should be in the immediate vicinity of the DPIC or DSV operator for instantaneous shutdown of the engine;
- f. If available, a secondary or redundant umbilical can be connected to the manifold; and
- g. The primary umbilical should be secured or lashed down topside in such a way as to prevent separation from the air compressor/manifold system (i.e., breaking free or uncoupling).
- 3) Operational limits
  - a. Live-boating should not be performed when conducting highly technical or deeper water work (e.g., diving below 60 fsw);
  - b. Only one surface-powered tool should be used at a time (e.g., a high-pressure water jet for harvesting geoduck clam);
  - c. If a commercial harvest diving operation requires a second hand-held tool, or one that is separately tended from the diver, it is highly recommended that that operation be completed by methods other than live-boating; and
  - d. Live-boating should not be performed within another vessel's anchor spread.

#### 6.5.2 OPERATIONAL GUIDELINES

Live-boating must not be undertaken lightly or haphazardly. To reiterate, careful planning and execution are required to minimize the effects of anchor retrieval and setting or propeller thrust on the diver and related equipment. It is absolutely imperative that the DPIC be experienced and knowledgeable in live-boating procedures. The DPIC must also be aware of the scope and status of the current underwater operation, including diver depth and duration of the dive, before commencing live-boating. The crew, especially the hose tender, must be aware of the diver's location and orientation to the DSV, continuously tracking how he or she may come into contact with the thrust unit or be adversely affected by propeller wash. The alert hose tender will prevent the umbilical developing a kink or forming a "bight", and will respond at once to any indication(s) of the diver being at risk, such as unusual movement or angle of and tension on the diver's umbilical. In addition, the DPIC should develop the following:

- 1) Protocols for moving the DSV, including measures to prevent collision or related contact with possible obstructions;
- 2) Precautionary steps to take against thrust unit wash or suction effect;
- 3) Down-line handling and related procedures, both at surface and underwater;
- 4) Precautionary steps to take with respect to weather, tides, and currents;
- 5) Standardized alert levels with easily-recognized warning signals, including protocols to follow in case of a change in status; and
- 6) Emergency response and diver evacuation plans.

#### 6.5.3 RECOMMENDED WAYS TO MITIGATE HAZARDS ASSOCIATED WITH LIVE-BOATING

- 1) The crew must be familiar with the DSV's overall design and operating characteristics (e.g., position of thrusters, propellers, intakes, and sea handling).
- 2) Live-boating should not be done:
  - a. If the DPIC deems existing conditions to be too risky or dangerous to switch over to live-boating;
  - b. In seas that impede the station-keeping ability of the vessel; or
  - c. During twilight, nighttime, or other periods of restricted visibility
    - i. Besides the lack of adequate daylight, restricted visibility means any condition in which DSV navigational or operational visibility is restricted by fog, mist, heavy rainstorm, falling snow, or other causes.

- 3) All live-boating operations should be tended forward of the stern to reduce the risk of the umbilical contacting the propeller wash zone.
- 4) Clear and concise communications should be maintained between the dive control station, deck, and wheel at all times:
  - a. Topside personnel must be able to speak directly to each other, hearing and responding to all communications between the diver, hose tender, and the DPIC.
- 5) The DSV should be maneuvered in such a way as to permit topside personnel to continuously monitor the direction of the diver's umbilical from the dive control station, deck, and wheel.
- 6) The DSV should not be in gear (i.e., no powered propeller movement) when the diver enters or exits the water.
- 7) It is highly recommended that commercial harvest diving crews use a detachable propeller guard when conducting commercial harvest diving operations that might require switching over to live-boating. A propeller guard can be attached to and removed from the DSV's outdrive as needed using hand-tightened wing nuts (Figure 8). Use of a detachable propeller guard can greatly decrease the risk of binding, wrapping, or severing a diver's umbilical while live-boating.



Figure 8. Examples of propeller guards that can be used while live-boating. These devices can greatly decrease the risk of binding, wrapping, or severing a diver's umbilical.



# **Marine Safety Information Bulletin**

Commandant U.S. Coast Guard Inspections and Compliance Directorate 2703 Martin Luther King Jr Ave, SE, STOP 7501 Washington, DC 20593-7501 MSIB Number: 18-14 (cor) Date: December 1, 2014 Contact: Mr. Jack Kemerer Phone: (202) 372-1249 E-Mail: <u>CGCVC@uscg.mil</u>

#### **Implementation of New Requirements for Commercial Fishing Vessels**

The purpose of this Bulletin is to remind the commercial fishing industry about safety and equipment requirements established by the *Coast Guard Authorization Act of 2010* and the *Coast Guard and Maritime Transportation Act of 2012*. The Acts made significant changes to Chapters 45 and 51 of Title 46 United States Code (USC) that will be reflected in amended regulations (Parts 28 and 42 of Title 46 Code of Federal Regulations (CFR)). These new requirements are scheduled to go into effect by the date(s) set forth under the law. The specific provisions to be implemented are discussed and explained in this Bulletin.

**Mandatory Dockside Safety Examinations**: Both Acts mentioned above amended 46 USC §4502(f) and directed that both State-registered and Federally-documented vessels that meet the following criteria, receive a safety examination no later than <u>October 15, 2015</u>, the date this requirement is scheduled to take effect. The criteria includes: operating beyond 3 nautical miles of the baseline of the U.S. territorial sea or the coastline of the Great Lakes, operating anywhere with more than 16 individuals on board (either inside 3 miles of the baseline or beyond 3 miles of the baseline), and fish tender vessels engaged in the Aleutian trade. These vessels will need to complete this dockside safety examination <u>at least once every 5 years</u>, however, some vessels, depending on their operation or areas of service, may be subject to a more frequent examination schedule.

If you have had your vessel examined recently, but the safety decal that was issued expires before the new requirement takes effect, you should have your vessel re-examined prior to October 15, 2015 if the above criteria applies. If you do not have a valid safety decal after October 15, 2015, you could be subject to operational controls that may be directed by a Captain of the Port Order. To help alleviate last minute exam scheduling backlogs, do not wait until the last minute to request an examination as there will likely be a rush on examination requests closer to the scheduled October 2015 deadline.

**Survival Craft**: The Acts also amended 46 USC §4502(b)(2)(B) by deleting the words "lifeboats or liferafts," and replacing them with, "a survival craft that ensures that no part of an individual is immersed in water..." This means that all commercial fishing industry vessels operating beyond 3 nautical miles of the base line or the coastline of the Great Lakes will be required to carry a survival craft that keeps you out of the water (i.e., a lifeboat, inflatable liferaft, or inflatable buoyant apparatus) in the event of an abandon ship need. Current life floats and buoyant apparatus are not designed to keep an individual out of the water when used in an emergency. This requirement for a survival craft, such as a lifeboat, inflatable liferaft, or inflatable buoyant apparatus that keeps one out of the water, is scheduled to go into effect on February 16, 2016.

**Newly-Built Vessels**: Note – The 2012 Act amended 46 USC §4503 by adding a new subsection (e) that states, "For the purposes of this section, the term "*built*" means, with respect to a vessel, that the vessel's construction has reached any of the following stages: (1) The vessel's keel is laid. (2) Construction identifiable with the vessel has begun and assembly of that vessel has commenced comprising of at least 50 metric tons or one percent of the estimated mass of all structural material, whichever is less." Also note that, "overall in length," means the horizontal distance of the hull between the foremost part of the stem and the aftermost part of the stern excluding fittings and attachments, which is different from the "registered length."

This release has been issued for public information and notification purposes only.

With this in mind, and with regard to vessels at least 50 feet overall in length, the 2010 Act amended 46 USC §4503 to add a requirement that commercial fishing vessels at least 50 feet overall in length, built after July 1, 2012 that operate beyond 3 nautical miles of the baseline must be designed, constructed, and maintained to the standards of a recognized classification society. The 2010 Act also required that vessels classed before July 1, 2012 shall remain subject to the requirements of a classification society and have on board a certificate from that society. The 2012 Act extended that "built after" date to July 1, 2013. So, after July 1, 2013, if a vessel 50 feet or more overall in length was, or is, built, it must meet survey and classification requirements. A vessel 50 feet or greater overall in length built after July 1, 2013, but not built to class, will be ineligible to commercially fish beyond 3 nautical miles of the baseline under a Fishery endorsement on its Certificate of Documentation.

<u>Vessels less than 50 feet overall in length</u>: The 2010 Act, also amended 46 USC §4502 by adding a new subsection (h) that requires commercial fishing vessels less than 50 feet overall in length, <u>built after January 1</u>, <u>2010</u>, to be constructed in a manner that provides a level of safety equivalent to the minimum safety standards established for recreational vessels. The standards/requirements for recreational vessels can be found in 33 CFR Parts 181 and 183.

**Load Lines**: The 2010 Act amended 46 USC §5102(b) to require commercial fishing vessels 79 feet or greater in length (and that will operate beyond the Boundary Line) to have a load line assigned. Per the 2010 Act, this provision applied to commercial fishing vessels built after July 1, 2012, however, the 2012 Act changed the <u>effective date</u> to <u>July 1, 2013</u>. Generally, most commercial fishing vessels were previously exempt from load line requirements. A load line indicates the minimum safe freeboard to which a vessel may be loaded. Conditions evaluated when calculating and assigning a load line include watertight integrity of the vessel, subdivision, and loading capacity. To be consistent with the definition for determining length for load line purposes already accepted and in use for other vessels, the registered or documented length of a commercial fishing vessel will be used for load line applicability as set forth in Subchapter E of 46 CFR Part 42.

Alternate Safety Programs: The 2010 Act added a new Subsection (d) to 46 USC §4503. This provision requires the Coast Guard to prescribe and develop, in cooperation with the commercial fishing industry, an Alternate Safety Compliance Program for commercial fishing vessels that operate beyond the 3 nautical mile line, if the vessel is: (1) at least 50 feet overall in length; (2) was built before July 1, 2012; and (3) is 25 years of age or older (in 2020); or, was built on or before July 1, 2012, and undergoes a substantial change to the dimension of, or type of vessel, completed after July 1, 2012, or a later date set by the Coast Guard. The 2012 Act changed the date of applicability from July 1, 2012 to July 1, 2013. In general, the Alternate Safety Compliance Programs must be prescribed by 2017 and implementation beginning by 2020. The Coast Guard is in the process of finalizing draft criteria and requirements for the Programs and the Commercial Fishing Safety Advisory Committee has been consulted on the draft. Prior to final promulgation, the fishing industry will be offered an opportunity to review, comment, and make recommendations as to how to apply the requirements based on risk, vessel operations, and operating areas. The 2010 and 2012 Acts also amended 46 USC \$5103 by adding a requirement for vessels that undergo a major conversion after July 1, 2013, or a date set by the Secretary, to comply with an Alternate Load Line Compliance Program. This Program will be developed in cooperation with the fishing industry. The Alternate Load Line Compliance Program will apply to vessels 79 feet or greater in length, and the criteria is expected to be included in the Alternate Safety Compliance Program guidelines for consideration by the industry.

Questions regarding these requirements should be forwarded to the Coast Guard Office of Commercial Vessel Compliance, Fishing Vessels Division (CG-CVC-3) at **202-372-1249** or by email at <u>CGCVC@uscg.mil</u>. Or, you may also contact your local Coast Guard District Fishing Vessel Safety Coordinator or local Sector Fishing Vessel Safety Examiner. The points of contact for these individuals can be found on the web site, <u>www.fishsafe.info</u>, and click on the "Locate Examiners" tab.

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# **Commercial Fishing Vessel Safety Examination Checklist**

# Less than 26 feet in length Inside Boundary Line Waters Inside Coastal



	GENERAL VESSEL REQUIREMENT	5		
Vessel Name:	Number:			
Contraction of	BRIDGE & DOCUMENTS			
33 CFR 173	Registration/Markings: Original on board, current; Vessel's number on both sides of forward part of hull. Contrasting color		O No	O N/A
46 CFR 28.165	Injury Placard (All Vessels)		O No	O N/A
33 USC 1602 33 USC 2020 72 COLREGS	<ul> <li>Navigation Lights: Required during darkness and/or in or near areas of restricted visibility (fog)</li> <li>Side Lights (112.5°)</li> <li>All around white light or masthead (225° and sternlight 135°)</li> <li>Fishing lights Red over White (360°) 1 meter apart, required on all fishing vessels except TROLLERS. Trawlers use green over white.</li> </ul>	O Yes	<b>O</b> No	O N/A
33 USC 1602 33 USC 2020 72 COLREGS	<b>Dayshapes</b> Required fishing dayshape, two black cones apex to apex. Not required on TROLLERS.	O Yes	O No	O N/A
33 USC 1602 33 USC 2020 72 COLREGS	Sound Producing Devices: Vessels < 12m: Means of Making an Efficient Sound Signal	O Yes	O No	O N/A

Call March -	LIFESAVING		
46 CFR 28.110 46 CFR 28.135 46 CFR 28.140	Personal Flotation Devices (PFDs) Type I, II, III, V or Immersion Suit. One for each person on board. Marked with name and retroreflective tape Properly maintained in good working order and in good shape Stowed readily accessible	OYes ONC	0 N/A
46 CFR 28.115 46 CFR 28.135	Ring Life Buoys: Less than 16 feet: None required 16 to less than 26 feet: 1 cushion (Type IV PFD) or ring life buoy. a. Marking with name and retroreflective tape b. Ring buoy is required to have 60 feet of line attached. c. Stowed readily accessible in good working condition.	O Yes O No	<b>O</b> N/A
46 CFR 28.120 46 CFR 28.125 46 CFR 28.130 46 CFR 28.140	Survival Craft: Not required if less than 4 persons on board. 4 or more people on board: <u>Buoyant Apparatus</u> Stowed in a readily accessible location. Marked with vessel's name or number and reflective tape.	O Yes O No	• <b>O</b> N/A
	ENGINE ROOM/MISCELLANEOUS		
46 CFR 28.155 46 CFR 28.160 46 CFR 25.30	Portable Fire Extinguishing Equipment: Required one B-I Fire Ext on board. Approved by USCG, UL or FM. Good Condition/Pressure gauge OK or weighed and tagged if no gauge. Mounted properly in bracket	O Yes O No	• <b>O</b> N/A
46 CFR 25.35	Flame Arrestor (gas power) Approved and in good condition	O Yes O No	O N/A
46 CFR 25.40	Ventilation (gas power) Adequate/Working ventilation to engine compartment Marine Societation Device: Required only if there is an DISTALLED to the	O Yes O No	O N/A
<b>33 CFK 139.</b> /	Type III: Holding tank to prevent overboard discharge. Overboard valve must be secured	UYES UNC	$\mathbf{U}$ N/A
POLICY	<ul> <li>Excess Safety Equipment: Any safety equipment (PFDs, EPIRBs, Survival Craft, Fire Extinguishers, Visual Distress Signals) that is in excess than what is required on board must meet one of the following: <ol> <li>Serviced and properly maintained in good working order,</li> <li>Marked "For Training Only" and kept separate from serviceable items, or</li> <li>Removed from the vessel.</li> </ol> </li> </ul>		

## **CFVS VESSEL CHECKLIST GUIDELINES**

This booklet is to be used to record voluntary examinations of commercial fishing industry vessels. It provides a summary list of Coast Guard requirements to examiners and owners/operators of commercial fishing industry vessels. This checklist should be used in conjunction with the regulations or other aids developed by the Coast Guard to assist in understanding of the regulations.

For a Voluntary Dockside Commercial Fishing Vessel Safety Exam contact:

Marine Safety Office Puget Sound 206-217-6208 1-800-688-6664 ext. 6208

## Exams are provided FREE of charge. Schedule one today!

# **Commercial Fishing Vessel Safety Examination Checklist**

# 26 to less than 40 feet in length Inside Boundary Line Waters Inside Coastal



Vessel Name:	Number:			
	BRIDGE & DOCUMENTS			
33 CFR 173	Registration/Markings: Original on board, current; Vessel's number on both sides of forward part of hull. Contrasting color	O Yes	O No	O N/A
46 CFR 28.165	Injury Placard (All Vessels)	O Yes	O No	O N/A
33 CFR 155.450	Oil Pollution Placard (Vessels ≥ 26 Feet)	O Yes	O No	O N/A
33 CFR 151.59	MARPOL (Garbage) Placard (Vessels ≥ 26 Feet)	O Yes	O No	O N/A
33 USC 1602 33 USC 2020 72 COLREGS	<ul> <li>Navigation Lights: Required during darkness and/or in or near areas of restricted visibility (fog)</li> <li>Side Lights (112.5°)</li> <li>All around white light or masthead (225° and sternlight 135°)</li> <li>Fishing lights Red over White (360°) 1 meter apart, required on all fishing vessels except TROLLERS. Trawlers use green over white.</li> </ul>	O Yes	O No	O N/A
33 USC 1602 33 USC 2020 72 COLREGS	Dayshapes Required fishing dayshape, two black cones apex to apex. Not required on TROLLERS.	O Yes	O No	O N/A
33 USC 1602 33 USC 2020 72 COLREGS	Sound Producing Devices: Vessels < 12m (39.4 ft): Means of Making an Efficient Sound Signal 12m < 20m (65.6 ft) a powered whistle	O Yes	O No	O N/A

LIFESAVING				
46 CFR 28.110 46 CFR 28.135 46 CFR 28.140	Personal Flotation Devices (PFDs) Type I, II, III, V or Immersion Suit. One for each person on board. Marked with name and retroreflective tape Properly maintained in good working order and in good shape Stowed readily accessible	O Yes	O No	O N/A
46 CFR 28.115 46 CFR 28.135	Ring Life Buoys: Required 1 orange ring life buoy, 24 inches in diameter. a. Marking with name and retroreflective tape b. Ring buoy is required to have 60 feet of line attached. c. Stowed readily accessible in good working condition.	O Yes	O No	O N/A
de la selle de la	ENGINE ROOM/MISCELLANEOUS			
46 CFR 28.155 46 CFR 28.160 46 CFR 25.30	Portable Fire Extinguishing Equipment: Required 2 B-I Fire Ext on board. Approved by USCG, UL or FM. Good Condition/Pressure gauge OK or weighed and tagged if no gauge. Mounted properly in bracket	O Yes	O No	O N/A
46 CFR 25.35	Flame Arrestor (gas power) Approved and in good condition	O Yes	O No	O N/A
46 CFR 25.40	Ventilation (gas power) Adequate/Working ventilation to engine compartment	O Yes	O No	O N/A
33 CFR 159.7	Marine Sanitation Device: Required only if there is an INSTALLED toilet. Type III: Holding tank to prevent overboard discharge. Overboard valve must be secured	O Yes	O No	O N/A
POLICY	<ul> <li>Excess Safety Equipment: Any safety equipment (PFDs, EPIRBs, Survival Craft, Fire Extinguishers, Visual Distress Signals) that is in excess than what is required on board must meet one of the following: <ol> <li>Serviced and properly maintained in good working order,</li> <li>Marked "For Training Only" and kept separate from serviceable items, or</li> <li>Removed from the vessel.</li> </ol> </li> </ul>			

## **CFVS VESSEL CHECKLIST GUIDELINES**

This booklet is to be used to record voluntary examinations of commercial fishing industry vessels. It provides a summary list of Coast Guard requirements to examiners and owners/operators of commercial fishing industry vessels. This checklist should be used in conjunction with the regulations or other aids developed by the Coast Guard to assist in understanding of the regulations.

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Marine Safety Office Puget Sound 206-217-6208 1-800-688-6664 ext. 6208

Exams are provided FREE of charge. Schedule one today!

# COMMERCIAL HARVEST DIVING STANDARDS





# COMMERCIAL HARVEST DIVING STANDARDS





## **7.0 UNDERWATER OPERATIONS: ADMINISTRATIVE PROCEDURES**

The DVO is responsible for setting the tone or establishing a workplace culture of safety aboard his or her DSV (see also Chapter 4). This chapter summarizes the minimum *administrative* requirements for conducting a safe commercial harvest diving operation. These measures are to be shared with the DPIC and other crew members aboard the DVO's DSV.

#### 7.1 DECOMPRESSION CHAMBER AVAILABILITY AND ASSUMPTION OF RISK

Many jurisdictions outside of the Lummi Nation require that commercial diving operations have an emergency hyperbaric or decompression chamber onboard the DSV or within five minutes of a dive location when diving in excess of 100 fsw, when live-boating in waters deeper than 60 fsw, or when planned decompression is incorporated into the day's work. Given the nature of Lummi commercial harvest diving compared to other commercial diving applications (e.g., simpler or reduced underwater task loading, not working in enclosed or overhead environments, working almost exclusively with compressed air, and generally diving at shallower depths), requiring an onboard decompression chamber is excessive, especially since, as of this writing, the LNR standards do not allow for deep work (e.g., diver depth generally > 100–130 fsw) or planned decompression, and no LNR-registered DSV is capable of supporting such a unit. Dive-qualified Lummi fishers must therefore assume a certain level of risk when participating in commercial harvest diving operations.

Commercial harvest diving is not a risk-free endeavor. Inherent risks include barotraumas or hyperbaric injuries (e.g., ruptured ear drum), hypoxia, hypercapnia (carbon dioxide build-up, e.g., possibly from over breathing mask or helmet), inert gas narcosis, oxygen toxicity [e.g., misuse of enriched air ("nitrox") or emergency oxygen], decompression sickness, gas expansion injuries (e.g., arterial gas embolism), or drowning. Treatment for these and other maladies may require a hyperbaric chamber or specialized medical facility that is not conveniently located near the primary fishing grounds of the Lummi Nation. In practice, prior to mobilization, the prudent DVO or DPIC should weigh the day's planned commercial harvest diving operations against the availability of the nearest available decompression chamber (Seattle, King County, Washington). Factors to consider may include, but are not limited to, the following:

- 1) Whether excessive decompression obligations will be incurred;
- 2) Multi-day and repetitive commercial harvest diving operations;
- 3) Potential for diver fouling or entrapment; and
- 4) Diving operations conducted in remote locations.

Upon completing his or her evaluation, and if warranted, the DVO or DPIC should prepare a job hazard analysis (Section 8.10.3), apprising the crew of the inherent risks associated with commercial harvest diving, and make known the whereabouts of the nearest hyperbaric chamber. <u>All Lummi fishers permitted to participate in</u> <u>commercial harvest diving operations under the auspices of the Lummi Nation must recognize/acknowledge that</u> <u>the nearest recompression chamber is *at least* two hours away from the Lummi Reservation and the Lummi usualand-accustomed fishing grounds and stations. The DVO or DPIC may use the generic assumption of risk form at the end of this chapter for that purpose.</u>

#### **7.2 SAFE PRACTICES OR SAFE OPERATIONS MANUAL**

Every DVO shall maintain a safe practices or safe operations manual as required by the LNR, which is consistent with jurisdictions outside of the Lummi Nation, and shall make this manual, which provides for the safety and health of the crew, available at the dive location to all crew members. The LNR Commercial Harvest Diving Standards may be used as the minimum set of standards for this purpose or they may serve as the basis for the DVO when developing his or her own specific safe practices or safe operations manual that exceeds the LNR standards. On the water, the DPIC is responsible for modifying or complementing any of the procedures, checklists,

or standards in accordance with applicable regulatory requirements or as dictated by specific policies and practices of the DVO. The safe practices or safe operations manual shall, at a minimum, contain the following information:

- 1) Specific references to, or copies of, applicable government regulations for the conduct of commercial harvest diving or other underwater operations;
- 2) Assignments and responsibilities of commercial harvest diving crew members;
- 3) Equipment procedures and checklists;
- 4) Operational safety procedures and checklists;
- 5) Emergency procedures for medical injury and illness, equipment failure, fire, or adverse environmental conditions; and
- 6) A definitive statement regarding the use of drugs or alcohol aboard the DSV:
  - a. Such language should reference the DVO's policy on workplace use of drugs and alcohol, and
  - b. Also reference applicable governmental regulations regarding drug and alcohol use in the work place (see Section 2.4.2 and Chapter 3).

#### **7.3 SAFE DIVE PLATFORM**

Vessels from which diving and other underwater operations are conducted shall afford a safe working platform.

#### 7.4 PERSONAL PROTECTIVE EQUIPMENT

The appropriate ANSI-approved personal protective equipment should be worn when required. These items include, but are not limited to, the following:

- 1) Personal flotation devices (PFDs) to appropriate regulatory standard;
- 2) Eye and face protection (e.g., setting up and starting water jet for geoduck clam harvest);
- 3) Hearing protection (e.g., working around running compressor);
- 4) Hand and arm protection (e.g., handling sea urchins);
- 5) Thermal protection (e.g., foul-weather gear or appropriate dry suit underwear);
- 6) Protective footwear (e.g., appropriate deck boots or diver "rock" boots); and
- 7) Respiratory equipment (e.g., fueling or handling solvents).

#### 7.5 WARNING DISPLAYS FOR DIVING OPERATIONS

For areas that support marine traffic, an appropriate warning display with all-around visibility shall be exhibited near the work site. Examples of displays include, but are not limited to, shapes, lights, flags (at minimum, internationally-recognized alpha, but also may include "diver down"), and placards. These signals should be given only when actual commercial harvest diving operations are being conducted (see also Section 6.3).

#### **7.6 ENTERING AND EXITING THE WATER**

There shall be a safe means of entering and exiting the water aboard the DSV such as a ladder or other appropriate device. If a ladder is used, it should extend, at a minimum, three feet below the surface of the water. In addition, a means of entering and exiting the water shall be adequate to facilitate diver extraction or rescue of a man overboard. In the least likely event that the air gap from the deck to the waterline is greater than 15 feet (e.g., possibly aboard some seiners), it is highly recommended that a lifting stage or other appropriate device be the preferred means of entering and exiting the water.

#### 7.7 TERMINATION OF DIVE

A dive shall be terminated when:

- 1) Directed by the DPIC;
- 2) Requested by the diver;

- 3) The diver fails to respond correctly to communications or signals from crew members;
- 4) Communications are lost between the diver and crew members and cannot be re-established quickly;
- 5) Requested by the DSV operator during a live-boating operation; or
- 6) The diver switches to his or her emergence gas supply irrespective of source (i.e., diver-carried or topside).

Finally, under no circumstances shall a diver be required to dive against his or her will.

### 7.8 POST-DIVE PROCEDURES

After completing the day's work, but especially after finishing an ambitious or strenuous set of dives, the DPIC should:

- 1) Query divers about their physical condition;
- 2) Instruct divers to report any physical problems or adverse physiological effects, including symptoms of decompression sickness or gas embolism (Chapter 10);
- 3) Alert divers to the potential hazards of flying after diving or traveling to higher elevations from the dive site; and
- 4) Advise divers of the location of the nearest operational decompression chamber (Seattle, King County, Washington).

After completing dives that exceed the no-decompression time or depth limits, the following are recommended:

- 1) Take reasonable steps to keep the diver awake for at least one hour, preferably in the vicinity of a decompression chamber, if available;
- 2) Advise diver to remain within two hours travel time of the nearest operational decompression chamber (Seattle, King County, Washington) for an additional five hours; and
- 3) Alert diver to the potential hazards of flying after diving or traveling to higher elevations from the dive site.

If decompression sickness is suspected or ensues, consult with proper medical authorities or activate emergency management services, and follow procedures outlined in Chapter 10.

#### 7.9 RECORD KEEPING

Proper record keeping is an essential component of conducting a safe, professional commercial harvest diving operation. Furthermore, properly-maintained records affect the bottom-line and can improve fishing success. For example, record keeping is critical when reviewing diving accidents or incidents aboard the DSV and provides an archive of successful fishing accomplishments on the water. Finally, the responsibility of record keeping aboard a DSV falls not only on the DPIC and crew, but also on individual divers as well.

#### 7.9.1 SHIPBOARD OR "COMPANY" RECORD OF LOGGED DIVES

The DVO or his or her designee (i.e., the DPIC) shall establish and maintain a record of every diver's hyperbaric exposure aboard his or her DSV on a daily basis. This record must be available to LNR authorities upon request and should contain the following:

- 1) Name and contact information for the DVO;
- 2) Date, time, and location of commercial harvest diving operations;
- 3) Names of DPIC and crew members;
- 4) Types of diving equipment worn or used;
- 5) Composition of breathing gas mix used;
- 6) Depths of dives (fsw);
- 7) Bottom times (min);

- 8) Surface intervals or elapsed time since last pressure exposures (if less than 24 hours) and repetitive dive designations;
- 9) If applicable, dive tables or dive schedules used;
- 10) If not harvesting, other type(s) of work performed;
- 11) Environmental conditions such as approximate sea state, tides and currents, water temperature, underwater visibility, and unusual conditions; and
- 12) Descriptions of incidents or diving accidents (Chapter 10).

#### 7.9.2 DIVER'S PERSONAL RECORDS AND LOG BOOK

Individual crew members advancing from HT through EDO classifications should maintain a personal log book (or equivalent) detailing their training, work performed, and hyperbaric exposures to facilitate review and evaluation by LNR for advancement purposes. It is highly recommended that an individual document his or her professional development beyond his or her original classification by LNR if or when he or she is being considered for work outside of the Lummi Nation. The personal log book must be traceable back to the individual and should contain, at a minimum, the following information:

- 1) Name and contact information;
- 2) Date, time, and location of commercial harvest diving operations;
- 3) Names of DSV, DVO and/or DPIC;
- 4) Types of diving equipment worn or used;
- 5) Composition of breathing gas mix used;
- 6) Depths of dives (fsw);
- 7) Bottom times (min);
- 8) Surface intervals or elapsed time since last pressure exposures (if less than 24 hours) and repetitive dive designations;
- 9) If applicable, dive tables or dive schedules used;
- 10) If not harvesting, other type(s) of work performed;
- 11) Environmental conditions such as approximate sea state, tides and currents, water temperature, underwater visibility, and unusual conditions;
- 12) Descriptions of incidents or diving accidents (Chapter 10); and
- 13) When applicable, signature line for DVO and/or DPIC.

# **Example Form**

## **Voluntary Assumption of Risk**

## Participation in Commercial Harvest Diving Operations

, hereby affirm that I am a Lummi Natural Resources Department (LNR)-classified Hose Tender, Trainee Diver, Experienced Diver, or Experienced Diver Operator (EDO) under the control and/or supervision of an LNR-classified EDO or Dive Vessel Owner (i.e., the designated person-incharge, DPIC) who acknowledges that commercial harvest diving, especially when diving below 60 fsw, when liveboating, or if involving unplanned decompression, with compressed air or oxygen-enriched air (NITROX) supplied by a standard onboard surface supply compressor, involves certain inherent risks. These risks include, but are not limited to, the following: barotraumas or hyperbaric injuries, hypoxia, hypercapnia, inert gas narcosis, oxygen toxicity, decompression sickness, gas expansion injuries, or drowning. I understand that treatment for such injuries may require a hyperbaric chamber or medical facility that is located over two hours away from the Lummi Reservation and the Lummi Nation usual-and-accustomed fishing grounds and stations. I further understand that commercial harvest diving activities may occur at remote sites which are isolated by time and distance from the nearest operational hyperbaric chamber or medical facility. I still freely choose, without coercion by the DPIC, to proceed with such work despite the distance to the nearest hyperbaric chamber or medical facility and the lack of such equipment at the dive site. I understand that, by participating in a commercial harvest diving operation, I am subject to certain requirements and approval by LNR (hereafter, qualified crew member), and I am subject to additional hazards during transit to and from the dive site which may include, but are not limited to, the following: slipping or falling while onboard, being struck by the diving support vessel or other vessel while in the water, injuries occurring while entering or exiting the diving support vessel, and other perils of the sea.

I, \_\_\_\_\_\_\_\_\_, hereby affirm that, in the case of exercising the privilege of using an unqualified Lummi fisher as a hose tender on a limited-term basis when an LNR-classified hose tender is considered a "no-show" for the day (i.e., variance for a "no-show" hose tender), I accept all risks, liabilities, and limitations associated with this action. Further, I understand that, if am not an LNR-classified hose tender or dive-qualified crew member, I may not be able to perform routine tasks associated with a typical commercial harvest diving operation nor may I respond appropriately during a diving emergency. Having acknowledged the risks, liabilities, and limitations associated with exercising the variance for a "no-show" hose tender, I still freely choose, without coercion by the DPIC, to participate in this activity.

Signature of Participant		Date	
Signature of DVO or DPIC		Date	
EMERGENCY CONTACT INFORMATION:			
Name	Phone #	Relationship	

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# COMMERCIAL HARVEST DIVING STANDARDS





## COMMERCIAL HARVEST DIVING STANDARDS



In memory of Robert Davis III



## **8.0 UNDERWATER OPERATIONS: PLANNING and PREPARATION**

### **8.1 GENERAL**

Proper pre-job planning is required to ensure that the necessary levels of personnel and equipment are available for a safe commercial harvest diving operation. Prior to mobilization, potential hazards should be identified and their inherent risks assessed. Specific procedures for an operation will vary with the type of diving mode used. The minimum requirements for a typical commercial harvest diving operation are outlined in this chapter. Increased manning levels and additional equipment should be considered for more complex or technical diving operations. Additional information for these diving modes can be found in subsequent chapters. For example, standards for geoduck clam harvesting are summarized in Chapter 9.

During surface supplied air commercial harvest diving operations, all crew members must respond to direction from a designated person-in-charge or DPIC. Individuals other than divers (e.g., HTs) may be used to tend cables and lines entering the water. Furthermore, at least one qualified fisher among the dive crew must be fully competent, equipped, and designated to perform the duties of a standby diver, lending emergency assistance to the current or active diver, if necessary. All crew members should be present at a pre-dive safety meeting, and prior to commencing a complex or technical diving operation (Chapter 9), the prudent DPIC will prepare a Job Hazard Analysis (JHA, Section 8.10.3) to be shared with his or her crew during the planning phase of the operation. The JHA may also include methods for the safe extraction or recovery of an incapacitated diver.

### **8.2 DESIGNATING THE PERSON-IN-CHARGE**

A qualified person shall be designated in charge of each commercial harvest diving operation (hereafter, designated person-in-charge or DPIC). The DPIC must be an LNR-classified ED or EDO in good standing. A DVO may serve as the DPIC so long as he or she is dive-qualified and has experience and training in conducting harvest diving operations as outlined in these standards. A formerly-classified and qualified ED or EDO may serve as the DPIC so long as he or she left service in good standing and is fit to serve in the capacity of a DPIC as outlined in these standards. LNR-classified HTs and TDs may not serve as the DPIC. The responsibilities of the DPIC include planning and coordinating operations, record keeping and proper response to any job-related emergency, and knowledge of the appropriate rules and guidelines in the Lummi Natural Resources Code (Title 10) and the most-recent version of these standards (see also Chapter 4).

#### **8.3 MINIMUM PERSONNEL REQUIREMENTS**

The minimum number of persons comprising a commercial harvest diving crew shall never be less than three LNR-classified individuals with the following configuration:

- 1) One Designated Person-in-Charge or DPIC (ED, EDO, or dive-qualified DVO);
- 2) One secondary or standby diver (e.g., ED or TD); and
- 3) One HT (but may also be a third LNR-classified diver).

Lummi fishers assigned to a commercial harvest diving crew must be adequately trained and experienced in the procedures and equipment associated with this type of fishing activity. Prior to participating in a commercial harvest diving operation and being assigned specific duties by the DPIC, crew members must demonstrate their knowledge and ability in performing all necessary tasks as per the DPIC's satisfaction. While the DPIC is generally responsible for the health, safety, and welfare of his or her crew, individual divers and hose tenders are ultimately responsible for ensuring their own familiarity with the procedures and equipment associated with a safe and reliable commercial harvest diving operation. At no time should any member of the crew be asked to perform an activity that prevents him or her from fulfilling his or her assigned duties and responsibilities as set forth by the DPIC.

In the event an LNR-classified hose tender fails to report for duty as planned for a given fishery opening, the DPIC or DVO may contact the DSA to seek conditional approval for an unqualified yet trusted Lummi fisher to participate on his or her commercial harvest diving crew for the day as per Section 2.6.3. The variance for a "no-show" hose tender should be used rarely and should never be used as a substitute for properly manning a qualified and experienced crew.

#### **8.4 TEMPORARY IMPAIRMENT OR CONDITION**

A crew member should not dive or be otherwise exposed to hyperbaric conditions for the duration of any known temporary impairment or condition, especially if the condition is likely to adversely affect his or her health, interfere with the person's ability to safely be exposed to hyperbaric conditions, or to safely perform a specific task related to the commercial harvest diving operation. Examples include but are not limited to: colds, alcoholic intoxication or its after effects, influence of drugs, pregnancy, respiratory or middle ear diseases, skin or external ear infections, excessive fatigue, or emotional distress. A diver should be consulted by the DPIC before such determination is made. In no case shall a diver be required to dive or be exposed to hyperbaric conditions against his or her will except for controlled, treatment procedures by qualified professionals during an emergency.

#### **8.5 STANDBY DIVER REQUIREMENT**

At least one member of every commercial harvest diving crew shall be designated the standby diver and should be suitably prepared to enter the water when directed by the DPIC. The standby diver may be an LNR-classified TD, ED, or EDO. Prior to commencement of the operation, the standby diver's equipment shall be verified as functioning correctly and thereafter maintained in that condition until completion of the dive. Should the standby diver be required to enter the water, a surface check shall be completed to ensure proper breathing gas supply, bailout function and effective communications before the diver leaves the surface. The standby diver should utilize the same mode and level of equipment as the primary diver.

Note: If the commercial harvest diving operation calls for more than one working diver in the water at a time, each working diver should be continuously tended by a separate crew member. If the nature of the work does not subject the second diver in the water to the same hazard as the primary diver, the second diver in the water can serve as the standby diver. Finally, the secondary or standby diver must remain in close proximity to the primary diver.

#### **8.6 TEAM BRIEFING**

Before commencing underwater operations, the crew members should be briefed on:

- 1) The tasks to be undertaken;
- 2) Safety procedures for the diving mode;
- 3) Any unusual hazards or environmental conditions likely to affect the safety of the underwater operation; and
- 4) Any modifications to operating procedures necessitated by the specific underwater operation.

In addition, before each dive, the diver should be instructed to report and record any physical problems or adverse physiological effects that might render him or her unfit to dive. An example of a pre-dive safety checklist is available at the end of this chapter.

#### **8.7 REVIEWING SAFETY PROCEDURES**

The following should be considered a minimum set of guidelines for reviewing safety procedures aboard an LNRregistered commercial harvest diving vessel. Modifications may be required depending on the needs or nature of the planned commercial harvest diving operation.

#### 8.7.1 SAFE PRACTICES OR SAFE OPERATIONS MANUAL (see also Chapter 7)

- 1) The most recent version of a safe practices or safe operations manual; the LNR Commercial Harvest Diving Standards may serve as a safe practices manual;
- 2) Copy given to DPIC, when requested;
- 3) Available to all crew members at dive site;
- 4) Team member assignments and responsibilities;
- 5) Safety procedure checklist;
- 6) Equipment procedures and checklist;
- 7) Specific individual procedures for tools, equipment and associated systems; and
- 8) Emergency procedures for medical illness or injury, fire, equipment failure, and adverse environmental conditions.

#### 8.7.2 EMERGENCY AID (see also Chapter 10 and Appendix II)

- 1) Nearest decompression chamber (off -site);
- 2) Nearest hospital/medical treatment facility;
- 3) Air or ground emergency transportation;
- 4) On-call physician;
- 5) U.S. Coast Guard, other national Rescue Coordination Centers, or other responding authority;
- 6) Emergency rescue source other than U.S. Coast Guard; and
- 7) Two-way communications available on site and where practical, tested to emergency response link.

#### 8.7.3 FIRST AID (see also Chapter 10)

- 1) First aid kit;
- 2) First aid manual(s);
- 3) Bag-type manual resuscitator; and
- 4) Emergency oxygen administration kit.

## **8.8 VOICE COMMUNICATIONS ON STATION**

There should be a properly functioning two-way audio-communication system between the diver and crew at the dive location. During underwater operations, topside communications must be established between the DPIC, the diver, and other key personnel (e.g., HT) and continuously maintained for the duration of the dive.

#### **8.9 OPERATIONS PLANNING AND ASSESSMENT**

Prior to commencing a dive, an operations plan should be developed to ensure successful completion of the work in a safe, efficient manner. A commercial harvest diving operations plan is a critical element of any underwater project. In general, the commercial harvest diving operations plan will address regulatory requirements, goals and objectives of the project, operational sequence and safety, crew and equipment requirements, communications, and emergency procedures. This list is not finite, and the items to be addressed in a commercial harvest diving operations plan may change depending on the nature of a particular project.

#### 8.9.1 PLANNING AND ASSESSMENT

- 1) Site assessment;
- 2) Evaluate environmental factors and response readiness where applicable;
- 3) Thermal protection (all crew members);
- 4) Crew assignments, briefing, and fitness to dive:
  - a. Designate DPIC; and
  - b. Inert gas status of diving crew members (repetitive dive designations).
- 5) Dive plan:
  - a. Discuss nature and planned times for proposed underwater operation;

- b. Diving mode/equipment system(s);
- c. Involvement of the DSV's personnel;
- d. Review any necessary modifications to the safe practices/operations manual; and
- e. Develop job hazard analysis for complex, technical diving operations (see also Chapter 9).
- 6) Dive station setup:
  - a. Communications procedures and methods for all personnel involved in the operation;
  - b. Breathing gas supplies, including reserves (set up and tested); and
  - c. Means of water entry and exit.
- 7) Emergency procedures:
  - a. Decompression and treatment procedures; and
  - b. Evacuation plan.

#### 8.9.2 JOB/PROJECT SAFETY

Diving operations should be planned in accordance with the LNR Commercial Harvest Diving Standards and those policies set forth by the DVO or DPIC and should include the following elements:

- 1) An LNR-classified EDO or qualified ED should be in charge of the commercial harvest diving operation (i.e., designated DPIC);
- 2) All diving personnel shall be LNR-classified for the task they are assigned;
- 3) The job and all tasks should be defined, reviewed and understood by the crew and vessel personnel;
- 4) A pre-dive safety meeting should be conducted;
- 5) An emergency action or response plan should be discussed, posted, or otherwise reviewed by all personnel (see example emergency action plan at end of chapter); and
- 6) If necessary, the DPIC will perform a job-specific JHA (Section 8.10.3) for complex, technical diving operations (see also Chapter 9).

#### 8.9.3 DIVING AND SUPPORT PERSONNEL

- 1) All divers must be trained and experienced for the task they are to perform;
- 2) The DPIC shall verify that all divers are physically and mentally fit to dive; and
- 3) All personnel on the job must have direct communication with all parties directly involved in the commercial harvest diving operation.

#### 8.9.4 EQUIPMENT

- 1) Inspect and check all dive gear and support equipment for readiness (see example of pre-dive safety checklist at end of this chapter and the example audit sheet in Appendix IV);
- 2) Ensure all methods of communication are available and functioning;
- 3) Confirm that emergency support equipment is inspected and checked for functionality:
  - a. Ensure all first aid/CPR (resuscitator)/emergency oxygen administration equipment and kits are well-supplied and available.
- 4) Confirm that all dive flags/shapes/signals are prominently displayed during commercial harvest diving operations (see also Chapter 7).

## 8.10 HAZARDS TO UNDERWATER OPERATIONS

Commercial harvest diving operations should not occur where activities or conditions in the vicinity of the dive site pose a safety hazard to a diver or impede the crew from safely carrying out their work. Notice should be given, including daily start and finish times, to other parties in the vicinity of the dive site whose activities might interfere with or pose a hazard to the commercial harvest diving crew. Examples include movement of other surface vessels, including dredgers or draggers, and lifting material directly over the commercial harvest diving operation. Finally, in no case shall a diver be required to dive against his or her will.

#### 8.10.1 EXAMPLES OF HAZARDS TO COMMERCIAL HARVEST DIVING OPERATIONS AT SURFACE

- 1) Weather or other environmental conditions (e.g., tides and currents) affecting the DSV or related diving equipment;
- 2) Surface vessel, shore traffic, and some aircraft operations;
- 3) Other fishing operations; and
- 4) Overhead crane/gantry operations.

#### 8.10.2 EXAMPLES OF POTENTIAL UNDERWATER HAZARDS

- 1) High currents or severe tidal conditions;
- 2) Submerged obstructions;
- 3) Foreign waterborne materials (e.g., drift logs);
- 4) Limited access or confined space;
- 5) Umbilical fouling and entrapment;
- 6) Marine life;
- 7) Contaminated or toxic liquid (e.g., sewer or stormwater outfalls);
- 8) Differential pressures (as found in some fish and shellfish hatchery settings);
- 9) Underwater sonar;
- 10) Use of explosives or seismic activities (e.g., U.S. Navy operations); and
- 11) Cathodic protection (as used in marinas that are highly prone to electrolysis).

#### 8.10.3 HOW TO CONDUCT A JOB HAZARD ANALYSIS (JHA)

Before conducting a complex or technical underwater operation (see also Chapter 9), the DPIC should consider performing a job hazard analysis (JHA). The purpose of the JHA is to provide a way of identifying hazards associated with each step of a job and develop solutions that will reduce, eliminate, or guard against hazards. A JHA differs from a commercial harvest diving operations plan (Section 8.9) in that the JHA is focused specifically on project safety, whereas the commercial harvest diving operations plan is designed to ensure the work is wellunderstood and properly planned, manned, and equipped. When written, JHA sentences should be short and simple, and may include but not be limited to the following:

- 1) Sequence of basic job steps:
  - a. Break the job into observable steps and number each one;
  - b. Begin steps with an active verb, e.g., "Disconnect all...", "Start the...", "Check for...", "Invert the...", "Assemble the...", "Isolate all...", and so on;
  - c. Use clear and concise language, avoiding vagueness and verbosity; and
  - d. If the job is too complex, break it down into several smaller tasks, possibly preparing a JHA for each one.
- 2) Potential hazards:
  - a. Identify possible hazards associated with each step and list that hazard opposite the job step;
  - b. Consider potential accident causes (e.g., strain, sprain, slip, fall, cut, or crush); and
  - c. Consider environmental and health hazards (e.g., vapors, gases, heat, noise, or toxicity).
- 3) Recommend safe procedures and protection:
  - a. Develop solutions for each potential hazard and list the solution opposite the hazard;
  - b. Detail controls (e.g., ventilate, isolate, allow to cool, secure, guard, or train); and
  - c. List personal protective equipment (PPE) required (e.g., personal flotation devices, gloves, eye protection, respirators, or fall protection).
- 4) Assign Responsibility:
  - a. Assign a specific person the responsibility of implementing the safety procedures or protection required (usually the DPIC, e.g., an EDO or qualified ED).
- 5) Personnel Involved:

- a. Identify the person(s) preparing, reviewing, and approving the JHA (usually the DPIC, e.g., an EDO or qualified ED); and
- b. Distribute the JHA to all personnel involved in the job or task and ensure that each person is familiar with the contents of the JHA.
- 6) Revising the JHA
  - a. The JHA should be reviewed and updated whenever new equipment, products, or procedures are introduced into the work site. This is especially true if an accident has occurred on a task upon which a JHA has been performed

## 8.11 INSPECTION OF LIFE-SUPPORT SYSTEMS, EQUIPMENT, AND TOOLS

All operational systems, equipment, and tools used while commercial harvest diving should be in compliance with the standards presented in Chapter 5 and should also be appropriate for the tasks at hand. Furthermore, all operational systems, equipment, and tools should be inspected daily and routinely monitored by designated crew members. Each diving crew member should inspect his or her own personal diving equipment and confirm its operational readiness prior to use. In addition, the DPIC (or his or her designee) should complete a final check of each diver's equipment before the diver enters the water. To ensure the highest level of safety, standardized checklists should be used to confirm that all operational systems, equipment, and tools are in safe working order (see pre-dive safety checklist at end of this chapter; but see also Chapter 5 and Appendix IV).

#### 8.11.1 GENERAL EQUIPMENT PREPARATION

- 1) Lay-out, assemble, and inspect all diving equipment and spares intended for the job, including all accessory equipment and tools;
- 2) Check all helmets and masks and ensure they are certified and properly functioning; and
- 3) Confirm that all accessory equipment (e.g., tools, lights, special systems, or spares) is at the dive site and in working order.

#### 8.11.2 PREPARING THE BREATHING GAS SUPPLIES

Primary and back-up breathing gas supplies should be checked, available in sufficient volumes, and properly mixed to accommodate the diving mode and profile. In addition, supply pressures should be deemed adequate for the intended operation (i.e., appropriate for the helmets or masks to be used) and the breathing gases should comply with regulations for purity.

- 1) Verify that breathing gas supplies are adequate to "feed" or pressurize all necessary equipment and are suitable for all phases of the planned operation including decompression.
- 2) Confirm that the available breathing gas supply pressure is adequate for the intended depth and duration of the dive, and that it will accommodate the over-bottom pressure and minimum flow requirements (as per manufacturer's specifications) of the helmet or dive mask to be used in the operation. Air flow requirements can be calculated by:
  - a. Flow = (((D + 33)/33)\*ACFM)\*n, where
    - i. D equals the depth (in feet) of the intended dive;
    - ii. *ACFM* equals the minimum air flow requirement based on the manufacturer's specifications for the intended helmet or mask; and
    - iii. *n* equals the number of divers (Note: The standby diver must be included in the equation; hence, if the dive is conducted by one individual, *n* will be 2).
- 3) Check that suitable volume tank and filtration system are installed in the air supply line between the supply source and diver's hose connection.
  - a. A filtration system must be installed between the volume tank and dive manifold.
- 4) Inspect all supply hoses running to and from the compressor. Verify that proper leads:
  - a. Do not pass near high-heat areas such as steam lines,
  - b. Are free of kinks and bends, and
- c. Are not exposed on deck in such a way that leads could be crushed, rolled over, damaged, or severed by machinery or other means.
- 5) Confirm that all high-pressure supply and interface hoses have safety lines and strain relief properly attached.
- 6) Should O<sub>2</sub> in excess of 50 percent be used for in-water breathing media, the equipment should be O<sub>2</sub> clean and designed for use with pure oxygen. All personnel should be formally trained in its use (see also Section 9.6).

#### 8.11.3 CHECKS ON COMPRESSOR SYSTEMS

- 1) All compressors should be serviced, fully fueled, and lubricated:
  - a. Check that sufficient fuel, coolant, and lubricants (and anti-freeze, if applicable) are available to service all components throughout the operation;
  - b. Verify that oil in the compressor is of an approved type;
  - c. To avoid contaminating the air supply, do not overflow the compressor oil fill mark during servicing; and
  - d. Oil and fuel spillage should be cleaned up immediately.
- 2) Ideally, compressors should not be covered during operation:
  - a. Ensure compressor is adequately ventilated.
- 3) Check that the compressor's exhaust is vented or directed away from the work area;
- 4) Be sure that compressor inlet is located in an area free of potential contaminants and not in the path of exhaust gases;
- 5) Inspect all filters, cleaners, and oil separators for cleanliness;
- 6) Bleed off condensed moisture from filters and from the bottom of volume tanks;
- 7) Check all manifold drain plugs;
- 8) See that all valves are properly aligned;
- 9) Check all pressure-release valves, check valves and automatic un-loaders; and
- 10) Ensure that belt-guards are properly in place on drive units.

#### 8.11.4 ACTIVATING THE BREATHING GAS SUPPLIES

- 1) Compressors:
  - a. Follow all warm-up procedures correctly;
  - b. Check all petcocks, filler valves, filler caps, overflow points, bleed valves and drain plugs for leakage or malfunction of any kind;
  - c. Leak-check all valves and connections; and
  - d. Verify that there is a properly functioning pressure gauge on the air receiver and that the compressor is meeting its delivery requirements.
- 2) Cylinders:
  - a. Check all cylinders for proper pressure;
  - b. Verify availability and suitability of reserve cylinders;
  - c. Check all manifolds and valves for operation; and
  - d. Activate cylinders and check delivery.

#### 8.11.5 BREATHING GAS HOSES

- 1) Ensure that breathing gas hoses are suitable for their intended purpose and the gases to be used;
- 2) Maintain cleanliness and proper condition of breathing gas hoses;
- 3) Ensure all hoses have a clear lead and are protected from excessive heating or physical damage;
- 4) Secure or tie-off umbilical so that it does not break away or uncouple from the compressor;
- 5) Prior to connecting breathing gas hoses, briefly blow through them; and
- 6) Ensure that umbilical is properly marked to determine its distance when paid out from the dive control station or DSV.

7) <u>When available and used, the pneumofathometer (pneumo) hose should always contain the same</u> breathing gas mix as the diver breathing media; this is crucial when the pneumo hose is used during an emergency procedure.

#### 8.11.6 TESTING OF EQUIPMENT WITH BREATHING GAS SUPPLY ACTIVATED

- 1) Hook up breathing gas hoses to helmets, masks, and bailout systems;
- 2) Make connection between back-up supply and primary supply manifold;
- 3) Verify flow to helmets and masks;
- 4) Check all exhaust and non-return valves;
- 5) Check breathing gas hoses and fittings for secure connectivity, leaks, and flow; and
- 6) Ensure breathing gas mix is suitable for depth and diving mode used.

#### 8.11.7 DIVER-WORN OR DIVER-CARRIED EMERGENCY GAS SUPPLY

A diver-worn or diver-carried emergency gas supply, EGS (i.e., the bailout system), shall be provided for all surface supplied air commercial harvest diving operations. The duration of the reserve breathing gas cylinder must be considered and should be part of the pre-dive planning process. The bailout system shall provide:

- 1) The appropriate breathing gas for the type of operation;
- 2) A *minimum* four-minute capacity calculated for the depths involved or deepest depth to be attained so that the diver can:
  - a. Reach the surface, including any required decompression, from his or her maximum depth,
  - b. Reach another source of breathing media, or
  - c. Be reached by the standby diver equipped with another source of breathing media;
- 3) A positive indication to the diver that his or her reserve has been actuated. For example, a:
  - a. Requirement for the diver to open a valve;
  - b. Visual signal or other appropriate method;
  - c. Readily-accessible gauge (Figure 9); or
  - d. Pre-dive bailout drill.

Consumption of an EGS can be determined from a bailout calculation. Table 4 summarizes the results of bailout calculations for a variety of cylinder sizes. This information is provided to aid in selecting a reserve breathing cylinder size appropriate for the intended commercial harvest diving operation.

**Table 4**. Duration (min:sec) of bailout cylinders (30, 50, 80, and 120 ft<sup>3</sup>) at various depths (feet, seawater) under normal conditions (i.e., no stress, exertion, or task-loading). Data are based on bailout calculations reported in the 2011 version of the ADCI standards.

Depth	Cylinder	Duration	Cylinder	Duration	Cylinder	Duration	Cylinder	Duration
(ft <i>,</i> sw)	volume	at depth	volume	at depth	volume	at depth	volume	at depth
25		10:46		17:57		28:43		43:25
50		07:30		12:29	80 ft <sup>3</sup>	19:59	120 ft <sup>3</sup>	30:14
75		05:44		09:34		15:18		23:10
100	20 ft <sup>3</sup>	04:38	50.ft <sup>3</sup>	07:44		12:23		18:45
125	5011	03:53	5011	06:29	80 H	10:23	120 11	15:44
150		03:21		05:35		08:55		13:32
175		02:56		04:53		07:49		11:52
200		02:37		04:20		06:57		10:34

Activation of a diver's breathing gas reserve should cause the dive to be aborted *unless* the primary gas supply can be immediately restored. Irrespective of the reason(s) for bailout activation, all problems must be determined and corrected prior to continued use of the involved equipment.

Finally, <u>it is highly recommended that a diver attach a functioning second stage regulator ("safe second") to the</u> <u>first stage regulator of his or her bailout system</u> (Figure 9). In this way, in the least likely event that a diver loses both his or her primary air source and proper helmet or mask function, e.g., due to failure of the valves when bypassing the failed primary gas supply, failure of the regulator housed inside the helmet or mask itself, or removal (intentional or otherwise) of the helmet or mask (or all three, for that matter!), the diver will at least have access to the "safe second" attached to his or her bailout cylinder in a crisis situation, increasing the probability of completing a successful emergency ascent.



**Figure 9.** Example of a diver-worn or diver-carried emergency gas supply with the second stage of an alternate air source ("safe second") regulator attached to the first stage. A readable pressure gauge may also serve as the positive indication that a diver's reserve has been actuated.

## PRE-DIVE SAFETY CHECKLIST

(Rev. 28 June 2007)

#### Please print all information.

Date: Time: _	Job Number:
Location:	Vessel/Platform:
Person(s) Performing Safety Check:	
Name	Title
Name	Title
Dive Team Members and Assignments:	
Name	Title
(All personnel assigned to th	e dive team should have a valid ADCI Certification Card on record.)
Place a check next to each item and rec	ord all applicable information.
DIVE STATION REQUIRED DOCUMENTATI	ON:
JSA:Tables/Schedules: Dive S	afety Manual: Emergency Contacts and information:
DIVE STA	TION EQUIPMENT AND SYSTEMS
First Aid Kit/First Aid Procedures (Required by ADCI/USCG)	Defibrillator/Bag Type Manual Resuscitator (Required by ADCI/USCG)
Primary Breathing Gas	Air HeO2(%)
Compressor(s)	Fluids/Fuel/Filters:
(Standby Air) Compressed Air Banks/Bottle	
Pressure (PSI/Bar)	Check on Delivery and Activation of GasValves
Gas Supply	
HeO <sub>2</sub> : Number of Banks/Bottles:	Online Pressure (PSIG/Bar):

50/50: Number of Banks/Bottles:	Online Pressure (PSIG/Bar):
O2: Number of Banks/Bottles:	Online Pressure (PSIG/Bar):
Air: Number of Banks/Bottles:	Online Pressure (PSIG/Bar):
Bailout: Air:	HeO <sub>2</sub> (%)
COMMUNICATIONS: Two-way communications on site for emergencies:	(Ensure all communications are hooked up and tested.) (Required by ADCI/USCG)

GAUGES	
Calibrated:	Verifying Documentation:
ALPHA FLAGS/DAY SHAPES/NIGHT LIGHTS:	(Required by ADCI/USCG) (Required by ADCI/USCG)
DIVE LADDER:	(Ensure that it is secured to vessel/platform and in a safe location.)
DIVE HOSES/UMBILICALS:	(Check all diving hoses for proper hook-up, staging and serviceability.)
HELMETS AND MASKS:	(Ensure that all helmets and masks have undergone pre-dive checks and are in
	compliance with manufacturer's inspection guidelines.)
HARNESSES:	(Check for serviceability.)
	(circuit of the output of
BAILOUTS/REGULATORS:	(Ensure that EGS has been activated at the bottle; bailout check and hose
	pressui inducti prior to mater end pr
HARNESSES:	(Check for serviceability.)
Note: Hardhats safety glasses steel-toed boots a	and personal floatation devices adequate for the project are required by ADCI
USCG.	ing personal notation derrees diequite for the project die required by river
COMMENTS:	
Signature(s) of Person(s) Completing Safety Checkl	ist:
Name of Designated Person-in-Charge/Supervisor:	
(Required by ADCI/USCG)	(PRINT)
DPIC / Supervisor's Signature:	

## **EXAMPLE EMERGENCY ACTION OR RESPONSE PLAN**

Diving Emergency Preparedness	Identify injured diver	
Dive Site	Retrieve & evaluate	
Dive Operator	(Hesponsive or Unresponsive r)	
First-Aid Equipment at Dive Site/Boat Name of qualified, on-site first aid provider	Prepare to provide first aid Emergency equipment to scene; oxygen first-aid kit; AED	)
Oxygen Type of oxygen delivery	Unresponsive Responsive	ve
Available quantity		
Location/storage	Determine presence     Provide 0,:	Ask
First-Aid Kit  Available Not Available  Type	of pulse/respiration; start CPR, O <sub>2</sub> and other care as needed	ioms V te)
Location/storage		
AED	Alert Emergency	
Available Not Available	Medical Services (911 or other)	
Location/storage		
Local Information (Include directions to dive site that can be provided to EMS)	Alert USCG or marines by emergency frequency	
Nearest Emergency Department (Include distance, name, address and phone number)	Contact DAN +1 (919) 684-9111	
	Reference Use DAN CPR & First-Aid Slate	
Alternative Medical Facility (Include distance, name, address and phone number)	for care guidelines	
	Record     Complete DAN Diving     Injury Report Summary Slate	
Local Law Enforcement (other than 911)	Manage Risk Complete incident report or	
Name Phone number	by organization / agency	
Local Transportation (taxi service, etc.)		

## COMMERCIAL HARVEST DIVING STANDARDS





# COMMERCIAL HARVEST DIVING STANDARDS



In memory of Hank Hoskins, Sr. (photo credit: NWIFC)



## 9.0 UNDERWATER OPERATIONS: TYPES of DIVING

#### 9.1 GENERAL

Given the wide spectrum of work-related diving, commercial harvest diving is, at its core, technically simple, yet physically challenging for crew members: small, weighted items of value (i.e., live seafood products) are retrieved from physiologically-manageable depths, by hand, over and over again. One of the primary challenges to Lummi fishers participating in this activity then comes from the catch value [price paid (\$US) per lb of landed product] driving commercial harvest diving crews to overextend themselves in a cold or temperate, hyperbaric environment. Restricting the types of diving available to eligible Lummi fishers, therefore, helps offset the natural inclination to push safety limits in the midst of financial gain, ultimately decreasing risk to life, limb, and costly equipment. For example, nitrogen "dosing" of divers can be reasonably controlled by establishing a depth floor, requiring no-decompression diving, and allowing for enriched-air or NITROX diving within an appropriate depth range. Being mindful of the effects of marine air, cool temperatures, and seawater on commercial harvest diving in a cold, marine climate. Finally, a thoughtful, safety-minded approach to more advanced types of diving that are potentially available to eligible Lummi fishers as job complexity increases.

#### 9.2 SURFACE SUPPLIED AIR DIVING 0-100 fsw WITH NO DECOMPRESSION

A surface supplied air (SSA) diving operation at 0–100 fsw with no decompression is the primary type of diving undertaken by Lummi commercial harvest diving crews. The following information in this section is considered mostly redundant, and not necessarily comprehensive, since the majority of requirements for this type of diving were covered in the previous chapters.

#### 9.2.1 MINIMUM PERSONNEL REQUIREMENTS

To reiterate, the minimum number of *qualified* persons comprising a Lummi commercial harvest diving crew is <u>never less than three</u> [i.e., one DPIC (EDO or ED), one standby diver (ED or TD), and one hose tender]. When planning for personnel, the DVO and/or DPIC must take into consideration not only the essential requirements of the work to be performed, but factors known or suspected that could potentially compromise the commercial harvest diving operation. Put another way, merely because a commercial harvest diving crew comprised of three qualified persons is adequate for one job, it does not necessarily mean the same number of persons will be adequate for another. For example, commercial harvest diving operations taking place in a remote location where emergency medical services are limited or not readily available might warrant adding a fourth qualified crew member. Following are some reminders concerning the key three personnel aboard a Lummi DSV:

- 1) One Designated Person-in-Charge or DPIC
  - a. A dive-qualified person shall be designated as the DPIC for each commercial harvest diving operation. The DPIC is in charge of planning and executing the commercial harvest diving operation, and is generally responsible for the safety and health of the crew.
  - b. The DPIC shall posses a proper LNR classification card (e.g., ED or EDO) and be familiar with all techniques, procedures, emergency procedures, and operational parameters for the diving mode under his or her direct supervision.
  - c. The DPIC must consider whether the use of any surface-tended equipment by a diver will require an additional crew member (e.g., HT or TD) to handle associated cables or hoses not affixed to the diver's umbilical.
  - d. The DPIC might also consider an additional crew member (e.g., HT or ED) when any commercial harvest diving operation is conducted that increases the likelihood of a diver being affected by or becoming incapacitated due to existing topside conditions or underwater hazards. These may include, but are not limited to, the following:
    - i. Adverse environmental conditions (e.g., variable weather and tides);

- ii. Possible entanglements (e.g., commercial fishing gear or submerged boulders);
- iii. Other vessels, including DSVs, actively working the area; or
- iv. Physical, chemical, and other hazards (e.g., electrical).
- 2) One standby diver (e.g., TD or ED) with training and experience in the following areas:
  - a. Familiarity with the type of work engaged in;
  - b. Surface supplied air diving procedures and techniques;
  - c. Proper operation and use of all equipment related to SSA diving;
  - d. Performing the duties of a standby diver;
  - e. Diving accident prevention and treatment procedures; and
  - f. Emergency evacuation procedures.
- 3) One HT (but may also be a third LNR-classified diver) with training and experience in the following areas:
  - a. Familiarity with the type of work engaged in;
  - b. Surface supplied air diving procedures and techniques;
  - c. Proper operation and use of all *topside* equipment related to SSA diving;
  - d. Performing the duties of a hose tender;
  - e. Diving accident prevention and treatment procedures; and
  - f. Emergency evacuation procedures.

#### 9.2.2 MINIMUM EQUIPMENT REQUIREMENTS

The information below serves only as a reminder to the DVO and/or the DPIC of the minimum equipment requirements for conducting a safe, successful SSA diving operation. Further details are provided in the previous chapters, which should not be overlooked by him or her.

- 1) Proper means of and equipment for securely anchoring the DSV;
- 2) Appropriate warning display with all-around visibility (e.g., alpha flag);
- 3) Functioning compressor system suited for the job;
- 4) Adequate supply of breathing gas for the planned dive profile;
- 5) Single air source and volume tank to support two divers;
- 6) Topside secondary air source (i.e., the on-deck backup emergency gas supply cylinder);
- 7) At least one hose group (umbilical) consisting of:
  - a. Air hose;
  - b. Strength member/strain relief;
    - i. The strength member may be the entire hose assembly, if so designed.
  - c. Communications cable; and
  - d. Optional pneumofathometer hose.
- 8) Personal depth and time-keeping devices (i.e., dive computers) for all divers aboard the DSV;
- 9) Redundant set of personal diving equipment which may include, but not be limited to, the following:
  - a. Protective clothing (i.e., insulated undergarment);
  - b. Helmet or mask;
  - c. Diver-worn EGS;
  - d. Safety harness and weight belt;
  - e. Alternative time-keeping device (i.e., dive watch); and
  - f. Knives, cutting devices, or other tools as required.
- 10) Control station(s) consisting of:
  - a. Gas distribution system with the capability to supply and control two divers (if applicable to the commercial harvest diving operation) at the maximum work depth;
  - b. Communication systems (i.e., two-way radio);
  - c. Depth gauges, if available (e.g., when using pneumofathometer hose); and
  - d. Appropriate set of air diving tables and procedures to serve as a backup to the divers' computers.
- 11) Basic first aid kit with means of manual resuscitation (pocket mask or others);
- 12) Emergency O<sub>2</sub> administration kit;

- 13) Safe practices manual;
- 14) Shipboard logbook or dive sheets and logs;
- 15) If applicable to the job, confirmation of completing a JHA, written or otherwise; and
- 16) Other relevant spare parts as required (catch or harvest bags, plugs, belts, etc.).

#### 9.2.3 GENERAL OPERATIONAL GUIDELINES

As with sections 9.2.1 and 9.2.2, the information provided here serves only to remind the DVO and/or DPIC of some basic tenets of conducting a safe SSA diving operation. The prudent DVO and/or DPIC will be familiar with all of the contents of these standards; in addition, he or she will pay particular attention to the following:

- 1) The nearest manned, operational decompression chamber should be made known by the DPIC (Seattle, King County, Washington; Appendix II) and acknowledged by the other crew members (Chapter 7);
- 2) For each diving location, it is highly recommended that an evacuation plan be in place;
- 3) Commercial harvest diving crews should be comfortable with and adept at using checklists for all systems;
- 4) The environmental conditions and depth profile for each dive should be determined and discussed *before* the start of operations;
- 5) A dive should be planned ahead of time, and the diver should "dive the plan";
- 6) Each commercial harvest diving operation shall have a primary breathing gas supply sufficient to support all divers for the depth and duration of the planned dive, including unplanned decompression, if circumstances warrant it;
- 7) A diver-worn or diver-carried emergency gas supply (EGS) shall be utilized; and
- 8) Each diver shall be continuously tended while in the water by a separate crew member.

## 9.3 DIVING IN COLD WEATHER AND COLD WATER (<40°F/4°C)

Cold weather and cold water are particularly hard on diving personnel and associated equipment systems. For example, chilling increases fatigue and reduces physical and mental dexterity of crew members both topside and underwater. Divers and hose tenders who are out of shape, underweight, smokers, or have been using drugs or alcohol are at increased risk of chilling; hence, negative impacts can occur even before hypothermia sets in. Furthermore, throughout the Puget Sound estuary, hyposaline seawater (i.e., low salinity or brackish water) or seasonal freshwater lenses might freeze at the surface potentially affecting both diver and his or her equipment. Wind chill might result in freezing conditions onboard impacting critical life support equipment for the diver (who might actually be warmer underwater than his or her topside counterparts!). In any case, precautions should be taken to protect divers and topside personnel from adverse thermal exposure and to maintain proper thermal balance while engaged in commercial harvest diving operations.

#### 9.3.1 HOSE TENDER AND OTHER TOPSIDE PERSONNEL

Hose tenders and topside personnel should:

- 1) Wear warm layers, including head protection, and waterproof or water-resistant outerwear;
- 2) Wear personal flotation devices (PFD) the extra layer will provide additional insulation; and
- 3) Anticipate taking extra time to perform routine or challenging tasks under cold or freezing conditions.

#### 9.3.2 DIVER

- 1) To help prevent chilling and hypothermia, the diver should wear appropriate thermal protection based upon ambient temperature and expected bottom time;
- In cold weather and water (< 40°F/4°C), a proper fitting and well-sealed dry suit should be worn to keep the diver adequately protected;
- 3) Underwater tasks must be clearly identified and diver condition must be monitored continuously since severe chilling can result in impaired judgment;

- 4) Divers should remain hydrated and avoid overexertion since underwater exercise causes body temperature to fall more rapidly in cold- vs. warm water;
- 5) Recall diver if he or she shows symptoms of hypothermia:
  - a. Minor symptoms include uncontrolled shivering, slurred speech, imbalance, or poor judgment.
  - b. Severe symptoms include loss of shivering, impaired mental status, irregular heartbeat, shallow pulse or respiration this is a medical emergency!
- 6) Upon exiting water:
  - a. Consider flushing suited diver with warm water, if available, to provide comforting, heat-replacing effect;
  - b. Remove diver to relatively dry, warm area as soon as possible;
  - c. Have diver remove wet dress, dry off, and don warm, protective clothing as soon as possible; and
  - d. Provide diver with hot, non-alcoholic beverages to drink.

#### 9.3.3 EQUIPMENT AND MAINTENANCE

The preventative maintenance and considerations identified below are not intended to be the only items commercial harvest diving crews should be aware of when operating in cold weather and cold water. Put another way, the following list is not comprehensive; when operating under such conditions, common sense and experience should prevail.

- 1) Extreme caution must be exercised when refueling in dry, cold weather:
  - a. Static electricity may form in clothing layers, possibly causing a spontaneous discharge of electricity (i.e., spark), which can ignite fuels;
  - b. Static electricity may be "drained off" by grounding affected equipment;
  - c. Static electricity built up on a portable fuel container may be drained off, away from vapor openings, with a free hand;
  - d. Use of a copper-screened funnel can help filter out ice particles and other foreign debris.
- 2) Gasoline and diesel engines must be cold-weather modified to prevent engine freeze-up. For example:
  - a. Use proper lubricants in the diver's air compressor; and
  - b. Use appropriate cold-temperature lubricants in pre-packed bearings.
- 3) Extra batteries should be on hand freezing temperatures can shorten the life of a typical battery;
- 4) Moisture build-up in an air compressor or air lines must be minimized or removed to prevent freezing, which can cause catastrophic damage or failure in a diver's life support system:
  - a. Topside personnel must continually empty the excess water out of the volume tank to help reduce the amount of moisture in the system;
  - b. The diver's umbilical should not rest for long periods on extremely cold or frozen surfaces, e.g., fittings on the umbilical can transfer the extremely cold or freezing temperature to the moisture inside the diver's umbilical, causing it to freeze.
- 5) In the rare event of working in *water* temperatures of 37° F (3° C) or less, first stage regulators on bailouts should be equipped with proper cold water setups (i.e., "environmental kits");
- 6) Caution must be taken to ensure that bailout cylinders are completely dry inside, that moisture-free air was used to fill the cylinders, and that regulators are thoroughly dried prior to use;
- 7) If available, maintained, and working properly, high-volume, high-pressure cylinders on deck may be used in lieu of a low-pressure air compressor system since the cylinders contain "drier" air compared to that produced by a low-pressure compressor; and
- 8) A hypothermia management kit should be considered.

## 9.4 GEODUCK CLAM HARVESTING

The geoduck clam is the world's largest burrowing clam and is often found three feet below the sediment surface or mud line. The geoduck clam is the target of a high-value fishery in Washington State. Sometimes this leads to a "gold rush" mentality in a commercial harvest diving crew resulting in unsafe practices. The purpose of this section

is to identify precautions, potential hazards, and ways to mitigate the hazards associated with geoduck clam harvesting.

#### 9.4.1 GENERAL

Harvesting subtidal geoduck clams requires the use of a water pump, hose, hand-held nozzle, and water jet to liquefy the substrate in order to easily remove the organism. Serious harm and injury may result from misusing this equipment or using the gear with improperly selected fittings, hoses, and attachments.

#### 9.4.2 MINIMUM PERSONNEL REQUIREMENTS

Besides the minimum personnel and equipment requirements reviewed in Section 9.2, personnel assigned to a geoduck clam harvesting operation should be adequately trained in using the equipment associated with this activity. Furthermore, crew members should be able to properly demonstrate their knowledge and ability to perform a task as per the DPIC's satisfaction prior to being required to do so. The DPIC is generally responsible for the welfare and safety of the crew; however, an individual diver is ultimately responsible for ensuring that he or she is familiar with the principles of a geoduck harvest diving operation and that he or she is performing the associated tasks in a safe and responsible manner while underwater. Following are the minimum personnel required for this activity:

- 1) One DPIC (ED, EDO, or dive-qualified DVO);
- 2) One standby diver (e.g., TD or ED); and
- 3) One HT (but may also be a third LNR-classified diver).

#### 9.4.3 PRECAUTIONS

All crew members should be familiar with the equipment used to harvest geoduck clams underwater and the hazards associated with its operation. Recommended practices and procedures do not replace proper training in the operation of high-pressure water jet systems. When performing tasks underwater, divers are required to excavate areas or enter excavated areas; therefore, common sense and remaining alert are considered essential components for approaching operations of this nature.

#### 9.4.4 POTENTIAL HAZARDS ASSOCIATED WITH WATER JETS OR NOZZLES

Variations in slope and bottom conditions in harvest areas can cause changes in sediment stability, which warrants a more thoughtful approach to underwater excavation by commercial harvest divers. Furthermore, while hand-jetting, a diver may create a small hole which collapses around the diver's arm posing a temporary or minor entrapment hazard. Suspended material might foul the diver's personal equipment (e.g., helmet/regulator or dry suit exhaust valve) or at the least, obscure visibility. Injuries caused by water jets are highly susceptible to infection and should be treated immediately. Anyone suffering an injection of high-pressure water should immediately stop working, report to the DPIC, and seek proper medical advice or treatment. Other potential hazards include:

- 1) Using substandard equipment or parts in the system that affect discharge pressure of the water jet;
- 2) Inadvertently reducing, blocking, or shutting off water supply to water pump resulting in overheating or damage to water pump;
- 3) Malfunction of jet nozzle or other components of system;
- 4) Injury to topside personnel due to malfunction in hand-jetting equipment;
- 5) A hose or fitting failure that allows leaking, pressurized stream to contact/injure topside personnel;
- 6) Topside personnel inadvertently directing pressure stream against themselves or others when preparing, testing, or using the system;
- 7) Airborne debris or particles resulting from using/testing system topside;
- 8) Bodily strains incurred by topside personnel while handling hose;
- 9) Diver inadvertently directing pressure stream against self, umbilical, or other equipment;
- 10) Injury or damage to diver or equipment from directed pressure stream;

- 11) Valve and nozzle assemblies malfunction affecting diver's ability to properly direct pressure stream;
- 12) Diver's umbilical becoming entangled with water jet nozzle, hose, and anchor line or other submerged obstructions; and
- 13) Diver extending his or her bottom time to the point of pushing or violating no-decompression limits.

#### 9.4.5 RECOMMENDED WAYS TO MITIGATE HAZARDS ASSOCIATED WITH WATER JETS OR NOZZLES

All components of the system should be checked against the manufacturer's instructions to ensure that they are compatible and of the correct thread size and pressure rating for the intended service. Prior to operation, all equipment should be inspected for damage and deterioration, with particular attention paid to high-pressure hoses, fittings and gun trigger function. Before diving, the water blasting equipment should be fully assembled and functionally tested, including emergency shutdown or dump valve operation. Other ways to mitigate hazards include:

- 1) Pre- and post-dive inspections of all equipment and systems to reduce risk of malfunction(s);
- 2) Confirming that diver is capable of handling the force/pressure emitted from end of jet nozzle;
- 3) Periodically assessing potential hazards to diver, his or her umbilical, or hand-jet equipment;
- 4) Maintaining situational awareness on the part of the diver and topside personnel, i.e., routine checks on diver location;
- 5) Diver maintaining proper balance, footing, and positioning to ensure that back or forward spray from jet nozzle does not injure him or her or damage his or her equipment;
- 6) Because of increased sedimentation occurring during excavation, sending gas to the diver's pneumo hose (if applicable) and partially activating the diver's free flow to help "clear" the system; and
- 7) Monitoring diver depth and bottom time to avoid pushing or violating no-decompression limits.

#### 9.5 SCUBA DIVING 0-100 fsw WITH NO DECOMPRESSION

Self-contained underwater breathing apparatus (scuba) and related equipment generally are not used for the conduct of Lummi commercial harvest diving operations; however, there are circumstances or conditions that warrant further consideration of scuba. For example, the hazards of diving in cold weather and cold water were reviewed in Section 9.3: the use of scuba may reduce some risks associated with cold or freezing temperatures. Furthermore, diving in complex, three-dimensional habitats or among submerged objects (e.g., large boulders) that pose entanglement hazards to SSA divers may be better-suited for un-tethered scuba divers. Irrespective of conditions encountered, if scuba is safer or more efficient than the traditional mode of commercial harvest diving, then scuba should be considered. The following subsections describe the minimum requirements for commercial scuba diving operations in 0-100 fsw with no decompression.

#### 9.5.1 MINIMUM PERSONNEL REQUIREMENTS

Lummi fishers participating as divers in the tribe's commercial harvest diving fisheries must successfully complete, at a minimum, an open water scuba diving certification course through a widely-recognized training agency (see Section 2.3). Most newly-certified divers in Lummi's commercial harvest diving fleet transition straight to SSA diving, receiving the bulk of their post-open water SSA training on the job. After this transition, personnel oftentimes neglect maintaining their open water scuba diving skills; therefore, prior to conducting commercial scuba diving operations, crew members should refresh their open water skills. The minimum personnel requirements reviewed in Section 9.2 apply to commercial scuba diving operations as well traditional SSA operations. Besides these, a diver should be physically fit to swim with fins and should be adept at maintaining neutral buoyancy while working/maneuvering underwater. The latter is particularly important for managing air consumption since the diver operating in this mode is now limited only to the gas he or she carries in his or her personal cylinder. Following are the minimum personnel requirements for this activity:

- 1) One DPIC (ED, EDO, or dive-qualified DVO);
- 2) One standby diver (e.g., TD or ED); and

3) One HT (but may also be a third LNR-classified diver).

Finally, if deploying two solo line-tended divers during a commercial scuba diving operation, a fourth qualified person is warranted for the additional tender duties.

#### 9.5.2 MINIMUM EQUIPMENT REQUIREMENTS

Besides the minimum equipment requirements reviewed in previous sections and chapters, if scuba diving with a buddy team, two complete yet independent sets of gear shall be used by the divers. Furthermore, under no circumstances shall solo line-tended scuba divers or buddy teams share a single dive computer. Other gear reminders and requirements include:

- 1) An appropriate harness or backpack with quick release buckles shall be worn to secure the primary cylinder to a scuba diver;
- 2) If not line-tended, a buoyancy compensating device (BCD) shall be worn by a scuba diver to secure the primary breathing cylinder to his or her body;
- The BCD shall also provide him or her with adequate buoyancy control, underwater or at the surface, as needed;
- 4) A weight belt with quick release(s) shall be worn that is appropriate for the diver's dress and his or her planned working depth profile;
- 5) A scuba diver shall be equipped with a submersible pressure gauge that is easily reached and read by him or her;
- 6) Full face masks with through-water communications to topside personnel are preferred;
- 7) Diver-to-diver communications (e.g., hydrophones, transmitters, and receivers) are desirable when deploying two divers;
- 8) In lieu of electronic communications, a buddy team can use common hand signals to communicate with each other (Figure 10);
- 9) When solo line-tended, a scuba diver shall be equipped with a diver-carried emergency gas supply:
  - a. Diver worn/carried emergency gas supply (bailout) must have a calculated four-minute air supply, at a minimum, for the anticipated maximum depth (see Section 8.11.7);
- 10) Every diver should be equipped with a cutting device;
- 11) A scuba diver should carry a diving wristwatch and depth gauge to serve as a backup to his or her dive computer in the event it fails; and
- 12) If not line-tended, divers shall carry whistles or other signaling devices (e.g., submersible lights) to alert topside after surfacing.

#### 9.5.3 GENERAL OPERATIONAL GUIDELINES

When it comes to diving safety, there is considerable overlap between traditional SSA and commercial scuba diving operations. Commercial harvest diving crews should be familiar with the material presented in previous sections and chapters before embarking on a commercial scuba diving operation. Additional safety considerations include:

- 1) Primary cylinder pressure (and bailout pressure, if diving solo line-tended) must be determined immediately before every dive;
- 2) A scuba diver may be solo line-tended from the surface or accompanied by another diver underwater;
- 3) If operating as a free-swimming buddy team, the divers will remain in continuous visual contact with each other throughout the dive;
- 4) During all solo line-tended dives, a standby diver must be available while the primary diver is in the water;
- 5) When two scuba divers are simultaneously in the water and can maintain visual contact, they can serve as each other's standby diver;
- 6) The planned duration of a scuba diving operation should not exceed the no-decompression limits nor the capacity of the cylinder(s) used in the operation;

- 7) Like SSA diving, two-way radio communication between a solo line-tended scuba diver and topside personnel is expected; however, a buddy team may use common hand signals (Figure 10);
- 8) The working depth should not exceed 100 fsw without additional training at deeper depths;
- 9) During periods of low or poor visibility, underwater or at the surface, divers should carry submersible lights for signaling purposes;
- Commercial harvest diving crews should avoid conducting operations against currents exceeding one knot;
- 11) Enclosed or physically-confining underwater spaces should be avoided; and
- 12) A diver should surface with a prudent reserve of breathing gas remaining in his or her cylinder (e.g., primary cylinder pressure  $\geq$  500 PSI).



Figure 10. Common hand signals used by scuba divers for communicating underwater (Source: NOAA Diving Manual, 6<sup>th</sup> edition).

#### 9.6 ENRICHED-AIR or NITROX DIVING

The use of enriched-air or nitrogen-oxygen (NITROX) gas in diving is an advanced, technical mode of operation whereby the percentage of oxygen ( $O_2$ ) in the breathing media is raised above 21%, the amount normally found in air, while the proportional balance of nitrogen ( $N_2$ ) and trace gases, the major component of air, is reduced below 79%. Because of the reduction in  $N_2$  content, a diver may work longer at depth without incurring as high of a decompression burden as a diver breathing normal air working at the same depth. In fact, NITROX can significantly extend bottom times depending on the depths at which it is used. NITROX use is becoming more common in non-Lummi commercial harvest diving operations, and is an acceptable practice to improve the efficiency of some commercial harvest diving operations while reducing the risk of decompression sickness.

#### 9.6.1 ADVANTAGES AND DISADVANTAGES OF NITROX

NITROX is most effective when used at shallow to moderate depths (e.g., 40 - 80 fsw); and while the maximum operating depth (MOD) varies with the percentage of  $O_2$  in the breathing mix, the MOD averages to about 100 fsw. Following are some advantages of NITROX diving over normal air diving:

- 1) Extended bottom times for no-decompression diving;
- 2) Reduced decompression time;
- 3) Reduced residual nitrogen in the body after a dive;
- 4) Shorter surface intervals between dives;
- 5) Useful for multiday, repetitive diving; and
- 6) Beneficial in helping prevent or reduce decompression sickness.

While the advantages of NITROX can be significant, the use of any breathing gas in lieu of normal air brings with it additional complexities, responsibilities, and hazards that must be addressed prior to its use. <u>The use of NITROX</u> requires specialized training and experience by ALL crew members. **MISUNDERSTANDING OR MISUSING ENRICHED-AIR/NITROX CAN RESULT IN DIVER INJURY OR DEATH**. <u>There is no margin for error or complacency</u> when using NITROX. Other disadvantages of using it include:

- 1) Additional training, certification, and the ability to mix and analyze gases;
- Conforming to required (strict) depth and bottom time limits (e.g., an average MOD of no deeper than 100 fsw);
- 3) Ensuring the proper mix of breathing gas is being used for the intended working depth profile;
- 4) Routine, specialized equipment maintenance;
- 5) Increased risk of pulmonary oxygen toxicity; and
- 6) Increased risk of central nervous system (CNS) oxygen toxicity when the  $O_2$  dose is too high for too long.

With the exception of the minimum personnel requirements (Section 9.6.2), the concepts and safety elements addressed hereafter are intentionally left at an introductory level. <u>This material is not comprehensive, nor is it intended to be a replacement for proper training, certification, and experience in using NITROX</u>. The primary reference documents for this section are the 2008 U.S. Navy Diving Manual (6<sup>th</sup> revision) and the 2017 NOAA Diving Manual – Diving for Science and Technology (6<sup>th</sup> edition).

#### 9.6.2 MINIMUM PERSONNEL REQUIREMENTS

As described in previous sections and chapters, the minimum personnel requirements for this type of activity are:

- 1) One DPIC (ED, EDO, or dive-qualified DVO);
- 2) One standby diver (e.g., TD or ED); and
- 3) One HT (but may also be a third LNR-classified diver).

Besides the minimum crew size of three, additional training beyond that identified in Chapter 2 is required. <u>All</u> <u>personnel participating in a commercial harvest diving operation using NITROX shall be trained and certified in its</u> <u>use by a widely-recognized training agency according to a widely-accepted diving industry standard</u>. This training must be fully documented, submitted to the DSA as per Section 2.6, and will include the following topics:

- 1) NITROX use: History, terminology, advantages, and disadvantages;
- 2) Theory: Gas laws and calculations, concept of equivalent air depth, tables, and computers;
- 3) Equipment considerations;
- 4) Gas supply: Preparing, mixing/blending, and analysis; and
- 5) Procedures: Time and depth considerations, repetitive diving, and emergencies.

#### 9.6.3 MINIMUM EQUIPMENT REQUIREMENTS

- 1) Cleaning equipment for oxygen service:
  - a. Equipment used for handling higher than normal levels of O<sub>2</sub> should be made of O<sub>2</sub>-compatible materials and must be clean, free of hydrocarbons, particulates, or other materials that could potentially burn in the presence of O<sub>2</sub>;
  - b. Formal cleaning procedures require strict adherence to published federal and industry standards and must be performed by technicians trained and authorized in those procedures;
  - c. Informal procedures include removing any visible debris, scrubbing manually or ultrasonically with a strong detergent in hot water, then rinsing several times in clean, hot water; and
  - d. Current federal guidelines allow gas mixes with  $O_2$  up to 40% to be handled as if they were air. Most of this equipment can be cleaned informally. Formal cleaning is recommended for equipment using gas mixes with percentages of  $O_2$  higher than 40; however, the commercial diving industry routinely uses up to 50%  $O_2$  at low delivery pressures without formal  $O_2$  cleaning (see the U.S. Navy and NOAA diving manuals for appropriate details on the federal guidelines).
- 2) Breathing gas certifications and labeling:
  - a. All gas cylinders used in NITROX operations shall be cleaned, certified, and clearly marked as to that use by the vendor or dive contractor supplying the gas; and
- b. The gas mix of each cylinder (e.g., "32% O<sub>2</sub>") shall be indicated with an appropriate tag or label.
  3) Breathing gas purity (see also Chapter 5):
- 3) Breatning gas purity (see also Chapter 5):
  - a. It is essential that all gases used in producing a NITROX mix meet the breathing gas purity standards for  $O_2$  and  $N_2$ ;
  - b. If air is to be blended with  $O_2$  to produce the breathing gas mix, it must meet the purity requirements of oil-free air; and
  - c. Air or  $N_2$  must be filtered prior to being mixed with  $O_2$ .
- 4) Mix testing and tolerance:
  - a. Each container of NITROX being placed on-line in support of a commercial harvest diving operation must be tested on-line, e.g., at the point of distribution manifold, with a calibrated oxygen analyzer by the DPIC, the diver, or a qualified, designated crew member to confirm the gas mix prior to use; and
  - b. All NITROX gases shall be within +/- one percent (1%) of the certified breathing gas mix.

#### 9.6.4 CONCEPT OF EQUIVALENT AIR DEPTH (EAD)

The equivalent air depth (EAD) is the diver depth based on the partial pressure of  $N_2$  in the NITROX mix to be breathed rather than the actual depth of the dive. So, when breathing less  $N_2$  than what is normally found in air, a diver's equivalent depth is less or shallower than if he or she was breathing air at a specific depth. Put another way, although the diver is *physically* at a specific depth, his or her body *physiologically* is absorbing  $N_2$  equivalent to a *shallower* depth, thereby decreasing his or her nitrogen load and potential decompression burden. When diving with air, the EAD is simply the actual depth. When breathing a gas mix with more than 21%  $O_2$ , and therefore, less than 79%  $N_2$ , the EAD will be shallower than the actual depth. The EAD is calculated using the following equation:

 $EAD = ((FN_2/0.79)^*(d + 33)) - 33$ 

This can be rearranged as:

 $EAD = ((FN_2^*(d + 33))/0.79) - 33$ 

Where  $FN_2$  is the fraction of  $N_2$  in the NITROX mix (i.e.,  $1 - FO_2$ ), 0.79 is the fraction of  $N_2$  in normal air (including the trace gases), *d* is the actual depth in the appropriate units (e.g., fsw), and 33 is the depth of seawater (fsw) equal to one atmosphere of pressure.

These values can be arranged in a table for easy reference. The NOAA Diving Manual provides EADs for  $O_2$  percentages between 28 and 40, whereas the U.S. Navy Diving Manual provides EADs for  $O_2$  percentages between 25 and 40. Commercial harvest diving operations using NITROX can then plan dives using any schedule from the U.S. Navy no-decompression air tables by knowing the EAD for the NITROX mix used (Appendix III). Today, most dive computers have settings for NITROX-use which allow a diver to select for the percentage of  $O_2$  he or she will be using on a particular dive obviating the need for tables. Still, commercial harvest diving crew members should be verse in using the tables in the event of a dive computer failure or if blending their own mix of gases topside.

#### 9.6.5 GENERAL OPERATIONAL GUIDELINES

When selecting the appropriate NITROX mix for a commercial harvest diving operation, caution should be exercised and planning must occur. The maximum depth of a dive and the planned bottom time must be determined in advance. Indeed, if a diver exceeds his or her planned depth profile and bottom time for the planned NITROX mix, he or she is at greater risk of developing pulmonary oxygen toxicity or even life-threatening central nervous system (CNS) oxygen toxicity. Appendix III provides tables for maximum single and 24-hour exposure times for PPO<sub>2</sub> values ranging from 0.5 to 1.6; when diving, these times must not be exceeded. The following operational guidelines, when used with an appropriate NITROX-capable dive computer or the U.S. Navy no-decompression air tables (Appendix III), will greatly reduce the risk to the diver from the onset of pulmonary oxygen toxicity or CNS oxygen toxicity. To reiterate, this material is not comprehensive, nor is it intended to be a replacement for proper training, certification, and experience in using NITROX.

- 1) Dives must be planned so that, should a diver be switched from NITROX to compressed air at any time during the dive, the diver's decompression commitment will not exceed the operational planning limits of an air-dive at that depth.
- 2) Maximum oxygen percentage of the NITROX mix shall be 40 percent (except when used as a decompression or therapeutic media).
- 3) All NITROX gases shall be within ± 1 percent of the certified breathing gas mix. Round all gas mixes to the nearest whole percent using the following rule:
  - a. Gas readings ending with 0.1 0.4%, round down to the next whole percent;
  - b. Gas readings ending at or above 0.5%, round up to the next whole percent.
- 4) If a NITROX-capable dive computer is unavailable for use, repetitive dives may be performed using EADs and the schedules contained within the U.S. Navy no-decompression air tables. In other words, once an EAD is determined for a specific dive, the U.S. Navy no-decompression air tables can be used for that depth for the duration of the dive (Appendix III).
- 5) SSA divers shall wear bailout cylinders at all times; these will be filled with the same NITROX mix as the primary supply, tested, and properly labeled.
- 6) During all commercial harvest diving operations, there will be an additional back-up supply of a matching NITROX mix inline with the diver's primary gas supply aboard the DSV.
- 7) During all commercial harvest diving operations, when blending breathing gases, a diver's gas supply is to be continuously analyzed for  $O_2$  content, with high/low and audio/visual alarms switched on, if available.
- 8) A diver's oxygen exposure times should be tracked for both single exposure and daily dose maximums. Examples of oxygen exposure charts can be found in Appendix III.
- 9) Should a diver breathe air under pressure during a NITROX dive, the following is to be strictly adhered to: Abort the dive and decompress the diver as though he or she had breathed AIR throughout the entire dive at the actual depth of the dive (i.e., <u>not</u> the EAD).
- 10) Should a diver experience early symptoms of oxygen toxicity, following are some appropriate responses by the crew:
  - a. Diver reports signs and symptoms to topside, DPIC notes them;
  - b. Topside reduces oxygen partial pressure, lowering the PPO<sub>2</sub> of mixed gases, or switches to air;
  - c. DPIC readies and possibly deploys standby diver; and
  - d. Diver continues decompression as per NITROX-capable dive computer or appropriate table(s).

#### 9.7 UNDERWATER LIFT BAG OPERATIONS

When performing tasks underwater, working divers occasionally move or lift heavy objects using the assistance of underwater lift bags. Lummi fishermen generally do not use the devices, opting rather to use a DSV's hydraulics, davit, and crab block to retrieve/lift their catch aboard the vessel. Still, some non-Lummi commercial harvest diving operations have begun using underwater lift bags to transfer harvested product from the bottom to topside. The purpose of this section then is to identify potential hazards associated with the practice and to provide safe guidelines to follow when working with underwater lift bags.

#### 9.7.1 DEFINITIONS

**Anchor point** – A point where an anchor line is attached to the underwater lift bag to restrain the load. Anchor points must have a mass in excess of the maximum lift capacity of the underwater lift bag. An anchor point is also referred to as a "dead man anchor".

**Dump line** – A line attached to the dump valve inside of the lift bag. It should be distinguishable from any other line. The dump line controls deflation of the lift bag by the diver. Some lift bags are outfitted with an extra long dump line which allows the diver to operate the dump valve from a safe distance.

**Dump line anchor** – A weight attached to the dump line with enough mass to activate the dump valve during an unplanned ascent.

**Dump valve** – A valve located inside of the lift bag for deflation of it, which is controlled by the diver through use of the dump line.

**Inversion line/upset line** – A line running from the top of the lift bag to an appropriate anchor point to ensure that the lift bag inverts and deflates in the event of the failure of the lift bag's rigging.

**Main lifting lines** – This is the standard rigging that is attached to the lift bag, generally in either a two- or four-strap configuration. These lines are normally shackled to the object to be lifted.

#### 9.7.2 POTENTIAL HAZARDS

Underwater lift bags are not like other forms of lifting devices. The lifting action is produced by the displacement of water when the lift bag is filled with air; therefore, <u>extreme caution must be used when inflating one since the device poses a threat of an uncontrolled ascent of the object lifted, and possibly of the diver, if he or she is fouled on the lift bag or its rigging. Other potential hazards include the following:</u>

- 1) Over-inflation of the lift bag;
- 2) Accidental deflation of the lift bag;
- 3) Failure of the rigging or lift bag straps;
- 4) Failure of the lift bag fabric;
- 5) Use of a lift bag not rated for the load; and
- 6) Obstructions in the path of the lift, either in the water column or at surface.

#### 9.7.3 RECOMMENDED WAYS TO MITIGATE POTENTIAL HAZARDS

A prudent DPIC will conduct a job hazard analysis (Section 8.10.3), updating it as the work progresses, to reflect current conditions and the status of the operation. In this way, additional precautions can be implemented, as needed, in a timely fashion. Common sense, attention to detail, and remaining alert are considered essential qualities of crew members participating in underwater lift bag operations. If using enclosed lift bags or lift bags with multiple attachment points, additional planning is required; the DPIC should refer to the manufacturer's suggested guidelines for proper use and operation of all gear. Umbilical management is essential to prevent entanglement of the diver with the underwater lift bag rigging or the object to be lifted. To avoid fouling, a diver

must be aware of the location and orientation of his or her umbilical at all times. Additional considerations include the following:

- 1) Appropriate training in and understanding of applicable diving physics and formulas (e.g., Boyle's Law, Archimedes' Principle, and hydrostatic and absolute pressures);
- 2) Proper training in and maintenance, inspection and testing of lift bags and associated rigging. It is recommended that a log be maintained for these purposes;
- 3) Gear should be visibly marked with appropriate ratings and the units of measurement used to express those ratings (e.g., lb or kg);
- 4) Use lift bags with capacities as close as possible to the weights of the objects to be lifted. This helps with preventing additional tilt of the objects during ascent;
- 5) Ensure that dump lines are unique in appearance, i.e., distinguishable from all other lines;
- 6) When applicable, ensure that an anchor/restraining line is present with sufficient strength to remain attached to the load and anchor point;
- 7) When applicable, ensure that anchor points are heavier than the greatest potential lift of the lift bag(s);
- 8) Secure an inversion line to the top of the lift bag and to an anchor point, if applicable;
- 9) Complete an assessment or survey of the work area prior to initiating a lift;
- 10) Encourage situational awareness on the part of the diver and topside personnel;
- 11) Confirm that diver's personal equipment and tools are not at risk of fouling the dump line, rigging, or object to be lifted; and
- 12) Use of excess buoyancy, or overfilling the lift bag, to "break out" or "free" a load from the seabed must be avoided since this practice can result in an uncontrolled ascent of the load (and possibly, the diver).

#### 9.7.4 GENERAL OPERATIONAL GUIDELINES

The DPIC is responsible for developing the operational plan and maintaining the welfare and safety of his or her crew; it is critical to establish a safe and damage- or injury-free lift operation (see previous section). Divers are responsible for ensuring their familiarity with the principles and techniques of safe underwater lift bag operations. Besides evaluating their working environment, including weather, tides and currents, seabed conditions and possible seabed obstructions, crews should be able to:

- 1) Provide details of the object to be lifted and its position in the water column (i.e., assess the object's exact position and its stability, composition, and possible lifting points);
- 2) Perform all necessary calculations to determine the object's weight, if necessary, taking into consideration the object's submerged weight, stability, and its approximate center of gravity;
- 3) Assess the best position and number of lift bags required to avoid damaging the object(s) lifted;
- 4) Determine inflation sequence when using multiple lift bags; and
- 5) Recall that lift bags will inflate more rapidly in shallower water compared to deeper water. In shallow water, air entering the lift bag will experience a greater change in proportional volume as it ascends through the water column compared to the air filling a lift bag at a deeper depth.

#### 9.7.5 EXAMPLE OF CALCULATING FREE AIR REQUIRED TO COMPLETE A LIFT

Approximately three (3) crates worth of geoduck clams need to be lifted to the surface from a depth of 66 ft using an air-filled lift bag. Assume that: a) the inside volume of a single geoduck clam crate is 1.3 ft<sup>3</sup>, b) the <u>hypothetical</u> density of geoduck clams is 75 lb/ft<sup>3</sup>, and c) the density of seawater is 64 lb/ft<sup>3</sup>. Calculate the volume of free air (ft<sup>3</sup>) required to complete the lift.

- 1) Calculate weight (lb) of object(s) in water (W<sub>immersed</sub>):
  - a. Weight of geoduck clams when immersed in seawater = Weight of geoduck clams in air Weight of seawater displaced (aka upthrust)
    - i. Volume of geoduck clam crates (Volume<sub>3 crates</sub>) = 3 X 1.3  $ft^3$  = 3.9  $ft^3$

- ii. Weight of geoducks in air (W<sub>geoducks</sub>) = Volume<sub>3 crates</sub> X Density<sub>geoducks</sub>
  - 1.  $W_{geoducks} = 3.9 \text{ ft}^3 \text{ X} 75 \text{ lb/ft}^3 = 293 \text{ lb}$
- iii. Upthrust = Volume<sub>3 crates</sub> X Density<sub>seawater</sub>
  - 1. Upthrust =  $3.9 \text{ ft}^3 \times 64 \text{ lb/ft}^3 = 250 \text{ lb}$  seawater displaced by about three densely-packed crates worth of geoduck clams
- iv.  $W_{immersed} = W_{qeoducks} Upthrust = 293 lb 250 lb = 43 lb$
- 2) Calculate ambient pressure at lift site:
  - a. Ambient pressure at lift site (D, seawater depth in feet) = Atmospheric pressure + pressure due to D feet of seawater (aka absolute pressure expressed as atmospheres absolute or ata)
    - Note: At sea level, atmospheric pressure = 14.7 pounds/inch<sup>2</sup> (psi) = 1 atm; pressure of 1 ft seawater = 0.445 psi
    - ii. Ambient pressure (P<sub>ambient</sub> ata) at 66 ft = 1 atm + ((66 ft X 0.445 psi)/14.7 psi)

1. 
$$P_{ambient} = 1 + (29.4/14.7) = 3$$
 ata

- 3) Calculate air required for lift:
  - a. To achieve neutral buoyancy, the lift bag must displace a volume of seawater equal in weight to the weight of the geoduck clams immersed in seawater (W<sub>immersed</sub>)
    - Min. volume of lift bag required (V<sub>lift bag</sub>) = W<sub>immersed</sub>/Density<sub>seawater</sub> = 43 lb/(64 lb/ft<sup>3</sup>) = 0.67 ft<sup>3</sup>

Free air required for lift (Air<sub>free</sub>) =  $V_{lift bag} X P_{ambient} = 0.67 \text{ ft}^3 X 3 \text{ ata} = 2.0 \text{ ft}^3$ 

# 9.8 DIFFERENTIAL PRESSURE (Delta P): DEFINITIONS, APPLICABILITY, and RECOMMENDATIONS

Many fatalities in the commercial diving industry involve work settings or conditions where divers encounter differential pressures (Delta P). It should be noted that the risk to Lummi commercial harvest divers encountering Delta P during normal LNR-approved commercial harvest diving operations in open water is essentially non-existent; <u>however</u>, <u>qualified Lummi fishers may be offered other forms of diving employment where Delta P must be a serious consideration</u>. Examples of this type of work include maintenance diving at shellfish or finfish hatcheries, dams or weirs, and elevated water tanks or towers. Salvage work around a non-flooded, submerged fishing vessel is another example of where Delta P exists. This section provides cursory information on how to recognize and avoid Delta P. Additional information about Delta P hazards is also available on the ADCI video, *The Hazards of Working in "Delta-P" Work Environments*.

#### 9.8.1 CAUSES OF DELTA P

Delta P is caused by the pressure differential created by a head of water vs. decreased pressure on the opposite side of a bulkhead, valve, underwater discharge, intake, culvert, or other structure. The tide gates along the Lummi Sea Pond dike road are examples of structures where Delta P exists between the pond and Lummi Bay, especially during low tide. Delta P also occurs when:

- 1) Water levels between adjoining areas vary and are attempting to equalize;
- 2) Water is adjacent to a gaseous void at lower pressure than the water pressure;

- 3) Water is mechanically drawn through intakes or pumps;
- 4) Water is mechanically drawn towards propellers or other types of thrusters on ships; or
- 5) Positive pressure is released from high pressure subsea wells or pipelines.

#### 9.8.2 EXAMPLES OF DELTA P

Following are some more specific examples of work settings where Delta P arises:

- 1) Clogged intake screen;
- 2) Outlet screen/trash rack on dams;
- Hole in water storage tank;
- Open sluice gates;
- 5) Opening in a barrier between two areas;
- 6) Transfer pipes;
- 7) Water tower drain;
- 8) Installing a section of pipe with flange protectors over the ends without a vent;
- 9) Hole in an underwater pipeline;
- 10) Cutting into an underwater pipeline or other void with Delta P;
- 11) Pump house intake;
- 12) Air lifts or dredges; and
- 13) Draw from thrusters on a ship or large fishing vessel.

#### 9.8.3 MISCELLANEOUS CAUTIONS AND FACTS REGARDING DELTA P

Delta P is 'invisible' to the diver. With the turn of a valve or lifting of a gate, Delta P can strike suddenly, without warning. Once a diver is trapped by Delta P, there is virtually no escape. Other safety considerations include:

- 1) The application of as little as 77 lb (35 kg) on a diver's torso can impair respiration and disrupt blood flow;
- 2) Even small forces may be compounded by factors such as immobilization of limbs; and
- 3) The velocity profile of a Delta P hazard is such that at its periphery, the diver may approach the hazard without any perceptible increase in water flow velocity. By the time the diver feels the change in water velocity, it is already at a dangerous level.

#### 9.8.4 RECOMMENDATIONS

Prevention of Delta P situations is the key to working in the aforementioned environments. Indeed, planning, preparation, and mindful-participation of crew members are the essential safety elements for these types of operations. With this in mind, it is highly recommended that diving personnel and other participants:

- 1) Recognize where the potential for Delta P exists in the workplace;
- 2) Voice concerns about potential Delta P hazards to representatives of the hiring company;
- 3) Attend a pre-job meeting with the hiring company to gain better understanding of its Delta P hazards;
- 4) Familiarize self with the job site; if available, review facility plans and "as-builts";
- 5) Inquire about and inspect any pumps, suctions, gates, or valves;
- 6) Calculate the potential water forces in Delta P areas (e.g., a properly-trained DPIC should be able to determine the rate at which water will flow into a sinking ship through a 1 ft x 2 ft rectangular hole located 10 feet below the water surface);
- 7) Ensure that adequate, well-informed leadership, background information, and training are available to the diving crew and other participating personnel;
- 8) Ensure that both diver and DPIC know how piping and valve systems work together, if applicable;
- 9) Check for flow using a flow meter, if relevant;
- 10) Physically verify that all gates or valves around the divers' work area are properly positioned and locked/tagged out as applicable; and
- 11) Follow all lockout/tag-out procedures necessary to perform the job as safely as possible.

#### 9.8.5 ADDITIONAL DELTA P REFERENCES

Fisher, A. S., M. J. Gilber, and T. G. Anthony. 2009. Differential pressure hazards in diving. Health and Safety Executive RR761. Pp. 107.

Tucker, W. C. 1980. Diver's handbook of underwater calculations. Best Publishing Company, San Pedro, California.

# COMMERCIAL HARVEST DIVING STANDARDS





## COMMERCIAL HARVEST DIVING STANDARDS





# **10.0 EMERGENCY PREPAREDNESS, ASSESSMENTS, PROCEDURES, and ACCIDENT REPORTING**

## **10.1 EMERGENCY MEDICAL SERVICES**

# **IN AN EMERGENCY, CALL 911**

Given the remote nature of Lummi commercial harvest diving operations, a qualified crew must be reliably selfsufficient and be capable of fulfilling the role of first responder in the event of a medical emergency or diving accident until emergency medical services (EMS) arrives. To this end, the DVO or DPIC will develop and maintain a list of available sources of emergency aid, equipment, and professional services with call signs, phone numbers, or other means of establishing emergency contacts nearby where commercial harvest diving operations are being conducted. Appendix II can be used to form the basis for this list, which must be available at the place of business, aboard the DSV, at the dive site, or to the person responsible for developing an emergency action or response plan (e.g., the DPIC; Section 8.9.2). The list should include the following information and can be adjusted depending on the type of diving or underwater activity being conducted:

- 1) Coast Guard or other national Rescue Coordination Centers;
- 2) Local marine patrols;
- 3) On-call physician, if available;
- 4) Decompression chamber;
- 5) Nearest hospital or medical treatment facility; and
- 6) Air or ground transportation.

Finally, two-way communications shall be available and accessible at any diving work site or other hyperbaric setting in order to engage emergency medical services as required.

## **10.2 PREPARING FOR EMERGENCIES: FIRST AID SUPPLIES**

Having the capacity and resources to adequately respond to an onboard incident or emergency is of paramount importance for commercial harvest diving crews. At the work site, appropriate first aid supplies shall be provided and kept readily accessible in a clearly marked, and preferably water-proof, container. In addition, as of this writing, every LNR-registered DSV is required to carry an emergency  $O_2$  administration kit; crew members must be formally trained in its use. Following is the minimum list of supplies recommended for an onboard first aid kit. The prudent DVO and DPIC will review this list and make additions or substitutions as needed to ensure that appropriate first aid can be administered.

#### 10.2.1 MINIMUM INVENTORY (AND QUANTITY) SUGGESTED FOR DIVING FIRST AID KIT:

- 1) Adhesive "Band-Aid" strips, assorted sizes (100);
- 2) Triangular bandage;
- 3) Adhesive tape (one roll);
- 4) Ammonia inhalants (two);
- 5) Absorbent cotton (one package);
- 6) Eye wash (one bottle);
- 7) Gauze bandage, 1 in x 10 yd;
- 8) Aspirin tablets (20);
- 9) Gauze bandage, 2 in x 10 yd;
- 10) Antiseptic wipes (four);
- 11) Elastic bandage, 3 in x 5 yd;

- 12) Scissors (one pair);
- 13) Non-adherent pads, 2 in x 3 in (10);
- 14) Latex examination gloves (six pairs);
- 15) Eye patches (four);
- 16) Cold pack;
- 17) Burn dressing kit, including gel pack;
- 18) Tourniquet;
- 19) Rescue airway;
- 20) Tweezers (one pair);
- 21) Trauma dressing, 8 in x 10 in;
- 22) First aid booklet;
- 23) CPR shields, two one-way;
- 24) Contents or inventory card;
- 25) First aid cream (one tube);
- 26) Waterproof case;
- 27) Triple antibiotic cream (one tube);
- 28) Biohazard bags (four); and
- 29) Manual resuscitator (bag type) with transparent mask and tubing.

In addition, the following items (or their equivalents) are recommended when conducting operations at remote locations:

- 1) Oral analgesic;
- 2) Alka Seltzer Plus;
- 3) Benadryl cream;
- 4) Antacid tablets;
- 5) Neosporin opthalmic ointment;
- 6) Basic poison antidote kit;
- 7) Insect repellent;
- 8) Immodium AD;
- 9) Sudafed tablets;
- 10) Sunscreen, 15+ SPF;
- 11) Robitussin DM cough syrup;
- 12) Nasal spray; and
- 13) Ear drops.

#### 10.2.2 CONTENTS OF A TYPICAL DAN EMERGENCY OXYGEN ADMINISTRATION KIT:

- 1) 1600 Pelican case with dual foam (DAN Product Code 611-4020);
- 2) Non-rebreather mask (DAN Product Code 611-8100);
- 3) Oronasal resuscitation mask (DAN Product Code 611-8300);
- 4) Dive and travel medical guide (DAN Product Code 801-0100);
- 5) Declaration/warning (DAN Product Code 651-0600);
- 6) Brass multi-function regulator (DAN Product Code 611-2000);
- 7) Demand valve with 6-foot hose (DAN Product Code 611-3000);
- 8) Jumbo D cylinder (DAN Product Code 611-1010); and
- 9) Tru-fit mask (DAN Product Code 611-8400).

## **10.3 EMERGENCY ASSESSMENTS AND EVALUATIONS**

Should an onboard incident or emergency arise, commercial harvest diving crews must be able to assess and evaluate the nature of the event, and to act appropriately to ensure the best possible outcome for the accident victim(s). This section and the following one provide useful background information, steps to follow, and general

reminders for responding to diving-related incidents or emergencies. In general, every emergency will cause the dive to be aborted until the cause has been fully remedied.

#### 10.3.1 COMMON DIVING MALADIES

As land-dwelling animals, human beings have evolved to respire and process air, mechanically and physiologically, under relatively passive conditions, gas pressure-wise. Not surprisingly then, most diving maladies involve physical or chemical changes in the properties of gases under hyperbaric conditions when a diver is breathing underwater. Having a basic understanding of how a diver's body responds to air or other gases, breathing or otherwise, under hyperbaric conditions can help with responding to the most common diving maladies. Table 5 summarizes some of the most common maladies that Lummi fishers could experience when conducting normal commercial harvest diving operations. A precautionary approach to such activities will prevent the vast majority of these incidents from occurring.

**Table 5.** List of common diving maladies, including symptoms, causes, treatments, and preventions. Diver shouldalways notify topside at the onset of unusual signs, symptoms, or sensations.

Diving Malady	Symptoms	Cause	Treatment	Prevention
<b>SQUEEZE</b> – Bodily damage to, or pain/discomfort in, gas- or air-filled spaces that do not equalize with ambient pressure ( <i>see also</i> <i>barotraumas</i> <i>below</i> ).	Pain or sense of increased pressure in affected area; varies with type of squeeze.	Rapid compression or expansion of gas- or air-filled space with change in ambient pressure; Compression of diver-worn equipment under hyperbaric conditions.	Depends on type of squeeze; diver ascends or descends a few feet (depending on direction of onset of symptoms) to offset symptoms with respect to ambient pressure.	Preemptive equalization of gas- or air-filled space; avoid wearing poorly-fitted exposure suit; maintain proper dental care; use proper buoyancy control and descent/ascent techniques.
OUTER EAR BAROTRAUMA (OEB) – Damage to or discomfort in external auditory ear canal.	Pain in external auditory ear canal; blood visible in outer ear.	Blockage or swelling in external auditory ear canal; use of tight-fitted hood; wax impaction; or ear infection.	If symptoms do not resolve or if blood is visible in outer ear, seek medical attention.	Avoid diving with ear infection; avoid using ear plugs that prevent pressure equalization; pull hood away from face near affected ear to allow intrusion of water and to equalize pressurize; practice preemptive equalization; use proper buoyancy control and descent/ascent techniques.
MIDDLE EAR BAROTRAUMA (MEB) – Damage to or discomfort in middle ear due to changes in ambient	Fullness, pressure, or pain inside of ear; mild hearing loss or possible ringing in ear (tinnitus); if ear	Common cold or "head" cold; runny nose or congestion; upper respiratory infection; prolonged use of pasal sprays;	Diver ascends or descends a few feet (depending on direction of onset of symptoms) to equalize pressure: if	Avoid diving with cold or when congested; practice preemptive equalization; use

<b>Table 5.</b> List of common diving maladies, including symptoms, causes, treatments, and a always notify topside at the onset of unusual signs, symptoms, or sensations.				entions. Diver should
Diving Malady	Symptoms	Cause	Treatment	Prevention
pressure relative to middle-ear pressure.	underwater, vertigo ("spinning"); and possible blood/fluid in external ear canal or back of throat.	abnormal anatomy; and dysfunctional Eustachian tube.	necessary, abort dive and seek medical attention.	control and descent/ascent techniques.
INNER EAR BAROTRAUMA (IEB) – Inner ear contains no gas, so not subject to direct barotraumas; however, injury may occur as a result of MEB.	Same as MEB; vertigo with nausea and vomiting; uncontrolled eye movements (nystagmus); significant hearing loss; and ringing or roaring in ear (tinnitus).	Same as MEB, but also may include abnormal anatomy or dysfunctional Eustachian tube; rupture of round or oval window; dramatic or violent shift in fluid of the inner ear; or hemorrhage into inner ear.	Diver ascends or descends (depending on direction of onset of symptoms) a few feet to equalize pressure; abort dive, and seek medical attention (may be due to ear drum rupture or arterial gas embolism, AGE).	Avoid diving with cold or when congested; practice preemptive equalization; avoid straining or forceful ear-clearing or Valsalva maneuvers; use proper buoyancy control and descent/ascent techniques.
NITROGEN NARCOSIS – Confusion or stupor resulting from breathing N <sub>2</sub> , an inert gas, under pressure.	Impaired judgment or diminished motor skills; false feeling of well-being; lack of concern for job or safety; inappropriate laughter; and possible euphoria or anxiety.	Nitrogen is an inert gas that the body does not use or metabolize; when breathed under pressure, may cause narcosis, which usually starts at ~100 fsw or ~4 ATA.	No specific treatment other than diver ascending; narcosis rapidly (< 1 min) reverses with ascent.	Limit working depth; if must conduct deep work, practice "work-up" dives, a series of progressively deeper dives to increase a diver's tolerance for the effects of narcosis; avoid deep diving when cold, fatigued, hung-over, anxious, or after taking medications that reduce alertness or cause drowsiness.
<b>HYPOXIA</b> – Low or inadequate supply of oxygen to body tissues.	Bluish discoloration of lips, skin, and nail beds (cyanosis); increased pulse rate; confusion, clumsiness, and slowing of responses (similar to intoxication); drowsiness; and loss of consciousness.	PO <sub>2</sub> falls below 0.16 ATA (i.e., < 16% O <sub>2</sub> in breathing mix); air supply failure; and airway obstruction or restriction.	If underwater, perform necessary emergency procedure for mask, rig, or helmet (e.g., increase O <sub>2</sub> supply). At surface, breathe fresh air, or provide 100% O <sub>2</sub> , preferably with demand inhalator mask; perform CPR, if necessary, and	Pre-dive checks and gas analyses; if blending gases, constantly monitor O <sub>2</sub> levels in breathable mix; and avoid hyper- ventilating.

<b>Table 5.</b> List of common diving maladies, including symptoms, causes, treatments, and preventions. Diver shou				
always notify topside	at the onset of unusual	signs, symptoms, or ser	nsations.	Drevention
Diving Malady	Symptoms	Cause	transport to medical facility.	Prevention
<b>PULMONARY O<sub>2</sub></b> <b>TOXICITY</b> – Irritation of lungs from toxic effects of elevated O <sub>2</sub> levels (e.g., from use of NITROX or during O <sub>2</sub> treatment).	Chest pain or discomfort; coughing or inability to take a deep breath without coughing; lung congestion (fluid buildup in lungs); and reduction in vital capacity (i.e., the maximum amount of gas exhaled after taking in a full breath).	Excessive exposure to elevated levels of oxygen for protracted periods of time.	Discontinue or interrupt exposure to O <sub>2</sub> by breathing air, wait for symptoms to subside, and consult certified diving physician.	Follow appropriate tables and adhere to oxygen exposure limits; when using NITROX, plan an appropriate mix or gas blend with the appropriate dive profile; if providing O <sub>2</sub> treatment, take air "breaks" of 5 min for every 20 min of treatment.
<b>CNS O<sub>2</sub> TOXICITY</b> – Central nervous system oxygen toxicity from variable duration exposure to high levels of O <sub>2</sub> .	VENTID-CON: Visual disturbances, tunnel vision; Ears ringing or roaring; Nausea; Tingling, twitching, muscle spasms; Irritability, restlessness; Dizziness; and Convulsions.	Exposure to PPO <sub>2</sub> approaching or exceeding 1.6 ATA (e.g., diving beyond maximum operating depth for a given NITROX mix).	Discontinue or interrupt exposure to $O_2$ by breathing air, wait for symptoms to subside, and consult with certified diving physician.	Follow appropriate tables and adhere to oxygen exposure limits; when using NITROX, plan an appropriate mix or gas blend with the appropriate dive profile; if providing O <sub>2</sub> treatment, take air "breaks" of 5 min for every 20 min of treatment.
CARBON MONOXIDE (CO) TOXICITY – Disruption of transport, uptake, and body's utilization of O <sub>2</sub> from toxic CO in breathing mix.	Tightness across forehead; pounding headache; nausea; vomiting; confusion; and possible sudden loss of consciousness.	Compressor intake down-wind of exhaust; improper compressor oils; or faulty air compressor system.	Remove patient from CO exposure; conduct neurological exam to rule out arterial gas embolism; provide 100% O <sub>2</sub> , preferably with demand inhalator mask and transport to medical facility.	Locate compressor intake well away (≥ 15 ft) from engine exhaust; properly maintain compressor system; Pre-dive checks and gas analyses.
HYPERCAPNIA (CO <sub>2</sub> Toxicity) – Excess buildup of carbon dioxide in blood.	Headache; inability to concentrate; confusion; increased respiration ("air starvation"); drowsiness; or loss of consciousness.	Heavy exertion at depth; skip breathing, especially at depths > 60 fsw; over-breathing the rig, mask or helmet; incomplete or inadequate lung	If underwater, decrease workload, rest, breathe fully, follow emergency procedures, abort dive, and seek medical attention, if needed. At surface.	Hose tender monitors diver breathing rate; diver maintains moderate workload; refrain from skip breathing; use free-flow mask or helmet (ventilate

<b>Table 5.</b> List of common diving maladies, including symptoms, causes, treatments, and preventions. Diver should always notify topside at the onset of unusual signs, symptoms, or sensations.					
Diving Malady	Symptoms	Cause	Treatment	Prevention	
		ventilation; or gear malfunction.	breathe fresh air or provide 100% O <sub>2</sub> , preferably with demand inhalator mask; conduct neurological exam to rule out AGE, and seek medical attention, if needed.	system); and avoid over-breathing diving apparatus.	
ARTERIAL GAS EMBOLISM (AGE) – Air bubbles enter blood stream following alveolar rupture in lungs; bubbles then block blood flow to tissues downstream.	Symptoms usually occur immediately or within 5 min of surfacing, and may include chest pain, cough and possibly bloody sputum, headache, visual disturbances, numbness or weakness, loss of sensation in affected area of body, dizziness and confusion, sudden unconsciousness, respiratory arrest, and death.	Exposure to sudden decrease in pressure following exposure to hyperbaric conditions (e.g., rapid ascent); holding breath during ascent, i.e., lungs over-inflate rupturing alveoli causing gas to enter circulatory system.	Provide first aid and CPR; administer 100% O <sub>2</sub> , preferably with demand inhalator mask, with diver in supine or recovery position; when possible, complete neurological exam; transport to nearest hyperbaric medical facility (if flying, maintain elevation below 1,000 feet above sea level); and initiate recompression as	Breathe normally, never hold breath when diving with compressed gas; do not dive with chest cold or obstructed airways; ascend slowly (e.g., 30 ft/min); be proficient in all aspects of buoyancy control; have sufficient breathing gas to complete all aspects of a dive; and exhale during an emergency or rapid ascent.	

10.3.2 DECOMPRESSION SICKNESS FIELD EVALUATION

Decompression sickness, DCS, is perhaps the most widely known diving malady which deserves its own subsection. Sometimes referred to as "the bends", DCS is the result of inadequate decompression following exposure to increased pressure. DCS is caused by the formation of small bubbles of inert gas (in the case of compressed air diving, nitrogen) in body tissues after a reduction in ambient pressure (visualize the small bubbles coming out of solution when opening a soda bottle). The malady occurs in different tissues throughout the diver's body, but is commonly felt in the joints. The symptoms of DCS vary by type and location of bubble formation and may include but not be limited to deep joint pain that intensifies over time, excessive fatigue, weakness, dizziness or difficulty maintaining balance, visual or hearing disturbances, vertigo, nausea, numbness, "pins and needles", paralysis, and mottled or itchy skin. The major determinants of the risk of DCS are depth, time, ascent rate, and multiple dives ("too deep for too long"). While DCS most often occurs when safe diving practices are violated ("deserved hit"), the malady also may occur when dive tables and dive computers are properly used ("undeserved hit"). Prevention measures include planning dive operations well and developing backup plans, adherence to dive tables and dive computers, ascending slowly (e.g., 30 ft/min), making appropriate safety stops as conditions allow, incorporating longer surface intervals into dive operations, maintaining a healthy level of physical fitness and proper nutrition, and staying hydrated. The following tables review what commercial harvest diving crews can do in the field if faced with a suspected case of DCS. Treatment protocols for DCS and other diving maladies, including first aid, CPR, and emergency oxygen administration, are reviewed in Section 10.4.

CS FIEld Evaluation	
Diver (and/or Buddy) Intervie	W
Details of all dive profiles	
heck One: 🛛 Air 🔹 Nitrox	Trimix02%
ny unusual events ?	Entanglement
Out-of-Air Emergency	Significant Over-Exertion
Equipment Malfunction	Loss of Buoyancy Control
Buddy Separation	Rapid Ascent
Other:	
ny Prior History of DCS ? 🛛 No	Q Yes (if yes, enter Date
and symptoms of DCS	
Chie Bach	Hearing Disturbances
Skin Rash	Hearing Disturbances
Skin Rash Tingling or Numbness	Hearing Disturbances Visual Disturbances Slurred Speech
Skin Rash Tingling or Numbness Joint or Limb Pain Back or Abdominal Pain	Hearing Disturbances Visual Disturbances Slurred Speech Distressed Breathing
Skin Rash Tingling or Numbness Joint or Limb Pain Back or Abdominal Pain Chest Pain or Discomfort	Hearing Disturbances Visual Disturbances Slurred Speech Distressed Breathing Severe Coughing
Skin Rash         Tingling or Numbness         Joint or Limb Pain         Back or Abdominal Pain         Chest Pain or Discomfort         Extreme Fatigue	Hearing Disturbances         Visual Disturbances         Slurred Speech         Distressed Breathing         Severe Coughing         Blood or Froth in Mouth
Skin Rash         Tingling or Numbness         Joint or Limb Pain         Back or Abdominal Pain         Chest Pain or Discomfort         Extreme Fatigue         Loss of Muscle Strength	Hearing Disturbances         Visual Disturbances         Slurred Speech         Distressed Breathing         Severe Coughing         Blood or Froth in Mouth         Paralysis
Skin Rash         Tingling or Numbness         Joint or Limb Pain         Back or Abdominal Pain         Chest Pain or Discomfort         Extreme Fatigue         Loss of Muscle Strength         Loss of Coordination	Hearing Disturbances         Visual Disturbances         Slurred Speech         Distressed Breathing         Severe Coughing         Blood or Froth in Mouth         Paralysis         Convulsions
Skin Rash         Tingling or Numbness         Joint or Limb Pain         Back or Abdominal Pain         Chest Pain or Discomfort         Extreme Fatigue         Loss of Muscle Strength         Loss of Coordination         Dizziness	Hearing Disturbances         Visual Disturbances         Slurred Speech         Distressed Breathing         Severe Coughing         Blood or Froth in Mouth         Paralysis         Convulsions         Unconsciousness
Skin Rash         Tingling or Numbness         Joint or Limb Pain         Back or Abdominal Pain         Chest Pain or Discomfort         Extreme Fatigue         Loss of Muscle Strength         Loss of Coordination         Dizziness         Disorientation	Hearing Disturbances         Visual Disturbances         Slurred Speech         Distressed Breathing         Severe Coughing         Blood or Froth in Mouth         Paralysis         Convulsions         Unconsciousness         Cardiac Arrest
Skin Rash         Tingling or Numbness         Joint or Limb Pain         Back or Abdominal Pain         Chest Pain or Discomfort         Extreme Fatigue         Loss of Muscle Strength         Loss of Coordination         Disorientation         Neck Swelling	Hearing Disturbances         Visual Disturbances         Slurred Speech         Distressed Breathing         Severe Coughing         Blood or Froth in Mouth         Paralysis         Convulsions         Unconsciousness         Cardiac Arrest         Rapid or Erratic Pulse
Skin Rash         Tingling or Numbness         Joint or Limb Pain         Back or Abdominal Pain         Chest Pain or Discomfort         Extreme Fatigue         Loss of Muscle Strength         Loss of Coordination         Dizziness         Disorientation         Neck Swelling         Abnormal Sounding Voice	Hearing Disturbances         Visual Disturbances         Slurred Speech         Distressed Breathing         Severe Coughing         Blood or Froth in Mouth         Paralysis         Convulsions         Unconsciousness         Cardiac Arrest         Rapid or Erratic Pulse         Signs of Shock
Skin Rash         Tingling or Numbness         Joint or Limb Pain         Back or Abdominal Pain         Chest Pain or Discomfort         Extreme Fatigue         Loss of Muscle Strength         Loss of Coordination         Dizziness         Disorientation         Neck Swelling         Abnormal Sounding Voice	Hearing Disturbances         Visual Disturbances         Slurred Speech         Distressed Breathing         Severe Coughing         Blood or Froth in Mouth         Paralysis         Convulsions         Unconsciousness         Cardiac Arrest         Rapid or Erratic Pulse         Signs of Shock
Skin Rash         Tingling or Numbness         Joint or Limb Pain         Back or Abdominal Pain         Chest Pain or Discomfort         Extreme Fatigue         Loss of Muscle Strength         Loss of Coordination         Disorientation         Neck Swelling         Abnormal Sounding Voice	Hearing Disturbances         Visual Disturbances         Slurred Speech         Distressed Breathing         Severe Coughing         Blood or Froth in Mouth         Paralysis         Convulsions         Unconsciousness         Cardiac Arrest         Rapid or Erratic Pulse         Signs of Shock         Administer Oxygen
Skin Rash         Tingling or Numbness         Joint or Limb Pain         Back or Abdominal Pain         Chest Pain or Discomfort         Extreme Fatigue         Loss of Muscle Strength         Loss of Coordination         Dizziness         Disorientation         Neck Swelling         Abnormal Sounding Voice	Hearing Disturbances         Visual Disturbances         Slurred Speech         Distressed Breathing         Severe Coughing         Blood or Froth in Mouth         Paralysis         Convulsions         Unconsciousness         Cardiac Arrest         Rapid or Erratic Pulse         Signs of Shock         Administer Oxygen         Monitor Patient
Skin Rash         Tingling or Numbness         Joint or Limb Pain         Back or Abdominal Pain         Chest Pain or Discomfort         Extreme Fatigue         Loss of Muscle Strength         Loss of Coordination         Dizziness         Disorientation         Neck Swelling         Abnormal Sounding Voice	Hearing Disturbances         Visual Disturbances         Slurred Speech         Distressed Breathing         Severe Coughing         Blood or Froth in Mouth         Paralysis         Convulsions         Unconsciousness         Cardiac Arrest         Rapid or Erratic Pulse         Signs of Shock         Administer Oxygen         Monitor Patient         Treat for Shock

# 5 Minute Field Neurological Evaluation Exam



This field neurological exam should be conducted immediately whenever DCS is suspected, and then repeated periodically if medical attention is delayed; record all observations, and note the time.

- Look for deviations from the expected norm
- Look for differences, one side versus the other
- Look for any changes over time

Orientation	Ask patient his/her name, age, the location, date, and/or approximate time of day; evaluate overall alertness.
Eyes	Ask patient to track your moving finger, evaluate uniform and fluid movement of eyes; also check pupil size and reaction to light; inquire about blurred vision or other visual disturbances.
Forehead	Check sensation, in response to touch; ask patient to raise and lower eyebrows, evaluate uniform movement.
Face	Ask patient to whistle, smile and/or ciench teeth, evaluate uni- form movement, and check for equal tension in Jaw muscles.
Ears	With patient's eyes closed, rub your fingers together and de- termine distance from each ear that patient hears this sound; inquire about ringing in ears or other hearing disturbances.
Gag Reflex	Ask patient to swallow, observe movement of Adam's apple and/or neck muscles, watch for any difficulty.
Tongue	Ask patient to stick out tongue, watch for any drooping or one-sided tendency.
Shoulders	Check sensation, in response to touch; ask patient to raise shoulders against resistance, compare muscle strength.
Arms & Hands	Check sensation, in response to touch; ask patient to move arms against resistance and also ask patient to squeeze your hands, compare muscle strength.
Chest	Check sensation, in response to touch; observe general breath- ing pattern, and inquire about any difficulty or discomfort.
Legs	Check sensation, in response to touch; ask patient to move legs against resistance, compare muscle strength.
Heel-to-Toe Walk	Observe patient's baiance and coordination (use caution, or omit this exercise completely, on a moving boat).

# Field Neurological Observation Record



This field neurological exam should be conducted immediately whenever DCS is suspected, and then repeated periodically if medical attention is delayed; record all observations, and note the time. Look for deviations from the expected norm

- Look for differences, one side versus the other
- Look for any changes over time

#### Name of individual(s) being examined:

Time (hr:min)	_: 🖬 +15 m	ninute 🖬 +15 minute	+15 minute
Orientation			
Eyes			
Forehead			
Face		10	
Ears			
Gag Reflex			
Tongue			
Shoulders			_
Arms & Hands			
Chest			
Legs			
Heel-to-Toe Walk			

Field	Neuro	logical	Notes:
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# **10.4 BASIC EMERGENCY PROCEDURES AND GUIDELINES**

This section reviews information that most Lummi fishers will have learned prior to receiving permission to participate in the Lummi Nation's dive fisheries. The first aid, CPR, and emergency oxygen administration procedures outlined here are not a substitute for proper training from a certified instructor; rather, these guidelines serve as a reminder to commercial harvest diving crews of steps to follow in case of an emergency. Furthermore, Section 10.4 covers other types of incidents and provides suggestions on some useful responses in those events. In summary, the following items are offered as minimum guidelines only to assist the DVO, the DPIC, and their crews in developing operation-specific emergency plans. Since each emergency will dictate its own set of priorities, the steps listed here may not be in order of preference. Irrespective of order, commercial harvest diving crews should review this material periodically, add to it when necessary, and practice the requisite skills to become proficient in them.

#### **10.4.1 TREATMENT OF DECOMPRESSION SICKNESS**

After evaluating whether diver might be suffering from DCS (Section 10.3.2), activate EMS. If diver's condition permits, complete a rapid neurological exam (Section 10.3.2) to determine if event is a physical, "pain only" case. Administer 100% oxygen, preferably with demand inhalator mask, with diver in supine or recovery position (Section 10.4.3). If necessary, provide first aid and CPR (Section 10.4.2) in conjunction with emergency oxygen administration. Reassess diver's condition regularly and record findings until EMS arrives or takes over treatment. When possible, transport to nearest hyperbaric medical facility (if flying, maintain elevation below 1,000 feet above sea level) and initiate recompression as soon as possible.

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10.4.2 BASIC FIRST AID AND CPR





## **10.4.3 EMERGENCY OXYGEN ADMINISTRATION**





# COMMERCIAL HARVEST DIVING STANDARDS





# Preparing the Emergency Oxygen Kit







# Preparing the Emergency Oxygen Kit

How to Decide Which Procedure to Use



# Demand Inhalator Mask and Valve: Use for Alert (Conscious) <u>Breathing</u> Diver



# **Regulator Setting for Demand Inhalator Mask and Valve**





# Non-Rebreather Mask and Valve: Use for Alert or Unconscious <u>Breathing</u> Diver

# **Regulator Setting for Non-Rebreather Inhalator Mask and Valve**





Simple Face Mask: Use for Alert or Unconscious <u>Breathing</u> Diver

**Regulator Setting for Simple Face Mask** 



# Laerdal Pocket Mask and Valve: Use for Unconscious <u>Non-Breathing</u> Diver during CPR



# **Regulator Setting for Laerdal Pocket Mask and Valve**



**Responder Using Laerdal Pocket Mask and Valve during CPR** 





# **Recovery Positions for Injured Divers**





Never Leave an Injured Diver Unattended Always Monitor Breathing Continue CPR until Help Arrives

## 10.4.4 LOSS OF BREATHING GAS

- 1) Switch to secondary breathing gas supply:
  - a. Diver switches over to his or her diver-worn bailout system; or
    - i. If mask/helmet malfunction or failure, and if applicable, diver switches to "safe second" or alternate air source attached to first stage of bailout cylinder (Section 8.11.7); or
  - b. Activate topside secondary breathing gas supply, i.e., the onboard EGS cylinder; or
  - c. If applicable, charge diver's pneumofathometer hose with appropriate breathing gas and have diver insert "pneumo" hose into his or her helmet or mask.
- 2) Determine nature of loss:
  - a. Compressor malfunction or failure; or
  - b. Hose malfunction or failure (e.g., hose disconnected, kinked, or umbilical severed); or
  - c. Mask/helmet malfunction or failure; and
  - d. If appropriate, and if time allows, trouble-shoot problem (e.g., if compressor merely runs out of fuel, refill fuel tank, and restart compressor);
  - e. Re-establish breathing gas supply.
- 3) Be prepared to terminate dive, and do so, if nature of loss warrants it.
- 4) Ready crew, including hose tender, to retrieve primary diver; alert standby diver.
- 5) If hose or umbilical is severed, mark primary diver's last known location or position; deploy marker buoy (or PFD, ring float, seat cushion, etc.) with down-line and anchor in controlled way (e.g., by hand) to reduce risk of injuring primary diver.
- 6) Deploy standby diver with secondary breathing gas source (e.g., new hose or bailout bottle) to assist primary diver, if necessary.
- 7) Prepare for emergency ascent, diver extraction, and possibility of administering first aid (sections 10.4.2 and 10.4.3).

## 10.4.5 LOSS OF COMMUNICATIONS

- 1) Determine nature of loss and attempt to re-establish electronic communications.
- 2) If communications cannot be re-established, attempt to communicate through *prearranged* line-pull signals, e.g., hose tender takes the **OATH** and prepares for **Emergencies**:
  - a. 1 pull **O**K
  - b. 2 pulls Advance give slack or take slack out
  - c. 3 pulls Take take in slack or come back to boat
  - d. 4 pulls Home leaving bottom, coming up
  - e. 5 pulls Emergency abort dive or aborting dive
- 3) Once communications are re-established through line-pull signals, DPIC can determine whether or not to immediately abort operations.
- 4) Be prepared to terminate dive, and do so, if nature of loss warrants it.
- 5) Ready crew, including hose tender, to retrieve primary diver; alert standby diver.
- 6) If unable to establish any form of communications with diver, terminate dive, check diver's exhaust bubbles at surface for normal-looking breathing pattern, and initiate retrieval of primary diver.
- 7) Deploy standby diver to assist primary diver, if necessary.

## 10.4.6 FOULED OR ENTRAPPED DIVER

- 1) Diver informs topside of fouling or entrapment; topside stands by.
- 2) Diver determines extent of fouling or entrapment; attempts to free self, avoiding panic.
- 3) Topside confirms that primary diver will not unnecessarily ditch his or her equipment; readies standby diver.
- 4) If primary diver tangled in DSV anchor line, DPIC directs crew in detangling procedure.
- 5) If necessary, send standby diver to assist primary diver.

6) When primary diver is free, if unable or unwilling to continue his or her dive, OR if standby diver was required to go to primary diver's assistance, then dive should be terminated.

### 10.4.7 INJURED DIVER IN WATER

- 1) Diver informs topside of injury; aborts dive.
- 2) Diver determines nature and extent of injury.
- 3) Topside readies standby diver; activates EMS, if necessary.
- 4) If required, deploy standby diver to assist primary diver (e.g., to evaluate injury or to administer first aid).
- 5) Standby diver remains with primary diver, monitoring his or her breathing.
  - a. If primary diver stops breathing, his or her regulator should be over-pressurized, if possible.
- 6) If applicable, standby diver assists injured diver to surface, following proper decompression procedures *except* when severity of injury indicates a greater risk than omitting decompression.
- 7) Initiate *prearranged* diver recovery and extraction procedures.
- 8) Prepare for emergency ascent and possibility of administering first aid (sections 10.4.2 and 10.4.3).

## 10.4.8 EQUIPMENT FAILURE - DIVER IN THE WATER

- 1) Evaluate effect of failure on diver; terminate dive, if necessary.
- 2) Diver and topside are apprised of problem; propose corrective action plan and alert standby diver.
- 3) Topside confirms primary diver's willingness to initiate the proposed corrective action plan.
- 4) Activate plan.

## 10.4.9 OXYGEN TOXICITY DURING TREATMENT OF DIVING MALADY - DIVER TOPSIDE

- 1) Maintain open communication between diver and topside emergency care provider(s).
- 2) When oxygen toxicity symptoms arise, instruct diver to discontinue breathing oxygen, and instead, breathe air for several minutes (up to 15).
- 3) After symptoms disappear, continue oxygen treatment, but disregard time spent breathing air (i.e., continue treatment from where oxygen was stopped).
- 4) If oxygen toxicity symptoms occur for second time, repeat step 2.
- 5) If oxygen toxicity symptoms occur for a third time, discontinue oxygen treatment and immediately request medical advice or assistance from EMS or a designated medical professional (e.g., Divers Alert Network or Virginia Mason Hospital, Appendix II).

## **10.4.10 ADVERSE ENVIRONMENTAL CONDITIONS**

Prudent commercial harvest diving crews will develop operation-specific procedures, as applicable, to address adverse environmental conditions including, but not limited to, the following:

- 1) Weather;
- 2) Sea state;
- 3) Tides and currents;
- 4) Lightning;
- 5) Winds; or
- 6) Dangerous marine life.

#### 10.4.11 FIRE - TOPSIDE

- 1) Commercial harvest diving crews should be fully aware of emergency fire suppression procedures, including which fire suppressants to use for specific types of onboard fires.
- 2) If required, terminate diving activities and evacuate diving station.
- 3) <u>Open flames, sparks, or smoldering materials should never be used in the presence of emergency oxygen,</u> <u>fuels (e.g., when refueling compressor), or other combustibles.</u>

#### **10.4.12 EMERGENCY EVACUATION**

Commercial harvest diving crews should develop additional procedures, as needed, to address emergency evacuations related but not limited to diving accidents, adverse environmental conditions, a swamped or sinking DSV, or accidental loss of power supplies. An evacuation plan should include crew and EMS notification procedures, decompression procedures to be followed if a diver is working underwater when initiating the plan, travel routes, landing or contact points, and a crew duty roster.

## **10.5 ACCIDENT REPORTING**

Most regulatory authorities outside of the jurisdiction of the Lummi Nation (e.g., U. S. Coast Guard or U. S. Department of Labor) require commercial harvest diving operations to record and report the occurrence of any diving-related injury or illness. Similarly, all DVOs, DPICs, and associated crew members shall record and report any serious or catastrophic diving-related injuries, including fatalities, using the confidential LNR incident form following this section. The mandatory federal reporting requirements are located there as well.

Irrespective of the lead investigating agency, the DSA will interview crew members following such accidents, and apprise the appropriate LIBC authorities (e.g., LNR enforcement or the Lummi Tribal Health Center) as instructed by the LNR Director in conjunction with the LFNRC. Completed LNR forms must be submitted to the DSA within seven to 10 working days of the incident. It should be noted that it is not the intent of LNR to disclose identities of individuals, operations, or circumstances contained in reports received for punitive purposes. The main purpose of the LNR reporting system is to gather information for developing an accurate database of diving accident statistics, issuing safety alerts, or revising/updating the LNR Commercial Harvest Diving Standards; in short, the reporting system is intended to promote improved diver safety.

Accidents involving decompression sickness, DCS, are typically referred to the hyperbaric medicine unit at the Virginia Mason Medical Center (VMMC) in Seattle, Washington. There, a VMMC diving physician will evaluate and treat the incidence of DCS based on a recorded history provided by the diver patient, which is occasionally augmented with additional information provided by a fellow crew member or family member. Following treatment in a VMMC recompression chamber, the diving physician will prepare a written evaluation and discharge summary with corrective action to take by the diver to reduce the probability of the recurrence of DCS. In addition, the diver's susceptibility to DCS and his or he return-to-work orders are generally provided in this document, which must be submitted to the DSA before the LNR Director and LFNRC will again permit the diver to participate in the Lummi Nation's dive fisheries. The VMMC authorization to release patient health information form is appended at the end of Chapter 10 for this purpose.

Finally, the DVO or DPIC employing the recovered diver must review the incident with his or her commercial harvest diving crew. Consideration must be given to the recovered diver's behavior leading to the incident, the diver's susceptibility to DCS, the past performance of the dive computer or decompression tables used during commercial harvest diving operations, and the crew's response to the incident. In the end, all efforts must be made to reduce the risk of such accidents from occurring in the future.



LUMMI INDIAN BUSINESS COUNCIL 2665 kwina road bellingham, washington 98226 (360) 312-2000

DEPARTMENT LUMMI NATURAL RESOURCES

DIRECT NO.

# Incident Report for Injuries/Accidents Occurring while Diving Under the Auspices of Lummi Nation

Names, addresses, and phone numbers of diving personnel involved

Summary of experience of diving personnel involved (include LNR-registered dive vessel owner and Experienced Dive Operator)

Location and description of dive site, including vessel, and description of conditions that led to incident

Chronology of events leading up to incident

Description of symptoms, including depth and time of onset, and extent of injuries/illness

# **Description of treatment provided and results**

# Administrative follow-up and other comments

# Summary details (circle relevant item)

Diving purpose:	Harvest		Mainte	enance	Other	
Diving gas:	Air		NITRO	x	Mixed Gas	
Diving mode:	Open Circuit Scuba		Surface Supplied		Other (e.g., rebreather)	
Decomp. planning:	Dive Tables		Dive Co	omputer	PC Software	
Depth range:	0 – 30 ft	31 – 60	) ft	61 – 100 ft	101 – 130 ft	Other
Incident type:	Hyperbaric	Barotr	auma	Illness	Drowning	Near-Drowning
	Hypoxia/Hypercapnea			Hyperoxic	Injury	Other
Incident rating:	Minor	Moder	ate	Seriou	IS	Fatality

# **Disposition of case**

Name(s) of person(s) completing form

# Date completed

Petert Name	VIRGINIA MASON 1100 9th Avenue, Seattle WA 98101, A-HIS-ROI	Mason Medical Center ph 206-223-6975 fax 206-223-8885 www.virginiamason.
Date of Birth       // is utbricket the following organization to release information as stated below from the patient health information record is stated below from the patient health information record is stated below from the patient health information record is stated below from the patient health information record is stated below from the patient health information record is stated below from the patient health information record organization         Wrignia Mason Medical Center or       Organization / Person         Street Address       City, State, Zip         Phone       Fax         Phone       Fax         Control of service for records requested:       Beginning         Thru       Discharge Summaries         Operative Reports       Radiology Reports         Enclarage Summaries       Operative Reports         Radiology Cop       Cher (coords will be in paper format.         Please note if a format is not selected, records will be in paper format.       PurPOSE OF RELEASE         Continuing care       Copies for own use       Transfer to another provider       Legal       Coordination with Sche         Other       AUTHORIZATION FOR GENERAL RELEASE OF INFORMATION       Information Services Department. Lunderstand that once information services Department.       Understand that once information services Department.       Understand that once information services Department.       Understand that once information related action will be theath information service begin days from the date signed	Patient Name Medical F	Record # (if known)
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AUTHORIZATION TO RELEA	SE PATIENT HEALTH INFORMATION
VIRGINJA Virginia N	lason Medical Center
MASON 1100 9th Avenue, Seattle WA 98101, A-HIS-ROI	ph 206-223-6975 fax 206-223-8885 www.virginiamason.org
Patient Name Medical Re	ecord # (if known)
I authorize the following organization to release information as	s stated below from the patient health information record:
INFORMATION TO BE RELEASED FROM:	INFORMATION TO BE RELEASED TO:
	Virginia Mason Medical Center or
Organization	Organization / Person
Street Address City, State, Zip	Street Address City, State, Zip
Phone Fax	Phone Fax Additional recipient(s). Please see supplemental page. (Form 903346)
INFORMATION T	O BE RELEASED
Dates of service for records requested: Beginning	
Clinic Notes Radiology CD Other (	gy reports ED Records Lab/Pathology Report
Format for records (please check ONLY one box): Paper	CD (requires email address)
PURPOSE C	DF RELEASE
Continuing care Copies for own use Transfer to	another provider 🔲 Legal 🗌 Coordination with School
AUTHORIZATION FOR GENERA	AL RELEASE OF INFORMATION
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(including pain management)	(VM's program closed 5/93)
SIGNATURE OF PATIENT /	LEGAL REPRESENTATIVE
Signature of Patient or Legally Responsible Party	Date (month/day/year)
Relationship to patient, if not signed by patient	
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## **AUTHORIZATION TO RELEASE PATIENT HEALTH INFORMATION**

This authorization is not valid to release future health care to an employer or financial institution more than 90 days from the date signed (except for payment purposes).

#### **INFORMATION PROTECTED BY STATE / FEDERAL LAW**

Release of mental health [RCW71.05], alcohol and drug abuse [RCW70.96A; 42 C.F.R Part 2], sexually transmitted diseases, including HIV/AIDS [RCW 70.24], and certain minor treatment records may require specific patient authorization.

#### INFORMATION FROM A DRUG OR ALCOHOL ABUSE TREATMENT PROGRAM

Virginia Mason's drug/alcohol treatment program closed in May, 2003. Federal regulations [42 C.F.R. Part 2], where applicable, may prohibit any further disclosure of this information except with specific written consent of the person to whom the information pertains or the parent or legal guardian of a minor child to whom it pertains, unless otherwise permitted by federal and state law. A general authorization for the release of information is NOT sufficient for this purpose. This consent is subject to revocation at any time except to the extent that the program that is to make the disclosure has already taken action in reliance on it. The Federal rules restrict any use of information to criminally investigate or prosecute any alcohol or drug abuse patient and establish fines for violating any provision of the law.

#### MENTAL HEALTH TREATMENT INFORMATION

Where applicable, state law may prohibit any further disclosure of mental health treatment information without specific written consent of the person to whom the information pertains, or the parent or legal guardian or a minor child to whom it pertains, unless otherwise permitted by state law. A general authorization to release information is NOT sufficient for this purpose. [RCW 71.05.390]

# SEXUALLY TRANSMITTED DISEASE INFORMATION (includes HIV / AIDS)

State law prohibits any further disclosure of sexually transmitted disease information without specific written consent of the person to whom the information pertains, or the parent or legal guardian of a minor child to whom it pertains, unless otherwise permitted by state law. A general authorization is NOT sufficient for this purpose. Any violation of the law is a gross misdemeanor and may lead to the imposition of fines. [RCW 70.24.105; WAC 246-101-320]

#### **CONSENT OF MINOR**

Where a minor has the right to consent to medical treatment, he or she also has the right to control information related to that treatment. A competent minor patient's signature may be required to release information related to:

- reproductive care including, but not limited to, birth control [RCW 9.02.100(1)] and pregnancy-related services [State v. Koome, 84 Wn.2d 901];
- testing or treatment for HIV/AIDS and other sexually transmitted diseases for patients age 14 and above [RCW 70.24.110];
- 3) outpatient alcohol and drug abuse treatment for patients age 13 and above [RCW 70.96A.095]; and
- 4) mental health treatment for patients age 13 and above [RCW 71.34.500; RCW 71.34.530]

#### AUTHORIZED PERSONAL REPRESENTATIVE FOR PATIENTS NOT COMPETENT

A personal representative is an individual who may act on behalf of a patient when the patient lacks decision-making capacity to make health care treatment decisions. The personal representative may need legal documentation to demonstrate authority to sign for the patient. A member of one of the following classes of persons may sign for an adult patient who lacks capacity to consent, in the following order of priority: (a) the appointed guardian of the patient, if any; (b) the individual, if any, to whom the patient has given a durable power of attorney that includes the authority to make health care decisions; (c) the patient's spouse; (d) children of the patient who are at least eighteen years of age, if unanimous; (e) parents of the patient, if unanimous; and (f) adult brothers and sisters of the patient, if unanimous. If a person is not available in a given class to provide authority regarding health care decisions, then a person (or group of persons acting as one) must be found in the next successive class. [RCW 7.70.065(1)].

#### AUTHORIZED PERSONAL REPRESENTATIVE FOR MINORS

A member of one of the following classes of persons may sign for a minor patient in the following order of priority: (a) the appointed guardian; (b) a person appointed by the court to consent to medical care for a child in out of home placement pursuant to RCW 13.32A or RCW 13.34; (c) parents; (d) an individual to whom a parent has given a signed authorization to make health care decisions for the child; and (e) an adult representing him or herself as responsible for the health care of the minor (a health care provider may, at its discretion, require documentation of this person's claimed status). [RCW 7.70.065(2)]

Note: Under state law each parent has full and equal access to the health care records of their child absent a court order to the contrary. Neither parent may veto the access requested by the other parent. [RCW 26.09.225]

PATIENT NAME & ID #	VIRGINIA MASON MEDICAL CENTER – Seattle WA Authorization To Release Patient Health Information				
	DISTRIBUTION: WHITE: Medical Record	YELLOW: Patient	VMMC Form 93010 (04-12)		



# **Marine Safety Information Bulletin**

Commandant U.S. Coast Guard, CG-OES-2 Commercial Regulations and Standards Directorate 2703 Martin Luther King Jr. Ave SE, Stop 7509 Washington, DC 20593-7509 MSIB Number: 004-14 Date: February 11, 2014 Contact: Mr. Ken Smith Phone: (202) 372-1413 E-Mail: ken.a.smith@uscg.mil

# **Commercial Diving – USCG/OSHA Casualty Reporting Requirements**

**Background:** Several members of the commercial diving industry have expressed uncertainty in understanding the differences of when casualties related to commercial diving are required to be reported to the Coast Guard and when they are required to be reported to OSHA. They have requested that the Coast Guard publish such information and this MSIB is intended to fulfill that request. This MSIB does not apply to recreational scuba diving operations performed from inspected and uninspected commercial vessels. However, it should be noted that marine casualties associated with inspected vessels are required to be reported to the Coast Guard in accordance with Title 46, Code of Federal (CFR), Part 4. Additionally, casualties occurring on state-registered recreational or commercial vessels not subject to Coast Guard inspection (i.e. uninspected passenger vessels), are required to be reported to State boating authorities in accordance with the boating safety regulations outlined in 33 CFR Part 173.

**USCG:** U.S. Coast Guard regulations apply to commercial diving operations (diver engaged in underwater work for hire) taking place: at any deepwater port or the safety zone thereof as specified by 33 CFR Part 150; from any artificial island, installation, or other device on the Outer Continental Shelf (OCS) and the waters adjacent thereto as defined in 33 CFR Part 147, or otherwise related to activities on the OCS; from all vessels with a valid certificate of inspection (COI) issued by the U.S. Coast Guard (i.e., "inspected" vessels), including mobile offshore drilling units (MODUs) regardless of their geographic location; from any vessel connected with a deepwater port or within the deepwater port safety zone; and from any vessel engaged in activities related to the OCS.

Under 46 CFR 197.484 *Notice of Casualty*, the person-in-charge of a commercial diving operation must notify the Officer-in-Charge, Marine Inspection (OCMI), as soon as possible after a diving casualty occurs, if the casualty involves: 1) loss of life, 2) any diving-related injury to any person causing incapacitation for more than 72 hours, or 3) any diving-related injury to any person requiring hospitalization for more than 24 hours. The notice must contain: 1) Name and official number (if applicable) of the vessel or facility, 2) Name of the owner or agent of the vessel or facility, 3) Name of the person-in-charge, 4) Name of the diving supervisor, 5) Description of the casualty including presumed cause, and 6) Nature and extent of the injury to persons.

Under 46 CFR 197.486 *Written report of casualty*, the person-in-charge of a vessel or facility for which a notice of casualty was made under § 197.484 must submit a report to the OCMI, as soon as possible after the casualty occurs, as follows: 1) On Form CG-2692, when the diving installation is on a vessel, 2) Using a written report, in narrative form, when the diving installation is on a facility, and must contain the information required by § 197.484. If decompression sickness is involved, the report must be accompanied by a copy of the report required by § 197.410(a)(9) and must include information relating to alcohol or drug involvement as required by § 4.05-12.

This release has been issued for public information and notification purposes only. It was developed by USCG Headquarters in cooperation with OSHA's National Office in Washington, DC.

Contact information for various Coast Guard units can be obtained through the Coast Guard's Homeport website on the internet at the following location: <u>http://www.uscg.mil/top/units/</u>

**OSHA:** Reporting is required by employers who have employees aboard vessels (such as ships and barges), or on off-shore oil rigs and platforms, when such vessels or rigs and platforms are located on or within U.S. navigable waterways and State territorial seas. State territorial seas extend three (3) nautical miles from the general coastline for all States and U.S. Territories except: Texas, Puerto Rico, and the Gulf Coast of Florida, which extend nine (9) nautical miles from the general coastline; and the Great Lakes and St. Lawrence Seaway States where the U.S. Inland "navigable waters" include all waters up to the international boundary line with Canada.

Reporting to OSHA is required regardless of which federal agency regulates the working conditions. Exemptions from fatality and multiple-hospitalization reporting to OSHA do not exist.

Under 29 CFR 1904.39 *Reporting fatalities and multiple hospitalization incidents to OSHA*, employers are required to report any occupational fatality or incident involving inpatient hospitalization of three (3) or more employees within eight (8) hours of the incident. The report must include the following information: company name; location and time of the incident; number of fatalities or hospitalized employees; contact person for the company; phone number(s) for the company contact person; and a brief description of the incident. Additionally, employers conducting activities within a State-Plan State must comply with the requirements of that State Plan, and must report work-related fatalities, hospitalizations and certain injuries and illnesses to the appropriate State agency.

Employers must report fatalities and multiple hospitalizations by telephone or in person to the nearest OSHA Area Office, or by using OSHA's toll-free hotline at 1-800-321-OSHA. The caller making the accident report must talk directly to a person at OSHA (i.e., they cannot leave a message on the phone, send a fax, or send an e-mail).

FOR FURTHER INFORMATION CONTACT: If you have questions on this information bulletin, call Mr. Ken Smith at the number listed above.

-uscg-

This release has been issued for public information and notification purposes only. It was developed by USCG Headquarters in cooperation with OSHA's National Office in Washington, DC.

# **APPENDIX I – GLOSSARY OF TERMS**

# COMMERCIAL HARVEST DIVING STANDARDS





ACF – Actual Cubic Feet.

**ACFM (acfm)** – Actual cubic feet per minute. Refers to the actual volume of gas supplied to a diver at ambient pressure.

**Ambient Pressure** – The surrounding pressure at depth (actual or simulated, in a hyperbaric chamber) to which the diver is subjected.

ANSI – American National Standards Institute.

**Appropriate Breathing Mix** – A breathing mixture that, having regard to the system and equipment used in the diving operations, the work undertaken in those operations, and the conditions in which and the depth at which they are to be carried out, is suitable in content and temperature and of adequate pressure.

Ascent Times – The time interval between leaving the bottom when the dive is terminated and reaching the surface.

**ATA (ata)** – Atmosphere(s) absolute. Total pressure, including atmospheric, to which a diver, bell, etc., is subjected.

**ATM (atm)** – Atmosphere(s). Atmospheric (atm) unit equivalent to 14.7 psi or 760 (mm) of mercury.

**Bailout Bottle (EGS)** – See Diver-Worn or Diver-Carried Emergency Gas Supply.

**Bar** – A unit of pressure equal to 1 atmosphere (atm).

**Bell (Open Bell and Closed Bell)** – An enclosed compartment, pressurized (closed bell) or unpressurized (open bell), that allows the diver to be transported to and from the underwater work area and that may be used as a temporary refuge during diving operations.

Bends – See Decompression Sickness.

**BIBS** – Built-in breathing system. A breathing gas system built into all deck chambers and SDCs by

which emergency breathing gas or a treatment gas can be supplied to the diver through an oral-nasal mask or hood.

**Bottom Time** – The total elapsed time, measured in minutes, from the time that the diver leaves the surface in descent to the time that the diver begins ascent.

**Breathing System** – Device or apparatus for delivering appropriate breathing gas mix.

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

**CDP** – Certified dive physician.

**CFM** – Cubic Feet per Minute.

**CGA** – Compressed Gas Association.

Check Valve – See Non-Return Valve.

**Cleaned for Oxygen Service** – Cleaning of equipment or system to ensure elimination of all hydrocarbons and other potentially dangerous contaminants when system is to be used in oxygen service. See also Oxygen Cleaning.

**CNS** – Central nervous system.

**Commercial Diver** – An individual who has applied for and been awarded a certification card or other officially-recognized document that reflects the formal training, field experience, and on-the-job performance or capabilities of the individual hired to work underwater.

**Compressor** – A machine that raises air or other gases to a pressure above one (1) atmosphere.

**CPR** – Cardio-pulmonary resuscitation. A combination of artificial respiration and artificial circulation.

Cylinder – A pressure vessel for the storage of gases.

D – Diameter.

DCB – Diving Control Board.

**Decompression** – Releasing from pressure or compression following a specific decompression table or procedure during ascent; ascending in the water or experiencing decreasing pressure in the chamber.

**Deck Decompression Chamber** – A hyperbaric chamber which is an integral part of a deep diving system, located on a surface platform from which diving is conducted.

**Decompression Chamber** – An enclosed space used to gradually decrease pressure to which a diver is exposed from ambient underwater pressure back to 1 atmosphere.

**Decompression Schedule** – A time-depth profile with a specific bottom time and depth; its application is calculated to safely reduce the pressure on a diver.

**Decompression Sickness** – A condition with a variety of symptoms that causes the formation of bubbles of gas in the blood or other tissues of the diver during or subsequent to ascent or other pressure reduction.

**Decompression Table** – A set of decompression schedules developed and available from a recognized source of expertise (such as the U.S. Navy) or developed by a recognized diving physiologist on behalf of a company. Such table must have been thoroughly field tested and evaluated before being used in operational practice.

**Differential Pressure (Delta P)** – Occurs when there is suction of water, or where water moves from an area of high pressure to one of low pressure. This flow may be the result of the movement of water under its own weight or an active process involving powered machinery (e.g., pumps or thrusters).

**Dive Location** – The vessel or other structure from which dives are conducted and supported; more specifically, the point from which the actual dive is controlled.

**Dive Station** – The site from which diving operations are directly controlled. This site shall also include any auxiliary or peripheral equipment necessary to the conduct of the diving operation.

**Dive Team** – Hose tenders, divers, and diver support personnel involved in a diving operation, including the designated person-in-charge (diving supervisor).

**Diver's Indicator Light** – A light attached to a diver for the purpose of indicating the position of the diver when he or she is on the surface of the water.

**Diver-Worn or Diver-Carried Emergency Gas Supply** (i.e., Bailout System) – The auxiliary breathing gas supply required to be worn or carried by the diver underwater while conducting surface supplied air diving operations.

**Diving Bell** – A tethered underwater support system providing life-support services and used to transport divers.

**Diving Operations** – Any work operation requiring some type of diving or work underwater that involves planned human exposure to increased pressures to perform the job.

**Diving Operating Personnel** – Any member of the dive team whose activities are scheduled to conduct diving operations at or from the dive station.

**Diving Superintendent** – A superintendent or designated diving supervisor having complete responsibility for the safety of the diving operation, including responsibility for the safety and health of all diving personnel.

**Diving Supervisor** – An individual, who through training, experience, demonstrated competency, and certification, is appointed as the person responsible for executing the diving operation, ensuring the safety protocols are followed, and ensuring the overall safety of the diving operation.

**DMT** – Diver medical technician.

**DPIC** – Designated person-in-charge. In relation to the craft, barge, or structure, includes the captain or any other person made responsible by the owner of the dive vessel or facility, its operation, and the safety, health and welfare of those on board.

**Dry Suit** – A diving suit designed to exclude water from the surface of the body.

**DSA** – Diving Safety Administrator; the LIBC employee responsible for administering the LNR Commercial Harvest Diving Standards.

**DSO** – Diving Safety Officer.

DSV – Dive support vessel.

DVO – Dive Vessel Owner.

**Dual-lock Chamber** – Multi-lock deck decompression chamber.

**ED** – Experienced Diver.

EDO – Experienced Dive Operator.

**EES** – Emergency evacuation system (i.e., HRC or SPHLB).

EGS – Emergency gas supply (bailout).

Embolism – See Gas Embolism.

EMS – Emergency Management Services.

**Exhaust Valve** – A valve controlling the venting of gas from any higher pressure source such as a DDC, diver's helmet, suit, buoyancy system, volume tank, etc.

FFW – Feet of Fresh Water (elevation may vary).

**FSW (fsw)** – Foot or feet of seawater. A unit of depth or a unit of pressure at sea level generally defined as representing the pressure exerted by a foot of seawater having a specific gravity of 1.027, and is equal to approximately 0.445 pounds per square inch. FV – Floodable Volume.

**Gas Embolism** – A condition caused by expanding gases that have been taken into and retained in the lungs while breathing under pressure, being forced into the bloodstream or other tissues during ascent or decompression.

**GFCI (GFI)** – A ground fault circuit interrupter attached to the topside AC power source having receptacles, any of which may be attached to underwater cables supplying power to tools or lighting.

**Harness** – The combination of straps and fasteners used to attach equipment and umbilical to the diver that can be utilized as a lifting point to remove the diver from the water in the event of an emergency.

**HIPAA** – Health Insurance Portability and Accountability Act of 1996.

HT – Hose Tender.

**HP** – High Pressure.

**HPU** – Hydraulic power unit.

HRC – Hyperbaric rescue chamber.

**Hyperbaric Conditions** – Pressure conditions in excess of surface pressure.

Hypothermia – Profound loss of body heat.

JHA – Job hazard analysis.

Kluge – See Pneumofathometer.

LARS – Launch and recovery system.

**LFNRC** – Lummi Fisheries and Natural Resources Commission.

LIBC – Lummi Indian Business Council.

**Live-boating** – The practice of supporting a diver from a vessel that is underway.

LNR – Lummi Natural Resources Department.

LP – Low pressure (less than 500 PSI).

**Management of Change** – A formal process by which changes to normal operations procedures or policies are managed.

**Manifold** – Panel for the distribution of diver breathing gas.

Manifold Operator – In gas blending NITROX applications, the individual who is trained, experienced, and designated to perform the duties of gas distribution on a surface-supplied diving operation; who is also experienced and trained in the operation of the manifold, and whose primary responsibility is to operate the manifold.

**Master** – Normally considered to be the person in charge of a marine asset.

**MAWP** – Maximum allowable working pressure. See Maximum Working Pressure.

**Maximum Working Pressure (MWP)** – The maximum pressure to which a pressure containment device can be exposed under operating conditions.

**Med-lock** – A lock located in the inner lock of a hyperbaric chamber, to facilitate the transfer of medical supplies, food or other articles between the chamber occupants and personnel outside.

**MFW** – Meters of Fresh Water (elevation may vary).

**Mixed-gas Diving** – A diving technique in which the diver is supplied with a breathing gas mix other than air for respiration.

**MOD** – Maximum operating depth; a term used in NITROX diving.

MSW - Meter or meters of seawater.

**NITROX** – Nitrogen-oxygen or enriched air breathing gas.

**NOAA** – National Oceanic and Atmospheric Administration.

**No-Decompression Diving** – Diving that involves depths and times shallow and short enough so that the ascent can be made to the surface without water stops or subsequent chamber decompression.

Non-Return Valve – A one-way check valve installed in a fluid or gas system to permit flow in one direction only. All diving helmets must have a nonreturn valve at the gas supply inlet to prevent depressurization of the helmet and the resultant squeeze should the gas supply be lost.

**OSHA** – Occupational Safety and Health Administration.

**Oxygen Cleaning** – Special cleaning process for equipment to be used in oxygen systems.

**Oxygen Compatibility** – The ability of a substance to make contact with oxygen without a reaction.

**Oxygen Toxicity (CNS O<sub>2</sub>)** – A condition usually not encountered unless  $PPO_2$  approaches or exceeds 1.6 ATA. However, could be encountered as low as 1.4 ATA.

**Oxygen Toxicity (Pulmonary O<sub>2</sub>)** – A condition from long exposures to increased PPO<sub>2</sub> that causes direct pulmonary irritation. Oxygen toxicity can occur during decompression sickness Treatment Tables 4, 7, 8, and also through back–to-back administration of decompression sickness Treatment Table 6.

**Partial Pressure (PP)** – That portion of the total gas pressure exerted by a particular constituent of a breathing gas mix.

**PHI** – Protected Health Information.

Pneumo or Pneumo Hose – See Pneumofathometer.

**Pneumofathometer** – A depth-measuring device consisting of an open-end hose fixed to the diver, with the surface end connected to a gas supply and pressure gauge (usually marked in msw). Gauge measures pressure required to discharge water to depth of diver. **PP02** – Partial Pressure of Oxygen.

**PPM** – Parts Per Million.

**PSI (psi)** – Pounds per square inch. An expression of pressure; for example, 1 atmosphere equals 14.7 psi.

**PSIA** – Pounds per square inch absolute (pounds per square inch gauge plus 1 atmosphere (14.7).

**PSIG (psig)** – Pounds per square inch gauge (pounds per square inch absolute minus 1 atmosphere.

**Relief Valve** – A pressure-relieving device that prevents pressure from rising above a preset level.

Saturation Diving – Procedures in accordance with which a diver is continuously subjected to an ambient pressure greater than atmospheric pressure so that his or her body tissues and blood become saturated with the constituent elements of the breathing gas. Once the diver's body becomes saturated, he or she can remain within a specified zone for an unlimited time without incurring any additional decompression obligation.

SCF – Standard Cubic Feet.

**SCFM** – Standard Cubic Feet per Minute.

Scuba – Acronym for self-contained underwater breathing apparatus. Used to describe apparatus in which the inspired air is delivered by demand regulator and exhaled into the surrounding water (open-circuit); the air supply is carried on the diver's back. Primarily used for relatively shallow, recreational-related diving.

**SPHL** – Self-propelled hyperbaric lifeboat.

**Squeeze** – A lack of equalization between parts of the body or between the body and the equipment. Extreme cases can cause severe injury or death.

SSA – Surface supplied air [diving].

**Standby Diver(s)** – Another qualified diver at the dive location who is in a state of readiness to assist the diver in the water.

**Surface-Supplied Diving** – Diving mode in which divers receive breathing gas from a supply on the surface.

TD – Trainee Diver.

**Tender** – A term reserved for an apprentice diver or diver helper.

**Title 10** – The Lummi Nation's Code of Laws pertaining to Natural Resources.

**Treatment Tables** – A depth, time and breathing gas profile designed to treat a diver for gas embolism or decompression sickness.

**Umbilical** – A hose bundle between the onboard compressor and the diver that supplies, at a minimum, a lifeline, breathing gas, and communications as appropriate to the diving mode or conditions. Underwater harvest bags can also be carried as component parts of the umbilical and can be clipped, taped or banded to it on a temporary basis.

USCG – United States Coast Guard.

**V** – Volume.

**Valve** – A device that starts, stops, or regulates the flow of fluids or gas.

**Volume Tank** – A pressure vessel connected to the outlet of a gas supply and used as a gas reservoir.

W – Weight.

Working Pressure (WP) – The pressure to which a pressure containment device is exposed under normal operating conditions.

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# APPENDIX II – RESOURCES AND CONTACTS

## PLEASE NOTE:

# LISTING CENTERS, VENDORS, AND PRACTICIONERS HERE DOES NOT IMPLY ENDORSEMENT BY THE LUMMI INDIAN BUSINESS COUNCIL OR LNR.

Lummi Natural Resources Department (LNR) does not perform as an educational organization and as such does not endorse, certify, or accredit any individual instructor or commercial school participating in the training of personnel. Individual instructors and commercial schools are expected to obtain and maintain appropriate accreditation from agencies under whose jurisdiction their educational requirements must be upheld. Although LNR primarily recognizes formal training certificates issued by local instructors or from regional training facilities, the department will also evaluate and recognize formal training certificates issued from out-of-state organizations or jurisdictions. A formal course of study in diving practices can be completed at any accredited school, military school, or equivalent whose curriculum satisfies elements of the American National Standards Institute (ANSI) technical document ANSI/ACDE-01-2009 relevant to surface supplied air diving. This standard can be found on-line at <a href="http://www.acde.us/ansistd.pdf">http://www.acde.us/ansistd.pdf</a> or on file at the LNR office and is available from the LNR Diving Safety Administrator.

# IN AN EMERGENCY, CALL 911

# **EMERGENCY RADIO FREQUENCIES**

U. S. Coast Guard – VHF Channel 16 Canadian Coast Guard – VHF Channel 16 Citizen Band (CB) – Channel 9

# U. S. COAST GUARD RESCUE COORDINATION CENTERS (listed north to south)

Alaska Phone: (907) 463–2000

Victoria, British Columbia Phone: (800) 567–5111 or (250) 363–2333

Washington and Oregon Phone: (206) 220–7001

## NEAREST HOSPITAL

PeaceHealth St. Joseph Medical Center 2901 Squalicum Parkway Bellingham, Washington 98225 Phone: (360) 734–5400

# PACIFIC NORTHWEST RECOMPRESSION CHAMBERS (listed north to south)

American Hyperbaric Center, Anchorage, Alaska Phone: (907) 562–5420

Anchorage Regional Hospital, Alaska Phone: (907) 264–1583

Bartlett Memorial Hospital, Juneau, Alaska Phone: (907) 586–2611

Ketchikan General Hospital, Ketchikan, Alaska Phone: (907) 225–5171

Vancouver General Hospital, Vancouver, British Columbia Phone: (604) 875–4111 Fleet Diving Unit Pacific, Victoria, British Columbia Phone: (250) 363–2379

Fairchild Air Force Base, Spokane, Washington Phone: (509) 247–5661 or (509) 247–5406

U.S. Naval Station, Keyport, Washington Phone: (360) 396–2552 (24 hrs) or (360) 296–2111

Divers Institute of Technology, Seattle, Washington Phone: (206) 783–5543

## Virginia Mason Hospital, Seattle, Washington Phone: (206) 583–6543

St. Joseph's Medical Center, Tacoma, Washington Phone: (253) 426–6630

Providence Hospital, Portland, Oregon Phone: (503) 215–1111

# LUMMI POLICE DEPARTMENT

Natural Resources Enforcement Patrol Phone: (360) 312–2274 After business hours, call 911

# **MARINE PATROLS**

Whidbey Island area: Island County Sheriff's Office 101 NE 6<sup>th</sup> Street Coupeville, Washington 98239 Phone: (360) 678-4422 Phone: (360) 321-5113, ext. 7310

Port Townsend area: Jefferson County Sheriff's Office 79 Elkins Road Port Hadlock, Washington 98339 Phone: (360) 385-3831

<u>Kingston area</u>: Kitsap County Sheriff's Office 614 Division Street, MS–37 Port Orchard, Washington 98366 Phone: (360) 337-7101

San Juan Islands area: San Juan County Sheriff's Office 96 2<sup>nd</sup> Street Friday Harbor, Washington 98250 Phone: (360) 378-4151

# DIVING (or HYPERBARIC) MEDICINE CONSULTATION and EVALUATION

Divers Alert Network (DAN) Phone: (919) 684-9111 (Emergencies) Phone: (919) 684-2948 (Medical information)

Lummi Tribal Health Center Dr. Justin Iwasaki, Director; OR Dr. Dakotah Lane, UHMS Level 1 Medical Examiner of Divers Phone: (360) 384-0464

Undersea and Hyperbaric Medical Society Phone: (877) 533-8467; OR Phone: (919) 490-5140 https://www.uhms.org/resources/diving-medicalexaminers-list.html

Dr. Elizabeth McKendry U.S. HealthWorks Tukwila 200 Andover Park East, Suite 8 Tukwila, Washington 98188 Phone: (206) 575-3136 FAX: (206) 575-7657

Dr. Yu Wang U.S. HealthWorks Seattle 3223 1<sup>st</sup> Avenue South, Suite C Seattle, Washington 98134 Phone: (206) 624-3651 FAX: (206) 624-2391

Virginia Mason Medical Center Emergency Room Phone: (206) 583–6433; OR Hyperbaric Unit 24-Hour Consultation Phone: (206) 583–6543

# LUMMI INDIAN BUSINESS COUNCIL (LIBC)

LIBC Front Desk and Directory Phone: (360) 312–2000

LIBC Workplace Safety Officer Phone: (360) 312-2193; OR Cell: (360) 325-5976 Lummi Natural Resources Department (LNR) LNR Diving Safety Administrator Phone: (360) 312-2316; OR LNR Harvest Manager Phone: (360) 312-2300

#### **DIVING EQUIPMENT AND TRAINING**

Anacortes Diving Contact: Bob and Kelley Scarzafava 2502 Commercial Avenue Anacortes, Washington 98221 Phone: (360) 293-2070 FAX: (360) 293-8822

Dive Commercial International 7058 15<sup>th</sup> Avenue NW Seattle, Washington 98117 Phone: (866) 784-5050 (toll free); OR Phone: (206) 784-5050 (local); OR Phone: (206) 696-2126 (after hours) FAX: (206) 286-2723 info@divecommercial.com

Divers Institute of Technology 4315 11<sup>th</sup> Avenue NW Seattle, Washington 98107 Phone: (800) 634-8377 (toll free); OR Phone: (206) 783-5542; OR Phone: (206) 783-2658 info@diversinstitute.com

Gone Diving Contact: Charlynn Andrews 1740 Iowa Street Bellingham, Washington 98229 Phone: (360) 738-2042 info@gonediving.org

Hoodsport'n Dive 24080 North Hwy 101 Hoodsport, Washington 98548 Phone: (360) 877-6818; OR 3409 Capitol Blvd SE Tumwater, Washington 98501 Phone: (360) 866-3684

Lighthouse Diving Center, Inc. Contact: Harry Truitt 5421 196<sup>th</sup> Street SW, #6
Lynwood, Washington 98036 Phone: (425) 771-2679; OR Phone: (800) 777-3483

Nisqually Marine Services Contact: Dennis Lucia 4820 She-Nah-Num Drive SE Olympia, Washington 98513 Phone: (360) 456-5221, ext. 2135 Iuciadiver@msn.com

Nathan Schwarck Diving Safety Officer and Diving First Aid Instructor WWU Shannon Point Marine Center 1900 Shannon Point Road Anacortes, Washington 98221 Phone: (360) 293-2188; OR Cell: (360) 319–1474

Octopus Gardens Diving Contact: Don Peterson 2410 Washington Street Port Townsend, Washington 98368 Phone: (360)-385-3483

Washington Divers Contact: Jeremy Jones 700 Block of Coho Way, Squalicum Harbor Bellingham Washington 98225 Phone: (360)-676-8029

#### **OXYGEN REFILL STATIONS**

Airgas 401 Kansas Street Bellingham, WA 98225 Phone: (360) 734-4980 (Vern) (1–week turnaround time)

Central Welding Supply 4282 Pacific Highway Bellingham, Washington 98226; OR 13300 38th Avenue NE Marysville, Washington 98271 Phone: (360) 454-5540, ext. 337 (Gary Emerson) garyemerson@centralwelding.com; OR Phone: (206) 423-6422 (John Groom) johngroom@centralwelding.com (1–week turnaround time) Norco Medical 101 East Stuart Road (Located off Meridian Street, by WalMart) Bellingham, Washington 98226 Phone: (360) 746-0826 (Aaron) <u>aaronm@norco-inc.com</u> (2–week turnaround time)

Anacortes Diving Contact: Bob and Kelley Scarzafava 2502 Commercial Avenue Anacortes, Washington 98221 Phone: (360) 293-2070 FAX: (360) 293-8822 (1–day turnaround time)

#### DAN OXYGEN KIT SERVICE AND REPAIRS

Bemes, Inc. 800 Sun Park Drive Fenton, Missouri 63026 Phone: (800) 969-2363 FAX: (636) 349-3377 Web: www.bemes.com

Coast Biomedical 2865 Progress Pl Suite C Escondido, California 92029 Phone: (760)317-5608

EMS Technologies 238 West Main Street Leola, Pennsylvania 17540 Phone: (717) 656-6583

Riley's Emergency Medical Repair Center 3129 Demaret Drive Titusville, Florida 32780 Phone: (321) 268-3342 FAX: (321) 385-1942

#### MARINE LIFE RESOURCES

Salish Sea Research Center Northwest Indian College 2522 Kwina Road Bellingham, Washington 98226 Phone: (360) 594-4082

UW Friday Harbor Laboratories 620 University Road, San Juan Island Friday Harbor, Washington 98250 Phone: (360) 378-2165

WWU Shannon Point Marine Center 1900 Shannon Point Road, Fidalgo Island Anacortes, Washington 98221 Phone: (360) 293-2188

## **APPENDIX III – DIVE TABLES**

U. S. NAVY NO-DECOMPRESSION TABLE (AIR)

U. S. NAVY RESIDUAL NITROGEN AND REPETITIVE DIVE TABLE (AIR)

NOAA AIR DIVING TABLE

## NOAA NITROX DIVE PLANNING WORKSHEET

NOAA NO-DECOMPRESSION TABLE (NITROX 32)

NOAA NO-DECOMPRESSION TABLE (NITROX 36)

EAD – PPO2 – MOD – OXYGEN EXPOSURE TIME LIMITS TABLES

## **COMMERCIAL HARVEST DIVING STANDARDS**





## **U.S. NAVY DIVE TABLE 9-7**

No-Decompression Limits and Repetitive Group Designators for No-Decompression Air Dives

/few	(mew)	Limit (Min)	-		~	-	-	-	-				14				~	-
(15W)	(msw)		A	8	C	D	E	F	Ģ	н		J	к	L	<u>M</u> _	N	0	z
10	0.1	Unitrited	57	101	156	240	420	*										
15	4.6	Unlimited	36	60	88	121	163	217	297	449	*							
20	6.1	Unlimited	26	43	61	82	106	133	165	205	256	330	461	*				
25	7.7	595	20	33	47	62	78	97	117	140	166	198	236	285	354	469	595	
30	9.2	371	17	27	38	50	62	76	91	107	125	145	167	193	223	260	307	371
35	10.7	232	14	23	32	42	52	63	74	87	100	115	131	148	168	190	215	232
40	12.3	163	12	20	27	36	44	53	63	73	84	95	108	121	135	151	163	
45	13.8	125	11	17	24	31	39	46	55	63	72	82	92	102	114	125		
50	15.3	92	9	15	21	28	34	41	48	56	63	71	80	89	92			
55	16.9	74	8	14	19	25	31	37	43	50	56	63	71	74				
60	18.4	60	7	12	17	22	28	33	39	45	51	57	60					
70	21.4	48	6	10	14	19	23	28	32	37	42	47	48					
80	24.5	39	5	9	12	16	20	24	28	32	36	39						
90	27.6	30	4	7	11	14	17	21	24	28	30							
100	30.6	25	4	6	9	12	15	18	21	25								
110	33.7	20	3	6	8	11	14	16	19	20								
120	36.8	15	3	5	7	10	12	15										
130	39.8	10	2	4	6	9	10											
140	42.9	10	2	4	6	8	10											
150	46.0	5	2	3	5													
160	49.0	5	L. Rall	3	5													
170	52.1	5			4	5												
180	55.2	5	and the second	N	4	5												
190	58.2	5	THE PARTY PROPERTY		3	5												



\*\* Residual Nitrogen Time cannot be determined using this table (see Paragraph G.2.4)

? Read vertically downward to the 30 fsw (9.2 msw) repetitive dive depth. Use the corresponding residual nitrogen times to compute the equivalent single dive time (ESDT). Decompress using the 30 fsw (9.2 msw) air decompression table.









	40%	49	63	76	89	102				SHARE	TUNNT		erson, - even	the user	82	8	66	+-
-	39%	48	61	74	87	100	113		1	TREAM	INTERN		person to p ntee that	Therefore, t recommen	85	93	102	the next shi is have been bar/ata.
	38%	47	9	22	85	<b>98</b> 1.6	110			H	NG.	Ž	n vary from e can guara	Caution is	88	97	105	L ded down 2 values ar higher 0.1
	37%	46.0	58	23	83	85	108			1	A DIVIN		n toxicity ca nning devic	oth of these his product	16	100	109	e been roum actional PO to the next
	36%	40	57	69	81	22	<b>106</b>	119			SCUB	Z	s and oxyge	om one or b the use of	95	104	113	r values hav interger. Fi led upward
	35%	43	55	1:1	80	32	104	<b>116</b>				K	sion sidnes e table, com	not suffer fr ociated with	66	108	117	depth lower
	34%	42 8.0	54	8:	78	87	102	114	127			5	decompres	- you will r all risks ass	102	112	122	the bottom of th that MOC
	33%	41 0.8	53	25	76	82	100	112	<b>123</b>		1		eptibility to from day to	d correctly - Nist assume	107	117	127	s not exceed howm at the sociated wi
	32%	<b>40</b> 8.0	51	1.63	75	987	98	109	121	133		2	Susc	ifuse	111	121	132	L depth doe oth (MOD) s e the PO2 as
	31%	39	50	30	73	23	<b>96</b> 1.3	107	119	<b>130</b> 1.6	143				116	126	137	e actual dive berating Der s okay to use
	30%	38 0.7	49	996	71	8:	94	105	117	128 15	139	151			121	132	143	s long as th taximum Of he table, it i
	29%	37 0.7	48 0.8	59	70	181	92	103	114	126	137	<b>148</b> 1.6	159		126	137	149	value de value
-	28%	36 0.6	47 0.7	58	<b>69</b> 0.9	80.1	1.1	101	112	123	134	145 1.6	<b>156</b> 1.6		132	143	156	L ttely below 1 ctual depth ft-band oth
	27%	35 0.6	46	56 0.8	67 0.9	78	<b>89</b> 1.0	100	110	121	132	143	<b>154</b> 1.6	ths	138	150	162	ear immedia t from the a
	26%	34 0.6	44 0.7	55 0.7	66	76 0.9	87	98	<b>108</b>	119	130	141	151	Dep	144	157	170	L th will app (D, move lef
	25%	33	43 0.6	54 0.7	64	75 0.9	86 0.9	1.0	107	117	128	<b>138</b> 1.3	149	ing	151	165	178	for this dep mine the EA
	24%	32 0.5	42 0.6	53	63	74	84 0.9	1.04	105	115	126	<b>136</b> 1.3	146	erat	159	173	187	The PO2 number - To deter
	23%	31 0.5	41 0.6	52 0.6	62 0.7	22 8.0	82 0.9	93	103	113	123	134	144	ope	167	182	196	fal pressure thure used. therefore
	22%	30	40	51 0.6	61 0.7	F.0	81 0.8	91 6.0	101	111	121	132	142	m	177	192	207	(D) and part for the mix find the dep actual dive
	21%	30	40	50	60	70	80	90	100	110	120	130	140	xim	187	202	218	ir Depth (E/ ve FO2 value in until you
	F02													Ma				or Use Equivalent A 2), start at th e FO2 column
	AD	30	40	20	50	20	30	90	00	10	20	30	40	03	4.	.s	9.	uctions fi etermine E sygen (PO2 e down thu

P02	Single Dive Limit 24-Hour Limit	-	2	S	4	5	10	15	20	25	30	35	40	45	50	55	60	<b>Time in Minutes</b>
0.6	720	1%	1%	1%	1%	1%	1%	2%	3%	3%	4%	5%	<b>6%</b>	%9 %9	3%2	8% 8%	8%8%	
	540	10%	10%	10/2	10%	10/0	20%	30/0	40%	50/0	60%	9/09	7%	8%	0/06	10%	11%	
0.7	540	1%	19%	1%	1%	19%	2%	3%	4%	5%	6%9	6%	7%	8%	9%6	10%	11%	
0.8	<b>450</b> 450	<mark>%</mark> %	1%	1%	1%	1%	2%	3%	<b>4%</b>	<b>6%</b>	2% 7%	8%	<b>9%</b>	10%	11%	12%	13%	
0.9	360	1%	1%	1%	1%	1%	3%	4%	<b>6%</b>	7%	8% 8%	10%	11%	13%	14%	15%	17%	
1.0	300 300	1%	22	1%	1%	<b>2%</b> 2%	3%	5%	<b>7%</b>	8%8	10%	<b>12%</b> 12%	13%	15%	17%	18%	20%	
1.1	<b>240</b> 270	1%	1%	1%	2%	2%	4%	6%	8%	10%	13%	15%	17%	19%	21%	23%	25%	
1.2	<b>210</b> 240	1%	1%	18	2%	2%	5% 4%	7%	10%	12%	<b>14%</b> 13%	17%	19%	21%	<b>24%</b> 21%	<b>26%</b> 23%	29%	
1.3	<b>180</b> 210	1%	1%	2%	2%	3%	<b>6%</b> 5%	8%	11%	14%	17%	19%	22%	25%	28% 24%	31%	33%	SCUBA DIVINO
1.4	<b>150</b> 180	1%	182	2%	3%	3%	7%	10%	13%	17% 14%	<b>20%</b> 17%	23%	27%	30%	33%	37% 31%	<b>40%</b> 33%	
1.5	120 180	1%	2%	3%	3%	4%	8%	13%	17%	21%	25%	29%	33%	38%	42% 28%	46% 31%	50% 33%	TRCBNCAL BYVING
1.6	<b>45</b>	2%	<b>4%</b> 1%	7%	<b>9%</b> 3%	11%	<b>22%</b> 7%	<b>33%</b> 10%	<b>44%</b> 13%	<b>56%</b> 17%	67% 20%	78%	89%	<b>100%</b>	33%	37%	40%	INTERNATIONAL
nstructions or Use	<ul> <li>This chart allows you: oxygen exposure life outsethe chart, be oxygen (PO2) exper reverse side).</li> <li>Find this PO2 value horizontally until ye the drive, in minutes the drive, in minutes the origon of the si percentage of the si</li> </ul>	the quictly cannot be quictly cannot be quictly cannot be the source of the case of the ca	kulate what we consume ermitaing the the deepest band column than column tha column tha esent the pe we. The topn limit consum	percentage ed on each point durin point durin n, and ther in and ther threat durin red; the lor ned; the lor ned; the lor	of your tota dive. essure of ng the dive ( he length o f the total ti represents th wermost val	the firm	a can combi ermine tot minute div umns. multiple di possible to possible to e limits for n rounded in n rounded	ne percent add the r e, add the r recover's so ult the TDI ion. Working Div to the near	age values precise to t recontage ed by suffin and of the 1 Advanced 1 re based on vers. Fractic	from differe the minute. I s from the 6 cient surface titme limits o Nitrox Diver in the MOAA ( mal percent xumber, with.	nt columns for example 0, 5 and 2 n 0, 6 and 2 n 0, 6 and 2 n 0, 6 and 2 n 0, 6 and 2 n 0, 7 and 2 n 0, 9 and 2 n 0, 10	to 2, for a minute minute n previ uual for bave have ralue of	Succession of the second	om day to di correctly -	kcompression by No diversion by No diversion	n sidness at able computer from the atted with the	RR R nd avgen to the or planni one or both	ddty can var from person ddthce problems - therefore, the u product - dutions is recommended

# **APPENDIX IV – EXAMPLE AUDIT SHEET**

FOR USE BY COMMERCIAL HARVEST DIVING OPERATION TO VERIFY COMPLIANCE WITH A SET OF STANDARDS (Source: ADCI 2011)

## COMMERCIAL HARVEST DIVING STANDARDS





### AUDIT SHEET

	1. General Information
Company Name	
Address	
Telephone	
Facsimile	
Email	
Website	
Business Scope	
President, Managing Director	
Safety Manager	
QA/QC Manager	
Operations or Diving Manager	
	2. Personnel Requirements
2.2 Existing members are N records on each diver en certification card number	OT required to submit complete information on these personnel but are required to have complete aployed or used during the conduct of commercial diving operations. <u>Identify personnel by ADCI</u>
Diver's Training	
Other Training Course(s)	
Diver's Certification Section 3	
Diver's Log Book Section 5	
Diving Supervisor(s) Section 3 and Section 5	
Life-support Technician(s) Section 3	
2.3 Medical Requirements Note: It is not intended has been conducted and	(Must be on-file at the company location for each diver). that disclosure of doctor-to-patient information is required but rather that a valid medical examination I that examinee as been judged "fit to dive."
Medical Examination Section 2	
Examining Physician Organization Section 2	
Medical Records Section 2	Note: No confidential information is desired.

	3. Operations Procedures
3.1 General Operations Proc	cedures
Safe Practices/Operations Manual Section 5	
Does the safe practices / operations manual contain copies of recognized tables for decompression and treatment (including altitude corrections)?	YES NO What tables does your company use?
Emergency Aid Section 5	
First Aid Section 5	
Planning and Assessment Section 5	
Job Safety Analysis Procedure <b>Section 5</b>	
Dive Team Briefing Section 5	
Minimum Dive Team Numbers <b>Section 4</b>	
Inspection of Systems, Equipment and Tools Section 5 and Section 10	
Decompression Chamber Section 6	
Standby Diver Section 5	
Warning Display Section 5	
Reserve Breathing Supply Section 5	
Communications Section 5	
Company Record of Dives Section 5	
Personal Protective Equipment Section 5	
3.2 Assignments and Respor	nsibilities (Are your procedures consistent with the requirements set forth in the consensus standards?)
Diving Supervisor Section 3 and Section 5	
Diver Section 3	
Standby Diver Section 3	
Entry-level Tender/Diver Section 5	

Life-suppo Technic	ort (Saturation) ian Section 3						
3.3 Safety I	Procedure Checklist – Sec	tion 5 and Section 10					
3.4 Equipm	ent Procedure Checklist -	- Section 5 and Section 10					
3.5 Specific	Operations Procedures (I	hand-held power tools; welding	and burning equipment; explosives) - Sectio	on 5			
3.6 Emerge	ncy Procedures (fire; equip	oment failure; adverse environme	ental conditions; medical illness; treatment of	finjuries) – Section 7			
		4. Equipment a	and Systems				
4.1 Does th diving a 4.2 Identif	<ul> <li>4.1 Does the company have established check-off lists for inspection of equipment and systems intended to be used for commerci diving and underwater operations to ensure functional and operational readiness and safety for intended use?</li> <li>4.2 Identify personnel who perform the initial and periodic examination, testing and certification of diving equipment and systems</li> </ul>						
		4.3 Diver's Dress	s – Section 6				
Item	Description	Numbers	Last Inspection or Testing Date(s)	Comments			
1	Dry Suits						
2	Hot Water Suits						
3	Harnesses						
4	Bailout Systems						
		4.4 Helmets and Ma	usks – Section 6				
Item	Description	Numbers	Last Inspection or Testing Date(s)	Comments			
1	Heavyweight Helmet						
2	Lightweight Helmet						
3	Masks						
~			1	1			

		4.5 Hoses and Manifo	lds – Section 6	
Item	Description	Numbers	Last Inspection or Testing Date(s)	Comments
1	Umbilical & Breathing Hoses			Are these properly marked?
2	Oxygen Hoses			
3	Air-supply Manifold			
4	Mixed-gGas Manifold			
5	Other Manifolds (Breathing Gas Control Systems)			
		4.6 Compressors	- Section 6	
Item	Description	Numbers	Last Inspection or Testing Date(s)	Comments
1	Compressors a. Low Pressure b. High Pressure			
2	Volume Tanks			
3	Filters			
4				
4	Air-purity Tests			
4	Air-purity Tests	4.7 Diver Entry and Egress	Systems – Section 6	
Item	Air-purity Tests Description	4.7 Diver Entry and Egress Numbers	Systems – Section 6 Last Inspection or Testing Date(s)	Comments

		4.9 Gauges – Se	ection 6	
Item	Description	Numbers	Last Inspection or Testing Date(s)	Comments
1				
2				
3				
	4.10 Rel	ief Valves – Ss Appropriate te	o System Installed – Section 6	
Item	Description	Numbers	Last Inspection or Testing Date(s)	Comments
1				
		4.11 Timekeeping Dev	rices - Section 6	
Item	Description	Numbers	Last Inspection or Testing Date(s)	Comments
1				
2				
3				

5. Accident Reporting	
Article I. 5.1 What accident recording procedure (Section 7) does your company use?	
Article II. 5.2 Record the number of lost time incidents, fatalities, or near-miss reporting figures for past three years as in company records/insurance information.?	recorded
6. Health, Safety and Environmental System Management (Company Process) – Section 10	
6.1 Is a health, safety and environmental management system in place, and how often is this communicated to employees?	
Article III. 6.2 What is your company's method for dealing with diving medical emergencies?	
6.3 Last emergency response drill conducted:	
6.4 Last safety meeting conducted:	
6.5 Last safety audit conducted:	
7. QA / QC Management (Company Process) – Section 10	
Article IV. 7.1 Does the company have an established QA/QC manual?	
7.2 ISO registered certifications achieved (if applicable):	
7.3 Last QA/QC in-house audit date:	

#### **Diving Personnel Information Form**

This form should be used by new member applicants and may be used by existing members as an internal record to maintain pertinent information of employees or other personnel used in the conduct of commercial diving or other underwater operations.

Existing members are **NOT** required to submit complete information on these personnel but are required to have complete records on each diver employed or used during the conduct of commercial diving operations. <u>Identify personnel by ADCI commercial diver certification card number</u>.

Name of Diver	
Divers' Training Course(s)	
Other Training Course(s)	
Diver Certification #	
Is a commercial diver's log book properly maintained and periodically checked by the employer?	
Supervisor's Designation (if applicable)	
Medical Examination	
Examining Physician or Organization	
Examination Standard	
Medical Records (see Section 2)	No confidential information is desired.

### DIVING CONTRACTORS' AUDIT FORM

#### **Chapter II: Personnel Requirements**

	1. DIVING SU	PERVISORS	
ITEM	DESCRIPTION	AUDIT RESPONSE	REMARK
1	Formal Supervisor Training Course	Yes 🖬 🛛 No 🗖	
2	Supervisor Certification	Yes 🖬 🛛 No 🗖	
3	Supervisor Appointment Letter	Yes 🖬 🛛 No 🗖	
4	Supervisor Log Book	Yes 🖬 🛛 No 🗖	
5	Number and Valid Date of Other Certifications or Required Documentation	Yes 🗆 No 🗖	
6	Health Certificate and Valid Current Physical	Yes 🖬 🛛 No 🗖	
	2. D I V	ERS	
ITEM	DESCRIPTION	AUDIT RESPONSE	REMARK
1	Formal Diver Training Course	Yes 🖬 🛛 No 🗖	
2	Diver Certification	Yes 🖬 🛛 No 🗖	
3	Diving Log Book	Yes 🖬 🛛 No 🗖	
4	Current Diving Physical: Fit for Diving?	Yes 🖬 🛛 No 🗖	
5	Number and Valid Date of Other Certifications or Required Documentation	Yes 🗅 No 🗖	
6	NDT Certificate (if needed)	Yes 🖬 🛛 No 🗖	
7	Welding Certificate (if needed)	Yes 🖬 No 🗖	
8	Water-jetting Operating Certificate (if needed)	Yes 🖬 🛛 No 🗖	
9	H2S Training Certificate (if needed)	Yes 🖬 No 🗖	

## DIVING CONTRACTORS' AUDIT FORM

#### Chapter III: Equipment and System

SCOPE					
	Maint	enance Records of Life-support l	Equipme	nt	
ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT R	ESPONSE	REMARK
1	Equipment Logs	Suitable equipment logs must be established and maintained in a correct and current condition.	Yes 🗖	No 🗖	
2	Unique Identity	All equipment must have a unique identity traceable to the equipment log.	Yes 🗖	No 🗖	
3	Content of Entries	Entries made in the equipment log must describe the nature of the work performed, including the dates of modification, repair or test; the name of the individual performing the work or test; and the particular piece of equipment involved.	Yes 🗖	No 🗖	
4	Signature	Any equipment repair and maintenance must be signed by divers or technicians.	Yes 🗖	No 🗖	
5	Instruction	Inspection and maintenance for any helmets or masks must be in accordance with instruction of manufacturer.	Yes 🗖	No 🗖	
DIVER'	S DRESS				
		Dry Suits			
ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT R	ESPONSE	REMARK
1	Preventing Over-inflation Device	If fitted with valves, have a means of preventing over-inflation, which could result in an uncontrolled ascent.	Yes 🗖	No 🗖	
2	Material	Be constructed of material suitable to the environment in which it is to be used.	Yes 🖵	No 🗖	
3	Environmental Protection	Protect the diver from the environment, whether temperature or hazardous material.	Yes 🖵	No 🗖	

Harnesses						
ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT RESPONSE	REMARK		
1	Material	Be made of material of suitable strength to lift the diver and his/her equipment from the water.	Yes 🗖 No 🗖			
2	Quick-release Device	Have a mechanical quick-release between the harness and the umbilical.	Yes 🗖 No 🗖			

3	Strain-protection Construction	Be constructed and fitted to prevent an unconscious diver from slipping free of the harness or from a strain being placed on mask or helmet.	Yes 🗖	No 🗆
4	Usage	Not be used as a weight belt.	Yes 🗖	No 🗖
5	Prevent Restriction of Diver's Breathing	Be designed to prevent restriction of the diver's breathing when his/her full weight is supported by the harness. Complies with ADCI current guidelines.	Yes 🗖	No 🗖
		Weight Belts		
1	Weight	Be of sufficient weight to maintain the diver at working depth.	Yes 🖵	No 🗖
2	Usage	Not be used as an attachment for the diving umbilical.	Yes 🗖	No 🗖
3	Release Buckle	Be equipped with an appropriate release buckle.	Yes 🗖	No 🗖
4	Avoid Accidental Disengagement	Be attached to the diver in a manner to avoid accidental disengagement.	Yes 🗖	No 🗖
	Diver	-worn or Carried Emergency Ga	s (Bailou	t)
1	Suitability	Be manufactured to recognized codes or standards.	Yes 🗖	No 🗖
2	Cylinder Overpressure Relief Disk	Be equipped with an overpressure relief device	Yes 🗖	No 🗖
3	Annual Inspection	Be inspected internally and externally for damage or corrosion within 1 year.	Yes 🗖	No 🗖
4	Hydrostatic Testing and Stamp	Be hydrostatically tested to the requirements of the code of manufacturer by an authorized test facility within 5 years and <b>stamped</b> with the date of test.	Yes 🗖	No 🗖
5	Record and Certificate	Have a unique identity with results of all tests being <b>recorded</b> or <b>certified</b> in the equipment log.	Yes 🗖	No 🗖
6	Regulator	Have a regulator on the cylinder capable of delivering the proper pressure and flow to the diver's helmet or mask in accordance with the flow characteristics recommended by the helmet or mask manufacturer.	Yes 🗖	No 🗖
7	Prevent Disengagement Device	Have a means of attachment to the helmet or mask that prevents accidental disengagement.	Yes 🖵	No 🗖
8	Sufficient Capacity	Be of sufficient capacity to permit return of the diver to the surface or to the diving stage at a travel rate of 10 meters/minute.	Yes 🗖	No 🗖
9	Sufficient Capacity	Capable of providing 4 minutes of EGS at depth.	Yes 🖵	No 🗖
10	Appropriate Content	Be charged with an appropriate breathing gas mixture to accommodate mode of diving/depth requirement.	Yes 🗖	No 🗖

Helmet	s & Masks				
		General			
ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT RI	ESPONSE	REMARK
1	Suitability for Usage	Be appropriate for the task intended.	Yes 🗖	No 🗖	
2	Capability of Ventilation	Be capable of ventilating the required gas when supplied at the pressure recommended by the manufacturer of the equipment at any depth at which they are operated.	Yes 🗖	No 🗖	
3	PP CO <sub>2</sub>	Be capable of maintaining the diver's respired CO <sub>2</sub> partial pressure below 0.02 ATA.	Yes 🗖	No 🖵	
4	Communication	Be fitted with two-way communications	Yes 🗖	No 🖵	
5	Non-return Valve	Be equipped with a non-return valve in the main gas supply that closes readily and positively. Have check valves with springs not exceeding 3 psi cracking pressure.	Yes 🗖	No 🗖	
6	Material	Be made of corrosion-resistant material.	Yes 🗖	No 🖵	
7	Over-pressure Protection	Be protected from over-pressurization.	Yes 🗆	No 🗖	
8	Marking	Each helmet or mask should have a unique serial number.	Yes 🗖	No 🗖	
9	Maintenance	Each helmet or mask must be subject to regular planned maintenance and a <b>record</b> of such maintenance should be available.	Yes 🗖	No 🗖	
10	Inspection and Testing	Inspection and function test at atmospheric pressure at least annually with <b>record</b> or <b>certificate</b> .	Yes 🗖	No 🗖	
Hoses					
		<b>Breathing Gas Hoses</b>			
1	Burst Pressure	Have a minimum burst pressure equal to 4 times the maximum working pressure.	Yes 🗖	No 🗖	
2	Flow Rating	Flow rating to meet intended use.	Yes 🗖	No 🗖	
3	Connector Pressure	Connector pressure equal to or greater than the system on which they are installed.	Yes 🗖	No 🗖	
4	Material	Have fittings of corrosion-resistant material that cannot be accidentally disengaged.	Yes 🗖	No 🗖	
5	Collapse Prevention	Be kink-resistant or arranged to prevent kinking.	Yes 🗖	No 🗖	
6	Annual Testing	Examine visually and pressure test to 1.5 times maximum working pressure within 1 year with record.	Yes 🗖	No 🖵	
7	Testing After Repair	Examine visually and pressure test after each repair and alteration with <b>record.</b>	Yes 🗖	No 🗖	
8	Suitability	Be suitable for breathing gas service.	Yes 🗖	No 🗖	
		Umbilicals			
ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT RI	ESPONSE	REMARK
1	Burst Pressure	Have a minimum burst pressure equal to 4 times the maximum working pressure.	Yes 🗖	No 🗖	

2	Flow Rating	Flow rating not less than the system in which it is installed or used and suitable for the service intended.	Yes 🗖	No 🗖
3	Connector Pressure	Connector pressure equal to or greater than the system on which they are installed.	Yes 🗖	No 🗖
4	Material	Have fittings of corrosion-resistant material that cannot be accidentally disengaged.	Yes 🗖	No 🗖
5	Collapse Prevention	Be collapse-resistant or arranged to prevent collapse.	Yes 🗖	No 🗖
6	Annual Testing	Examine visually and pressure test to 1.5 times maximum working pressure within 1 year with <b>record</b> , and pull test for fitting.	Yes 🗖	No 🗖
7	Testing After Repair	Examine visually and pressure test after each repair and alteration with <b>record</b>	Yes 🗖	No 🗖
8	Marking	Umbilical must be marked for length using a recognized system that allows easy visual identification of the length paid out.	Yes 🗆	No 🗖
9	Maintenance Plan	Be marked with a unique identity and subjected to a planned maintenance program.	Yes 🗖	No 🗖
10	Composition	Consist of a breathing gas hose, communications cable, a means of determining the diver's depth and an included strength member, when required.	Yes 🗖	No 🗖
11	Material	Have a minimum member made of material unaffected by immersion in water for extended period.	Yes 🗆	No 🗖
12	Minimum Break Strength	Have a minimum hose assembly break strength of 1,000 lbs.	Yes 🗖	No 🗖
13	Security	The diver's end of the umbilical must be fitted with a means that allows it to be securely fastened to the diver's safety harness without putting any strain on the individual whip ends.	Yes 🗖	No 🗖
14	Standby Diver	The umbilical assembly used for the standby diver must be of sufficient length to reach the primary diver at the farthest distance he/she can proceed from the dive station.	Yes 🗖	No 🗖
		Oxygen Hoses for Life Suppor	rt	
1	Burst Pressure	Have a minimum burst pressure equal to 4 times the maximum working pressure	Yes 🗖	No 🗖
2	Flow Rating	Flow rating not less than the system in which it is installed or used and suitable for the service intended.	Yes 🗆	No 🗖
3	Connector Pressure	Connector pressure equal to or greater than the system on which they are installed.	Yes 🗖	No 🗖
4	Material	Have fittings of corrosion-resistant material that cannot be accidentally disengaged.	Yes 🗖	No 🗖
5	Collapse Prevention	Be collapse-resistant or arranged to prevent collapse.	Yes 🗖	No 🖵

6	Annual Testing	Examine visually and pressure test to 1.5 times maximum working pressure within 1 year with record.	Yes 🗖	No 🗖	
7	Testing After Repair	Examine visually and pressure test after each repair and alteration with <b>Record.</b>	Yes 🗖	No 🗖	
8	Oxygen Cleaning	Hose assemblies used in systems containing greater than 50% oxygen are to be cleaned for oxygen service.	Yes 🗆	No 🗖	
9	Marking	Hoses used for 100% oxygen service should be identified by a consistent color code or tagged "FOR OXYGEN USE ONLY."	Yes 🗖	No 🗖	
10	Lubricants	Lubricants used to assemble fittings on hoses for oxygen service must be compatible with oxygen.	Yes 🗆	No 🗖	
11	Hose and Fittings	Hose and fittings must be brass or other alloys suitable for O <sup>2</sup> use.	Yes 🖵	No 🗖	
Compr	essor Systems				
	Co	ompressors & Gas Pumps for Life	Support		
1	Personnel Protection	Have suitable personnel protection around rotating machinery.	Yes 🖵	No 🗖	
2	Instruction	Have the necessary instruction to facilitate operations	Yes 🖵	No 🗖	
3	Suitability	Be of the proper type, pressure and flow rate, suitable for service intended.	Yes 🗖	No 🗖	
4	Pollution Protection	Have its air intake positioned to be clear of exhaust fumes and other contaminants.	Yes 🗖	No 🗖	
5	Piping	Have piping system in accordance with recognized codes of standards.	Yes 🗖	No 🗖	
6	Flexible Hoses	Have flexible hoses in accordance with "hoses requirement."	Yes 🖵	No 🗖	
7	Electrical Controls	Have electrical controls, wiring and drive units meeting the jurisdictional requirements when so equipped.	Yes 🗖	No 🗖	
8	Oxygen Transfer	Be cleaned for oxygen service when used with mixtures of greater than 50% oxygen and equipped using rising stem type valve.	Yes 🗆	No 🗖	
9	Access	Be easily accessible to diving personnel, both for routine maintenance and during an emergency.	Yes 🗖	No 🗖	
		Recording of Maintenance and Re	epairs		
ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT R	ESPONSE	REMARK
1	Entries of Repair	Entries must be made in the equipment log for all maintenance and repairs performed on the compressor and gas system.	Yes 🗖	No 🗖	
2	Quality Tests	Results of air quality tests must be retained to document their results and accomplishment.	Yes 🗖	No 🗖	
3	Unique Identity	Compressors must have a unique identity incorporating manufacturer, model, serial number, maximum rates outlet pressure, rated flow capacity and safety valve settings.	Yes 🗖	No 🗖	

4	Planned Maintenance	Compressor units must be subjected to planned maintenance.	Yes 🗖	No 🗖	
		Volume Tanks			
1	Manufacture	Be designed, fabricated, inspected, tested and certified in accordance with recognized codes or statutory or classification society requirements.	Yes 🗖	No 🗖	
2	Pressure Gauge	Be equipped with a pressure gauge.	Yes 🗖	No 🗖	
3	Check Valve	Be equipped with a check valve on the inlet side.	Yes 🗖	No 🗖	
4	Relief Valve	Be equipped with a relief valve as required by code of manufacturer.	Yes 🗖	No 🗖	
5	Drain Valve	Be equipped with condensate drain valve located at its lowest point.	Yes 🗖	No 🗖	
6	Annual Inspection	Be inspected internally and externally within 1 year for damage or corrosion with <b>record</b> .	Yes 🗖	No 🗖	
7	Pneumatically Testing	Be pneumatically tested to maximum working pressure within 1 year for the breathing mixture normally used with <b>record</b> .	Yes 🗖	No 🗖	
8	Hydrostatic Testing	Be hydrostatically tested to 1.2 times maximum working pressure within 5 years or after any repair, modification or alteration to the pressure boundary and <b>stamped</b> with the test date.	Yes 🗖	No 🗖	
9	Record and Certificate	Have a unique identity with results of all tests being recorded in the equipment <b>log</b> with	Yes 🗖	No 🗖	
		certificate.			
		certificate. Filtration			
ITEM	DESCRIPTION	Certificate. Filtration DIVING OPERATIONS REQUIREMENT	AUDIT R	ESPONSE	REMARK
ITEM 1	<b>DESCRIPTION</b> Filters	certificate. Filtration DIVING OPERATIONS REQUIREMENT Filters, when installed to prevent contamination, must meet or exceed the flow rate and pressure rating of the compressor or piping system in which they are installed and be able to deliver breathing gas in compliance with recognized purity standards for extended operation	AUDIT R Yes 🗅	ESPONSE No 🗖	REMARK
ITEM 1	<b>DESCRIPTION</b> Filters	certificate. Filtration DIVING OPERATIONS REQUIREMENT Filters, when installed to prevent contamination, must meet or exceed the flow rate and pressure rating of the compressor or piping system in which they are installed and be able to deliver breathing gas in compliance with recognized purity standards for extended operation Air Purity Requirements	AUDIT R Yes 🗅	ESPONSE No 🗖	REMARK
1 <b>TEM</b> 1 1 1	DESCRIPTION Filters Quality Testing	certificate. Filtration DIVING OPERATIONS REQUIREMENT Filters, when installed to prevent contamination, must meet or exceed the flow rate and pressure rating of the compressor or piping system in which they are installed and be able to deliver breathing gas in compliance with recognized purity standards for extended operation Air Purity Requirements All compressor, transfer pumps or booster pumps used for breathing air service must be subjected to a quality test in last 6 months.	AUDIT R Yes 🗅 Yes	ESPONSE No 🗆	REMARK
1 <b>TEM</b> 1 1 2	DESCRIPTION Filters Quality Testing Selecting Point	certificate.         Filtration         DIVING OPERATIONS REQUIREMENT         Filters, when installed to prevent contamination, must meet or exceed the flow rate and pressure rating of the compressor or piping system in which they are installed and be able to deliver breathing gas in compliance with recognized purity standards for extended operation <b>Air Purity Requirements</b> All compressor, transfer pumps or booster pumps used for breathing air service must be subjected to a quality test in last 6 months.         Tests must be taken at the discharge point that would normally supply the breathing gas system, the diver's hose or cylinder fill point.	AUDIT R Yes - Yes - Yes -	ESPONSE No 🗆 No 🗅	REMARK
1 1 1 2 3	DESCRIPTION Filters Quality Testing Selecting Point Testing Record	certificate.         Filtration         DIVING OPERATIONS REQUIREMENT         Filters, when installed to prevent contamination, must meet or exceed the flow rate and pressure rating of the compressor or piping system in which they are installed and be able to deliver breathing gas in compliance with recognized purity standards for extended operation <b>Air Purity Requirements</b> All compressor, transfer pumps or booster pumps used for breathing air service must be subjected to a quality test in last 6 months.         Tests must be taken at the discharge point that would normally supply the breathing gas system, the diver's hose or cylinder fill point.         Documentation of these tests must be kept on file and available upon request.	AUDIT R Yes 🗆 Yes	ESPONSE No 🗋 No 🗋 No	REMARK
<u>ITEM</u> 1 1 1 2 3 Diver E	DESCRIPTION Filters Quality Testing Selecting Point Testing Record Entry & Egress System	certificate.         Filtration         DIVING OPERATIONS REQUIREMENT         Filters, when installed to prevent contamination, must meet or exceed the flow rate and pressure rating of the compressor or piping system in which they are installed and be able to deliver breathing gas in compliance with recognized purity standards for extended operation <b>Air Purity Requirements</b> All compressor, transfer pumps or booster pumps used for breathing air service must be subjected to a quality test in last 6 months.         Tests must be taken at the discharge point that would normally supply the breathing gas system, the diver's hose or cylinder fill point.         Documentation of these tests must be kept on file and available upon request.	AUDIT R Yes 🗆 Yes	ESPONSE No 🗋 No 🗋 No	REMARK
11EM 1 1 2 3 Diver E	DESCRIPTION Filters Uality Testing Quality Testing Selecting Point Testing Record Entry & Egress System	certificate.         Filtration         DIVING OPERATIONS REQUIREMENT         Filters, when installed to prevent contamination, must meet or exceed the flow rate and pressure rating of the compressor or piping system in which they are installed and be able to deliver breathing gas in compliance with recognized purity standards for extended operation <b>Air Purity Requirements</b> All compressor, transfer pumps or booster pumps used for breathing air service must be subjected to a quality test in last 6 months.         Tests must be taken at the discharge point that would normally supply the breathing gas system, the diver's hose or cylinder fill point.         Documentation of these tests must be kept on file and available upon request. <b>Diving Ladder and Stage</b>	AUDIT R Yes - Yes - Yes -	ESPONSE No 🗋 No 🗍 No 🗍	REMARK
1TEM 1 1 2 3 Diver E 1 1	DESCRIPTION Filters Filters Quality Testing Quality Testing Selecting Point Testing Record Entry & Egress System Capability	certificate.         Filtration         DIVING OPERATIONS REQUIREMENT         Filters, when installed to prevent contamination, must meet or exceed the flow rate and pressure rating of the compressor or piping system in which they are installed and be able to deliver breathing gas in compliance with recognized purity standards for extended operation <b>Air Purity Requirements</b> All compressor, transfer pumps or booster pumps used for breathing air service must be subjected to a quality test in last 6 months.         Tests must be taken at the discharge point that would normally supply the breathing gas system, the diver's hose or cylinder fill point.         Documentation of these tests must be kept on file and available upon request. <b>Diving Ladder and Stage</b> Be capable of supporting the weight of two divers plus their gear.	AUDIT R Yes Yes Yes Yes Yes Yes	ESPONSE No 🗋 No 🗍 No 🗍 No 🗍	REMARK

3	Purpose	Be suitable for the purpose intended	Yes 🗖	No 🖵
4	Ladder Length	Ladder must extend a minimum of 1 meter (3 feet) below surface where installed.	Yes 🗖	No 🗖
5	Safety Chain and Hand Holds	Stage be provided with a safety chain and internal hand holds for diver safety during launch and recovery.	Yes 🖵	No 🗖
6	Cylinder and Regulator	Stage be provided with breathing gas cylinder and regulator for emergency breathing if required.	Yes 🗖	No 🗖

Gauges						
	Gauge	es utilized with diving equipment or s	systems mus	st:		
ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT R	ESPONSE	REMARK	
1	Suitability	Be suitable for purpose intended.	Yes 🗆	No 🗖		
		When used to indicate a diver's dept	h:			
2	Range and Graduation	Be of appropriate range and graduation.	Yes 🗖	No 🗖		
3	Consistent	Be graduated in units consistent with the decompression tables to be utilized.	Yes 🗖	No 🗖		
4	Calibration	Be calibrated to a known standard every 6 month with certificate	Yes 🗆	No 🗖		
5	Discrepancy	Be recalibrated when a discrepancy exists exceeding 2% of full scale.	Yes 🗖	No 🗖		
6	Calibration Mark	Be marked with a label, tag or sticker indicating date of last calibration and date due, which will not interfere with full-scale visibility.	Yes 🗖	No 🗖		
7	Deviation	Have a tag or label indicating amount of deviation (+/-) to the calibration standard.	Yes 🗖	No 🗖		
8	Calibrations Log	Have calibrations documented in the equipment log.	Yes 🗆	No 🗖		
9	Pressure-limiting Device	A pressure-limiting device may be fitted to gauges being over-pressurized.	Yes 🗖	No 🗖		
Timeke	Timekeeping Devices					
	Devices utilize	ed to monitor a diver's exposure time	under press	sure must:		
1	Suitability	Be suitable for purpose and easily readable, and have suitable backup	Yes 🗆	No 🗖		

Compressed Gas Equipment					
		Gas Storage Cylinders and Tub	es		
		High-pressure gas cylinders or tube	s must:		
ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT RESPONSE	REMARK	
1	Manufacture Standard	Be manufactured to recognized code or standard.	Yes 🗖 No 🗖		
2	Over-pressure Relief Device	Be equipped with an over-pressure relief device.	Yes 🗆 No 🗖		
3	Protection for Valve and Regulator	If rack-mounted into banks of cylinders or tubes, have valves and regulators protected from damage caused by falling objects.	Yes 🗖 No 🗖		
4	Hydrostatic Testing and Stamp	Be hydrostatically tested according to manufacturer and/or regulatory authorities, and stamped with the test date.	Yes 🗖 No 🗖		
5	Annual Internal and External Inspection	Visually inspected internally and externally for damage or corrosion within 1 year if used underwater.	Yes 🗖 No 🗖		
6	Contents Label	Be labeled as to contents. Fire-hazard warning signs must be erected in the vicinity of stored oxygen.	Yes 🗆 No 🗖		
7	Storage	Be stored in a well-ventilated area, protected from overheating and secured from falling. Fire- warning signs must be erected in the vicinity of stored oxygen.	Yes 🗖 No 🗖		
8	Contents and Pressure Records	A record must be kept in a designated place of the contents and pressure of each cylinder, quad or bank. These records must be updated daily when the system is in use.	Yes 🗖 No 🗖		

## Diving Contractors' Audit Form Chapter IV: Operation Procedures

ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT RESPONSE	REMARK
		There must be a safe practices/operations manual at the job site.	Yes 🗖 No 🗖	
		The manual has met the requirement of the ADCI CS.	Yes 🗖 No 🗖	
1	Safety Practices /Operations Manual	The manual contains related government regulations, safety procedures, checklists, assignments and responsibilities of diving personnel, equipment procedures and checklists, emergency procedures, etc.	Yes 🔲 No 🗖	
		The manual contains a definitive statement regarding the use of drugs or alcohol.	Yes 🗆 No 🗖	
	Emergency Aid	Developed and maintained a contact list for emergency response.	Yes 🗖 No 🗖	
2		The emergency contact list has been made available at the contractor's principal place of business and at the dive site.	Yes 🔲 No 🗖	
		The contact list includes decompression chamber, hospital, air or ground transportation, on-call diving physician, national rescue center, etc.	Yes 🗆 No 🗖	
		Two-way communications are available at the dive site as required.	Yes 🗖 No 🗖	

		First aid supplies are appropriate and available for the type of operation being conducted.	Yes 🖵	No 🗖	
		First aid kit is readily accessible in a clearly marked container at the work site.	Yes 🗖	No 🗖	
3	First Aid	First aid handbook is available at the diving location.	Yes 🗖	No 🗖	
		A bag-type manual resuscitator/defibrillator is available at the diving location.	Yes 🗖	No 🗖	
		The first aid kit's contents meet with the ADCI recommendations.	Yes 🗖	No 🗖	
		There was a dive plan established for each operation.	Yes 🗖	No 🗖	
		The dive plan included a job safety analysis.	Yes 🖵	No 🗖	
		The dive plan included personnel assignments, tasks and responsibilities.	Yes 🗖	No 🗖	
4	Planning and Assessment	The dive plan included operational equipment preparation.	Yes 🖵	No 🗖	
		The dive plan included decompression procedure and treatment procedure.	Yes 🗖	No 🗖	
		The dive plan included all emergency procedures.	Yes 🗆	No 🗖	
		There was a safety meeting conducted before any dive operation.	Yes 🗖	No 🗖	
5	Team Briefing	During the meeting, dive team members were briefed on underwater tasks, safety procedures and any hazards, related to the underwater operation.	Yes 🗖	No 🖵	
		Before/after each dive, the diver's physical condition was reported and recorded.	Yes 🖵	No 🗖	
6	Inspection of Systems, Equipment and Tolls	Checklists were used to confirm that the systems and equipment are in safe working order.	Yes 🗖	No 🗖	
		For any diving excess of 30 MSW/100 FSW, a chamber must be available and ready for use at the diving site.	Yes 🗖	No 🗖	
7	Decompression Chamber	The minimum capability of chamber must be not less than 6 ATA.	Yes 🖵	No 🖵	
		The chamber must be a dual-lock decompression chamber.	Yes 🖵	No 🗖	
		Standby diver must be assigned for any diving operation.	Yes 🗖	No 🗖	
8	Standby Diver	Prior to commencement of the operation, the standby diver's equipment must be fully verified as functioning correctly and thereafter maintained in that condition until completion of the diving.	Yes 🗆	No 🗖	
9	Warning Display	For areas that support marine traffic, an appropriate warning display must be exhibited near the work site so that it has all-around visibility.	Yes 🗆	No 🗖	

		A diver-carried reserve breathing supply must be provided for all diving operations.	Yes 🖵	No 🗖	
10	Reserve Breathing Supply	Diver-carried reserve breathing gas supplied must provide a positive indication to the diver that his/her reserve has been actuated (e.g., gauges, etc.).	Yes 🗖	No 🖵	
		There must be a properly functioning two-way audio-communication system between the diver and supervisor.	Yes 🗖	No 🗖	
11	Communications	There must be a properly functioning two- way audio-communication system between the supervisor and others, such as winch operator, master, etc.	Yes 🗆	No 🗖	
12	Company Record of Dive	Diving contractor must establish and maintain a record of each diving operation.	Yes 🗖	No 🗖	
	Company Record of Dive	The content of the record meets with ADCI CS requirements.	Yes 🗖	No 🗖	
13	Personal Protective Equipment	The appropriate protective equipment was worn when personnel were working at diving location.	Yes 🗖	No 🗖	
		Provide a written document identifying hazards associated with each step of the job and ways to mitigate potential hazards.	Yes 🗖	No 🗖	
14	Job Safety Analysis (JSA)	Assign a specific person the responsibility of implementing the safety procedures or protection required.	Yes 🗖	No 🗖	
		The JSA must be reviewed and updated whenever new equipment, products or procedures are introduced into the work site.	Yes 🗖	No 🗖	
		Designate, in writing, a qualified person as diving supervisor to be in charge of each diving project.	Yes 🗖	No 🗖	
		Diving supervisor's responsibilities must be defined in writing.	Yes 🗖	No 🗖	
		Diver's responsibilities must be designated in writing.	Yes 🗖	No 🗖	
15	Assignment and Responsibilities	Standby diver's responsibilities must be designated in writing.	Yes 🗖	No 🗖	
		Tender's responsibilities must be designated in writing.	Yes 🗖	No 🗖	
		LST's responsibilities must be designated in writing, if there is one assigned to the job.	Yes 🗖	No 🗖	
		Diving physician's responsibilities must be designated in writing, if there is one.	Yes 🗆	No 🗖	
16	Safety Procedure Checklist	Is there a pre-dive checklist that can show all safety precautions have been taken prior to dive operations?	Yes 🗖	No 🗖	

17	Equipment Procedure Checklist	Is there a pre-dive checklist that can show all equipment is operational ready?	Yes 🗆	No 🗖	
	Minimum Dive Team Member	The minimum number of personnel comprised a diving team is never less than five (three of whom are divers) for offshore operations.	Yes 🗖	No 🗖	
	Minimum Qualification of Personnel	Do diving personnel meet the minimum qualifications, as outlined in the ADCI CS?	Yes 🗖	No 🗖	
	Minimum Equipment	Does the contractor's equipment meet the minimum requirements, as outlined in the ADCI CS?	Yes 🗖	No 🗖	
18	Hand-held Power Tools	Does the contractor have operating procedures for hand-held power tools?	Yes 🗖	No 🗖	
19	Welding and Burning	Does the contractor have procedures for underwater welding and burning?	Yes 🗖	No 🗖	
20	Emergency Procedure	Does the contractor have any emergency procedures for loss of breathing media, loss of communications, etc.?	Yes 🗖	No 🗖	
		Does the emergency procedure satisfy the requirements of ADCI CS?	Yes 🗖	No 🗖	

DIVING UMBILICAL(S)						
ITEM	DESCRIPTION	REQUIREMENT	RESPONSE	REMARK		
1	Diving umbilicals are designed	and fit for purpose.				
	1. Umbilical are properly m	arked for visual identification of the amount paid out.	Yes 🖬 🛛 No 🗖			
	2. Standby diver/bellman's u	imbilical is greater in length than the primary diver's.	Yes 🖬 🛛 No 🗖			
	3. Procedures for bell and s	urface umbilical management are available for review.	Yes 🗆 No 🗖			
	<ol> <li>Testing, maintenance and for review.</li> </ol>	inspection documents for diving umbilicals are available	Yes 🗖 No 🗖			
INDIVIDUAL DIVING EQUIPMENT						
ITEM	DESCRIPTION	REQUIREMENT	RESPONSE	REMARK		
1	Helmets					
	<ol> <li>Helmets are labeled with unique serial number (as recommended by manufacturer).</li> </ol>		Yes 🗖 No 🗖			
	2. Helmets are designed and	l fit for purpose.	Yes 🖬 🛛 No 🗖			
	3. Testing, maintenance and	l inspection documents are available for review.	Yes 🖬 🛛 No 🗖			

2	Diver-Worn Emergency Gas Sup	ply (Bailout Bottle/Emergency Rebreather)		
	1. Diverworn emergency gas	supply for all bell occupants.	Yes 🗆 No 🗖	
	<ol><li>EGS is designed and fit for depth of dive).</li></ol>	purpose (4-minute minimum EGS duration for deepest	Yes 🖬 No 🖬	
	3. All EGS cylinders/SLS are	marked with the name and mixture percentages.	Yes 🖵 No 🖵	
	4. Testing and inspection do	cuments for cylinders /SLS are available for review.	Yes 🗆 No 🗖	
3	Whips and Connectors for EGS	and Helmets		
	1. Fittings and connections a	re fit for purpose (as recommended by manufacturer).	Yes 🗆 No 🗖	
	<ol><li>Testing and maintenance review.</li></ol>	documents for whips and connectors are available for	Yes 🖬 No 🖬	
	(	COMPRESSORS AND PUMPS		
ITEM	DESCRIPTION	REQUIREMENT	RESPONSE	REMARK
1	Compressor is designated and fit	t for purpose		
	1. Compressors are located in	n accessible area for dive team personnel.	Yes 🖵 🛛 No 🖵	
	<ol> <li>Testing, maintenance (filte compressors are available)</li> </ol>	ers, etc.) and operation documentats for all pumps and for review.	Yes 🔍 No 🖵	
	3. Fire-suppression system a	nd procedures are available in the event of a fire.	Yes 🗆 No 🖵	
	<ol> <li>Testing and inspection doc for review.</li> </ol>	umentation for fire-suppression equipment are available	Yes 🗅 No 🗖	
	5. Compressors are equipped	l with safety devices.	Yes 🖵 🛛 No 🖵	
	a. Solenoid switches.		Yes 🗆 No 🖵	
	b. Relief valves.		Yes 🗆 No 🖵	
	c. Other manufacturer-	recommended or supplied safety devices.	Yes 🗆 No 🖵	
		AIR AND GAS RECEIVERS		
ITEM	DESCRIPTION	REQUIREMENT	RESPONSE	REMARK
1	All air and gas receivers are designed for a purpose.	gned and manufactured to a recognized code and fit	Yes 🖬 No 🗖	
	1. Testing and inspection docume	ntation is available for review.	Yes 🗆 No 🖵	
		ELECTRICAL SUPPLIES		
ITEM	DESCRIPTION	REQUIREMENT	RESPONSE	REMARK
1	All electrical supplies and equip	ment are designed and fit for purpose.	Yes 🖬 No 🗖	
	1. Testing and inspection docume	ntation is available for review.	Yes 🗆 No 🗖	
EXTERNAL ENVIRONMENTAL CONTROL UNIT				
ITEM	DESCRIPTION	REQUIREMENT	RESPONSE	REMARK
1	All components of the external e purpose.	nvironmental control unit are designated and fit for	Yes 🖬 No 🖬	
	1. Testing and inspection docume	ntation is available for review.	Yes 🗖 No 🗖	

	HIGH-PRESSURE GAS STORAGE		
ITEM	REQUIREMENT	RESPONSE	REMARK
1	1. Sufficient quantities of gas are available for the scope of work to be performed, plus other required medical and emergency backup supplies.	Yes 🖬 No 🗔	
	2. Gas supplies are located in an area of minimal risk of damage to cylinders.	Yes 🗅 No 🗅	
	3. All cylinders are label with name and percentage of contents.	Yes 🖬 No 🗖	
	4. Cylinders containing 25% $O_2$ or greater are stored in a vented area, free of fire hazards.	Yes 🗅 No 🗅	
	5. Enclosed locations containing HP gas are fitted with:	Yes 🖬 No 🖬	
	a. O2 analyzer with a HI /LOW alarm.	Yes 🖵 No 🖵	
	b. Hazard signs.	Yes 🗋 No 🖵	
	c. Lights and remote alarm to the vessel bridge and dive control.	Yes 🖵 No 🖵	
	d. Emergency air packs are available.	Yes 🗖 No 🗖	
	e. External condition of cylinders is free from rust and corrosion.	Yes 🖵 No 🖵	
	f. Testing and inspection documents are available for review.	Yes 🗆 No 🖵	
	g. Gas cylinders.	Yes 🗆 No 🖵	
	h. Pressure vessels.	Yes 🖵 No 🖵	
	i. Valves and pipe work.	Yes 🗆 No 🖵	
	j. Relief valves and bursting discs exhaust gas to a safe area.	Yes 🖬 No 🖬	
	k. Analyzers.	Yes 🖵 No 🖵	
	1. Fire suppression for HP gas storage.	Yes 🗅 No 🗅	
	m. Fire-suppression system and procedures are available in all areas where HP gas is stored.	Yes 🗖 No 🗖	
	n. Fire-detection systems are fitted in unmanned and enclosed areas where HP gas is stored.	Yes 🗖 No 🗖	
	o. Testing, maintenance and inspection documentation is available for review.	Yes 🖬 No 🗖	
	<ul> <li>Updated records are maintained of the contents and pressures of each cylinder or bank/quad of gas.</li> </ul>	Yes 🗅 No 🗅	
	q. Gas mixes of $O_2$ that are 25% or greater.	Yes 🗆 No 🗖	
	r. Dedicated compressors and pumps are available for these mixtures.	Yes 🖬 No 🖬	
	s. Valves used are slow opening (needle or stem) valves.	Yes 🔍 No 🖵	
	t. Hard piping is fitted for the delivery of the gas.	Yes 🖵 No 🖵	

# APPENDIX V – EXAMPLE SSA TRAINING MANUAL

SURFACE SUPPLIED AIR DIVING FOR THE COMMERCIAL HARVESTER (2017 COURSE MANUAL FROM HOODSPORT'N DIVE)

#### **PLEASE NOTE:**

#### LISTING CENTERS, VENDORS, AND PRACTICIONERS HERE DOES NOT IMPLY ENDORSEMENT BY THE LUMMI INDIAN BUSINESS COUNCIL OR LNR.

Lummi Natural Resources Department (LNR) does not perform as an educational organization and as such does not endorse, certify, or accredit any individual instructor or commercial school participating in the training of personnel. Individual instructors and commercial schools are expected to obtain and maintain appropriate accreditation from agencies under whose jurisdiction their educational requirements must be upheld. Although LNR primarily recognizes formal training certificates issued by local instructors or from regional training facilities, the department will also evaluate and recognize formal training certificates issued from out-of-state organizations or jurisdictions. A formal course of study in diving practices can be completed at any accredited school, military school, or equivalent whose curriculum satisfies elements of the American National Standards Institute (ANSI) technical document ANSI/ACDE-01-2009 relevant to surface supplied air diving. This standard can be found on-line at <a href="http://www.acde.us/ansistd.pdf">http://www.acde.us/ansistd.pdf</a> or on file at the LNR office and is available from the LNR Diving Safety Administrator.
# HOODSPORT 'N DIVE SURFACE SUPPLIED AIR DIVING FOR THE COMMERCIAL HARVESTER

Systems and techniques for safely utilizing surface supplied air during commercial harvesting operations



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# HOODSPORT'N DIVE SURFACE SUPPLIED AIR DIVING COURSE

## **OBJECTIVES:**

The Surface Supplied Air (SSA) Diving Program is designed to take a person with experience as an Open Water SCUBA Diver and teach them the skills and techniques to safely use surface supplied diving equipment. The student will review all of the equipment necessary to conduct a surface supplied air dive. The student will review the compressor, manifold, emergency air supply, bailout and harness system as well as understand the basic functions of a Kirby Morgan band mask. The student will use the equipment while on the surface to ensure a full understanding of each piece of equipment and its safe use. Finally, the student will use the equipment to conduct in water dives utilizing surface supplied air.

The student will not only learn the safe use and operation of the surface supplied dive equipment, he or she will also go over the roles of a Tender. The Tender is an integral part of any SSA Dive operation. The student will learn how to properly outfit a Diver using a supplied checklist. The student will also understand Tender to Diver communications, safe umbilical handling, top side safety and safely exiting a SSA Diver from the water.

At the conclusion of the SSA program the participants will feel comfortable using the equipment, tending a Diver, and conducting an SSA dive. The student will be able to take this knowledge and obtain a job working as a commercial harvest diver.

## PREREQUISTES:

- 18 years of age or older
- Open water scuba diver certification
- Drysuit diving experience or certification
- Signed medical waiver
- Signed liability waiver

**Contributing Editors:** Ron Ault Darnell Foskett Don Kinney Marilyn Sutton

**Diagrams:** Thomas NG

## **COMPRESSOR**



The compressor has three primary components: the storage tank, the compressor unit and the engine. The engine powers the drive belt which is attached to the compressor unit. The compressor unit collects ambient air, compresses it, and moves it to the storage tank. The storage tank acts as a buffer so the engine does not need to continually run to supply air to the Diver. The storage tank also acts as a reserve in case the engine and compressor stop functioning. The Diver can utilize the stored air which creates a measure of safety for the Diver.

The compressor operator sets the pressure for the storage tank, normally between 100 and 150 psi, the amount of pressure necessary to supply the diving helmet. This feature has been referred to as the "Unloader." The engine will run and drive the compressor until the desired pressure in the tank is reached. Once the pressure is reached the engine will generally go to an idle mode (activating the unloader), thereby disengaging the compressor. The Diver utilizes the stored air in the tank until the pressure drops below the preset pressure, which causes the engine to engage, drive the compressor unit, and rebuild the pressure. The storage tank is not mandatory, however, without the storage tank the engine and compressor run continually and the actual psi reaching the Diver may fluctuate. If the engine were to stop for any reason, the Diver would have no air supply until he switches to his bailout system or to an emergency air supply located on the surface.

The compressor unit requires an engine, normally gas powered, because of the remote operation. The gas engine needs to have enough horse power (HP) to run the belt and force the compressor to work efficiently enough to supply air to the tank and Diver. An average HP rating would be approximately 8-13 HP.

The engine which runs the compressor requires motor oil for normal operation. The compressor component also has oil in the chamber, used for proper lubrication with the use of air tools. The oil in the compressor must be changed to breathing compatible. It is mandatory that the oil for the compressor be safe for human consumption. In order to change out the non-compatible oil, the original oil is drained and breathing compatible oil is added. The compressor is then operated for approximately 30 minutes. Oil is drained again and breathing compatible oil is added one more time. Draining, running and then draining again, ensuring that all of the non-compatible oil has been drained from the system. Having uncontaminated breathing compatible oil in the compressor is paramount to the Diver's safety.

An idea of what to look for on a label:

# Premium Performance Synthetic Food Grade Compressor Fluid Designed Specially for High Pressure Breathing Air Compressors used in the Diving & Fire Prevention Industry. NON-Toxic/Non-Hazardous – Made in the USA

A skill which is difficult to teach, but necessary, is training the Tender to monitor the engine and its sound. An experienced Tender is able to conduct his duties and subconsciously listen for changes in the sound of the engine. An obvious issue would be if the engine were to stop working. This may be a simple issue of the fuel tank running dry, or a more serious issue of an engine malfunction. In either case, the Tender must notify the Dive Control Specialist (Dive Con) or Diver and the Diver must be switched to the emergency air supply until the problem is resolved.

Another sound to distinguish is the pitch of the engine. A properly running engine will have a specific pitch or tone. A higher pitch sound may indicate a damaged or worn belt. A slowing pitch may indicate low or problem fuel. A trained and experienced Tender will listen to the compressor to alleviate the dangers of a compressor malfunction and loss of air to a Diver.

The compressor unit needs to be sufficient enough to supply air to the Diver and keep the storage tank filled. The actual amount of cubic feet per minute (cfm) required to maintain this function can be dependent on the Diver's lung capacity, work load and/or the depth the Diver is working. A larger Diver, one expending a lot of energy, or working at a deeper depth, will require more air which would then require a greater cfm capacity. It is recommended that the compressor system be able to generate at least 17 cfm, with a preferred capacity of 24 cfm, which is enough to support most diving operations. Many inexpensive compressor systems fall well below the desired 17 cfm rating and are not suitable for surface supplied diving operations. If the compressor will be supplying air to two divers then it is necessary that the compressor be rated above 24 cfm.

The air intake to the compressor needs to be positioned so that only clean air is put through the system. The Tender needs to monitor the air intake to ensure contaminates do not enter the system and the Diver's breathing supply. Contaminated air could come from any source, but the primary concern is the exhaust from any gas powered engine. If carbon monoxide produced by

a gas engine is in close enough proximity to the air intake something as simple as wind change could affect a Diver's safety. It is recommended per federal law **29 CFR 1910.430(b)(2)** that the air intake be at least 12' horizontal from any engine exhaust and 6' vertical from the ground. This will require an extension hose so the compressor can be placed a safe distance away. The hose needs to have the proper diameter so that it does not impede the flow of air into the compressor and it needs to be rigid enough not to cause the hose to collapse onto itself during normal operations. It is also recommended that a filter be placed at the end of the hose to prevent particulates from entering the compressor, which may harm the Diver or damage the compressor unit. The filter is generally fitted at the first point of inlet, at the end of the hose. The filter should be inspected regularly to ensure that it does not become clogged or excessively dirty.

The storage tank should have a bleeder valve to eliminate any moisture accumulated during the filling process. Anytime ambient air is compressed moisture is separated and collects in either the storage tank or pressure lines. The amount of moisture is dependent on the level of humidity. Thus if operated in a dry desert environment there will not be as much water as a moist coastal environment.

The storage tank should be drained on a regular basis, at least once during each day of use. Failure to drain the moisture from the tank will cause corrosion. The corrosion will weaken a storage tank and the rusting can cause the stored air to reduce its oxygen content. At a minimum, not draining the cylinder may cause stagnant air to reach the Diver. At a more dangerous level, a corroding cylinder may cause a rupture.

Some components available for the compressor system, but not commonly used, are an air alarm and a carbon monoxide alarm. The air alarm is set to go off if a Diver's air supply reaches below a pre-set limit, such as 80 psi. The carbon monoxide alarm is set to go off if carbon monoxide is detected going into the breathing air. Both of these components are important to Diver safety but tend not to be utilized during a diving operation. Some Tenders believe that they can smell any odors going into the breathing gas and state that they always monitor the Diver's air supply to ensure it will not go below a safe level. This may be true, but having safety devices such as the air alarm and carbon monoxide detection are preferred and highly suggested components.

## SPARE PART RECOMMENDATIONS:

- Gasoline
- Breathing compatible oil
- Drive belts
- Replacement air filters

## MANIFOLD



The compressor line goes from the compressor to a manifold block. The manifold block is the central control location for the Dive Controller (Dive Con) to regulate the flow of air or supply emergency air in the case of a compressor malfunction.

The first component is the one way valve. The hose from the compressor attaches to the one way valve which is attached to the filtration system. The one way valve is a safety component to ensure that if the compressor fails, or the supply line breaks, the emergency air is routed to the Diver and does not escape back through the compressor or broken line.

Most systems utilize a 2-stage filtration process. Two canisters are placed in sequence and filters inserted, one filter for moisture and one for odor. Both need to be changed regularly. The filtration system should be capable of filtering out contaminates which escape the air inlet filter, compressor banks or may have been stuck in the compressor line. The filter needs the ability to withstand the maximum operating pressure of the compressor without bursting or leaking. The filter is the last location to ensure that the Diver gets a safe air supply. The internal filter should be inspected regularly to ensure that it is clean and operable. If the filter looks damaged or dirty, it must be replaced. As air flows through the filtration system water may condense within the housing depending on the operating temperature and the moisture content in the air. The housing should have a drain valve located on the bottom. This drain valve should be opened periodically to keep the filter dry. When the filter housing is opened the Dive Con should take extra time to ensure that the housing must be replaced. If any cracks or deep penetrating pitting are detected the housing must be replaced.

The filter is then connected to the manifold. The manifold is the heart of the diver safety control system. From the manifold the Dive Con can monitor the Diver's pressure, shut down the Diver's air in case of a catastrophic compressor failure and switch the Diver to an emergency surface mounted air supply (Emergency Air Supply) while the problem is being solved.

Attached to the manifold is a pressure gauge and two valves: One valve to the emergency air supply and one valve to the Diver. The pressure gauge (0-300 rating) will monitor the amount of pressure going to the Diver's helmet, which should be between 120 and 150 psi. If the pressure drops below the 90 psi mark the Dive Con would need to determine the reason. The compressor may be malfunctioning, a hose may be crimped or the Diver may be breathing (working) too hard. If the pressure increases beyond the 150 psi the compressor may be malfunctioning. In either malfunction the Diver MUST be notified and the appropriate safety step taken. The Dive Con can switch the Diver to the emergency air supply or advise the Diver to switch to the bailout bottle. In either case the Diver should be told to plan on coming back to the surface.

Another safety device in the manifold is a one way valve from the regulator attached to the emergency air supply going to the manifold. Without a one way valve, if the valve is open, pressure from the compressor can be forced into the emergency air regulator, causing a reverse pressure. This pressure may cause damage to the emergency air supply regulator and create a failure.

The valve to the emergency air supply is generally left closed until needed. The valve going to the Diver is open. The only time to close the Diver's valve is during a catastrophic failure of a hose. If the hose is damaged or bursts, the valve must be shut and the Diver will switch to the bailout bottle. Anytime the Diver switches to his bailout the dive operation has ended and the Diver returns to the surface. The Diver's emergency bailout is only used during an emergency and any emergency will force the end of diving operations.

# **UMBILICALS**



The umbilical line is the Surface Supplied Air Diver's life line. The umbilical consists of three primary components: the air line for breathing, the communication line for relaying information between parties and the safety line if the need arises to pull the Diver to the surface. The three separate components are tethered together using tape to produce a thick stable dive line to the surface. The umbilical line can be designed for any length as long as it allows the Diver to reach the desired working depth. The most common length on harvesting vessels is between 200' and 300'. Not only can the umbilical be used for the previously listed items it can also be used for lowering Divers off the boat and/or raising them to the surface during normal harvesting operations.

Two different types of air line are available; sinking hose or floating hose. The sinking hose is negatively buoyant and drags along the bottom with the diver. The floating hose is buoyant and stays on the surface of the water, above the diver. There are advantages and disadvantages to both styles, and the specific style is designated by the environment and purpose of the dive.

The air line is the primary piece of life support in the umbilical system. The line needs to be constructed so that air can reach the Diver from the compressor. Since the Diver is working at depth and subject to the pressures of water, there needs to be enough of an air supply to overcome the pressures at a given depth. The compressor supplying the air must have the capability of working at approximately 150 psi. However, to ensure the air reaches the Diver the air line must have an internal diameter of at least ¼" for a Diver working to a maximum depth of 150'. For deeper depths the line would need a minimum diameter of 3/8".

Any smaller diameter hose may not have the capacity to supply the Diver with the needed air capacity. If the line is too small the pressure may read correctly at first, however, each time the Diver takes a breath the pressure gauge will drop. When the Diver exhales, the pressure will rebuild in the line and increase the pressure. Anytime the pressure gauge needle moves with the breathing of the Diver, not enough air is being supplied to the Diver.

The air line should be durable and capable of handling at least 300 psi to prevent bursting. The air line should also be abrasion resistant and flexible to reduce kinks during operation. One other important feature would be for nontoxic substances used in the manufacturing process. The Diver is using the line to supply his breathing gas. If the gas passes through the air line, which contains contaminates, those contaminates have the possibility of affecting the Diver's health.

The communications cable is normally either a 2-wire or a 4-wire design. The 2-wire line will provide Diver to Topside communication. Be cautious with inexpensive non-braided line. Constant use of not-supported line may cause stretching of the wires and cause failure of the comm system. A 4-wire system is used for Diver to topside and Diver to Diver communication. The 4-wire design is normally steel braided and strong enough to act as an additional safety line to the surface. However, with a 4-wire system the topside communication system (Comm Box) must have the capability of Diver to Diver communication. A dive operation might also benefit from Diver Comm Cord. This is a polyurethane filled cord within internal comm lines. If the cord

is severed the polyurethane prevents the comm line from filling with water. This reduces future failure.

When assembling the umbilical it is necessary to add additional length to the communication cable, beyond the length of the air line by 3' to 4'. The communication cable uses low voltage to allow the Diver to communicate topside, and electricity in the water will cause corrosion on the connection points making it necessary to periodically cut off the worn ends. If you do not have the extra communication line, you will be ending up shortening the air line when you need to cut off the ends of the communication line during repairs.

The safety line needs to be strong enough to pull a Diver to the surface in an emergency, yet small enough to keep the umbilical line manageable. A 3/8" polypropylene rope is of adequate strength yet has a small diameter. It is a good idea to build the umbilical with extra safety line. The end of the safety line attaches to a shackle which then attaches to the Diver. If the shackle needs to replaced or repaired, the rope may need to be cut for maintenance. Such as in the case of the communication line, the extra rope will allow for maintenance without having to shorten the air line. Divers have a choice of polypropylene rope or parachute cord. Paracord is thin yet strong and comes in 750 or 550 breaking strengths.



## HARNESS / BAILOUT ASSEMBLIES / WEIGHT SYSTEMS



The Diver relies on air from the compressor to stay underwater. In the event of an emergency, if the compressor fails or malfunctions, the Dive Controller (Dive Con) can switch the Diver to an emergency reserve of air, also located on the surface. In the event of a catastrophic emergency where both the compressor and emergency air supply fail, or the umbilical is severed and the Diver cannot receive air from the surface, the Diver must rely on his bailout system. The bailout system is worn on the Diver's back and attached to the Diver with a harness system. The harness not only attaches the air to the Diver, the harness also acts as the connection point for the safety line. In the case of extreme emergencies the Dive Tender can pull the Diver to the surface using the umbilical cord which contains the safety line attached to the harness/bailout system. The Harness/Bailout system is a Diver's safety system.

#### <u>Harness</u>

The harness system consists of a flexible back plate with nylon webbing which goes over the shoulders. There is another set of webbing from the bottom of the back plate which goes between the Diver's legs and attaches to points near the front of the waist and is referred to as the crotch strap. Other pieces of webbing may go across the front of the Diver's chest and the waist to secure the entire assembly to the Diver. These connection points ensure that if the Diver is pulled to the surface, the safety line, which is connected to the harness, does not pull or break away from the Diver. The Dive Tender must ensure that all of the connections are made to secure the Diver to the harness system.

## **Bailout**

On the back of the harness system, attached to the Diver's back, is the bailout system. The bailout system includes an emergency air supply, first stage regulator, pressure gauge and quick disconnect (QD) hose to the diving helmet. Stainless steel bands normally connect the back plate of the harness to the bailout bottle. Since stainless steel coming into contact with aluminum will cause bi-metallic corrosion it is highly recommended that a barrier be placed between the stainless bands and the aluminum cylinder. A thick piece of rubber or shrink tape are best suited since they will not retain moisture and both are easily removed for an inspection. If a barrier is not used, and bi-metallic corrosion begins, it could cause pitting in the cylinder which may cause it to be condemned prematurely.

The bailout bottle should have enough capacity to provide a Diver with air so he can safely make it to the surface. The size of the cylinder is dependent on the air consumption of the Diver, the depth he is working and the anticipated amount of time required to safely return to the surface. It would not be recommended to have a cylinder smaller than 19 cu ft., nor would it be necessary to have a cylinder as large as 80 cu ft. A recommended size for a bailout bottle is either 40 or 50 cu ft.

Attached to the bailout bottle is a first stage regulator which reduces the high pressure coming from the cylinder to approximately 125 psi working pressure, similar to the pressure coming from the compressor. The first stage requires at least two ports; one for high pressure and one for low pressure. The high pressure port is used to attach a pressure gauge. The Dive Tender needs to ensure that the cylinder is full and ready in case the Diver needs to switch to their bailout. The pressure gauge can also be monitored by the Diver to ensure that it is not leaking, and to monitor the air supply since it is the last line of defense in the event of a catastrophic failure. If the Diver notices a decreasing pressure during the dive it may indicate a leak or indicate the diver bailout know was accidently left open. If the leak can't be stopped the dive should end and repairs made.

The low pressure port is used to attach a direct air line to the Diver's helmet. A low pressure hose with a locking quick disconnect goes from the first stage to the gas supply non return valve on the helmet. If the Diver needs to use the bailout bottle he must turn on the auxiliary valve located on the manifold block on the right side of the helmet. The non-return valve ensures that the air from the bailout will not escape out a damaged air line.

The harness/bailout system requires very little maintenance other than a fresh water rinse. The first stage regulator should be serviced annually or according to the manufacturer's specifications. The cylinder (bailout bottle) needs internal inspection on an annual basis to detect corrosion and hydrostatically tested every five years per federal law. The above mentioned maintenance can be provided through a local SCUBA dive store.

## Weight System

The Diver is required to stay on the bottom and perform designated tasks. In order to remain on the bottom a large amount of weight may be required. Normally a Harvest Diver will require between 60 and 80 pounds, more likely towards the 80 pounds. Since the Diver cannot carry this much weight on his waist he utilizes a weight harness system. The weight harness goes under the harness/bailout system and is secured separately so that it can be removed in an underwater emergency.

It is important that the Tender ensure the weight system and harness system are not intertwined. The weight harness goes on first and the bailout harness next. The weight harness must be equipped with a release. In the event of an emergency, the Diver activates the release and the weight belt drops off freely.

The Tender and Diver must ensure that the Diver can reach the release for easy activation. The Diver and Tender must also ensure that the two pieces of equipment are not intertwined. If they are intertwined, if the Diver releases the weight belt it may get caught in the bailout harness and not drop off the Diver, effectively trapping the Diver on the bottom in an emergency.

# **COMMUNICATIONS**

One of the primary advantages to surface supplied diving is the availability of communication between the Diver and the Dive Controller (Dive Con). Communication between the surface and the Diver is also a requirement of OSHA (29 CFR 1910.422(c) so information can be exchanged and emergencies can be handled more efficiently. However, to have communication it is necessary to have electricity and electricity and water do not mix. Failure of the communication equipment is a regular occurrence. It is not a matter of if a communication system will fail, but when. To help alleviate this problem the communication gear should be checked regularly, replacement parts should be available and a backup communication plan, such as line pull signals, practiced regularly.

The electronic components of the communication equipment are comprised of the following:

- A. Surface communication box
  - a. The unit is powered by batteries or a low voltage power source. The wires from the Diver's umbilical are attached to a set of posts on the unit.
  - b. The Dive Con can use the internal speaker box to communicate with a Diver or attach a set of headphones and microphone for more convenient communication.
  - c. The surface communication box can be as simple as topside to Diver communication or be set up in such a way that multiple Divers can communicate between one other (as long as they have the appropriate wiring setup).

- d. Since a speaker is the same as a microphone, some Divers utilizing AGA or Guardian style full face masks, use a single speaker/headphone attached near the chin for 2-way communication.
- B. Diver Helmet
  - a. Two ear phones (waterproof)
  - b. One microphone (waterproof)
  - c. The leads from the umbilical are attached to the earphones/microphones inside the helmet. It does not matter which lead is attached to which post, they are universal, but must be separated.
- C. Umbilical Line
  - a. The umbilical line consists of three components: the air hose, the safety line and the communication line.
  - b. One end of the communication line is attached to the surface communication box and the other end is attached to the Diver's helmet.
  - c. The communication line may contain two or four wires. Two wires are commonly used for Diver to surface communications. Four wires are used for Diver to Diver and Diver to topside communications.

# **Communication Etiquette** (Rules)

The primary means of communication between the Diver and Dive Con is the hard line, or communication line. The communication line is easy and efficient and both parties can ask and answer questions or clarify statements. However, basic rules of etiquette need to be applied. Since both the Diver and Dive Con can speak simultaneously they need to be aware and courteous.

- The first rule is to speak only when necessary. If both parties begin idle chatter they can easily talk over one another and miss important information.
- To ensure the other party is not distracted it would be courteous for one party to acknowledge himself and wait for a reply. For example; "Diver to Topside," or "Topside to Diver."
- When one of the parties asks a question the other party should repeat the question and state "Copy" or something similar to show acknowledgment. Other terms may be "Check," "Copy," "Roger," "Affirm" or "Negative."
- Since the Diver is trying to speak between breathes, the Dive Con should wait for an inhalation so the Diver can hear in his headphones. It is very common for normal breathing to drown out sounds or speech.

The Diver MUST respond to all questions asked by the Dive Con. The only way for a Dive Controller to know if the Diver is safe is to monitor his breathing and ask questions about his status, depth, time and air supply. If the Diver does not respond the Dive Con will repeat the

question until he gets a response. In a worst case scenario a Dive Con may tell the Tender to start retrieving the Diver's line until the Diver responds or makes it safely back to the surface.

The Dive Con must pay attention to communication as well as to the Diver's breathing pattern. The Dive Con may ask about a Diver's status, and the Diver may give an affirmative response. However, if the Dive Con is listening to the breathing, and it sounds hard or labored, he may be able to calm a Diver by asking him to slow down. The Dive Con can also override the Diver, not believing what he is told, if the breathing pattern does not fit the activity. It is safer to bring a Diver to the surface and discuss what is happening, than it is to ignore the signs of labored breathing and have a Diver panic or become injured.

## **Communication Failure**

In the event of an electronic communication failure the Dive Con will need to rely on the Dive Tender. The Dive Tender will be tending the umbilical line and will need to communicate using line pulls. Losing electronic communication will generally require that the dive operation be cancelled. It is up to the Dive Con and Diver to determine the safest course of action.

In the event that the communications break down, the Diver and Dive Controller must have a backup system established. The easiest way to communicate is by using the umbilical line to signal and having a code set up to function until the Diver is brought back to the surface.

A common signal pattern is referred to as **OATHE** 

1 pull = **O**K

2 pulls = Advanced – give slack or take slack out

- 3 pulls = Take take in slack or come back to the boat (surface)
- 4 pulls = Home Leaving the bottom or coming up
- 5 pulls = Emergency abort dive or aborting dive

In order for the line pull signals to work they must be practiced and they must be firm and distinct. There can be well over 300' of line between the Tender and Diver. A slight or weak pull will not travel that great of a distance. Both parties must pay attention to the signals and be clear and firm with the response pulls. No signal will work unless both parties remember what the number of line pulls indicates. – PRACTICE – PRACTICE – PRACTICE

In the event of all loss of communication the dive is aborted until the problem can be resolved.

# **ROLES AND RESPONSIBILITIES**

# Supervisor

The Supervisor of the dive operation can be an owner or captain of a boat. The Supervisor may also wear many other hats such as the Dive Control (DC) Specialist and/or the Tender. The only role that the Supervisor cannot perform is that of the Diver. The Supervisor is the ultimate

authority at the dive site and takes on the overall responsibility for location and equipment. The Supervisor will choose the site location and ensure that it is safe to conduct a dive operation. The Supervisor will ensure that all the equipment is working properly, that the Diver is capable of a safe dive and that all emergency equipment is available and in proper working order.

# Site Selection

The Supervisor will choose the dive site and make an initial evaluation as to suitability and safety. The Supervisor will take into account the objective of the dive and ensure that the goals can be accomplished. He will check for natural hazards such as wind and check other surface weather conditions to ensure a safe dive. Other environmental concerns for the Diver may be tides and currents. The Supervisor will then monitor the area for man-made hazards such as boat traffic, visible nets or active fishing vessels. The ultimate objective of the Supervisor is to do everything possible for a safe dive operation.

# **Dive Station**

Once the site has been selected the Supervisor needs to begin setting up the dive station. The dive station includes a boat (if used) and the area to store all of the equipment for the dive operation. One of the primary concerns for the dive station is space. The amount of equipment necessary to conduct a safe dive is significant. The Diver's umbilical line is a minimum of 200 feet, and more likely 300+ feet long. Adding the compressor, water pump, dive station, dry suit, helmet and suiting area, increases the amount of space required to keep everything organized.

The station should take into account the weather conditions and the protection of top side personnel. Hypothermia (cold) and hyperthermia (hot) are concerns for all personnel, not just the Diver. Since the operation can last several hours or several days, all personnel should stay warm and comfortable for their safety.

# Log Sheets

Commercial harvesting is extremely busy with numerous activities occurring at one time. The Dive Con needs to monitor the safe operation of the Diver, Tender, dive environment and the boat operations. In order to maintain a safe environment for the Diver, the person most at risk of injury, the Dive Con must monitor the Diver's activities and ensure he is watching his depth, time and gas supplies. The best way to do this is by utilizing a dive log.

The dive log should contain the basic information of date and the Divers' names. The log should then be used to record the following diver's information:

Time: What time did the Diver enter the water / what time did the Diver exit the water?

Depth: Periodically ask the Diver for his depth and record the time by each entry.

Dive computer status: Is the computer warning the Diver of any issues?

Bailout Pressure: Periodically ask the Diver to check his bailout pressure to ensure he has an ample gas supply in case of an emergency.

The dive logs should be stored in a log book, and maintained for at least one year or longer if there is an incident involved during a dive. The log is a record of safe diving practices; the longer the records are kept and can be reviewed for an incident, the better the practice. The logs will record a continued practice of a safe diving environment. In the case of an injury or death, the logs may help determine why the accident occurred, or rule out unsafe diving practices. The actual length of time to retain the logs may be dictated by the Dive Con, Diver or the government rules of retention. OSHA (Occupational Safety Health Association) states the following:

# Retention Periods for Commercial Diving Records

Required by 29 CFR 1910.440	

Record or Document	Retention Period
Safe Practices Manual	Current document only
Depth / Time Profile	Until completion of the dive record; or if decompression sickness occurs during the dive, until completion of decompression- procedure assessment
Dive record	1 year; 5 years for records involving decompression sickness
Decompression procedure	assessment evaluations 5 years
Equipment inspection and testing records	Current entry or tag, unless the equipment is withdrawn from service (i.e., then no retention requirement)
Hospitalization records	5 years

## Emergency Plan

The Supervisor must plan for any emergency, both underwater and on the surface. One of the primary pieces of equipment is a standard first aid kit. The Supervisor should ensure that all the personnel are aware of the location of the first aid kit, that the kit is supplied with the proper first

aid equipment for the diving being conducted, and be trained on how to properly administer first aid. The Supervisor should ensure that the first aid kit is inventoried on a regular basis to make sure all the necessary supplies are readily available.

One of the primary pieces of safety equipment for any diving operation is an OXYGEN KIT. The primary procedure for any dive related incident or accident is the administration of oxygen to the injured diver. The Supervisor should have an adequate oxygen kit on site, capable enough to handle the number of Divers in the operation. The oxygen cylinder should have the capacity to deliver oxygen to an injured Diver in transit from the dive site to a medical facility. The more Divers and the greater the distance, the greater the required capacity of the oxygen cylinder.

The Supervisor should ensure that all of the personnel have been trained in the use and administration of oxygen to an injured person. The Supervisor should also ensure the training is current, CPR/Oxygen training current and currently refreshed training done every two years.

## **DIVER DOWN PROCEDURES**

If there is any loss of communication with the diver, a loss of electronic communication and lack of line pull signals, the tender should assume that the diver is in danger (Diver Down). The best procedure is to have a standby/safety diver available to enter the water immediately, follow the umbilical and assist the downed diver. However, very few commercial harvesting boats are set up and equipped or have the manpower for a standby/safety diver. If there is no standby/safety diver then the tender must rely on the strength of the umbilical line to pull the unresponsive diver back to the boat.

Pulling an unresponsive diver back to the boat using the umbilical line is no easy task. Keep in mind the weight of the diver and equipment (weight belt). You then need to factor in the weight of the umbilical line and forcing the downed diver past any in water obstacles. Once the diver is pulled back to the boat the tender must then have a system in place to lift the diver on to the boat so they can begin first aid.

Suggested procedures for lifting an injured diver out of the water and administering first aid:

- While the diver is in the water find the weight buckles and drop the weight belt
- If available, attach the bailout harness to a Davit, and lift the diver from the water. If no davit is available, or capable of lifting the diver, the tender can try and use any inflation device on the diver (drysuit) to float the diver for easier extraction.
- Once the unresponsive diver is on the boat remove the helmet / mask immediately
- Disconnect hoses / harnesses / belts etc....Anything which is attached to the diver
- Roll the diver, in one direction until the arm is free from any equipment and continue rolling until the diver is removed from the equipment and laying on their back
- Once the diver is on their back the tender needs to cut away any protective dive suit from the neck down to the waist as soon as possible. Cutting away the suit helps open the airways and eliminates any breathing restrictions. The tender can use trauma shears, zip knife or other sharp object, taking special care not to cut the injured diver.

These cutting instruments should be close at hand and readily available in the first aid equipment.

- As soon as possible get oxygen to the injured diver. The sooner the oxygen is applied, the greater chance of recovery.
- If the diver is unresponsive, and no breathing is detected the tender should begin administering CPR. If one is available, and after 2 minutes of CPR, attach an Automatic External Defibrillator (AED) and follow the instructions.
- Call 911 and continue these first aid procedures until relieved by a trained medical rescuer.

This procedure should take less than two (2) minutes to perform. For each delayed minute it could reduce the chance of a successful recovery by 10%. This drill should be reviewed and practiced by the team on a regular basis to ensure the most effective and efficient response in case of a Down Diver.

## Dive Con (Dive Control Specialist)

The Dive Control Specialist, often referred to as the Dive Con, is directly charged with monitoring the Diver, ensuring the compressor is functioning properly during the dive and ensuring the Diver's safety. All of this is accomplished through the Dive Control System (DCS). The DCS consists of the compressor, emergency air, manifold and communications. The Dive Con is seated top side and is in direct communication with the Tender and Diver. During the dive the Dive Con will maintain constant communication with the Diver. The Dive Con will regularly check the Diver's status and depth. The Dive Con will also keep the Diver informed of his dive time and of any activities on the surface.

While keeping contact with the Diver, the Dive Con will relay any pertinent information to the Dive Tender. Even though the Tender and Diver can communicate by line pulls, it is much more efficient for the information to be relayed verbally. If the Diver is in need of any equipment, the Dive Con can relay the exact items to the Tender who can then send the items down the umbilical line.

The Dive Con's primary purpose is safety. Along with ensuring the proper operation of the compressor, the Dive Con will monitor pressure gauges to make certain that the correct amount of pressure is maintained to supply the diving helmet. A reduction in pressure may not supply the correct amount of air. In case of reduced pressure the Dive Con can immediately switch to the emergency air supply while he determines the reason for the reduced pressure. When switching to the emergency air supply, the Dive Con should inform the Diver making him aware that the dive may be ending. The Dive Con will inform the Diver to switch to bail out in case the problem cannot be solved in a timely manner. The dive would immediately be aborted in this circumstance.

The Dive Con can also monitor safety by listening to the Diver through the communication equipment. The communication is two-way and the Dive Con will be able to hear every breath the Diver takes. If the Diver is nervous the Dive Con will hear rapid breaths and may even be

able to notice a reduction in the pressure on the lines. Breathing hard may be a sign of nervousness, panic, anxiety or over exertion. In any of these cases the Dive Con needs to remind the Diver to slow his breathing and calm himself. If the Diver continues to breathe excessively the Dive Con has the option to increase the pressure to ensure the Diver does not over-breathe the system. In a worst case scenario, the Dive Con may order the Diver to the surface for his own safety.

Other ways in which the Dive Con can maintain the safety of the Diver is to monitor his depth and time. The Dive Con will not know the Diver's depth, but can constantly ask the Diver to give updates using the Diver's personal computer system. Constantly asking the Diver for his depth will keep the Dive Con informed and act as a mental reminder to the Diver to monitor his computer. During these checks the Diver will provide the dive time based on his computer, but the Dive Con should also be recording the time using his own timing device. If there is any discrepancy on time, the more conservative time frame shall be used.

The Dive Con should be using a dive log to record regular time and depth checks with the Diver. The dive log will also work as a reminder to the Dive Con to ensure the Diver remains within nodecompression limits. This will normally be handled by the Diver's personal dive computer, but in case the computer was to fail, there is a record of approximate depths and times

## **Decompression Awareness**

One of the greatest dangers to any Diver, especially a working Diver, is decompression sickness (DCS), more commonly referred to as the bends. The Diver will wear a dive computer to try and avoid decompression sickness. However, the Dive Con should monitor the Diver's depth and time to help avoid decompression sickness. Even though the Diver is using a dive computer it does not guarantee that a Diver will not get decompression sickness. To ensure that the monitoring is done regularly, a dive log should be used.

HYDRATION is one of the easiest ways to help prevent decompression sickness. The diver should be properly hydrated to ensure that the nitrogen gases can easily and safely exit the body. Being properly hydrated is not something done immediately before a dive. The diver should be hydrated long before the dive, by regularly drinking clear fluids, such as water. The easiest way to determine proper hydration levels is by the color of the diver's Urine. The darker the color, the greater chance the diver is dehydrated. If the urine is clear or a light yellow, that indicated the diver is properly hydrated. See the chart below:



The Dive Con is also responsible for monitoring the Diver for at least one hour after the dive to look for signs of decompression illness. In case of suspected decompression sickness or any diving illness, the Dive Con is responsible for initiating first aid procedures, especially the administration of oxygen. After oxygen is being administered the Dive Con or Dive Supervisor should call 911 and get immediate assistance. In the event that the Diver shows signs of DCS after the dive, and it does not require a 911 call, the Dive Supervisor or Dive Con should know the location of the closest decompression chamber.

For more information contact Divers Alert Network (DAN) at www.diversalertnetwork.org

# Tender

The Dive Tender is the first line of safety for the Diver. The Diver is pre-occupied with the dive operation and setting up his equipment. Due to the sheer number of pieces of equipment it is easy for anyone to forget a step or make a mistake. The Dive Tender's role is to assist the Diver in setting up his equipment, not only to make donning it easier, but to ensure the Diver does not forget an important piece of equipment. It is highly recommended that a Tender use a check sheet to ensure nothing is forgotten or missed.

While the Diver is donning his suit and basic equipment the Tender should assist the Dive Con in ensuring the compressor is operating and the top side safety equipment is in place. When the compressor is operational the Dive Tender should set up the umbilical and ensure that it is not tangled or kinked.

After the Diver has placed on his dry suit, or other environmental protection, he should be seated where the Dive Tender can assist in setting up the remaining equipment. The Tender will

use a check sheet and set up the weight system, harness system and bailout bottle. The Tender will also ensure that all of the equipment is working properly and properly attached.

Once the Diver is ready to descend, the Dive Tender will ensure proper communication between the Dive Con and Diver. He will then assist the Diver into the water since the Diver has limited visibility while walking on the surface. Once the Diver has entered the water the Dive Tender will monitor the umbilical cord, ensuring that it does not tangle or hang up the Diver. The Dive Tender will then monitor the Diver's bubble trail and watch for any problems. At the end of the dive the Tender will assist the Diver back up to the surface, help the Diver undress, and ensure all the equipment is properly working and stored correctly.

## <u>Umbilical</u>

The umbilical is the most important part of the surface supply equipment since it transfers the air to the Diver, allows communication between the Diver and Topside and acts as a safety line in case of an emergency. The one drawback to the umbilical line is its size and length. The Dive Tender is charged with monitoring the line, making sure that it does not become entangled or get in the way with surface operations. The line should be kept taut to avoid entanglement. This is especially difficult knowing the limited space at most dive locations. The Tender is charged with monitoring the umbilical while keeping in contact with the Diver. When not in use, the umbilical should be capped at both ends to avoid any contaminates from entering the line. The line should be checked for damage or tape which may need to be replaced.

The first item of business for a Dive Tender is to maintain the work area. It must be kept neat and clean, putting things away, keeping them organized yet keeping everything accessible. The Tender must keep in mind the number of activities required in the minimum space and ensure that there is space to work safely.

The umbilical hose should be coiled or stored so that it is not walked on or tripped over. The amount of space required should be limited to less than 8 feet in diameter (or less depending on the size of the boat or work area). The Tender should learn how to perform an over/under coiling style, as well as a figure eight coiling style. When not in use, the umbilical should be capped at both ends to avoid any contaminates from entering the line. The line should be checked for damages, abrasions or cuts or tape which may need to be replaced.

## Sending Objects to Diver

The Diver may be in need of tools, but it is not feasible for the Diver to come to the surface to collect the tools. The Diver communicates his needs to the Dive Con. The Dive Con will then get the supplies to the Tender so the items can be sent to the Diver. Heavy items should be lowered prior to the Diver entering the water, however many other items can be lowered on a tag line in a bag. If items are too light they will not travel down the line and an added weight may be required. It is important to not keep the Diver waiting. The longer the Diver remains in the water, the more nitrogen he absorbs, making him more susceptible to hypothermia and decompression illness.

## Retrieving Items - Working with a Lift Bag

When a Diver is harvesting on the bottom, the product collected is placed in a bag. When the bag is full it is sent to the surface using a lift bag. The Tender sends back an empty harvesting bag. The Tender needs to become efficient in the process of lowering a bag using the umbilical and then retrieving a harvesting bag when it is sent to the surface using a lift bag.

The Tender will place a lift bag inside an empty harvesting bag. The Tender then attaches a rope designed to lower the bag to the Diver. The rope will not easily travel down an umbilical line. The end of the rope is placed into a large loop. This loop is commonly within a plastic tubing. The tubing causes a slick unobstructed surface so the rope easily travels to the Diver. The lift bag and harvesting bag are attached to the line. The end is then looped around the umbilical and slid down to the diver. In order to expedite this process some weight may need to be added to the bags so they slide down the rope.

If the slope from the boat to the Diver is not great enough, the bags will not slide all the way to the Diver. The Tender may decide to attach the loop to the umbilical line. Enough umbilical line must remain on the surface to attach the bag and ask the Diver to begin pulling the line until he can retrieve the bag. Obviously if the Diver is 200 feet away, and the bag is attached with less than 100' remaining on the surface, the Diver will have to walk to the bag for retrieval. With enough line all the Diver is required to do is pull the line until the bag arrives.

## Diver

The Diver is responsible to ensure that all of the dive gear is in working order. The Tender will be assisting the Diver, but the Diver is the one at risk, and ultimately responsible for checking all of the equipment. The Diver must prepare mentally for the task at hand as well as ensure being physically prepared.

Physically the Diver needs to make sure that he feels up to the task. If he is feeling ill, or is excessively fatigued, he should think about whether or not to conduct the dive. The Diver's health will have a great impact on his susceptibility to decompression sickness. Fatigue or illness can also affect the Diver's judgment and ability to perform tasks safely. Even minor mistakes in the water can jeopardize a Diver's wellbeing.

The same situation holds true for a Diver's mental wellbeing. If a Diver is distracted he increases the possibility of making mistakes. The mistake can be as simple as forgetting a basic task such as fastening a clip. If the Diver is not focusing on each task, the neglect of a task can be dangerous. Mistakes can involve the equipment, such as failing to check a critical piece of life support or forgetting a protocol such as monitoring the dive profile.

Before any dive, the Diver should advise the Dive Con of any concerns physically or mentally. The Diver should report abnormalities and be honest with the Diving Supervisor and with himself. If a Diver is confused about any instructions or directions he should ask for clarification to avoid future problems. The Diver should always remember that he can abort a dive at any time for any reason.

During the dive the Diver should develop a sense of his surroundings and be aware of any dangers. The Diver should monitor his computer to ensure his safety and avoid the risk of decompression illness. The Diver should also maintain constant communication with the Dive Con. The communication will help the Diver stay focused and give the Dive Con an idea of what tasks the Diver is performing. Having an extra person monitor the Diver will help maintain safety.

## **Underwater Umbilical Handling**

The Diver will need to handle the umbilical line while trying to conduct a safe dive. As much as the umbilical acts as a safety line which supplies air, it can be cumbersome and dangerous. The line is long, thick and capable of entanglement. When the Diver is moving around objects in the water he must ensure that the line lies over an object so it can be easily accessed in case of entanglement and not under an object where it can become an entrapment. If the line becomes tangled during the dive advise the Dive Con and then follow the line back to the point where it is caught. To avoid entanglement the line should be kept taut. A taut line also helps in line communication between the Diver and Tender. If the line becomes loose, or there is too much line, advise the Tender to pull in some of the slack.

## **Underwater Bag Work**

The Diver will be using a bag to collect the product during the harvesting process. If the harvest is successful, the Diver will be required to fill numerous bags during a single dive. Having the Diver leave the bottom to return a full bag and collect an empty bag is inefficient and adds risk to the Diver. Each time the Diver ascends and descends it places pressures on his body. Limiting the ascents and descents creates a safer working environment for the Diver. To alleviate this problem the Tender can send down an empty bag along with a lift bag so the Diver can send a full harvest bag to the surface.

The Tender may be able to slide the bag directly down the umbilical line to the Diver. If the slope is too low, and the bag will not slide, the Diver may have to pull the umbilical until the attached bag can be reached. When pulling the umbilical line to retrieve the bag, the Diver must pay particular attention so as not to get entangled with the additional umbilical line.

Once the bag is received the Diver detaches it from the umbilical line. The Diver then takes the lift bag and attaches it, along with the supplied surface retrieval rope, to the full harvesting bag. It is very important that the Diver remembers to attach the lift bag and the surface rope to the harvest bag. If he forgets to attach all three items, the lift bag may go to the surface alone. Without the harvest bag, or if the surface rope is not attached, the bag may go to the surface, but the Tender will be unable to retrieve the full harvest bag. The Tender needs the surface rope attached so the bag can be pulled to the boat.

Once the Diver has attached the lift bag with the surface rope to the harvest bag, the lift bag needs to be filled with air. The diver will need to place the bag above the helmet so the exhaust from the helmet will get trapped inside the bag. Once enough air is trapped, the bag will begin to rise to the surface. This process takes practice. The Diver must be aware of the entanglement hazards of the umbilical, lines, bags and other dive equipment. If the lift bag is full (positive 50+lbs.) and becomes entangled with the Diver, it could cause an uncontrolled Diver ascent. Any uncontrolled ascent involves the danger of an air embolism. Great care must be taken by the Diver to avoid entanglement and a possible uncontrolled ascent.

Surface Rope + Lift bag + Harvest bag (all attached) = Successful rise and retrieval at the surface.

# Water Hose

The Diver will need to learn to handle many items, objects and skills while working as a Harvest Diver. Along with handling the umbilical line, the Geoduck Harvester will also be using the water hose / "stinger". The water hose/"stinger", under pressure, is used to extricate the geoducks from the ground. The use of the pressurized hose takes practice so as not to become an entanglement or hazard during the harvesting process.

# **Safety Diver**

A Safety Diver is an excellent way to ensure a safe dive operation. A Safety Diver is an extra diver on the team. The Safety Diver's job is to be ready in a moment's notice in case a Diver is in need of emergency assistance. At the first sign of trouble the Dive Con or Tender will send the Safety Diver in to assist the Harvest Diver. The Safety Diver has no other task than to be suited in his gear and ready to dive. Due to limited available manpower, many smaller operations cannot or will not use a Safety Diver.

# **Backup Personnel**

A dive operation involves many people. Some people perform multiple roles, while others, such as the Diver, perform a single task. In order to help the operations go smoothly, backup personnel may be utilized. The backup personnel may be divers or non-divers. Their sole purpose is to make the operation run safely and smoothly. At times a Diver not able to dive may perform these roles:

- Assist the Tender
- Monitor the compressor for safe operation
- Organize the boat

# **DIVE STATION SET UP PROCEDURE**

When preparing for a surface supplied air dive the Dive Con or other designated person needs to ensure the proper setup of the dive station. The dive station includes the compressor, manifold assembly and umbilical lines. The Tender and Diver need to ensure the proper setup of the bailout assembly, weight harness and mask. The proper set up will help with the safety of the diving operation.

## **Compressor**

The compressor should be positioned so that it is accessible and away from any contaminated air sources. The compressor engine must be checked to ensure that it contains ample fuel, the belts are in good condition and all the other fluid levels, including the pump oil are at proper operating levels.

## **Manifold**

When hooking up the lines to the manifold ensure that all components are tight and leak proof. Turn on the compressor and open and close the air valve to listen for leaking. This is also an opportunity to blow air through the lines to remove any water or other contaminates before attaching them to the helmet. Next, check the lines from the emergency air supply and look for signs of leaking from the hose and valves. Finally, double check the pressure gauge. Tap it a few times to make sure that it is working properly. An improperly working gauge may freeze in position, falsely indicating that there is pressure, when there may be none.

## **Emergency Air Supply**

The emergency air needs to be adequate enough to support a Diver for the length of time to repair the compressor, or the ability to provide the Diver with enough air to safely make it back to the surface. The amount of emergency air required will be dependent upon the depth of the Diver and his personal air consumption. It is highly recommended that the minimum capacity of an emergency cylinder be 80 cu/ft. Having a second emergency cylinder on hand is also a good idea. A larger capacity cylinder is recommended for systems supporting more than one Diver and for diving operations requiring the Diver to work deeper than 30 feet.

## **Diving System**

The Diver and Tender need to spend time going over a safety checklist while putting together the helmet, bailout harness and weighting system. The weights need to be adequate enough to keep the Diver on the bottom without worry about buoyancy issues. While attaching the weight harness the Tender should ensure that the webbing does not interfere with the drysuit inflator or other diving components. It is important that the Diver have access to the emergency weight release on the harness system.

The bailout cylinder needs to be of adequate size to allow a Diver the ability to get back to the boat safely without having to rely on the Tender or Dive Con. The bailout cylinder needs to be

full and properly secured to the bailout harness. The Diver should have the ability to reach the valve on the bailout cylinder in the rare circumstance that it is not turned on before a dive operation. The first stage regulator should be fitted with the bailout hose with quick disconnect to the helmet and a pressure gauge readable by the Diver. The first stage should be attached and tested prior to the dive to ensure proper operation and that the "O" ring is working correctly. If the bailout cylinder is not charged prior to the dive, and the Diver needs to turn on the bailout system while underwater, it is likely that the first stage will have come loose from the cylinder valve and also likely that the first stage will not properly seal to the cylinder valve.

One very important step which must be conducted before the Diver enters the water is the testing of the one way valve on the diving helmet. The actual procedure is outlined on the attached check sheet and reviewed during the maintenance section of this manual. The Tender and Diver should check the one way valve on the helmet, and if working properly, attach the umbilical line to the helmet. After the lines have been charged the Diver and Tender should check the proper operation of the valves and communication equipment (earpieces and microphone).

During the setup procedure the Diver and Tender should check the lines and shackles to ensure proper operation and check for wear and tear.

# <u>Safety</u>

Prior to suiting the Diver everyone should make sure that it is a safe diving environment. Many things need to be considered: boat condition, weather conditions, health of the Diver, proper equipment operation and trained and available surface help. If for any reason anyone feels it is not a safe diving environment the dive must be cancelled. The most important decision maker is the Diver. The Diver can call a dive for any reason at any time, without repercussions. The Diver is the most likely member of the team to be injured and therefore needs to be able to make the ultimate decision.

# **Check Sheet**

There are many components of a safe diving system and each component needs to be set up correctly. In order to assist the dive team with the proper set up of such a complicated system the use of a check sheet is strongly recommended. It does not matter how much experience a Diver, Tender or Dive Con has setting up or conducting these types of dives, mistakes can be made. A check sheet helps to ensure that each step is performed correctly and nothing is forgotten. A review of the following check sheets will help the Diver or Tender ensure that proper steps are followed.

# **TENDER CHECK SHEET**

# Pre-Dive

- □ <u>Make sure Diver has checked one way valve on helmet</u>
  - Check bailout cylinder pressure
- □ Turn on compressor and attach the umbilical to the helmet (Band Mask)
- □ Treat faceplate with defog and disinfect (do this between divers)
- □ Check all valves for proper operation (prior to donning helmet)
- □ Hook up communication wires and ensure working properly with Dive Con
- □ Tape communication wire to air hose
- □ Don gloves and hood (optional Diver's preference on sequence)
- Dive computer working with adequate battery
- □ Don weight belt ensure weight belt release is accessible
- □ Don safety harness (ensure bailout is turned on)
- Don mask/helmet ensure proper fit w/ spider& nose block properly positioned
- □ Check Diver's shackle and bailout system
- □ Connect bailout to helmet (ensure bailout is on)
- □ Connect dry suit inflator hose
- □ Check communication between Diver and Dive Con
- □ Check regulator free flow and bailout
- □ Check entry area for hazards or concerns
- □ Assist Diver into the water monitoring for issues or concerns
- □ Tend umbilical prepare umbilical prior to dive to ensure smooth operation

# **During Dive**

- Umbilical handling (over under or figure 8)
- □ Signals (review signals with diver prior to entering the water)

# Post Dive

- □ Remove mask/ helmet IMMEDIATELY and hand to Diver
- □ Release umbilical from harness
- □ Remove harness and weight belt
- □ Secure harness and mask/helmet
- □ Check with Diver about any mechanical problems or items needing repair
- □ Turn off bailout and bleed lines
- Disconnect umbilical from mask
- Disconnect umbilical from DCS and check lines for wear and tear
- Disconnect bailout and ensure proper working order before stowing

# **DIVER CHECK SHEET**

## **Pre-Dive**

- Don exposure suit (remove excess air)
- □ Check helmet's one way valve
  - Turn on "C" <u>auxiliary valve</u> to supply air from the bailout
  - Keep "D" gas supply disconnected
  - When "C" is turned on no air should escape from "D"
- □ Test bailout primary importance is communication between Dive Con and Diver
  - Notify Diver to standby for bailout check Diver must acknowledge
  - Dive Con shuts off air notifies Diver and Tender
  - Ensure Diver bleeds off hose pressure
  - Ensure Diver turns on bailout after air is purged and Diver notifies the Dive Con that they are using their bailout. Diver notifies Dive Con of cylinder pressure
  - Dive Con turns back on primary supply and notifies the Diver Diver shuts off manifold
  - Tender ensures that Diver is back on primary and notifies Dive Con of any issues

# **DURING DIVE – Review following information prior to entry**

- □ Adjust regulator
- Defog mask
- □ Bailout on/off
- □ Computer check
- Depth readings
- □ Cylinder pressure readings
- □ Basic communication
- Umbilical handling
- □ Line signals

## **POST DIVE**

- Disconnect the dry suit inflator hose
- Remove weight belt
- □ Assist Tender in securing dive station
- □ Review data from dive computer
- □ Check out with Supervisor notify Dive Con of any issues with equipment or health

# KIRBY MORGAN BAND MASK FEATURES

A. Head Harness (Spider) keeps the mask in place on the divers head. The neoprene rubber spider has adjustment holes for varying the tension of the harness.

B. Hood/Face Seal provides the diver a comfortable thermal barrier around their head as well as pockets for earphones

C. Auxiliary Valve supplies backup breathing gas to the diver.

D. Gas Supply Non-Return Valve prevents loss of gas pressure in the event of umbilical damage, preventing a "squeeze".

*E.* Steady Flow Valve provides an additional flow of air into the mask for ventilation and defogging.

F. Communications Connections can be either bare wire posts or a waterproof connector. The waterproof type is recommended when a "round robin" or diver/tender both microphones "on" communications system is used.



*G.* Tri-Valve<sup>®</sup> Exhaust With Whisker Wings which retrofits to many previous Kirby Morgan Helmets and BandMasks<sup>®</sup>, has less breathing resistance than the older single valve exhaust while providing an extremely dry hat. The Tri-Valve<sup>®</sup> Exhaust is made of a chemical resistant compound.

H. Water Exhaust helps keep water drained from the mask.

I. Demand Regulators The SuperFlow<sup>®</sup> 350 KMB 18 and KMB 28 regulator provides easy breathing for hard work.

J. Nose Block Device allows the diver to block the nose to equalize ears.

K. Silicone Oral Nasal Mask is made of a superior silicone material which is hypo-allergenic. It also provides an attachment area for the optional prescription lens frame, kit part number <u>525-775</u> with oral nasal and <u>525-776</u> without oral nasal.

L. Mask Frame hand laid fiberglass for the KMB 18, injection molded plastic for the KMB 28

*M.* Band Keepers The new patent pending BandMask<sup>®</sup> BandKeepers<sup>®</sup> coupled with the redesigned hood not only prevent any separation of the hood from the mask but also makes it impossible for the bands to separate from the mask.

N. Stainless Steel Bands hold the Hood/Face seal in place on the mask frame. They also provide the mounting studs for the Head Harness (Spider).

# **MAINTENANCE OF SSA DIVING EQUIPMENT**

## BASIC MASK MAINTENANCE FOR THE DIVER/TENDER

The mask is the primary safety device for the commercial Diver. The mask protects the face and supplies air to the working diver. In order to ensure its proper continued operation, the Diver should periodically break it down and clean some simple components. This guide does not cover the break down or repair of the demand regulator (I). It simply shows the Diver how to break down the mask and ensure that it is clean, functioning properly and maintained in a good condition.

Remove the band (N) from the helmet leaving the screw in the screw slot. Remove any remnants from the band, clean and set aside.

Remove the Hood (B) from the helmet.

The comms are placed into the hood between the flaps. Remove the comms and clean

Check the foam around the hood. This is one of the components which needs to be replaced regularly

Soak the hood in fresh water while continuing with the maintenance procedures

Remove the nose block (J)

Remove the oral nasal mask (J)

Check for degradation

Inspect the one way valve (flap)

Check the comms which are placed into the oral nasal cavity

Remove the wired comms (F)

Ensure that each wire is going to a separate terminal

It does not matter which wire goes to which terminal

Ensure that the wires are separated so there is no bleed over

FYI – A speaker is a microphone and a microphone is a speaker. They are interchangeable.

Check the Water dump valve (H)

Check for slime or organic material and clean as necessary

If the valve is not working it will allow water into the mask

Check the "Whiskers" (G)

Perform Safety Check on check Valve (D).

The check valve will seal the line in the case of a catastrophic failure and allow the diver to use the bailout system. Without the check valve air will be forcibly sucked from the diver's lungs at depths as shallow as 15 feet.

Hook up a bail out bottle without attaching the umbilical line. Turn on the auxiliary valve (C). If air comes out of the check valve (D) then the check valve failed and needs to be rebuilt. If properly working no air should come out of the safety valve.

To place the unit back together follow the steps backwards from 7 to 1.

Storage: To ensure longevity the mask should be stored dry and kept away from moisture, oils, rodents or other damaging contaminates.

## COMMUNICATION GEAR

The communication gear includes anything that allows the Diver to talk to topside personnel. The basic components for the helmet include the microphone and earphones in the mask, along with the connector used to attach the mask comms to the comm line in the umbilical line. It is very common for the communication system in the mask to fail on a regular basis (water and electricity don't mix). In order to lengthen the lifespan of the microphone and earphones the Diver or Tender should take extra time to dry these components and ensure there is no corrosion on the contact points in the helmet.

Another location to monitor is the connection between the microphone/earphone and the comm line. This area should be rinsed with fresh water between dives and lubricated to lower the chance of corrosion. Another anti-corrosion technique includes wrapping the connection point between the mask and umbilical line with electrical tape after placing silicone or a similar lubricant into the connector.

The communication line is durable and requires minimal maintenance other than a post dive rinse and storage techniques that prevent the line from bending or breaking.

The communication box is also durable, but should be kept dry. The lines entering the box from the umbilical should be lubricated to reduce corrosion and protected from bending and twisting. If the unit uses an external battery source, the battery should be removed and stored in a dry location – away from the moist dive equipment. A re-chargeable battery system should be placed on the charging unit.

## UMBILICAL

The umbilical line needs to be protected from excessive wear and tear during the diving operation. Since the line is laid over a boat, or similar structure, it is very likely that it will scrape against a hard surface. Excessive scraping can weaken the umbilical tape, or worse, erode the air line. Prior to the dive the Tender should check the line to make sure that all three components (air line, safety line and communication line) are all intact with no excessive wear and tear. The Tender should also check the umbilical tape and replace where it is thinning or coming apart.

During the dive operation the Tender must ensure that the umbilical line does not get snagged and does not come into contact with sharp or hot surfaces; both of which can damage the line. While coiling the line for storage the Tender should ensure that there are no sharp bends and it should be coiled so that it can be stored out of the way, and in a safe location. Prior to storage it is recommended that the ends of the line be capped and then the entire umbilical line be rinsed with fresh water.

## Common Tips for Storage:

Cap or tape the ends of the air line

Protect the comm line (banana plug) from bending, breaking or shorting out

Rinse exterior with fresh water

Mild soap and soft brush can be used if needed

Air dry overnight before storage

At a minimum, remove excessive water from the line before storage

Protect from direct sunlight and caustics such as oils, acids or cleaning agents

NOTES:

#### HARNESS / BAILOUT ASSEMBLIES / WEIGHT SYSTEMS

The harness and weight system simply need a fresh water rinse and dry storage to maintain their integrity. The components of the bailout system; cylinder, first stage regulator, pressure gauge and helmet quick disconnect need extra care to maintain their performance.

The cylinder requires an annual inspection for internal and external corrosion along with a check to ensure there is no damage to the threads and valve assembly. The inspection should also include a look at the O-ring in the valve's face to make sure it is in good condition. If it is fraying or breaking down it should be replaced to prevent leaking.

When moisture is combined with a metal, corrosion becomes a concern. The cylinder should be inspected by a trained inspector. He will ensure the cylinder is safe to use and all of the safety devices (over pressure relief valves) are properly installed. The cylinder needs this annual inspection and is recommended by most SCUBA shops. In addition, a hydrostatic test, which is a federal requirement, needs to be done every five years. Without a current annual inspection and a current hydro-test stamp, a SCUBA store should not fill your cylinder.

Some other ways to ensure a long life of the cylinder is to avoid contact of dissimilar metals. If using a stainless steel band to attach the aluminum cylinder to the harness, the exterior of the cylinder will begin to corrode. The Diver should ensure there is some barrier between these two types of metals. The most common barrier is a cloth sleeve around the stainless band. Other barriers might be rubber inner-tube pieces, tape or other non-conductive material.

The regulator should be maintained annually to ensure proper operation for use during an emergency. There are many internal components within the regulator. If one of those components fails it will likely cause a leak. In a worst case scenario it will fail, causing the Diver to lose all the air in the bailout cylinder. Since the cylinder is located behind the Diver, he may not be aware of a catastrophic failure of the regulator assembly. An annual service is recommended to help prevent a failure.

The pressure gauge and quick disconnect should also be checked for proper operation. The pressure gauge has a spool which prevents leakage between the gauge and the hose. The O-rings inside are very small and very often break or leak. A service technician can easily replace these tiny O-rings to ensure the gauge does not leak. The Diver should also ensure that the needle within the gauge is working properly. The gauge can become stuck making the Diver wrongly think he has a full cylinder of air. Sometimes simply tapping the face of the gauge will indicate if the gauge is stuck or not working properly.

The quick disconnect has a seat within its mechanism. This seat requires periodic maintenance to ensure that it sits properly when not hooked to the helmet. Proper lubrication may be all that is required to keep this device functioning properly.

## **SAVE A DIVE KIT & ACCESSORIES**

#### Types of Ropes and Lines

Down line – The down line is a rope generally attached to the boat which is lowered to the floor of the diving environment. Since the dive ladder only goes into the water a few feet, and the dive site is normally more than 20 feet, the Diver needs a way to safely be lowered to the bottom. The down line should be strong enough to support the Diver, designed to prevent slipping, and securely attached to a structure, such as a boat. It is also recommended that the end of the rope be weighted to prevent it from floating or getting caught in other structures.

Bag line – The bag line is used to retrieve a lift bag or other object which was sent to a Diver who is working on the bottom. The bag line is attached to the object being lowered to the Diver. After the Diver sends the object to the surface the Tender uses the bag line to pull the object to the Tender. The Tender must make sure the bag line is long enough to reach the Diver. If the line is too short, either it will not reach the Diver, or it will leave the Tender's grasp.

The bag line will normally be looped at one end using a larger piece of plastic tubing. The loop within the tubing ensures a smooth ride down the umbilical line to the Diver. It is also helpful to have an attached clip large enough for the Diver to handle while wearing thick, working gloves. Once the Diver retrieves the line and bag, he fills the bag with the contents, attaches the bag and line to the lift bag and sends it to the surface.

#### **Hardware**

Snap links (carabineers) – A small number of connectors are necessary for Diver safety and to assist a Diver while harvesting. The primary piece of safety hardware is a spinacle shackle. The shackle is attached to the safety line of the umbilical assembly. The shackle is then attached to the Diver's safety harness on the left side. In case of an emergency the Tender can pull the Diver from the bottom using the umbilical line. The shackle attached to the Diver from the safety line ensures that the Diver will be pulled to the surface, even if the air hose or communication lines, within the umbilical fail.

Carabineers can be used by the Diver to attach the lift bag to the harvesting bag. Raising the harvest from the bottom using a lift bag prevents the Diver from needing to leave the bottom each time the bag is filled.

Down line weights – The rope leading from the boat to the bottom normally does not contain enough negative buoyancy to remain perpendicular to the bottom. A floating line will make it difficult for a Diver to grasp while entering or exiting the water. It also becomes an entanglement hazard with the Diver and possibly a spinning prop. A small weight, 3-5 lbs., should be attached at the bottom of the line to keep it taut while in the water.

## **Accessories**

Lift bags – Lift bags are used to raise an object or full harvest bag from the bottom. The size of the object being lifted will determine the appropriate lift bag capacity. A standard size lift bag for commercial harvesting will be 50-100 lbs. This size of lift bag is easy to manipulate while under the water, and will raise most items successfully.

Harvesting bags (Geoduck / Sea Urchin / Sea Cucumber) – The harvesting bag can be made of any material that does not erode in the water, and is durable. The attachment point should also be a consideration. A weak attachment point for the lift bag, or the handle, may cause the product to be accidently dumped back into the water. The bag should be large enough to contain the harvesting items, however, not so large as to be unmanageable by the Tender when retrieving it onto the boat. It is also recommended that the bag be capable of releasing water quickly, such as a mesh bag, to reduce the weight when it reaches the surface.

#### Save-A-Dive Kits

A properly assembled Save-A-Dive Kit may make the difference between a successful harvest or a failed trip. The chances of something not working, or failing during any diving operation is extremely high. The properly prepared Captain, Dive Con, Tender, and Diver may be able to save the trip, time and money.

<u>Hand Tools</u> – A basic tool kit should accompany every operation. The standard tools include; crescent wrench, screwdrivers, pliers, razor knife and socket sets. Other specialized equipment such as crimpers, wire strippers, or jeweler's tools may be added.

<u>Electrical Cable</u> – Basic two wire with ground electrical cable may be necessary to repair the communication equipment. The power cable can be picked up at any hardware or home improvement store. The ends of the cable may be used to connect the helmet comms with the surface comms. Stripped wires from the cable may also be used to repair broken or corroded wires within the dive system.

<u>Batteries</u> (computers and comm box batteries) – A simple non-functioning \$3 battery may mean the end of a safe dive operation. The dive computer, the item which keeps the Diver safe, is controlled with a very small inexpensive battery. If the dive computer has no battery, the Diver should not enter the water. The problem with these small batteries is that they can be unreliable. Make sure each Diver knows the type of battery for his computer, and carries spares.

The communication system is generally run off a 12 volt system. If the comm box is hooked to the boat's 12 volt system, and the motor is running, there is a high likelihood of feedback. A separate battery source for the communication system is recommended.
In order to save on money, it is also recommended that the dive operation use a rechargeable 12 volt battery system.

<u>Diver Microphone / Speakers</u> – It is not an issue of "IF" a Diver's microphone or earphone will fail, rather it is a concern of "WHEN" will the system fail. The microphones and earphones are electrical devices submerged in water, they WILL fail. Having an extra set on the boat will ensure proper communication between the Diver and the boat, which makes it safer for everyone.

<u>Connectors</u> (electrical) – The electrical lines can be connected with tape or special connectors. If special connectors are used, make sure to have spares on board the boat to fix breaks or corrosion.

<u>Fittings</u> (helmet and air station fittings) – The entire diving and communication system relies on connecting one piece of equipment to another. This equipment is either submerged in water, deals with electricity or needs to handle pressures greater than 40 psi. Because of this harsh environment something is bound to break, leak or fail. The problem is knowing which piece will fail, which needs to be replaced, or which piece can be fixed with a piece of tape. At a minimum, have some rebuild kits on hand for the valves being used on the helmet or the manifold. If the item bends or moves it is a wise and safe practice to have a spare in the save a dive kit.

<u>Tape</u> (electrical / umbilical / plumbers) - Tape is used regularly during the dive operation. Electrical tape is used to wrap the comm line to the Diver's helmet. This tape is replaced each time the helmet is connected to the umbilical line.

Plumber's tape is used to seal connections in the manifold, compressor or the components of the helmet.

Umbilical tape may be necessary to repair the umbilical line if it becomes torn or unsafe.

<u>Silicone Grease</u> - Silicone grease can be applied to the electrical connections to reduce the amount of corrosion. It is highly recommended to use a plug from the umbilical to the helmet. Place some silicone grease into the connection before wrapping the connection with electrical tape. This simple step may increase the life of the connector.

## Supervisor's Kit

A prepared Supervisor takes into account that he is responsible for the safety of the dive operation. The following equipment supplied by the Supervisor or Boat Captain may not be used on a regular basis, but it could save a life in the rare event it is needed.

<u>First aid / Oxygen</u> – Oxygen is the first line of defense in any suspected dive related injury. Simply administering oxygen at the first sign of a Diver's complaint of pain may help the Diver recover safer and faster. THERE IS NO EXCUSE NOT TO HAVE THIS BASIC PIECE OF FIRST AID DURING EVERY DIVE OPERATION. The Supervisor

should ensure that everyone is trained on where the oxygen is stored and that they know how to administer it safely. It is also important to ensure that the oxygen system is working and fully charged at the beginning of every dive operation.

<u>Manuals</u> – Having the manuals on hand for the equipment on the boat, and the equipment used by the Divers may assist in a quick repair. Other refresh manuals may be helpful, such as diving manuals or first aid manuals.

<u>Dive Timer</u> – The Dive Supervisor will be wearing many hats, but still must maintain safety. Having a simple dive timer, to keep track of his divers, will help in the safe operation of any dive.

<u>Log Sheets</u> – Log sheets are required for many commercial diving operations, and should be used during commercial harvest operations. The log should list all Divers and Tenders. It should record time in the water, and the time resting on the surface. The log should also show basic checks, such as air, depth and time, between the Diver and Dive Con.

<u>Dive Tables</u> – The Dive Con should have basic knowledge of the use of a dive table to track nitrogen levels of the Diver. With a constant update from the Diver of his depth, and the use of the Dive Cons surface timer, the Dive Con should be able to warn the Diver if he is beginning to become saturated with nitrogen. The Diver will be utilizing a dive computer, but extra tracking by the Dive Con using a dive table may ensure a safe dive operation.

## **Diver's Personal Kit**

A Diver should focus on items that make for a safe, comfortable dive. He should not rely on the Boat Captain or Dive Supervisor to ensure that all of the proper equipment is on hand. The items listed below will help a commercial harvest diver to operate safely.

<u>Water</u> – This is the number one preventative measure to keep a Diver from decompression sickness. The more water that a diver drinks, the healthier the body and the safer the dive.

<u>Dive Computer</u>- Commercial harvesters need to focus on the task at hand, harvesting. Trying to track depth and time, along with everything else being done, can be difficult. The dive computer will assist the Diver in calculating a safe dive time based on his depth.

<u>Batteries for Computer</u> – It is recommended that the Diver purchase a computer with user replaceable batteries. The Diver should ensure that the computer is working properly, and if there are any doubts about the battery life, the battery should be replaced before the computer goes dead during a dive.

<u>Disinfectant Spray</u> – Many harvesters share the helmet and other life support equipment. The equipment is used for breathing, and generally contains sweat and saliva from the previous diver. In order to stay safe and healthy it is recommended that the equipment be disinfected prior to use by each diver.

<u>Medicines</u> – The Diver is being subjected to pressure which affects the sinus cavities and prolonged diving might increase swelling of the membrane. There are some safe over the counter medications, which, when properly used, can help a Diver avoid some discomfort while diving. A physician should always be consulted about the safe use of decongestants prior to a dive.

Ear medicine (alcohol and glycerin) will help keep the ear free of water between dives, which may alleviate infections.

If you are diving in an area with stinging creatures, such as jellyfish, it would be helpful to have medication specifically designed to relieve the pain of a sting.

<u>Exposure Suit Maintenance</u> – The Diver should always take care of his exposure suit. The areas needing the most care are the seals (neck and wrist) and the zipper. If the seals are latex, then they should be treated daily with silicone. If the seals are neoprene the Diver should use powder while donning the suit to prevent tears. The zipper, the most expensive item to repair on an exposure suit, should be waxed daily IF METAL. If zipper is PLASTIC it needs to be properly lubricated daily. The waxing should be extensive enough that the zipper glides smoothly and does not create unnecessary wear on the teeth or sealing surface. All zippers should be rinsed to remove dirt.

NOTES:

## EXAMPLE DIVE LOG

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Diver's	Dive	Safety /	Bailout	Depth	Depth	Depth	Depth	Dive	Maximum
Name	Start	communication	Pressure	and	and	and	and	End	Depth
	Time	check	check	Time	Time	Time	Time	Time	
				check	check	check	check		

- Diver's Name: If you have two Divers with the same name, use a last initial or some other identifying symbol.
- Dive Start Time : The time the Diver's helmet goes below the water
- Safety Communication Check: Once the Diver is under the water ensure that everything is working: comms, computer, free flow, regulator adjustment and bailout.
- Bailout Pressure Check: Have the Diver check the bailout pressure and read the current pressure to the Dive Com. This ensures the Diver can locate the pressure gauge and it contains enough pressure to be used in an emergency.
- Depth and Time Checks: Periodically check with the Diver about his depth and dive time according to his computer. This gets the Diver paying attention to the dive computer. The Diver should be checking nitrogen levels and ensuring he has enough time on his computer to complete the task at hand.
- Dive End Time: The time the Diver exits the water.
- Maximum Depth: The Diver should be asked for his maximum depth as recorded by his dive computer.



