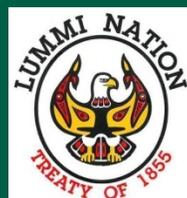


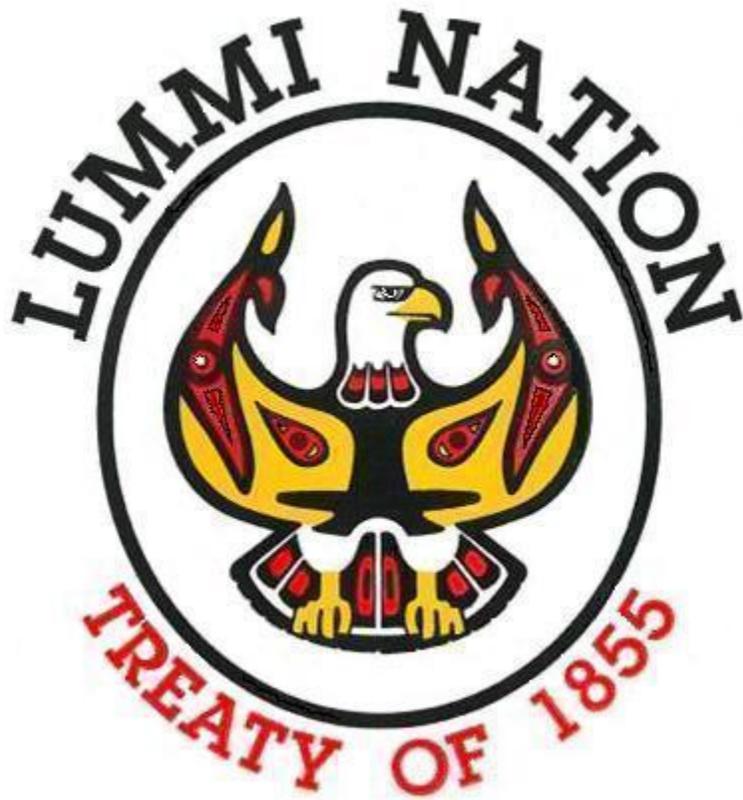
COMMERCIAL HARVEST DIVING STANDARDS



Lummi Natural Resources Department
Lummi Indian Business Council



COMMERCIAL HARVEST DIVING STANDARDS

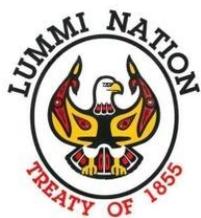


Lummi Natural Resources Department

Lummi Indian Business Council

July 2013

COMMERCIAL HARVEST DIVING STANDARDS



COMMERCIAL HARVEST DIVING STANDARDS



Compiled and Edited by:

Karl W. Mueller

Fisheries Management Biologist and Diving Safety Officer

Lummi Natural Resources Department

2665 Kwina Road

Bellingham, Washington 98226

July 2013

ACKNOWLEDGEMENTS AND DEDICATION

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. The Lummi Natural Resources Department (LNR) Commercial Harvest Diving Standards benefitted from many such conversations during the past several months. I thank the Lummi Fisheries and Natural Resources Commission, especially Elden Hillaire, Terry Hillaire, and Steve Solomon, for their vision, determination, and encouragement during the development of these standards. I also thank Merle Jefferson and Ben Starkhouse of LNR for their unwavering support, for allowing me the time to shepherd the diving safety process through to this conclusion. Many productive discussions, 'reality checks', and positive debates were had with members of the Lummi commercial harvest diving community. To this end, I thank the following Lummi fishers (listed alphabetically): Michael Alexander, James Ballew, Armando Brionez, Paul Casimir, Cliff Cultee, Shannon Cultee, Robert Davis III, Alfonso Felix, Johnny Felix, Casey Finkbonner, Anthony Galler, Markus George, Robert George, Albert Hillaire, Hank Hoskins, Benedict Jefferson, Dena Jefferson, Leonard Jefferson III, Phillip Jefferson, Randal Jefferson, Ray Jefferson, Sr., Ray Jefferson, Jr., Rob Jefferson, Todd Jefferson, William (Bill) Jefferson, Illya Joy, Aaron Julius, Randy Kinley, Jr., Tremaine Lawrence, Smokey LaClair, Jay Martin, Kenny Miller, Lonnie Phair, Terry Phair, Eugene Revey, Clinton Sieber, Jason Sieber, Rocque Tapuro, George Thomas, Daniel Washington, Donald Weeks, Raymond Wilbur, and Setrina Wilson. This work is dedicated to the memories of Albert and David Hillaire and to all the Lummi fishers participating in commercial harvest diving operations who are blessed to make their way of life underwater.

Karl W. Mueller

July 2013

Table of Contents

1.0 GENERAL PROVISIONS	9
1.1 SCOPE AND APPLICATION	9
1.2 HISTORY OF THE LNR COMMERCIAL HARVEST DIVING STANDARDS AND RELATED REGULATIONS ..	9
1.3 IMPLEMENTATION OF CHANGES TO STANDARDS, CLASSIFICATION, AND EQUIPMENT REQUIREMENTS	9
2.0 OVERVIEW OF QUALIFICATIONS FOR DIVE TEAM MEMBERS.....	11
2.1 GENERAL	11
2.2 ENTRY-LEVEL REQUIREMENTS	11
2.3 PERMISSIONS, EXPERIENCE, AND PROFICIENCY	12
2.4 MEDICAL REQUIREMENTS FOR DIVE TEAM MEMBERS	13
2.4.1 PHYSICIAN’S WRITTEN REPORT.....	14
2.4.2 POTENTIALLY DISQUALIFYING MEDICAL CONDITIONS	15
2.4.3 RE-EXAMINATION AFTER INJURY OR ILLNESS.....	16
2.4.4 WITHDRAWAL FROM HYPERBARIC CONDITIONS FOR DIVERS	16
2.4.5 MEDICAL RECORD KEEPING	16
3.0 DIVE TEAM MEMBER CERTIFICATIONS, QUALIFICATIONS, AND RESPONSIBILITIES	19
3.1 LNR COMMERCIAL HARVEST DIVING CLASSIFICATION PROGRAM.....	19
3.1.1 CARD ISSUE	19
3.2 DOCUMENTATION ACCEPTED.....	19
3.2.1 RECIPROCITY AND DOCUMENTATION REQUIRED BY NON-LUMMI CITIZENS	20
3.2.2 DATABASE MAINTENANCE.....	20
3.3 EXPERIENCED DIVE OPERATOR RESPONSIBILITIES	20
3.4 EXPERIENCED DIVER RESPONSIBILITIES	22
3.5 TRAINEE DIVER RESPONSIBILITIES	23

3.6 HOSE TENDER RESPONSIBILITIES	24
3.7 DIVING CONTROL BOARD	25
3.8 DIVING SAFETY OFFICER.....	26
4.0 DIVING (LIFE-SUPPORT) EQUIPMENT: REQUIREMENTS, MAINTENANCE, AND TESTING.....	27
4.1 GENERAL	27
4.2 MAINTENANCE RECORDS.....	27
4.3 DIVER’S DRESS.....	27
4.3.1 GENERAL	27
4.3.2 DRY SUITS.....	27
4.3.3 HOT WATER SUITS.....	27
4.3.4 HARNESES.....	28
4.3.5 WEIGHT BELTS.....	28
4.3.6 DIVER-WORN OR CARRIED EMERGENCY GAS SUPPLY (BAILOUT)	29
4.4 HELMETS AND MASKS.....	29
4.4.1 GENERAL	29
4.4.2 HEAVYWEIGHT DIVING HELMETS	29
4.4.3 LIGHTWEIGHT DIVING HELMETS.....	29
4.4.4 BIBS (BUILT-IN BREATHING SYSTEMS)	30
4.5 HOSES.....	30
4.5.1 GENERAL	30
4.5.2 BREATHING GAS HOSES (LP)	30
4.5.3 UMBILICALS.....	30
4.5.4 OXYGEN HOSES	31
4.6 COMPRESSOR SYSTEMS	31
4.6.1 COMPRESSORS AND GAS PUMPS	31

4.6.2 FILTRATION	32
4.6.3 TESTING.....	32
4.6.4 AIR PURITY REQUIREMENTS	32
4.7 DIVER ENTRY AND EGRESS SYSTEMS	32
4.7.1 DIVING LADDER.....	32
4.8 GAUGES.....	32
4.9 DIVE COMPUTERS	33
4.10 TIMEKEEPING DEVICES.....	33
4.11 COMPRESSED GAS EQUIPMENT.....	33
4.11.1 VOLUME TANKS/AIR RECEIVERS	33
4.11.2 GAS STORAGE CYLINDERS AND TUBES	34
4.11.3 SCUBA AND EGS (BAILOUT) BOTTLES	34
5.0 VESSELS AND FLOATING PLATFORMS FOR DIVING OPERATIONS.....	35
5.1 GENERAL	35
5.2 DIVE VESSEL REGISTRATION	35
5.3 ANCHORING DIVE VESSEL(S).....	36
5.4 LIVE-BOATING	36
5.4.1 MINIMUM REQUIREMENTS	36
5.4.2 OPERATIONAL GUIDELINES.....	37
5.4.3 RECOMMENDED WAYS TO MITIGATE HAZARDS ASSOCIATED WITH LIVE-BOATING	37
5.4.4 MINIMUM EQUIPMENT REQUIREMENTS	37
6.0 DIVING MODES: DEFINITIONS, REQUIREMENTS, AND GUIDELINES	39
6.1 GENERAL	39
6.2 SURFACE SUPPLIED AIR DIVING 0–100 fsw (0–30 msw) WITH NO DECOMPRESSION	39
6.2.1 MINIMUM PERSONNEL REQUIREMENTS.....	40

6.2.2 OPERATIONAL GUIDELINES.....	40
6.2.3 MINIMUM EQUIPMENT REQUIREMENTS	40
6.3 ENRICHED-AIR OR NITROX DIVING	41
6.3.1 DEFINITION AND ADVANTAGES	41
6.3.2 GENERAL	42
6.3.3 EQUIVALENT AIR DEPTH (EAD)	42
6.3.4 MINIMUM PERSONNEL REQUIREMENTS.....	42
6.3.5 OEPRATIONAL GUIDELINES.....	43
6.3.6 MINIMUM EQUIPMENT REQUIREMENTS	43
7.0 UNDERWATER OPERATIONS: PROCEDURES, CHECKLISTS, AND GUIDELINES	45
7.1 SAFE PRACTICES/OPERATIONS MANUAL.....	45
7.2 DIVER’S PERSONAL LOG BOOK.....	45
7.3 DESIGNATED EXPERIENCED DIVE OPERATOR (DIVING SUPERVISOR).....	46
7.4 STANDBY DIVER REQUIREMENT	46
7.5 OPERATIONS PLANNING AND ASSESSMENT	46
7.5.1 JOB/PROJECT SAFETY	46
7.5.2 DIVING AND SUPPORT PERSONNEL.....	46
7.5.3 EQUIPMENT	47
7.6 TEAM BRIEFING.....	47
7.7 TERMINATION OF DIVE	47
7.8 POST-DIVE PROCEDURES	47
7.9 COMPANY RECORD OF LOGGED DIVES.....	48
7.10 HAZARDS TO UNDERWATER OPERATIONS	48
7.11 TEMPORARY IMPAIRMENT OR CONDITION.....	48
7.12 ENTERING AND LEAVING THE WATER	49

7.13 DECOMPRESSION CHAMBER AVAILABILITY AND ASSUMPTION OF RISK	49
7.14 INSPECTION OF LIFE-SUPPORT SYSTEMS, EQUIPMENT AND TOOLS	49
7.15 PROCEDURES FOR DIVING IN COLD WEATHER AND COLD WATER (<40°F/4°C)	50
7.15.1 DIVER.....	50
7.15.2 HOSE TENDER AND TOPSIDE.....	50
7.15.3 EQUIPMENT AND MAINTENANCE.....	50
7.16 WARNING DISPLAYS FOR DIVING OPERATIONS.....	51
7.17 DIVER-WORN OR CARRIED EMERGENCY GAS SUPPLY (EGS)	51
7.18 VOICE COMMUNICATIONS ON STATION	51
7.19 SAFE DIVE PLATFORM	52
7.20 PERSONAL PROTECTIVE EQUIPMENT	52
7.21 SAFETY PROCEDURE GUIDELINES	52
7.21.1 SAFE PRACTICES/OPERATIONS MANUAL.....	52
7.21.2 EMERGENCY AID	52
7.21.3 FIRST AID	52
7.21.4 PLANNING AND ASSESSMENT.....	52
7.21.5 HAZARDS TO DIVING OPERATIONS.....	53
7.21.6 UNDERWATER HAZARDOUS CONDITIONS.....	53
7.21.7 RECORD KEEPING	53
7.22 LIFE-SUPPORT EQUIPMENT PROCEDURES CHECKLIST.....	53
7.22.1 EQUIPMENT PREPARATION	53
7.22.2 GENERAL EQUIPMENT	54
7.22.3 PREPARING THE BREATHING GAS SUPPLIES	54
7.22.4 ACTIVATING THE BREATHING GAS SUPPLIES.....	55
7.22.5 BREATHING GAS HOSES	55

7.22.6 TESTING OF EQUIPMENT WITH BREATHING GAS SUPPLY ACTIVATED.....	55
7.23 UNDERWATER LIFT BAG OPERATIONS.....	55
7.23.1 PURPOSE	55
7.23.2 DEFINITIONS.....	55
7.23.3 RESPONSIBILITY.....	56
7.23.4 OPERATIONAL CONSIDERATIONS WHEN USING UNDERWATER LIFT BAGS.....	56
7.23.5 PRECAUTIONS	56
7.23.6 POTENTIAL HAZARDS ASSOCIATED WITH UNDERWATER LIFT BAG OPERATIONS	57
7.23.7 RECOMMENDED WAYS TO MITIGATE HAZARDS ASSOCIATED WITH UNDERWATER LIFT BAG OPERATIONS	57
8.0 FIRST AID AND EMERGENCY PROCEDURES, ASSESSMENTS, AND REPORTING OF ACCIDENTS.....	59
8.1 EMERGENCY AID	59
8.2 FIRST AID	59
8.2.1 MINIMUM INVENTORY SUGGESTED FOR DIVING FIRST AID KIT:	59
8.2.2 MINIMUM INVENTORY REQUIRED FOR EMERGENCY OXYGEN ADMINISTRATION KIT:.....	60
8.3 BASIC EMERGENCY PROCEDURES GUIDELINES	60
8.3.1 LOSS OF BREATHING MEDIA	61
8.3.2 LOSS OF COMMUNICATIONS	61
8.3.3 FOULED OR ENTRAPPED DIVER COMMUNICATIONS.....	61
8.3.4 INJURED DIVER IN WATER.....	61
8.3.5 DIVER’S UMBILICAL SEVERED – GAS HOSE ONLY.....	62
8.3.6 UMBILICAL COMPLETELY SEVERED – ALL COMPONENTS.....	62
8.3.7 FIRE TOPSIDE.....	62
8.3.8 EQUIPMENT FAILURE - DIVER IN THE WATER.....	62
8.3.9 ADVERSE ENVIRONMENTAL CONDITIONS	62

8.3.10 OXYGEN TOXICITY (AS RELATED TO NITROX USE) – DIVER IN WATER..... 62

8.3.11 OXYGEN TOXICITY (AS RELATED TO NITROX USE) DURING TREATMENT OF DIVING MALADY – TOPSIDE..... 63

8.3.12 EMERGENCY EVACUATION 63

8.4 ACCIDENT REPORTING 63

1.0 GENERAL PROVISIONS

1.1 SCOPE AND APPLICATION

The Lummi Natural Resources Department (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 2001 version of the National Oceanographic and Atmospheric Administration (NOAA) Diving Manual, the 2012 version of the University of Washington Scientific Diving Safety Manual, and selected training materials from Technical Diving International (TDI) and the Divers Alert Network (DAN). The 2011 version of the Edmonds Technical Diving Services (ETDS) Surface Supplied Air Diving for the Commercial Harvester Manual was appended (Appendix 10) with permission for reference purposes only. These standards apply to all Lummi citizens permitted to participate in commercial harvest diving activities under the auspices of the Lummi Nation. These standards are intended for internal use only by LNR and for the personal use of Lummi commercial harvest diving personnel qualified to work aboard LNR-registered dive vessels; hence, this document must not be sold, lent, or given to any other person(s), institution, or organization.

1.2 HISTORY OF THE LNR COMMERCIAL HARVEST DIVING STANDARDS AND RELATED REGULATIONS

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, toward the close of the 20th century, a few intrepid Lummi fishers began commercial harvest diving for edible marine invertebrates. Shortly thereafter, the Lummi Fisheries and Natural Resources Commission (LFNRC or 'the commission') recognized that specialized training and experience were required to participate in the emerging tribal dive fisheries. In 1996, the commission approved LNR regulations designed to minimize the risks associated with working underwater: Regulation 96-03 outlined the minimum training requirements for Lummi citizens 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 local Lummi economy.

1.3 IMPLEMENTATION OF CHANGES TO STANDARDS, CLASSIFICATION, AND EQUIPMENT REQUIREMENTS

In the ensuing years, despite having a reasonable, albeit minimal, set of commercial harvest diving requirements (Regulation 96-04 drew heavily from the federal 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 two diving-related fatalities prompted the LFNRC to prioritize dive safety on the Lummi Reservation. During early 2012, the commission charged LNR staff with reviewing the current diving regulations and recommending ways in which LNR might improve upon the past dive safety record. These standards are a direct result of that process. Besides the LNR Commercial Harvest Diving Standards, other recommendations included (in no particular order):

- 1) Designating a diving safety officer (DSO);
- 2) Creating a diving control board (DCB);
- 3) Re-writing or developing new diving regulations;
- 4) Reconciling the Natural Resources Code of Laws (Title 10) with diving regulations and commercial dive fisheries;
- 5) Adopting new standards for medical requirements including drug testing;

- 6) Requiring more rigorous training for personnel new to dive fisheries and requiring refresher training for existing dive personnel;
- 7) Outfitting 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.

In August 2012, the commission 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. In June 2013, the commission approved and adopted this document as the standards to follow for all commercial harvest diving-related activities permitted under the auspices of the Lummi Nation. Regulation 2013-24, Lummi Nation Commercial Harvest Diving Standards, supersedes all previous commercial harvest diving regulations. Table 1A1 in Appendix 1 summarizes the chronology of events leading to the development of the LNR Commercial Harvest Diving Standards and other dive safety-related measures.

2.0 OVERVIEW OF QUALIFICATIONS FOR DIVE TEAM MEMBERS

2.1 GENERAL

Each person engaged in commercial harvest diving and underwater operations shall possess the necessary qualifications for the job assignment. Designation of skill levels in these standards incorporates three primary elements: 1) technical training, 2) field experience, and 3) demonstrated proficiency.

Persons participating in specific diving and underwater harvest activities shall possess:

- 1) Knowledge and skills gained through a combination of formal training and/or experience
 - a. Diving procedures and techniques;
 - b. Emergency procedures;
 - c. Physiology and physics as they relate to diving;
 - d. Diving equipment;
 - e. First aid, CPR, and emergency oxygen administration.
- 2) Familiarity with procedures and proficiency in the use of tools, equipment, devices and systems associated with the assigned tasks.
- 3) For persons engaged as dive team members or otherwise exposed to hyperbaric conditions, physical qualifications for such activities must be met as outlined in Section 2.4 and Appendix 8. Such physical qualifications must be documented on an LNR medical history and physical examination form, or an equivalent form.

Personnel trained and certified by recreational diving agencies such as, but not limited to, the 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 commercial harvest diving activities without additional training – this could be formal training from an accredited source (Appendix 2) or the recreationally-certified diver lacking the required experience and proficiency outlined above may be assigned a task (e.g., Trainee Diver or Hose Tender), under the direction of an experienced and qualified individual, in order to obtain the experience and level of proficiency required (i.e., the person may receive on-the-job training).

2.2 ENTRY-LEVEL REQUIREMENTS

The entry-level minimum skill designations/classifications on the diving crew are Hose Tender and Trainee Diver.

At a minimum, Hose Tenders must satisfy the following requirements:

- 1) Annual approval by a physician after passing a medical examination of the Hose Tender, including a drug screening and urinalysis, sufficient to identify factors which prohibit or restrict assisting with diving activity.
- 2) Current certification in First Aid, CPR, and emergency oxygen administration by the American Red Cross, Divers Alert Network, or other widely-recognized training agency.
- 3) Complete a review of and understand the current LNR Commercial Harvest Diving Standards verified by the LNR-registered dive vessel owner or Experienced Dive Operator (Appendix 9).
- 4) Four hours of training in the operation and maintenance of equipment used in the dive operations and the procedures to be followed by each member of a dive team verified by the LNR-registered dive vessel owner or Experienced Dive Operator (Appendix 9).

Trainee Divers must be 18 years old, a high school graduate (or equivalent), and must satisfy the minimum entry-level qualifications of diving proficiency, technical proficiency and experience by successfully completing a formal course of study or by obtaining the experience and level of proficiency required under the direct supervision of a certified, experienced, and qualified individual.

At a minimum, Trainee Divers must satisfy the following requirements:

- 1) Annual approval by a physician after passing a medical examination of the diver, including a drug screening and urinalysis, sufficient to identify factors which prohibit or restrict diving activity.
- 2) Open Water Certification in a scuba training program conforming to NAUI, PADI, SSI, SDI or similar standards.
- 3) Current certification in First Aid, CPR, and emergency oxygen administration by the American Red Cross, Divers Alert Network, or other widely-recognized training agency.
- 4) Four (4) non-commercial dives in open water at 20-40', with the equipment to be used in the dive 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 and verified by the LNR-registered dive vessel owner or Experienced Dive Operator (Appendix 9).
- 5) A complete review and understanding of the current LNR Commercial Harvest Diving Standards verified by the LNR-registered dive vessel owner or Experienced Dive Operator (Appendix 9).
- 6) Four hours of training in the operation and maintenance of equipment used in the dive operations and the procedures to be followed by each member of a dive team verified by the LNR-registered dive vessel owner or Experienced Dive Operator (Appendix 9).

Lummi citizens 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 LNR Diving Safety Officer together with presented documentation such as dive logs, supervisor logs, letters of reference from diving safety officers, etc., to determine whether the individual is eligible in all respects to participate in commercial harvest diving activities.

2.3 PERMISSIONS, EXPERIENCE, AND PROFICIENCY

Advancement beyond the Hose Tender or Trainee Diver 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 in commercial harvest diving operations. Advancement to higher designations (e.g., Experienced Diver or Experienced Dive Operator) requires completion of training and documented experience for all lower designations.

Upon completion of the requirements outlined above (2.2 Entry-Level Requirements), the Hose Tender may serve in that role aboard an LNR-registered commercial diving vessel engaged in harvest operations under the direct supervision of the dive-qualified vessel owner, or dive team member who is the person in charge of the commercial harvest dive, or Experienced Dive Operator.

Upon completion of the requirements outlined above (2.2 Entry-Level Requirements), the Trainee Diver may participate in no-decompression harvest dive operations aboard an LNR-registered commercial diving vessel as a member of a dive team under the direct supervision of the dive-qualified vessel owner or a dive team member approved at the Experienced Diver level. The Trainee Diver 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 Trainee Diver's initial diving certification (typically less than 60 ft), under safe conditions, to be verified by the LNR-registered dive vessel owner or Experienced Dive Operator (Appendix 9).

The Experienced Diver participates in commercial harvest diving operations as member of a dive team and supervises the activities of Trainee Divers and Hose Tenders under the direction of the Experienced Dive Operator or LNR-registered dive vessel owner.

At a minimum, Experienced Divers must satisfy the following requirements:

- 1) Completion of the Trainee Diver requirements above, including at least 90 logged dives under normal working conditions which have been signed and verified by the LNR-registered dive vessel owner or Experienced Dive Operator (Appendix 9).
- 2) Annual approval by a physician after passing a medical examination of the diver, including a drug screening and urinalysis, sufficient to identify factors which prohibit or restrict diving activity.
- 3) Current certification in First Aid, CPR, and emergency oxygen administration by the American Red Cross, Divers Alert Network, or other widely-recognized training agency.

The Experienced Dive Operator safely conducts all aspects of commercial harvest diving operations and supervises the activities of all dive team members.

At a minimum, the Experienced Dive Operator must satisfy the following requirements:

- 1) Completion of all training requirements outlined above for all other LNR classifications, including at least 1000 logged dives under normal working conditions which have been signed and verified by the LNR-registered dive vessel owner or another LNR-recognized Experienced Dive Operator.
- 2) A minimum of two (2) years experience safely conducting commercial harvest diving activities, including dive vessel operation, to be documented by the diver and verified by the LNR-registered dive vessel owner or another LNR-recognized Experienced Dive Operator.
- 3) Annual approval by a physician after passing a medical examination of the diver, including a drug screening and urinalysis, sufficient to identify factors which prohibit or restrict diving activity.
- 4) Current certification in First Aid, CPR, and emergency oxygen administration by the American Red Cross, Divers Alert Network, or other widely-recognized training agency.

All dives must be performed during a 24-month period immediately prior to issuance of the designation. Work must be performed during each dive with proper supervision. All dives must have a minimum of 20 minutes bottom time. A number of shorter-duration dives may be combined to equal one dive of the required 20-minute bottom time.

2.4 MEDICAL REQUIREMENTS FOR DIVE TEAM MEMBERS

All persons engaged in commercial harvest diving operations are required to get an annual physical examination. More frequent or extensive examination(s), including a complete medical re-examination, shall be required if there have been any illnesses or accidents (Sections 2.4.2 and 8.4; Appendices 7 and 9) during the course of that year that may have caused a change in the individual's medical condition and ability to participate in commercial harvest diving operations. It is recommended that candidates attending formal commercial diver training programs and schools follow the LNR medical and examination guidelines outlined in this section. Appendix 8 provides the guidelines, requirements, and recommendations for examining physicians. For persons engaged as divers (or otherwise subjected to hyperbaric conditions) and hose tenders, the following medical examinations (or equivalent) are required:

- 1) An initial examination including an initial drug screening (Appendix 8);
- 2) Re-examination after a serious diving-related injury or illness (Sections 2.4.2 and 8.4; Appendices 7 and 9) as needed to determine fitness to return to diving duty; and
- 3) Annual re-examination including drug screening (Appendix 8).

The initial exam and periodic medical re-examination of a diver include the following:

- 1) Work history;
- 2) The tests required in Table 1 and Appendix 8 as appropriate;

- 3) Any tests deemed necessary to establish the presence of any of the disqualifying conditions listed in this section (but see also Appendix 8); and
- 4) Any additional tests the physician deems necessary.

The initial exam and periodic medical re-examination of a hose tender include the following:

- 1) Work history;
- 2) A standard sport physical; and
- 3) Any additional tests the physician deems necessary.

Table 1. Medical tests required for divers participating in commercial harvest diving operations.			
Test	Initial	Annual	Comments
History & Physical (see Appendix 8)	X	X	Include predisposition to unconsciousness, vomiting, cardiac arrest, impairment of oxygen transport, serious blood loss or anything that, in the opinion of the examining physician, will interfere with effective underwater or topside work.
Chest X-ray	X	X	PA (Projection: 14" x 17" minimum).
Bone and Joint X-ray Survey	X		Optional and as medically indicated.
EKG: Standard (12 Leads)	X		Optional initially to establish baseline; annually after age 35; and as medically indicated.
EKG: Stress Test			Required only as medically indicated and should be considered after age 40.
Pulmonary Function Test	X	X	Required.
Audiogram	X	X	Threshold audiogram by pure tone audiometry; bone conduction audiogram as medically indicated.
EEG			Required only as medically indicated.
Visual Acuity	X	X	Required initially and as medically indicated.
Color Blindness	X		Required initially.
Complete Blood Count	X	X	
Routine Urinalysis	X	X	
Drug screen	X	X	Required initially to establish baseline; annually with dive physical; and as medically indicated.
Pregnancy Test	X	X	Recommended prior to commencing diving activities.
Sickle Cell Screen	X		
PPD	X	X	
Comprehensive Metabolic Profile	X	X	Optional, including cholesterol and triglycerides required for divers over 40.

2.4.1 PHYSICIAN'S WRITTEN REPORT

A written report outlining a person's medical condition and fitness to engage in commercial harvest diving operations or other hyperbaric activities should be provided by the examining physician at any time a physical examination is required herein. The written physical examination form should be accompanied with completed copies of the standard LNR medical history form or its equivalent and both the Lummi Tribal Health Center and Virginia Mason Medical Center authorizations to release patient health information forms (Appendix 9). By completing and signing these forms, diving personnel authorize the examining physician (clinic, etc.) to furnish LNR, specifically the DSO or equivalent, with a transcript of the medical record related to the diving physical

examination and drug screening. The transcript will be used only when requested by the applicant for purposes of processing his/her diving physical examination required for participation in an LNR-permitted commercial harvest diving operation.

The examining physician should preferably be qualified by experience or training for the conduct of commercial diver physical examinations or, if not, should consult with another medical practitioner so qualified (Appendix 7).

2.4.2 POTENTIALLY DISQUALIFYING MEDICAL CONDITIONS

Certain medical conditions are considered to be potentially disqualifying to diving based on the excessive risk to the diver, his/her team, or the mission. Included here are examples of medical conditions that affect the ability to dive or participate in commercial harvest dive operations in a safe manner (but see also Appendix 8). The list is not intended to be all inclusive, and failure to specify a particular condition under this section does not imply the condition is compatible with diving. If a dive team member has any of the following conditions, as determined by a physician's examination, the dive team member shall not be permitted to participate in an LNR-approved commercial harvest dive operation until the department receives confirmation from a physician that the medical issue is resolved and that the dive team member is medically fit to participate in the LNR-approved commercial harvest dive operation.

- 1) History of seizure disorder other than early childhood febrile conditions;
- 2) Cystic or cavitory disease of the lungs, significant obstructive or restrictive lung disease, or recurrent pneumothorax;
- 3) Significant cardiac abnormalities;
- 4) Chronic inability to equalize sinus and middle ear pressure;
- 5) Grossly impaired hearing;
- 6) Significant central or peripheral nervous system disease or impairment;
- 7) Significant hemoglobinopathies;
- 8) Significant malignancies;
- 9) Significant osteonecrosis;
- 10) Pregnancy;
- 11) History of psychosis; or
- 12) Evidence of substance misuse:
 - a. Alcohol-, drug-, or chemical-dependence, i.e., active, untreated addiction;
 - b. At the time of medical examination, use of any illegal or controlled substance, drug, or behavior-altering chemical, as indicated by a drug screening or urinalysis, when the use cannot be accounted for as a result of prescription by a physician.

In a case of substance misuse (item # 12 above), because of the increased risk of dereliction of duties by the dive team member under the influence that could affect his or her health and well-being and those of the greater Lummi commercial harvest diving community, the LNR DSO shall convene a meeting of a Diving Control Board (DCB) comprised of at least 10 individuals with five (5) or more years of experience each as Experienced Dive Operators (including LNR-registered dive vessel owners) or Experienced Divers from the Lummi commercial harvest diving community to deliberate the case (Section 3.7). The DCB will review the case and then present its recommendations to the LFNRC and the LFNRC Chair who has signatory authority over the affected dive team member's participation in commercial harvest diving activities permitted under the auspices of the Lummi Nation (Figure 1). The LFNRC can then determine whether the affected dive team member poses a risk to his/her fellow fishers, the harvested resource, or the general public pursuant to the Lummi Natural Resources Code (Title 10) and whether conditional approval of the affected dive team member to participate in commercial harvest diving activities is warranted or not.

2.4.3 RE-EXAMINATION AFTER INJURY OR ILLNESS

Any dive team member must have a medical examination following a known decompression sickness (DCS) or DCS with audio-vestibular, central nervous system dysfunction or arterial gas embolism. Moreover, any dive team 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 examining physician should determine the scope of the examination in light of the nature of the injury or illness. The affected dive team member(s) may be permitted to continue participating in the LNR-approved commercial harvest dive operation(s) after released by the physician to do so and after a review of the case by LNR using the following protocol: The LNR DSO shall convene a meeting of the DCB to deliberate the case (Section 3.7). The DCB will then present its findings/recommendations to the LFNRC and the LFNRC Chair who has signatory authority over the affected dive team member's participation in Lummi commercial harvest diving activities (Figure 1). The LFNRC can then determine whether the affected dive team member poses a risk to his/her fellow fishers, the harvested resource, or the general public pursuant to the Lummi Natural Resources Code (Title 10) and whether conditional approval of the affected dive team member to participate in commercial harvest diving activities is warranted or not.

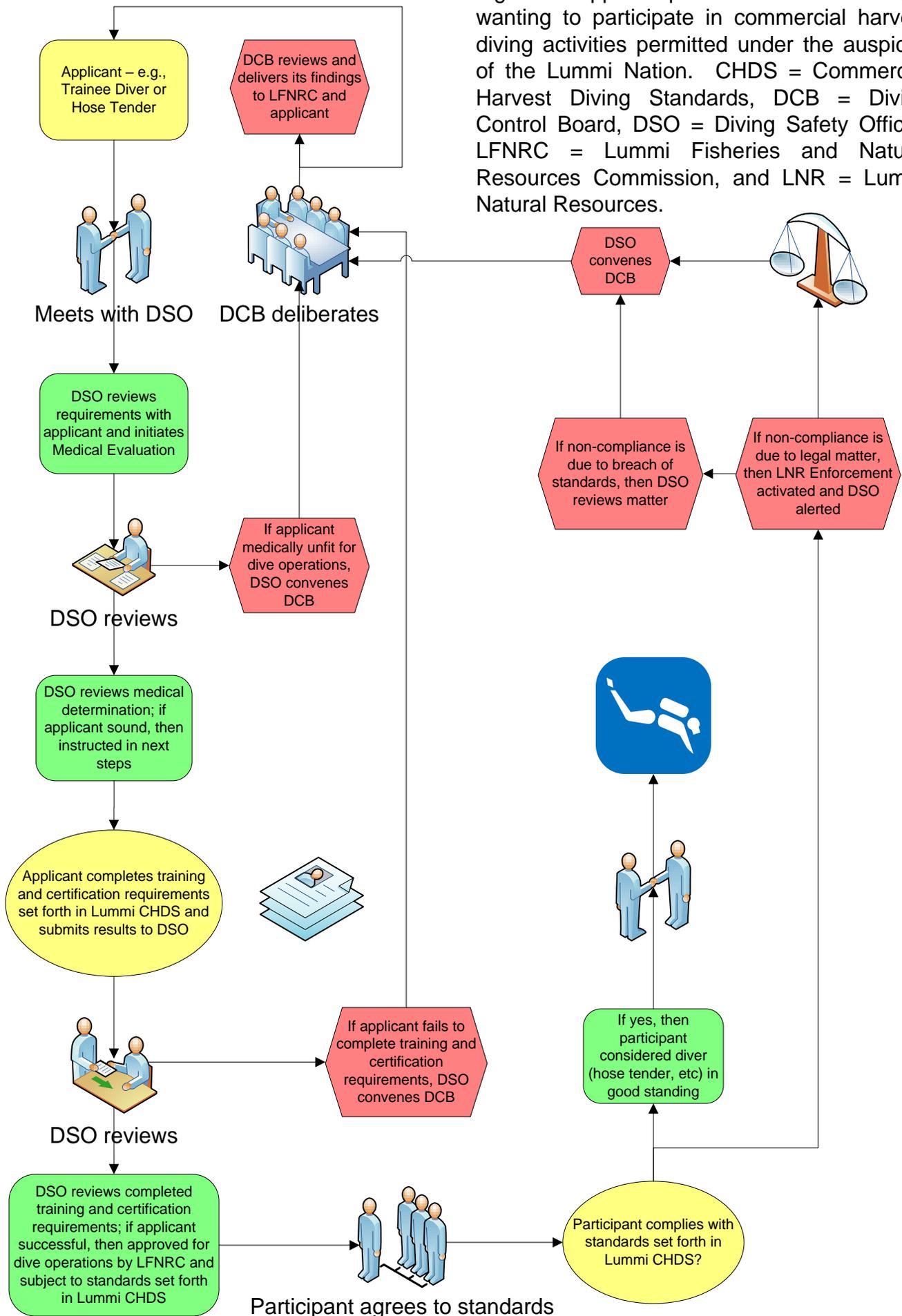
2.4.4 WITHDRAWAL FROM HYPERBARIC CONDITIONS FOR DIVERS

It should be determined on the basis of the physician's examination whether a diver's health will be materially impaired by continued exposure to hyperbaric conditions. The physician should indicate, in the written report, any limitations or restrictions that may apply to the diver's work activities.

2.4.5 MEDICAL RECORD KEEPING

An accurate medical record for each person subject to the medical specifications of this section shall be established and maintained by the dive team member. The record should include those physical examinations specified herein, including the LNR medical history/physical examination forms and the physician's written report (Appendices 8 and 9). LNR shall maintain a record of the examining physician's recommendation on the dive team member's fitness to participate in commercial harvest diving activities. All medical records shall be confidential and maintained for a minimum of five years from the date of the last hyperbaric exposure unless otherwise prescribed by law.

Figure 1. Approval process for Lummi citizens wanting to participate in commercial harvest diving activities permitted under the auspices of the Lummi Nation. CHDS = Commercial Harvest Diving Standards, DCB = Diving Control Board, DSO = Diving Safety Officer, LFNRC = Lummi Fisheries and Natural Resources Commission, and LNR = Lummi Natural Resources.



COMMERCIAL HARVEST DIVING STANDARDS



3.0 DIVE TEAM MEMBER CERTIFICATIONS, QUALIFICATIONS, AND RESPONSIBILITIES

Titles, duties, responsibilities and capabilities of personnel engaged in commercial harvest diving and underwater operations vary widely. The LNR-registered dive vessel owner is responsible for assigning personnel to a diving or underwater operation and will ensure all personnel are qualified by training and/or experience to perform the tasks assigned. The descriptions of the classification designations in this section indicate the minimum duties and responsibilities of dive team members.

3.1 LNR COMMERCIAL HARVEST DIVING CLASSIFICATION PROGRAM

LNR has established a program whereby properly-trained Lummi citizens can obtain a classification card that indicates their diving qualification and competency level as defined in the LNR Commercial Harvest Diving Standards. Certification cards issued by recreational agencies are not recognized as qualifying an individual to perform commercial harvest diving activities in the absence of additional formal commercial diving training from a reliable source. Diplomas issued by a civilian or military educational organization are for the purpose of attesting that an individual has received the necessary basic formal training to enter a vocational field. Such instruments should not be used to verify that the graduate can perform in the field without further on-the-job training and experience with actual demonstration of competency.

LNR-registered dive vessel owners shall employ persons to perform as commercial harvest diving personnel in the following categories:

- 1) Hose Tender;
- 2) Trainee Diver;
- 3) Experienced Diver; and
- 4) Experienced Dive Operator.

These individuals must be properly trained in accordance with the current edition of the LNR Commercial Harvest Diving Standards, progressing in their career through continued formal training, on-the-job training, and demonstrated field and leadership experience. Prospective diving personnel should use the forms found in Appendix 9 to document their on-the-job training in the LNR standards and the equipment/systems used during LNR-approved commercial harvest diving operations. 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., Hose Tender or Experienced Diver). This classification card needs to be obtained before fishing with an LNR-registered dive vessel owner.

3.1.1 CARD ISSUE

The LNR classification card will be a 2 ¹/₈ inch x 3 ³/₈ inch (5.5 cm x 8.5 cm) plastic laminated card suitably identified as issued by LNR and signed by the Chair of the Lummi Fisheries and Natural Resources Commission or his/her designee. Classification cards issued under this program will be valid for a period of one year from date of issue or through June 30 of each year, whichever comes first. LNR classification cards must be renewed annually and can be obtained only by presentation of acceptable documentation to the LNR Diving Safety Officer that the individual for whom the card is requested has recorded evidence of having successfully completed the requisite medical approval, training, and on-the-job experience necessary to support card issue at the appropriate level of classification.

3.2 DOCUMENTATION ACCEPTED

Proof of classification, certification, or qualification may be requested by LNR representatives (e.g., enforcement officers), current LNR-registered dive vessel owners, prospective dive vessel owners, or dive safety professionals

from other Treaty Tribes to verify that the Lummi citizen for whom LNR permission was granted is fully qualified to perform duties in the diver classification requested (i.e., Hose Tender, Trainee Diver, Experienced Diver, or Experienced Dive Operator). LNR should have on file, and shall retain for a period of at least five years, copies of information that show evidence that the individual for whom the LNR classification card is requested does, in fact, possess the necessary training (e.g., see forms in Appendix 9), field experience or required number of working dives, and medical approval to perform in that capacity. Other forms of acceptable documentation include:

- 1) A properly maintained commercial diver's log book;
- 2) In the case of the Experienced Diver, verifiable endorsements from certification authorities recognized by the LNR or from legitimate commercial harvest diving operations having records (e.g., commercial diver's log book) of performance as an Experienced Diver;
- 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
- 4) 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.

3.2.1 RECIPROCITY AND DOCUMENTATION REQUIRED BY NON-LUMMI CITIZENS

Non-Lummi citizens currently certified under the policies of another tribe, agency, university, or company (hereafter, "organization") may be authorized to dive in the LNR commercial harvest diving program if the requirements and standards for commercial harvest diver/hose tender certification within that organization are equivalent to or exceed those stated in this manual. Furthermore, the fishing activities involving the non-Lummi citizens shall be lawful and must comply with all tribal codes and court rulings related to treaty fishing rights in Washington. The LNR Diving Safety Officer will review all dive qualifications/documentation and confer with the appropriate diving safety professional from the other organization; the Lummi Fisheries and Natural Resources Commission shall have the final approval authority on whether the reciprocity and harvest diving activity is acceptable. A Lummi diver or hose tender may participate in the diving operation of another organization only if authorized to do so by that organization.

3.2.2 DATABASE MAINTENANCE

LNR will maintain a database containing a listing of all LNR-registered dive vessel owners, dive vessel information, including dates of safety inspections and air quality testing, and their diving crew rosters. The database will contain also a listing of all LNR classified card recipients based upon card issue. Records will include the name of the dive team member, a unique identifier provided by the applicant (i.e., Lummi fisher identification number), as well as the dates of medical approval and issue/expiration for all training cards/validations received by the dive team member. 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 dive operations, replacement of lost cards, renewal of cards, and as a means of generally tracking the numbers of certified commercial diving personnel within the Lummi commercial harvest diving fleet. The format and content of the database will not be changed without LNR Diving Safety Officer and/or Natural Resources Analyst approval.

3.3 EXPERIENCED DIVE OPERATOR RESPONSIBILITIES

A qualified person shall be designated as the Experienced Dive Operator for each diving operation. The Experienced Dive Operator may be the designated diving person in charge (DPIC) and is in charge of the planning and execution of the diving operation, including the responsibility for the safety and health of the dive team. The Experienced Dive Operator shall possess the proper LNR classification card and be knowledgeable and familiar with all techniques, procedures, emergency procedures and operational parameters for the diving mode under his or her direct supervision. In carrying out these responsibilities (as well as those of a Hose Tender, Trainee Diver, and

Experienced Diver), the Experienced Dive Operator's duties should include, but not necessarily be limited to, the following:

- 1) Be fully cognizant of and see that all relevant governmental regulatory agency regulations that apply to the diving operation and the diving mode employed, and the LNR-registered dive vessel owner's basic safe practices/operations manual are followed;
- 2) Have adequate knowledge, training and familiarization with all life-support and ancillary equipment designated to the diving operations;
- 3) While actually on duty, be in immediate control and available to implement emergency procedures. The Experienced Dive Operator is not permitted to dive unless another qualified diver is present who has also been appointed and designated to assume responsibility;
- 4) The Experienced Dive Operator must also ensure, prior to commencing a diving operation, in addition to parties directly involved in the diving operation, that masters of craft in the vicinity of the diving operation and all persons responsible for anything that affects the diving operation are advised that diving or underwater operations are to be undertaken;
- 5) Ensure diving operations are carried out from a suitable and safe location on the surface;
- 6) Develop or modify and produce pre- and post-dive checklists for the operation;
- 7) Develop and implement emergency/contingency procedures;
- 8) 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;
- 9) Only when applicable (e.g., deep diving operations or planned decompression, Appendix 10), prepare a Job Hazard Analysis (JHA, Appendix 9) for each task undertaken;
- 10) Establish a dive plan ensuring that sufficient breathing mixtures, supplies and proper equipment are available for safe and timely completion of the job task;
- 11) Assign the duties of all members of the dive team and personally direct them throughout the diving operation;
- 12) Personally inquire if all personnel on the dive team 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.
- 13) Ensure that the diving equipment designated for use is:
 - a. Suitable for the planned diving operation;
 - b. Compliant with regulatory requirements for the diving mode used; and
 - c. Inspected prior to each dive and is in good working order.
- 14) 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/or developments.
- 15) Ensure the detailed briefing of his or her diving team and support personnel, including:
 - a. Tasks to be undertaken;
 - b. Unusual hazards or environmental conditions;
- 16) 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;
- 17) Ensure that each diver is continuously tended while in the water;
- 18) 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 dive team members at the dive location;
 - c. Communication is lost between the vessel operator and the Experienced Dive Operator 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.

- 19) 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.
- 20) Report all accidents or incidents involving personnel as required by LNR-registered dive vessel owner's rules and relevant governmental regulations (Appendix 9);
- 21) Maintain and submit reports required by LNR-registered dive vessel owner and relevant tribal governmental regulations concerning diving operations and equipment maintenance, testing or repair;
- 22) When a dive team member is in training or advancement mode, view and ensure accuracy of diver's personal log book and affix signature to properly record activities;
- 23) Maintain a supervisor's log book that details all dives (see item # 16) and medical treatment supervised; and
- 24) Maintain an appropriate level of physical fitness.

3.4 EXPERIENCED DIVER RESPONSIBILITIES

The Experienced Diver is assigned by the LNR-registered dive vessel owner or Experienced Dive Operator to perform specific tasks in the water and topside. An Experienced Diver must have completed a formal course of diving instruction and must have logged at least 90 working dives, be cleared to dive by a physician who is familiar with diving medicine, have detailed knowledge of diving theory and practice, and have a full understanding of the diving equipment in use and of the tasks assigned. If advancing to the Experienced Dive Operator classification, the Experienced Diver shall be in possession of an up-to-date personal diver's log book, which can be used to establish his or her level of experience. In addition to carrying out the responsibilities of a Trainee Diver or Hose Tender, each Experienced Diver should:

- 1) Accomplish all tasks assigned by the Experienced Dive Operator;
- 2) Have adequate knowledge, training and familiarization with all life-support and ancillary equipment designated to the diving operations;
- 3) Read, understand and comply with all LNR-registered dive vessel owner policies and applicable governmental regulations, as they relate to their qualifications or performance while engaging in diving operations;
- 4) Only when applicable (e.g., deep diving operations or planned decompression, Appendix 10), have reviewed and be familiar with the JHA prepared by the Experienced Dive Operator (Appendix 9);
- 5) Maintain an appropriate level of physical fitness;
- 6) Comply with all commands or instructions from the Experienced Dive Operator or DPIC during the conduct of diving operations;
- 7) Ensure that the deepest depth attained during his or her dive has been established before ascent;
- 8) 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 Experienced Diver should:
 - a. Be ready to don diving helmet or mask when directed by the Experienced Dive Operator;
 - b. Remain in the immediate vicinity of the diver's water entry location and be ready to enter the water when directed by the Experienced Dive Operator;
 - 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.

- 9) Comply with regulations or instructions concerning the use, maintenance, repair, and testing of all diving equipment provided for the operation;
- 10) Report to the diving supervisor any recent medical treatment or illness so that a proper determination can be made concerning fitness and/or ability to dive;
- 11) Immediately report all symptoms or suspected symptoms of decompression sickness to the diving supervisor as early and accurately as possible;
- 12) Report to the diving supervisor any defect or malfunction of the diving equipment provided for the diving operation;
- 13) Follow safe diving practices at all times during the diving operation whether on deck or in the water. Bring to the attention of the diving supervisor any questionable items. Be alert for the safety of others as well as his/her own safety;
- 14) Assist in the training of new personnel (e.g., Trainee Diver or Hose Tender) as directed by the Experienced Dive Operator;
- 15) Know and observe the rules for flying after diving or traveling to altitudes higher than the dive site;
- 16) Ensure that diving equipment has been correctly maintained, prepared, and tested before each dive. This requirement should never be delegated to others; and
- 17) If advancing to the Experienced Dive Operator classification, maintain a personal diver's log book that details all dives and operations, and may include medical examinations, courses taken, certification level achieved, and personal equipment maintenance.

In the event an Experienced Diver is assigned a task for which he or she does not feel qualified either by training and/or experience, he or she should immediately inform the LNR-registered dive vessel owner, the Experienced Dive Operator, DPIC, or his/her representative.

3.5 TRAINEE DIVER RESPONSIBILITIES

The Trainee Diver is assigned by the LNR-registered dive vessel owner or Experienced Dive Operator to perform specific tasks in the water and topside. A Trainee Diver must be classified by LNR as such, have completed a formal course of diving instruction, be cleared to dive by a physician who is familiar with diving medicine, have detailed knowledge of diving theory and practice, and have a full understanding of the diving equipment in use and of the tasks assigned. All Trainee Divers should be in possession of an up-to-date personal diver's log book, which can be used to establish the status of their training. In addition to carrying out the responsibilities of a Hose Tender, each Trainee Diver, while carrying out his or her training, should:

- 1) Accomplish all tasks assigned by the Experienced Dive Operator;
- 2) Have adequate knowledge, training and familiarization with all life-support and ancillary equipment designated to the diving operations;
- 3) Read, understand and comply with all LNR-registered dive vessel owner policies and applicable governmental regulations, as they relate to their qualifications or performance while engaging in diving operations;
- 4) Only when applicable (e.g., deep diving operations or planned decompression, Appendix 10), have reviewed and be familiar with the JHA (Appendix 9). Note: While in training status, the Trainee Diver shall not participate in technical diving operations (Appendix 10) as a diver but may assist in those operations as directed by the Experienced Dive Operator;
- 5) Maintain an appropriate level of physical fitness;
- 6) Comply with all commands or instructions from the Experienced Dive Operator or DPIC during the conduct of diving operations;
- 7) Ensure that the deepest depth attained during his or her dive has been established before ascent;
- 8) 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 Trainee Diver should:

- a. Be ready to don diving helmet or mask when directed by the Experienced Dive Operator;
 - b. Remain in the immediate vicinity of the diver's water entry location and be ready to enter the water when directed by the Experienced Dive Operator;
 - 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.
- 9) Comply with regulations or instructions concerning the use, maintenance, repair, and testing of all diving equipment provided for the operation;
 - 10) Report to the diving supervisor any recent medical treatment or illness so that a proper determination can be made concerning fitness and/or ability to dive;
 - 11) Immediately report all symptoms or suspected symptoms of decompression sickness to the diving supervisor as early and accurately as possible;
 - 12) Report to the diving supervisor any defect or malfunction of the diving equipment provided for the diving operation;
 - 13) Follow safe diving practices at all times during the diving operation whether on deck or in the water. Bring to the attention of the diving supervisor any questionable items. Be alert for the safety of others as well as his/her own safety;
 - 14) Assist in the training of new personnel only as directed by the Experienced Dive Operator;
 - 15) Know and observe the rules for flying after diving or traveling to altitudes higher than the dive site;
 - 16) Ensure that his/her own personal diving equipment has been correctly maintained, prepared, and tested before each dive; and
 - 17) 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.

In the event a Trainee Diver is assigned a task for which he or she does not feel qualified either by training and/or experience, he or she should immediately inform the LNR-registered dive vessel owner, the Experienced Dive Operator, DPIC, or his/her representative.

3.6 HOSE TENDER RESPONSIBILITIES

The Hose Tender is assigned by the LNR-registered dive vessel owner, the Experienced Dive Operator or DPIC to perform various duties, which may include:

- 1) Continuously tend a diver;
- 2) Prepare for and support the dive until its completion;
- 3) Support any in-water decompression as required;
- 4) Assist the diver in dressing and undressing;
- 5) Confirm that the diver's equipment is functioning properly and inform the diving supervisor that the diver is ready;
- 6) Tend the diver's umbilical (keeping at least one hand on the umbilical at all times in the event that two-way audio-communications fail) and be aware of the diver's depth and location at all times.
- 7) Set up and operate all equipment as directed by the LNR-registered dive vessel owner, the Experienced Dive Operator, DPIC, or his/her representative;
- 8) 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 Experienced Dive Operator;
- 9) Assist in topside work as required or directed;
- 10) Be alert for and immediately report conditions that may be hazardous or unsafe;
- 11) Maintain certification in first aid, CPR, and emergency oxygen administration;
- 12) Maintain an appropriate level of physical fitness;
- 13) Properly complete all paperwork as required by LNR-registered dive vessel owner policy and/or tribal governmental regulations;

- 14) Report to the Experienced Dive Operator any recent medical treatment or illness so that a proper determination can be made concerning fitness and/or ability to participate in dive operations;
- 15) Immediately report all symptoms or suspected symptoms of decompression sickness to the Experienced Dive Operator as early and accurately as possible;
- 16) Report to the Experienced Dive Operator any defect or malfunction of the diving equipment provided for the diving operation; and
- 17) Read, understand and comply with all LNR-registered dive vessel owner's policies and applicable governmental regulations, as they relate to their qualifications or performance while engaging in diving operations.

In the event a Hose Tender is assigned a task for which he or she does not feel qualified either by training and/or experience, he or she should immediately inform the LNR-registered dive vessel owner, the Experienced Dive Operator, DPIC, or his/her representative.

3.7 DIVING CONTROL BOARD

The Diving Control Board (DCB) shall mean the LNR-organized ad hoc working group comprised of a majority of active divers including but not limited to the LNR DSO, at least 10 individuals with five (5) or more years of experience each as Experienced Dive Operators (including LNR-registered dive vessel owners) or Experienced Divers from the Lummi commercial harvest diving community, and at least one (1) representative each from the LNR Harvest Management Division, the Lummi Police Department (i.e., LNR Enforcement Officer), or the Lummi Indian Business Council (LIBC) workplace safety office. In addition, at least one (1) member should be a physician or person experienced or qualified in diving medicine.

This working group will be established to review commercial diving activities permitted under the auspices of the Lummi Nation. Moreover, the DCB will review any potentially disqualifying medical conditions (Section 2.4) and incidents or diving accidents and make safety recommendations as needed to the Lummi Fisheries and Natural Resources Commission (LFNRC). The primary goals of the DCB are to assist in developing safe diving practices and to assist in developing the standards to be included in a safe practices manual (i.e., the LNR Commercial Harvest Diving Standards). The DCB will meet these goals by:

- 1) Reviewing and revising as necessary the LNR Commercial Harvest Diving Standards to be used by the Lummi Nation dive community as a safe practices manual;
- 2) Establishing processes and program structure to effectively review or monitor working diving operations permitted under the auspices of the Lummi Nation;
- 3) Establishing or recommending the training and certification programs for participants of Lummi Nation-approved diving projects;
- 4) Reviewing and adopting the physical conditioning and medical standards required to promote diver safety;
- 5) Instructing and reminding diving participants to adhere to all Lummi Nation diving regulations, standards, policies, and procedures;
- 6) Participating in safety assessments as necessary;
- 7) Serving as a board of review for inquiries into the nature and cause of diving incidents (e.g., "near-misses") and accidents;
- 8) Serving as a board of review for breaches of applicable diving policies and standards (e.g., Section 2.4);
- 9) Recommending to LFNRC any action(s) needed to address unsafe, unwise, or noncompliant practices/diving operations;
- 10) Recommending to LFNRC the appropriate measures to mitigate recurrence of diving incidents;
- 11) Reviewing credentials of or recommending a suitable candidate for LNR Diving Safety Officer; and
- 12) Supporting any suspensions or revocations of privileges administered by the LFNRC for violations of the diving standards and procedures adopted by the Lummi Nation.

3.8 DIVING SAFETY OFFICER

The Lummi Natural Resources Department (LNR) Diving Safety Officer (DSO) shall mean the dive-qualified safety professional who is the primary contact between the Lummi commercial harvest diving community and the LNR, LFNRC, and the DCB. The LNR DSO 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 DSO should be an employee of LIBC, appointed through the LFNRC, preferably after review by the DCB. If the DSO is an employee of the LIBC, the person is subject to that organization's personnel policies. The primary responsibility of the DSO is administering the Lummi Nation diving safety program on behalf of the LNR, LFNRC, and the DCB. The DSO shall meet this responsibility by:

- 1) Developing and maintaining as necessary the LNR Commercial Harvest Diving Standards to be used by the Lummi Nation dive community as a safe practices manual;
- 2) Serving as a member of the DCB;
- 3) Soliciting qualified individuals from the Lummi commercial harvest diving community to serve on the DCB;
- 4) Assembling the DCB at least twice annually, or as needed, to address diving safety issues;
- 5) Reviewing and approving initial training and certification for the Lummi commercial harvest diving community to satisfy the requirements of the LNR Commercial Harvest Diving Standards;
- 6) Organizing or conducting dive safety refresher training on a biennial basis for the Lummi commercial harvest diving community to satisfy the requirements of the LNR Commercial Harvest Diving Standards;
- 7) Arranging or overseeing inspections of compressed air equipment aboard LNR-registered dive vessels and servicing or maintenance of LNR diving gear;
- 8) Maintaining the LNR diving safety database including individual records for Lummi citizens permitted to dive commercially under the auspices of the Lummi Nation, reviews of diving incidents, diving accidents, and inspections of LNR-registered dive vessels and related equipment (Section 3.2.2);
- 9) Ensuring compliance with the LNR Commercial Harvest Diving Standards;
- 10) Advising the LNR, LFNRC, and the DCB of breaches of applicable diving policies and standards;
- 11) Advising the DCB of updates on issues, policies, regulations, or equipment standards affecting diving safety;
- 12) Issuing or revoking LNR classification cards, through the LFNRC, to satisfy the requirements of the LNR Commercial Harvest Diving Standards;
- 13) Supporting any suspensions or revocations of privileges administered by the LFNRC for violations of the diving standards and procedures adopted by the Lummi Nation.

4.0 DIVING (LIFE-SUPPORT) EQUIPMENT: REQUIREMENTS, MAINTENANCE, AND TESTING

4.1 GENERAL

Due to the life-support nature of diving, personnel involved in the operation, maintenance and repair of diving systems and equipment shall have appropriate training and experience in the maintenance and use of type of equipment used. Equipment such as helmets, masks, bailout systems, regulators, etc., that provide direct life support shall be of a type familiar to the diver and subject to a planned maintenance system. The LNR-registered dive vessel owner and the Experienced Dive Operator shall ensure that all diving systems and equipment have been examined and tested prior to diving to determine their condition and suitability for service. No diving operation should be permitted to commence until all systems and equipment have been thoroughly tested for proper functionality.

4.2 MAINTENANCE RECORDS

A preventive maintenance program is required for all life-support equipment:

- 1) Suitable equipment logs should be established and maintained.
 - a. Equipment logs must be current and filled out correctly; and
 - b. Entries made in the equipment log should 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.
- 2) Life-support equipment should have a unique identity traceable to the equipment/maintenance log.

4.3 DIVER'S DRESS

4.3.1 GENERAL

Diver's dress should be suitable for the job intended and consider such factors as biological, chemical, and thermal conditions.

4.3.2 DRY SUITS

Diving personnel should be familiar with dry suit use requirements or should receive training prior to dry suit operations. Dry suits shall:

- 1) Have a means of preventing over-inflation, which could result in an uncontrolled ascent;
- 2) Be constructed of material suitable to the environment in which it is to be used; and
- 3) Protect the diver from the environment, e.g., temperature or hazardous material.

4.3.3 HOT WATER SUITS

Hot water suits are especially designed for use in water temperatures below 40°F/4°C or for use in prolonged decompression diving in cool or cold water. Dive teams should be familiar with hot water suit use requirements and should receive training prior to hot water suit operations. Hot water suits shall:

- 1) Flow sufficient water to maintain the diver(s) in thermal balance at the desired temperature;
- 2) Be capable of withstanding an operating temperature of 110° F (44° C); and
- 3) Have a means to allow the diver to bypass incoming water prior to it entering the suit.

4.3.4 HARNESSES

A working diver should be equipped with a harness appropriate to the diving activity that he or she is involved with and should include but not be limited to:

- 1) Provide a method to securely attach the umbilical to the diver;
- 2) Lift an unconscious or injured diver and his or her equipment from the water in an emergency;
- 3) Be utilized for underwater use;
- 4) Have an overall breaking strength of no less than 2,000 pounds;
- 5) Be equipped with a positive buckling device (i.e., designed to prevent strap pull-through and accidental release by the diver);
 - a. It should not be possible to release the harness by a single action.
- 6) Have 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 are to be clearly identified.
- 7) Be equipped with adjustable leg straps;
- 8) Be 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) Maintain the diver in a heads-up position during recovery (using the lifting ring) from the water in an emergency;
- 10) Allow for easy disconnect of the main umbilical and weights, without removal of the main bail-out harness. This may be achieved by use of a separate/independent outer harness or jacket for the bailout system and diver's weights, or similar systems.
- 11) Be visually inspected prior to use for any signs of deterioration or damage.
 - a. Any harness whose material condition is in doubt should not be used until a determination is made by the Experienced Dive Operator.
- 12) Be regularly maintained in accordance with the manufacturer's recommendations.
- 13) Be certified by the manufacturer as detailed below.
 - a. Certification and Testing of Diving Harnesses
 - i. A new diving harness should be certified by the manufacturer or supplier to confirm that:
 1. Each securing point intended for attaching an umbilical or lifting a diver out of the water in an emergency shall withstand a tensile of at least 2,000 pounds for five minutes without sustaining damage that would render it inoperable or unsafe to use.
 2. Each complete full-body harness, including adjustment systems, buckles, etc., shall 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.
 - ii. Each harness is clearly marked in a durable manner with the following minimum information:
 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.

4.3.5 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 equipped with an appropriate release buckle.
- 4) Be attached to the diver in a manner to avoid accidental disengagement.

4.3.6 DIVER-WORN OR CARRIED EMERGENCY GAS SUPPLY (BAILOUT)

Diver-worn or carried emergency gas supply (bailout) shall have a minimum calculated four-minute supply at the anticipated depth (see discussion in Section 7.17 and see Appendix 5 for calculations for various sizes of bailout cylinders). EGS systems shall:

- 1) Have a cylinder(s) meeting the requirements in Section 7.17;
- 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 the helmet or mask manufacturer's recommendations;
- 3) Have a means of attachment to the hat or mask, which prevents accidental disengagement;
- 4) Have a positive means of isolating the diver-carried EGS or mask/helmet from the primary gas supply;
- 5) When using a gas mixture other than air (e.g., NITROX), be sampled/tested to verify contents; and
- 6) When using a gas mixture other than air (e.g., NITROX), have cylinders clearly marked with content, date, pressure and the name of the individual performing this verification.

4.4 HELMETS AND MASKS

4.4.1 GENERAL

Helmets and masks and their associated diver-carried regulators are components of a critical life-support system that, if not functioning properly, can expose the diver to significant hazards. As such, all helmets and masks and their associated diver-carried regulators should be maintained and inspected in strict compliance with the manufacturer's recommendations. Suitable logs should be maintained to reflect compliance. Helmets and masks used for surface supplied diving operations shall:

- 1) Be appropriate for the task intended;
- 2) Be fitted with a two-way audio communications system;
- 3) Be equipped with a non-return (check) valve in the main gas supply that closes readily and positively;
- 4) Have non-return valves with springs not exceeding 3 PSI cracking pressure;
- 5) Be made of corrosion-resistant materials; and
- 6) Be maintained in accordance with manufacturer's specifications and have all modifications that affect safety or performance documented in the equipment log.

4.4.2 HEAVYWEIGHT DIVING HELMETS

Helmets designated as a heavyweight diving outfit (heavy gear) shall:

- 1) Meet the requirements of Section 4.4.1;
- 2) Have a helmet group consisting of a helmet, breastplate, and associated valves and connections; and
- 3) Be equipped with a quick-dump valve to prevent over-inflation.

4.4.3 LIGHTWEIGHT DIVING HELMETS

Lightweight diving helmets shall:

- 1) Meet the requirements of Section 4.4.1;
- 2) Be fitted to accept diver-worn EGS; and
- 3) Be fitted to allow for positive and ready removal from the diver in all uses.

4.4.4 BIBS (BUILT-IN BREATHING SYSTEMS)

Individual breathing equipment utilized in built-in breathing systems (BIBS) shall:

- 1) Be held in place by adjustable straps, hood, or other suitable means that frees the diver's hands;
- 2) Be capable of providing 2.0 ACFM (56.6 ALPM) at maximum depth (some regional and regulatory requirements may differ);
- 3) Be equipped to allow user to adjust for ease of breathing or constant free flow;
- 4) Be equipped with an exhaust valve;
- 5) Be equipped to prevent over-pressurization or rapid negative pressure from endangering the user; and
- 6) Be maintained in accordance with manufacturer's specifications.

4.5 HOSES

4.5.1 GENERAL

Flexible breathing gas hoses used with diving systems or equipment shall:

- 1) Have a minimum burst pressure equal to four times the maximum allowable working pressure (MAWP) and be suitable or rated by manufacturer for the work intended;
- 2) Have a MAWP and flow rating not less than the system in which it is installed or used and be suitable for the service intended;
- 3) Have connectors with pressure capability equal to or greater than the designed working pressure of the system on which they are installed;
- 4) Have fittings of corrosion-resistant material that cannot be accidentally disengaged;
- 5) Be kink-resistant or arranged to prevent kinking;
- 6) Have a suitable temperature rating when used for hot water service;
- 7) Be visually examined and pressure tested after each pressure boundary repair; and
- 8) Be of suitable design to prevent collapse when used for operation with higher external pressure than internal pressure.

4.5.2 BREATHING GAS HOSES (LP)

Breathing gas hose assemblies shall:

- 1) Meet requirements of Section 4.5.1;
- 2) Be suitable for breathing gas service;
- 3) Have a maximum allowable working pressure equal to or greater than supply pressure plus 150 psi (10.546 kg/sq cm); and
- 4) Be subjected to an annual pressure test to one-and-one-half times the design working pressure of the system with a 200-pound axial load applied on fittings while initial test pressure is applied. The test pressure should be maintained without loss of pressure (when corrected for temperature) for 10 minutes.
 - a. Note: The axial load weight may be removed after the initial test pressure has been applied, providing no leakage is evident.

4.5.3 UMBILICALS

Diver umbilical and dive hose assemblies shall:

- 1) Meet requirements of Section 4.5.1;
- 2) Be marked from the diver end in 10-foot intervals up to 100 feet and marked in 50-foot intervals thereafter;
- 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, and a strength member (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.

Note: If a pneumofathometer hose is incorporated into the umbilical, it should be annually pressure-tested for leakage. Furthermore, LNR recommends using the ADCI Standard 006 color coding scheme for umbilicals (Table 2) to ensure uniformity 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 furthest possible excursion from the dive station.

Table 2. Example of a standardized color coding scheme and banding pattern for umbilical lines used in diving (ADCI Standard 006). Beyond 300 feet (91.46 meters), continue to place yellow bands after 50 feet (15.25 meters) and red bands after 100 feet (30.49 meters).

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

4.5.4 OXYGEN HOSES

- 1) Oxygen hoses shall meet the requirements of this section and be suitable for the use intended;
- 2) LP hose assemblies (less than 500 psi) used in systems containing greater than 50 percent oxygen are to be cleaned for oxygen service;
- 3) Hoses used for oxygen (over 50 percent) service shall be identified by a consistent color code or tagged "FOR OXYGEN USE ONLY"; and
- 4) Lubricants used to assemble fittings on hoses for oxygen service shall be compatible with oxygen.

4.6 COMPRESSOR SYSTEMS

4.6.1 COMPRESSORS AND GAS PUMPS

Compressors, boosters, gas transfer pumps, and filters used to provide breathing air/gas for diving shall be designed and manufactured to:

- 1) Have suitable personnel protection around rotating machinery that meets applicable jurisdictional requirements;
- 2) Have the necessary instrumentation to facilitate operations;
- 3) Be of the proper type, pressure and flow rate, and be suitable for service intended;
- 4) Have its air intake arranged to be clear of exhaust fumes and other contaminants;
- 5) Have flexible pressure hoses in accordance with Section 4.5.1; and
- 6) Have electrical controls, wiring and drive units meeting the jurisdictional requirements, when so equipped.

4.6.2 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 (or equivalent) purity standards for extended operation.

4.6.3 TESTING

Compressors used for breathing gas should be functionally tested per the following schedule, and should conform to design specifications:

- 1) Prior to being put into service;
- 2) Periodically in accordance with manufacturer's recommendations and planned maintenance schedule;
- 3) During annual inspection; and
- 4) After any repairs that may affect the compressor's performance.

4.6.4 AIR PURITY REQUIREMENTS

- 1) All compressors, transfer pumps or booster pumps used for breathing air service will be subjected to an air quality test every six months. Compressors with a discharge pressure of 500 psi or less shall meet the standards of the current ANSI CGA required for Grade D air, or equivalent. Compressors with a discharge pressure that exceeds 500 psi shall meet the requirements of the current ANSI CGA for Grade E air, or equivalent.
- 2) Air purity tests shall be taken at the discharge point that would normally supply the breathing gas system, the diver's hose or cylinder fill point.
- 3) Documentation of the latest test(s) should be kept on file and available upon request.
- 4) Compressors used for breathing gas transfer other than atmospheric air (e.g., NITROX) shall be checked every six months to ensure they do not induce contaminants into the gas being processed.

4.7 DIVER ENTRY AND EGRESS SYSTEMS

4.7.1 DIVING LADDER

Diving ladders shall:

- 1) Be capable of supporting the weight of two divers plus their gear;
- 2) Be made of corrosion-resistant material or be maintained free of corrosion;
- 3) Be suitable for the purpose intended; and
- 4) Ladders must extend a minimum of 3 feet below surface where installed.

4.8 GAUGES

Gauges utilized with diving equipment or systems shall:

- 1) Be suitable for purpose intended;

- 2) Be cleaned for oxygen when installed in oxygen systems;
- 3) When used to indicate a diver's depth:
 - a. Be of appropriate range and graduation;
 - b. Be graduated in units consistent with the decompression tables (Appendix 6) to be utilized;
 - c. Be calibrated to a known standard every six months;
 - d. Be recalibrated when a discrepancy exists exceeding +/- 2 percent of full scale;
 - e. Be marked with a label, tag or sticker indicating date of last calibration and date due, which will not interfere with full-scale visibility;
 - f. Have a tag or label indicating amount of deviation (+/-) to the calibration standard;
 - g. Have calibrations documented in the equipment log; and
 - h. A pressure-limiting device may be fitted to avoid gauges being over-pressurized.

4.9 DIVE COMPUTERS

Diving personnel using computers must complete an appropriate practical training session on his/her unit. This may be completed through the vendor from which the dive computer was purchased, at a local dive shop, or with the Experienced Dive Operator or DPIC (providing that person is familiar with the dive computer used by the diver). The Experienced Dive Operator must be satisfied that his/her diving personnel are proficient in the use of their dive computers and that they understand the limitations of these units.

- 1) Each diver relying on a dive computer to plan dives and indicate or determine decompression status must have his/her own unit.
 - a. At no time shall divers share a single dive computer.
- 2) If a dive computer fails at any time during the dive, the dive must be terminated and appropriate surfacing procedures should be initiated immediately using appropriate dive tables (Appendix 6).
 - a. All dive team members must be proficient in the use of standard dive tables.
- 3) Divers entering decompression mode must follow the protocols/directions displayed on his/her dive computer. At no time should a diver deviate from this standard unless the dive computer fails, then # 2 above applies.
- 4) A diver should not dive for 18 hours before activating and using a new dive computer. This is required to clear residual nitrogen out of the diver's system to match the zero nitrogen uptake of the new dive computer.
- 5) Once a dive computer is in use, it must not be switched off until it indicates complete out-gassing has occurred or 18 hours have elapsed, whichever comes first.
- 6) When using a dive computer, non-emergency ascents are to be at a rate specified for the make and model of the dive computer being used.
- 7) Whenever practical, divers using a dive computer should make a stop between 10 and 30 fsw for three (3) to five (5) minutes, especially for dives below 60 fsw.
- 8) Multiple deep dives require special consideration.

4.10 TIMEKEEPING DEVICES

Devices utilized to monitor a diver's exposure time under pressure shall be suitable for the purpose and easily readable. It is highly recommended that a secondary timekeeping device shall be worn by a diver to be used in conjunction with the appropriate dive table(s) (Appendix 6) in the event that his/her dive computer fails.

4.11 COMPRESSED GAS EQUIPMENT

4.11.1 VOLUME TANKS/AIR RECEIVERS

Volume tanks used in diving systems shall:

- 1) Be designed, fabricated, inspected, tested and certified in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Section VIII, Div. I, "Unfired Pressure Vessels," and/or other statutory or classification society requirements;
- 2) Be equipped with a pressure gauge;
- 3) Be equipped with a check valve on the inlet side;
- 4) Be pressure-rated to the maximum system pressure on which it is installed;
- 5) Be equipped with a relief valve as required by code of manufacturer;
- 6) Be equipped with condensate drain valve, located at its lowest point;
- 7) Be equipped with slow-opening valves when used with design pressures exceeding 500 psi;
- 8) Be cleaned for oxygen service and have slow-opening valves when used in systems containing greater than 50 percent oxygen;
- 9) Be inspected internally and externally at least annually for damage or corrosion;
- 10) Be pneumatically tested to MAWP annually, utilizing the breathing mixture normally used;
- 11) Be 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; and
- 12) Have a unique identity with results of all tests being recorded in the equipment log.

4.11.2 GAS STORAGE CYLINDERS AND TUBES

High-pressure gas cylinders or tubes shall:

- 1) Be manufactured to recognized code or standard;
- 2) Be equipped with an overpressure relief device;
- 3) Be 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) Be 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) Be inspected internally and externally at least annually for damage or corrosion if used underwater;
- 7) Be labeled as to contents. Fire-hazard warning signs should be erected in the vicinity of stored oxygen;
- 8) Be stored in a well-ventilated area, protected from overheating and secured from falling; and
- 9) A record should be kept in a designated place of the contents and pressure of each cylinder, quad or bank. These records should be updated daily when the system is in use.

4.11.3 SCUBA AND EGS (BAILOUT) BOTTLES

High pressure bottles used for scuba and EGS (bailout) shall:

- 1) Be manufactured to recognized codes or standards;
- 2) Be equipped with an overpressure relief device;
- 3) Be inspected internally and externally at least annually for damage or corrosion;
- 4) Be 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; and
- 5) Have a unique identity with results of all tests being recorded in the equipment log.

Proper labeling of contents (bottom mix) should be visible on the bottle. It is further recommended that complete discharge of the bottom mix be conducted after the dive if the bottle is charged with a mixture other than air.

5.0 VESSELS AND FLOATING PLATFORMS FOR DIVING OPERATIONS

5.1 GENERAL

A dive support vessel (DSV) is defined in this document as a floating platform used to support 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 to purpose-built diving vessels with special four-point anchor systems or dynamically positioned vessels for offshore, long-term operations. DSVs must be carefully selected based on the requirements of the diving project, the diving to be performed, the tools and equipment required, and any potential environmental conditions.

While each diving platform will have its own characteristics that need to be assessed to enable the diving work to be carried out safely and successfully, certain common factors can be identified, and thus the particular "fitness for purpose" for a particular vessel, particular job and particular location can be determined. It is the responsibility of the Experienced Dive Operator or DPIC to use or not use a DSV based on the safety of the diving crew. While not all vessels are ideal, most can be adapted or modified, or additional equipment can be added to mitigate the shortcomings and therefore provide a safe working platform for the diving operation.

Much of the safety of a commercial harvest diver is based on the reliability of the diving life-support equipment; therefore, this equipment must be provided with adequate lashing, stowage, and protection from the elements and other ongoing operations.

When selecting a DSV, great care must be taken to consider worst case scenarios for wind, tide, current, and weather conditions. Adequate planning and proper equipment must be immediately available to allow the vessel to move from the dive site should environmental conditions require. While some DSVs can withstand harsher weather conditions compared to other vessels, great care should be taken to not exceed a DSV's operational limits before getting the vessel out of harm's way. Generally, DSVs are commonly utilized to safely and efficiently provide:

- 1) Transit to and from the work site for the personnel and equipment required;
- 2) Position maintenance during diving operations with adequate accuracy and security;
- 3) Deck space for the life support and safety equipment required;
- 4) Deck space for the tooling required for the divers to perform the work;
- 5) Communications for commercial and for emergency purposes;
- 6) Additional services may include but not be limited to:
 - 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.

The Experienced Dive Operator or DPIC will examine the DSV for adequacy in each of the applicable categories above, assuring compliance with the safety policies of the LNR-registered dive vessel owner and those of the LNR or, if relevant, other regulatory agencies (e.g., United States Coast Guard; see forms in Appendix 9).

5.2 DIVE VESSEL REGISTRATION

Every DSV engaged in commercial harvest dive operations must be registered with the Lummi Natural Resources Department (LNR). LNR will prepare documentation and issue a unique sticker identifying the owner of a dive vessel, valid from July 1 through June 30 of the following year, to be prominently displayed and applied to the registered dive vessel when the owner has satisfied the following requirements and/or when such information is requested by LNR officials:

- 1) A complete list of divers and hose tenders (including their current contact information) that are approved by LNR (Section 3.1) to participate in commercial harvest diving operations aboard the dive vessel(s). To be in compliance, the owner of the dive vessel(s), must keep LNR apprised of any changes in dive team personnel aboard the dive vessel(s);
- 2) Verifiable documentation of compressor systems being inspected annually and compressed air quality tested every six months by a trained, certificated individual or an organization specializing in such service;
- 3) Onboard location of mandatory emergency oxygen administration kit (“O₂ kit”) that is in working order with documentation or proof of annual visual inspection service and five-year hydrostatic testing; and
- 4) Onboard location of current LNR Commercial Harvest Diving Standards (i.e., safe practices manual).

5.3 ANCHORING DIVE VESSEL(S)

When anchored and engaged in diving operations, all LNR-registered DSVs should maintain a minimum distance apart (e.g., no less than 600 feet or 180 meters) to avoid another vessel’s anchor spread and to reduce the risk of entangling diver umbilical lines, anchor lines, or other types of hoses (e.g., water jet).

5.4 LIVE-BOATING

5.4.1 MINIMUM REQUIREMENTS

All equipment and manning levels should be considered the recommended minimum for approaching this type of diving operation. Proper pre-job planning should be conducted to ensure that the necessary levels of personnel and equipment are available for diving operations.

If a diving operation requires a hand-held tool that is separately tended from the diver, e.g., a high-pressure water blaster or jet for harvesting geoduck clam (*Panopea generosa*), it is highly recommended that it be performed by methods other than live-boating. The following are minimum requirements for live-boating operations:

- 1) Limits
 - a. Live-boating should not be conducted if performing a technical diving operation, e.g., diving below 100 fsw (30 msw) or operations involving planned decompression (Appendix 10);
 - b. Only one surface-powered tool can be used at a time; and
 - c. No live-boating shall be performed within another vessel’s anchor spread.
- 2) Minimum Personnel
 - a. In all cases, personnel and equipment shall be selected to ensure maximum safety during operation.
 - b. On small boats/vessels (e.g., less than 33 feet or 10 meters), the crew should consist of no fewer than three persons (Experienced Dive Operator, Experienced Diver, and Trainee Diver or Hose Tender).

It is absolutely imperative that the Experienced Dive Operator be experienced and knowledgeable in live-boating operations. In addition, the Experienced Dive Operator must be familiar with the scope of underwater tasks including depth and duration of the dive. Before any live-boating operation, the Experienced Dive Operator should develop procedures for the following:

- 1) Precautions with regard to weather;
- 2) Measures to prevent collision;
- 3) Standard alert levels (with description of warning signals);
 - a. Actions to be taken in case of changes in alert-level status
- 4) Precautions to guard against thrust unit wash or suction effect;
- 5) Surface support and down-line handling;
- 6) Moving vessel; and

- 7) Preparation and use of emergency plans.

5.4.2 OPERATIONAL GUIDELINES

These guidelines are based on the premise that, during surface supplied air diving, at no time should the length of the diver's umbilical from the tending point to the diver allow the diver to come into contact with the nearest thruster or propeller that is in an operating mode. Great care is required in planning and execution of shallow and surface-orientated diving operations to minimize the effect of thrust units on the divers. The effects of thrust unit wash or suction should be carefully considered, and precautions should be taken to guard against these conditions, particularly when a diver passes the potential wash zone of the propeller.

The diver's umbilical length and the manner of deploying him/her (over the side, from the bow, etc.) should be chosen so that the diver and his/her umbilical line is physically restrained from going to positions where the diver or the diver's equipment might come into contact with thrust units or be adversely affected by propeller wash. Furthermore, care should always be taken to prevent the umbilical developing a bight, and to respond at once to any indications of a diver being in difficulty, such as unusual tension on or angle of the umbilical.

5.4.3 RECOMMENDED WAYS TO MITIGATE HAZARDS ASSOCIATED WITH LIVE-BOATING

- 1) Continuous and easily understandable communications should be maintained between the dive station and wheelhouse at all times.
 - a. Topside personnel must be able to hear all communications between the diver(s) and the Experienced Dive Operator and must be able to speak directly to the supervisor.
- 2) The DSV should be maneuvered in such a way as to permit topside personnel to continuously monitor the direction of the diver's umbilical with respect to the dive control station.
- 3) The dive team must be familiar with the DSV's overall design and operating characteristics (e.g., position of thrusters, propellers, intakes, or obstructions).
- 4) The propellers of the DSV are to be stopped before the diver enters or exits the water.
- 5) Live-boating should not be done:
 - a. In seas that impede the station-keeping ability of the vessel;
 - b. During twilight or nighttime hours or other periods of restricted visibility:
 - i. Restricted visibility means any condition in which DSV navigational visibility is restricted by fog, mist, falling snow, heavy rainstorms, sandstorms or any other similar causes.
 - c. Any time existing conditions make live-boating unsafe in the opinion of the Experienced Dive Operator.
- 6) A standby diver should be continuously prepared to enter the water when directed by the Experienced Dive Operator.
- 7) All live-boating operations should be tended forward of the stern, and the DSV preferably operated from the wheelhouse or similar.

5.4.4 MINIMUM EQUIPMENT REQUIREMENTS

- 1) The DSV should be acceptable to the owner of the LNR-registered dive vessel, the Experienced Dive Operator, and the dive team.
- 2) A "kill switch" should be in the immediate vicinity of the operator of the DSV for instantaneous shutdown of the engines.
- 3) During live-boating operations, a diver- carried emergency gas supply bottle shall be worn by the diver (the availability of a second diving hose connected to the manifold is also recommended).
- 4) A means should be used to prevent the diver's hose from becoming entangled in the propellers of the vessel.

COMMERCIAL HARVEST DIVING STANDARDS



6.0 DIVING MODES: DEFINITIONS, REQUIREMENTS, AND GUIDELINES

6.1 GENERAL

All equipment and manning levels referenced in previous sections should be considered the recommended minimums for approaching ALL diving applications, which is based on one dive and any applicable decompression required. Increased manning levels and additional equipment may be required for any diving in excess of one dive and any decompression required. Proper pre-job planning should be conducted to ensure that the necessary levels of personnel and equipment are available for diving operations. The specific operations procedures vary with the type of diving mode employed. Prior to mobilization, a project risk assessment/hazard identification process or dive plan should be performed to determine the type of diving mode to be employed, equipment needed and job manning requirements.

In this chapter, the minimum requirements for a typical commercial harvest diving operation are outlined. Additional information for commercial harvest diving operations can be found in Appendix 10. Standards for more complex, technical diving operations (e.g., deep diving or planned decompression) are appended there as well. Prior to the commencement of any technical diving operation (e.g., deep diving or planned decompression, Appendix 10), a Job Hazard Analysis (JHA, Appendix 9) should be completed and all members of the dive team, including master of the vessel (as well as other involved personnel) should be present at a pre-dive safety meeting. During the planning phase of the intended technical diving operation, the JHA should be conducted to ensure that all factors necessary to support the highest levels of safety have been considered. The JHA should include a method for the safe recovery of an incapacitated diver.

During surface supplied air diving operations, individuals other than divers may be used to physically tend cables and/or lines entering the water. These individuals must at all times be immediately responsive to direction from the Experienced Dive Operator or designated person in charge. Furthermore, at least one qualified dive team member assigned to each dive crew must be fully competent, equipped and designated to perform the duties of a standby diver in order to render emergency assistance to a regularly assigned diver.

Note: If the dive operation calls for more than one working diver in the water at a time, each working diver should be continuously tended by a separate dive team 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 second/standby diver must remain in close proximity to the primary diver.

At no time shall any member of the dive team be asked to perform an activity that prevents that person from fulfilling his/her assigned duties and responsibilities as set forth by the Experienced Dive Operator.

6.2 SURFACE SUPPLIED AIR DIVING 0–100 fsw (0–30 msw) WITH NO DECOMPRESSION

The following are minimum requirements for surface supplied air diving operations at 0–100 fsw (0–30 msw) with no decompression. The minimum number of personnel comprising a dive team is never less than three; however, planning must take into consideration not only the direct requirements of the work to be performed, but also additional factors either known or suspected that may lead to complications during the conduct of the intended operation. Merely because a dive team comprised of three persons may be adequate during one operation does not mean the same number of persons will be sufficient to accommodate the requirements of another operation.

Diving contractor management and Experienced Dive Operators must carefully consider manning levels of the dive team. Although regulations may permit diving with a minimum crew of three persons that level of manning is strictly under optimal conditions. For example, any time commercial harvest diving operations are intended to take place in a remote location, at least a fourth member of the dive team should be considered.

6.2.1 MINIMUM PERSONNEL REQUIREMENTS

- 1) One Experienced Dive Operator;
 - a. A qualified person shall be designated as the Experienced Dive Operator for each diving operation. The Experienced Dive Operator is in charge of the planning and execution of the diving operation, including the responsibility for the safety and health of the dive team.
 - b. The Experienced Dive Operator shall possess the proper LNR classification card and be knowledgeable and familiar with all techniques, procedures, emergency procedures, and operational parameters for the diving mode under his or her direct supervision.
 - c. The Experienced Dive Operator must consider whether the use of any surface-tended equipment by the diver will require an additional individual (e.g., Hose Tender or Trainee Diver) to tend associated cables or hoses. This includes hand jetting, water blasting, cutting and welding, the use of any pneumatic or hydraulically operated tool, or the use of underwater video or sonar equipment requiring a power or data cable not affixed to the diver's umbilical.
 - d. The Experienced Dive Operator might also consider an additional dive crew member (e.g., Hose Tender or Trainee Diver) when any diving operation is conducted that has an increased likelihood of diver entrapment or potential for rendering the primary diver unconscious or incapacitated from chemical, physical, electrical, or topside hazards. Other hazards may include, but are not limited to, the following when present or planned:
 - i. Diving in remote locations where assistance from non-diving crew personnel is not immediately available.
- 2) One Experienced Diver or Trainee Diver with training and/or experience in the following areas:
 - a. Air-diving procedures and techniques;
 - b. Emergency procedures;
 - c. Diving accident treatment procedures;
 - d. Proper operation and use of all equipment related to air diving;
 - e. Use of air-diving equipment;
 - f. Familiarity with the type of work engaged in; and
 - g. Performing the duties of a standby diver.
- 3) One Hose Tender with training and/or experience in the following areas:
 - a. Supporting air-diving procedures and techniques;
 - b. Emergency procedures;
 - c. Diving accident treatment procedures;
 - d. Proper operation and use of all topside equipment related to air diving;
 - e. Use of air-diving equipment; and
 - f. Familiarity with the type of work engaged in.

6.2.2 OPERATIONAL GUIDELINES

- 1) The approximate depth of each dive should be determined prior to the start of operations;
- 2) The breathing mixture supplied to the diver must be composed of a mixture of gases that is appropriate for the depth of the dive;
 - a. When using mixed gas or enriched air (i.e., NITROX), all gases must be analyzed for O₂ content before they go on-line and for proper mixture necessary to support the maximum depth of the planned dive (see Section 6.3 below).
- 3) Each diver shall be continuously tended while in the water by a separate dive team member;
- 4) Each diving operation shall have a primary breathing gas supply sufficient to support all divers for the duration of the planned dive, including decompression;
- 5) Except when heavy gear (e.g., MK V type equipment) is worn, a diver-worn or carried emergency gas supply (EGS) shall be utilized;
- 6) If no decompression chamber is on site, the nearest manned operational chamber should be made known by the Experienced Dive Operator (Appendix 7) and acknowledged by the other dive team members (Appendix 9); and

- 7) It is highly recommended that an evacuation plan be in place.

6.2.3 MINIMUM EQUIPMENT REQUIREMENTS

- 1) One air source and volume tank to support two divers;
- 2) Topside secondary air source;
- 3) Adequate supply of gases for the planned dive profile;
- 4) 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.
- 5) One set of air decompression tables and procedures;
- 6) One control station consisting of:
 - a. Communication systems; and
 - b. Depth gauges and gas distribution system with the capability to supply and control two divers (if applicable to the dive operation) at the maximum work depth.
- 7) Two time-keeping devices;
- 8) One basic first aid kit with means of manual resuscitation (pocket mask or others);
- 9) Emergency O₂ administration kit;
- 10) Redundant set of personal diving equipment which may include but not be limited to:
 - a. Helmet or mask;
 - b. Diver-worn EGS;
 - c. Weight belt if needed;
 - d. Protective clothing;
 - e. Tools as required;
 - f. Safety harness; and
 - g. Knife or cutting device.
- 11) Spare parts as required; and
- 12) Log books, dive sheets, safe practices manual, first aid handbook, and if applicable to the job, a written JHA.

6.3 ENRICHED-AIR OR NITROX DIVING

6.3.1 DEFINITION AND ADVANTAGES

Nitrogen-oxygen diving (also called enriched-air or NITROX diving) is a technique whereby the O₂ percentage in the breathing mixture is elevated above 21 percent, and the balance of N₂ is reduced proportionately. Due to the reduction in the nitrogen content in the breathing mixture, a diver may work deeper or longer without decompression than a diver breathing air and maintain the same N₂ uptake. Following are some advantages of nitrogen-oxygen (NITROX) diving over 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) Reduced possibility of decompression sickness; and
- 5) Reduced nitrogen narcosis.

The disadvantages include:

- 1) Increased risk of central nervous system (CNS) oxygen toxicity; and
- 2) Long duration dives can result in pulmonary oxygen toxicity.

NITROX is most effective in shallow water with a maximum depth of 100 fsw (30 msw). It can significantly extend bottom time depending on the depth used.

6.3.2 GENERAL

The use of NITROX requires specialized training and experience by ALL dive team members. That being said, its use for diving operations has become a routine and accepted practice to improve divers' safety and the effectiveness of diving operations. While the benefits of using NITROX can be significant, the use of any breathing gas in lieu of naturally occurring air brings with it hazards that must be addressed prior to the start of any diving operation.

Operations using NITROX may plan dives using any schedule from the U. S. Navy Air Decompression tables (Appendix 6). Surface decompression using oxygen is not recommended when diving NITROX due to the increased uptake of oxygen during decompression.

When selecting the proper NITROX mixture, considerable caution must be used. The maximum depth of the dive must be known as well as the planned bottom time. If a diver's depth and time profile exceeds that allowed for a certain NITROX mixture, the diver is at a greater risk of life-threatening CNS oxygen toxicity as well as the longer-term effects associated with pulmonary oxygen toxicity. The NOAA Dive Manual provides maximum single and 24-hour exposure times for PPO₂ ranges of 0.6 to 1.6. These times must not be exceeded (Appendix 6).

Primary Reference Documents:

- 1) Current U.S. Navy Diving Manual
- 2) Current U.S. Department of Commerce NOAA Dive Manual

6.3.3 EQUIVALENT AIR DEPTH (EAD)

EAD is an accepted form of calculating the diver's equivalent air depth based on the amount of nitrogen in the diving breathing mix and is used to determine the proper depth profile when selecting the U.S. Navy Air No-Decompression or Air Decompression Table. EAD may also be tabulated using a look-up table (Appendix 6). The NOAA Dive Manual provides equivalent air depths for oxygen percentages between 28 and 40 percent. The U. S. Navy Diving Manual provides equivalent air depths for oxygen percentages from 25 percent to 40 percent.

The EAD is calculated using the formula:

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

Another form of the equation can be shown as:

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

Where FN₂ is the fraction of nitrogen in the NITROX mix, 0.79 is the fraction of nitrogen in air (including the trace gases), d is the actual depth in the appropriate units (fsw or msw), and x is the depth of water equivalent to 1 Bar in the appropriate units (33 fsw or 10 msw).

Using an EAD enables dives on NITROX to be planned using standard air tables (Appendix 6). When diving on air, the EAD is the actual depth. On a hypoxic mix (< 21 percent O₂), the EAD would be deeper than the actual depth. On a hyper-oxic mix (> 21 percent O₂), the EAD will be shallower than the actual depth.

6.3.4 MINIMUM PERSONNEL REQUIREMENTS

All Hose Tenders, Trainee Divers, Experienced Divers, and Experienced Dive Operators associated with any commercial harvest diving operation using NITROX shall be trained according to an accepted diving industry standard. Additional training beyond the recreational training standards may be required for commercial harvest diving operations. All training must be fully documented. The specific training shall include the following topics:

- 1) Definition of NITROX;
- 2) Historical perspective;
- 3) Advantages and limitations;
- 4) Gas laws and calculations;
- 5) Equivalent air depth formulas and tables;
- 6) Physiological aspects of oxygen;
- 7) Gas supply, blending, and analysis; and
- 8) Equipment considerations.

6.3.5 OPERATIONAL GUIDELINES

The following requirements, when used with U.S. Navy Air Decompression tables (Appendix 6), will greatly reduce the risk to the diver from CNS oxygen toxicity and pulmonary oxygen toxicity.

- 1) During all diving operations, the diver's on-line gas supply is to be continuously analyzed for O₂ content, with Hi/Lo audio/visual alarms armed if available.
- 2) Diver's oxygen exposure times shall be tracked for both single exposure and daily dose maximums. It is recommended that the NOAA Oxygen Exposure Chart of the NOAA Dive Manual or equivalent be utilized (Appendix 6).
- 3) Maximum oxygen percentage of the NITROX mix shall be 40 percent (except when used as a decompression or therapeutic media).
- 4) All NITROX gases shall be within ± 1 percent of the certified mixture.
- 5) During all diving operations, there will be a back-up supply of an appropriate NITROX mix online to the diver's gas supply panel, and if a third supply is deemed necessary, this may be air or NITROX. Any stage gas will also contain the same NITROX mix as the diver is breathing.
- 6) Divers shall wear bailout bottles at all times. The diver's bailout bottle shall be charged with the same NITROX mixture as the primary supply, tested, and properly labeled.
- 7) Although there are a number of variables to take into consideration in the event the diver does breathe air under pressure during the dive (e.g., incorrect gas mixture on line), the following is to be strictly adhered to:
 - a. 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 (not the EAD).
- 8) Dives shall be planned so that, should a diver be switched to compressed air at any time during the dive, his or her decompression commitment will not exceed the operational planning limits of an air-dive at that depth.
- 9) When using U.S. Navy tables, round all gas mixtures using the standard rounding rule: where gas mixes at or above 0.5 percent, round up to the next whole percent; and for mixes of 0.1 percent to 0.4 percent, round down to the next whole percent.
- 10) Repetitive dives may be performed using EAD and the U.S. Navy Air Decompression schedules. Once EAD is determined for a specific dive, the Standard Navy Air tables are used throughout the dive using the EAD (Appendix 6).
- 11) Diving at altitude using NITROX is allowed using NOAA Altitude tables to modify the standard NITROX EAD tables.

6.3.6 MINIMUM EQUIPMENT REQUIREMENTS

- 1) Breathing Gas Certifications and Labeling
 - a. All NITROX gas containers shall be certified as to the N₂O₂ mixture by the vendor or dive contractor supplying the gas and be clearly marked by gas mixture percentage on each container.
- 2) Mix Testing
 - a. Each container of NITROX being placed on-line in support of diving operations must be tested with a calibrated oxygen analyzer by the diver or Experienced Dive Operator to confirm gas mixture prior to use (on-line at the point of distribution-manifold).

- 3) Mix Tolerance
 - a. All NITROX gases shall be within +/- 1 percent of the certified mixture.
- 4) Breathing Gas Purity
 - a. Nitrogen or air must be filtered prior to being mixed with oxygen. It is essential that all gases used in producing a NITROX mixture meet the breathing gas purity standards for oxygen and nitrogen. If air is to be used to produce a mixture, it must meet the purity requirements of oil-free air (oil mist limit 0.1 mg/m³).
- 5) Cleaning for N₂O₂ Service
 - a. Cleanliness and the procedures used to obtain and maintain cleanliness are a concern with NITROX systems. Current NOAA, OSHA and USCG guidelines allow gas mixes with oxygen up to 40 percent to be handled as if they were air, and the commercial industry routinely uses up to 50 percent O₂ at low delivery pressures without formal O₂ cleaning. However, it is recommended that all equipment be cleaned of any visible debris, then scrubbed manually or cleaned ultrasonically with a strong detergent in hot water, then rinsed several times in clean hot water.

7.0 UNDERWATER OPERATIONS: PROCEDURES, CHECKLISTS, AND GUIDELINES

7.1 SAFE PRACTICES/OPERATIONS MANUAL

Each LNR-registered dive vessel owner shall maintain a safe practices/operations manual as required by the LNR and shall make this manual available at the dive location to each dive team member. This manual must provide for the safety and health of the dive team. The LNR Commercial Harvest Diving Standards may be used as a set of minimum guidelines or the standards may be used to assist LNR-registered dive vessel owners in developing their own specific safe practices/operations manual. Each LNR-registered dive vessel owner is responsible for modifying and/or complementing any of the procedures, checklists and standards in accordance with applicable LNR regulations and as dictated by specific policies and practices of the LNR-registered dive vessel owner. The safe practices/operations manual shall, at a minimum, contain the following information:

- 1) A copy of applicable government regulations for the conduct of commercial harvest diving or other underwater operations;
- 2) For each diving mode engaged in:
 - a. Safety procedures and checklists for commercial harvest diving operations.
 - b. Assignments and responsibilities of dive team members.
 - c. Equipment procedures and checklists.
 - d. Emergency procedures for fire, equipment failure, adverse environmental conditions, medical injury and illness.
- 3) A definitive statement regarding the use of drugs or alcohol. Such language should include references to applicable governmental regulations regarding drug and alcohol use in the work place (see Section 2.4.2 and Appendix 8). Additionally, such a statement should reference the LNR-registered dive vessel owner's policy on workplace use of drugs and alcohol program.

7.2 DIVER'S PERSONAL LOG BOOK

All divers shall maintain a personal log book or equivalent to detail hyperbaric exposures while training and for advancement purposes (i.e., advancing from LNR's Trainee Diver classification through the Experienced Dive Operator classification). Although not required for Experienced Divers, it is highly recommended that he or she maintain a personal log book for professional development and for being considered for work outside the Lummi Nation. The personal log book must be identified to the diver and it is highly recommended that it includes but is not limited to the following:

- 1) Diver's name and address;
- 2) Date of the dive;
- 3) The name or other designation and location of the diving site or vessel from which the diving operation was carried out;
- 4) Maximum depth reached on the dive;
- 5) The time left surface, bottom time and the time reached surface for each hyperbaric exposure;
- 6) Surface interval, if dive includes time for decompression;
- 7) Type of breathing apparatus and breathing mixture used;
- 8) Task(s) performed;
- 9) Designation of the decompression table and schedule used;
- 10) Any DCS or injury incurred during the dive;
- 11) Comments section;
- 12) Supervisor's signature;
- 13) Place for a counter-signature or stamp of the diving company;
- 14) Dates of diving physicals, signed by the examining physician; and

- 15) A record of all relevant training sessions.

7.3 DESIGNATED EXPERIENCED DIVE OPERATOR (DIVING SUPERVISOR)

A qualified person shall be designated in charge of each diving operation. The responsibilities of such designated persons should include planning and coordinating operations, record keeping and proper response to any job-related emergency, as well as knowledge of the appropriate rules in the Lummi Natural Resources Code (Title 10) and the current diving regulations (Appendix 1). All Experienced Dive Operators must possess a current LNR classification card reflecting the level of diving being conducted.

7.4 STANDBY DIVER REQUIREMENT

At least one member of every dive team shall be designated the standby diver and should be suitably prepared to enter the water when directed by the Experienced Dive Operator. Prior to commencement of the operation, the standby diver's equipment shall be fully 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 shall utilize the same mode and level of equipment as the primary diver.

7.5 OPERATIONS PLANNING AND ASSESSMENT

The planning of a diving or underwater operation should include a dive operations plan. During the planning and assessment phases of a diving or underwater operation, before diving operations commence, a plan should be developed to ensure the safe and efficient performance of the work. In either case, the dive operations plan is a critical element of any diving or underwater project.

In general, the operations plan will address such issues as the details relative to the goals and methods for the project, operational sequence, operational safety, crew and equipment requirements, emergency procedures, communications, and regulatory requirements. This list is not finite, and the items to be addressed in the dive operations plan will be uniquely dictated by the specifics of each particular project.

A dive operations plan differs from the Job Hazard Analysis (JHA, Appendix 9) in that the JHA is focused specifically on project safety only, whereas the dive operations plan is designed to ensure the work is well-understood and properly planned, manned, and equipped.

7.5.1 JOB/PROJECT SAFETY

Dive operations shall be planned in accordance with the LNR Commercial Harvest Diving Standards. Dive operations plans should include the following elements:

- 1) An LNR-classified Experienced Dive Operator shall be in charge of the diving operation;
- 2) All diving personnel shall be LNR-classified for the task they are assigned;
- 3) An emergency response plan should be available, posted and reviewed by all personnel;
- 4) A pre-dive safety meeting should be conducted;
- 5) The job and all tasks should be defined, reviewed and understood by the dive team and vessel personnel; and
- 6) The Experienced Dive Operator will perform a job-specific JHA (Appendix 9) for complex, technical diving operations (Appendix 10).

7.5.2 DIVING AND SUPPORT PERSONNEL

- 1) All divers must be trained and experienced for the task they are to perform;

- 2) Experienced Dive Operators 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 dive operation.

7.5.3 EQUIPMENT

- 1) Inspect/check all dive gear and support equipment for readiness for the dive operation(s) (see examples of pre-dive checklists in Appendix 5 and the audit form in Appendix 9).
- 2) Ensure all emergency and support equipment has been inspected and/or checked and is fully functional.
- 3) Ensure all needed methods of communication are available and functioning.
- 4) Ensure all first aid/CPR (resuscitator)/emergency oxygen administration equipment and kits are well-supplied and available.
- 5) Ensure that all dive flags/shapes/signals are prominently displayed during dive operations (Appendix 5).

7.6 TEAM BRIEFING

Before commencing with any underwater operation, the dive team 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 conditions, problems or adverse physiological effects that may render the diver unfit to dive. Appendix 5 has two examples related to dive briefings and pre-dive safety checklists.

7.7 TERMINATION OF DIVE

The working interval of a dive shall be terminated when:

- 1) Directed by the Experienced Dive Operator and/or the DPIC;
- 2) The diver requests termination;
- 3) The diver fails to respond correctly to communications or signals from a dive team member;
- 4) Communications are lost and cannot be quickly re-established with the diver, the Hose Tender and/or the Experienced Dive Operator;
- 5) In live-boating operations, the person controlling the vessel requests termination; or
- 6) The diver begins to use the diver-carried reserve breathing gas or the dive-location reserve breathing gas.

7.8 POST-DIVE PROCEDURES

After the completion of each dive, the diver should:

- 1) Be questioned as to his or her physical condition;
- 2) Be instructed to report any physical problems or adverse physiological effects, including symptoms of decompression sickness or gas embolism (Appendix 7);
- 3) Be advised of the location of an operational decompression chamber;
- 4) Be alerted to the potential hazards of flying after diving; and
- 5) Be alerted to the potential hazards of traveling to higher elevations from the dive site.

After the completion of any dive outside the no-decompression time/depth limits, the following are recommended:

- 1) Take reasonable steps to have the diver remain awake for at least one hour (in the vicinity of a decompression chamber, if available);
- 2) Instruct such divers to remain within two hours travel time of the decompression chamber for an additional five hours; and
- 3) Instruct such divers of the hazards of flying after diving.

On any dive that results in decompression sickness, proper medical authority should be consulted prior to the diver flying after treatment.

7.9 COMPANY RECORD OF LOGGED DIVES

Each LNR-registered dive vessel owner or Experienced Dive Operator shall establish and maintain a record of each diver's hyperbaric exposure. This record should contain the following:

- 1) Name and address of the company/LNR-registered dive vessel owner;
- 2) Location, time, and date of diving operations;
- 3) Names of the Experienced Dive Operator and Experienced Diver (or other team members such as Hose Tender);
- 4) Depth of dive;
- 5) Bottom time;
- 6) Environmental conditions (approximate sea state, underwater visibility, underwater currents, or water temperature);
- 7) Decompression tables and schedule used;
- 8) Elapsed time since last pressure exposure if less than 24 hours or repetitive dive designation;
- 9) Breathing mixture used and composition;
- 10) If not harvesting, other type(s) of work performed;
- 11) Type of diving equipment worn;
- 12) Any unusual conditions; and
- 13) Description(s) of any dive accidents or incidents (Appendix 9).

7.10 HAZARDS TO UNDERWATER OPERATIONS

Notice shall be given of the planned underwater operations, including the daily start and finish times, to those in the vicinity whose activities may interfere with or pose a hazard to personnel engaged in the operation. These activities include movement of surface vessels, lifting of material directly over the underwater operations, etc. Diving operations shall not take place wherever hazardous activities or conditions in the vicinity pose a safety hazard to the divers or impair the support personnel from safely carrying out their work tasks, and in no case shall the diver be required to dive against his or her will.

7.11 TEMPORARY IMPAIRMENT OR CONDITION

Divers shall not dive or be otherwise exposed to hyperbaric conditions for the duration of any known temporary impairment or condition if such is likely to adversely affect health or interfere materially with the person's ability to safely perform a specific diving task or safely be exposed to hyperbaric conditions. These 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. The diver should be consulted before such determination is made. In no case shall the diver be required to dive or be exposed to hyperbaric conditions against his or her will, except for treatment procedures.

7.12 ENTERING AND LEAVING THE WATER

There shall be a safe means for entering or leaving the water from the diving platform such as a ladder or other appropriate device. If a ladder is used, this device shall extend a minimum of 3 feet below the water surface. Additionally, the means of entering and leaving the water shall be adequate to facilitate rescue of personnel. In any instance where the air gap from the location of the dive station and waterline is greater than 15 feet (5 meters), it is highly recommended that a stage or other appropriate device be the preferred means of entering or exiting the water.

7.13 DECOMPRESSION CHAMBER AVAILABILITY AND ASSUMPTION OF RISK

Some jurisdictions outside of the Lummi Nation require that commercial diving operations have an emergency hyperbaric or decompression chamber onboard or within five minutes of the dive station or dive location for any commercial dive in excess of 100 fsw (30 msw), commercial dives deeper than 60 fsw (18 msw) when live-boating, or where commercial dives require planned decompression. Given the nature of Lummi commercial harvest diving compared to other commercial diving applications (e.g., not working in enclosed or overhead environments, simpler or reduced underwater task loading, and generally diving in shallower depths), requiring an onboard decompression chamber is excessive, especially since, as of this writing, none of the LNR-registered dive vessels are capable of supporting such a unit. Still, prior to mobilization on any dive job, the LNR-registered dive vessel owner or the Experienced Dive Operator should assess whether that day's diving operations merit the availability of a decompression chamber. Considerations may include but not be limited to:

- 1) Whether excessive decompression obligations will be incurred;
- 2) Multi-day and/or repetitive diving operations;
- 3) Potential for diver fouling or entrapment; or
- 4) Other potential hazards or factors such as conducting dive operations in remote locations.

If upon completing the evaluation the LNR-registered dive vessel owner or the Experienced Dive Operator determines that, ideally, the dive operation warrants the availability of a hyperbaric chamber [e.g., conducting harvest dive operations deeper than 100 fsw (30 msw) or conducting harvest dive operations requiring planned decompression], the Experienced Dive Operator shall prepare a job hazard analysis (Appendix 9), apprise the crew of the inherent risks associated with this type of diving, and make known the whereabouts of the nearest hyperbaric chamber. All Lummi citizens permitted to participate in commercial harvest diving operations under the auspices of the Lummi Nation must recognize/acknowledge annually that the nearest recompression chamber is at least two (2) hours away from the Lummi Reservation and the Lummi Usual and Accustomed fishing grounds (Appendix 7). LNR-registered dive vessel owners and Experienced Dive Operators may use the generic assumption of risk form in Appendix 9 for this purpose. Finally, under no circumstances shall a diver be required to dive against his or her will.

7.14 INSPECTION OF LIFE-SUPPORT SYSTEMS, EQUIPMENT AND TOOLS

Before diving or other underwater operations commence, personnel should confirm that all operational systems, equipment and tools to be used are in working order, appropriate for the tasks and are in compliance with the information presented in Section 4: Diving (Life-Support) Equipment: Requirements, Maintenance and Testing. To ensure the highest standard of safety, checklists should be used to confirm that the systems, equipment and tools are in safe working order (Appendix 9). Operational systems, equipment and tools used in underwater operations should be inspected daily and monitored throughout the operations by designated persons. Each person engaged as a diver in the diving operation should inspect his or her personal diving equipment and confirm its operational readiness prior to each use. Likewise, the Experienced Dive Operator or his/her designated alternate should check the equipment of each diver before the diver enters the water.

7.15 PROCEDURES FOR DIVING IN COLD WEATHER AND COLD WATER (<40°F/4°C)

Precautions should be taken to protect divers and topside personnel from adverse thermal exposure and maintain proper thermal balance while engaged in commercial harvest diving operations.

7.15.1 DIVER

- 1) To help prevent hypothermia, the diver should wear appropriate thermal protection based upon the water temperature and expected bottom time.
- 2) In cold water (below 40°F/4°C), a dry suit or hot water suit should be worn to keep the diver properly protected. All suits should fit properly and all seals should be in good condition.
- 3) Because severe chilling can result in impaired judgment, the tasks to be performed under water must be clearly identified, and the diver's condition should be continually monitored.
- 4) Keep hydrated at all times.
- 5) Divers should avoid overexerting themselves underwater since exercise causes body temperature to fall more rapidly in cold water compared to warm water.
- 6) Bring the diver up if the diver is showing minor or severe symptoms of hypothermia.
 - a. Minor symptoms include uncontrolled shivering, slurred speech, imbalance and/or poor judgment.
 - b. Severe symptoms include loss of shivering, impaired mental status, irregular heartbeat and/or very shallow pulse or respiration (this is a medical emergency).
- 7) Upon exiting cold water:
 - a. If the diver is wearing a wet suit or hot water suit, immediately flush the suit with warm water – doing so will have a comforting, heat-replacing effect;
 - b. Get the diver to a dry and relatively warm area as soon as possible;
 - c. The diver should remove any wet dress, dry off and don warm, protective clothing as soon as possible; and
 - d. Make available to the diver hot, non-alcoholic beverages.

7.15.2 HOSE TENDER AND TOPSIDE

- 1) Topside personnel should wear warm, proper protective clothing;
- 2) Personal flotation devices (PFD) can add another layer of insulation; and
- 3) Plan extra time to perform tasks under cold conditions.

7.15.3 EQUIPMENT AND MAINTENANCE

- 1) The moisture in an air compressor and air lines must be dealt with to prevent freezing in the air system, which can cause catastrophic damage or failures.
- 2) The dive crew can also make use of high-pressure cylinders, which generally will contain less moisture than air produced by a low-pressure compressor.
- 3) Topside must continually empty the excess water out of the volume tank to help reduce the amount of moisture in the system.
- 4) Do not allow the diver's umbilical to rest for long periods of time on cold surfaces (boat decks, etc.). Fittings on the umbilical can transfer the temperature from the cold surface and cause the moisture in the diver's umbilical to freeze.
- 5) In water temperatures of 37° F (3° C) or less, first stage regulator on bailouts should be equipped with a proper cold water setup (environmental kit).
- 6) Extra precautions must be taken to make sure that the bailout cylinders are completely dry inside, that moisture-free air is used and that the regulator is thoroughly dried prior to use.
- 7) If using a hot water machine, careful attention must be exercised to monitor the output temperature of the hot water machine. In extreme cold-water environments, the hot water machine is classified as life-support equipment. Failure in the system can cause catastrophic results for the diver.

- 8) Failure of the hot water machine during decompression must be considered during the operation and dive plan.
- 9) Gasoline and diesel engines must be cold-weather modified to prevent engine freeze-up.
 - a. Use proper lubricants in the diver's air compressor.
 - b. Use appropriate cold-temperature lubricants in pre-packed bearings.
- 10) Bring extra batteries for equipment. Cold temperatures can shorten the life of a typical battery.
- 11) A hypothermia management kit should be considered.
- 12) Extreme caution must be exercised when refueling in dry, cold weather. Static electricity should be "drained off" by grounding the equipment or fuel container (away from vapor openings) with the hand. Static electricity can form in the layers of clothing worn by personnel and can cause a spontaneous discharge of electricity, which can ignite fuels.
- 13) When using a funnel, use funnels with copper screen to help filter out ice particles and foreign debris.

7.16 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. This may include, but is not limited to, shapes, lights, flags or placards. These signals should be given only when actual diving operations are being conducted (Appendix 5).

7.17 DIVER-WORN OR CARRIED EMERGENCY GAS SUPPLY (EGS)

A diver-worn or carried emergency gas supply must be provided for all diving operations, except where heavy gear (defined as diving equipment of the nature of the U.S. Navy MK V or equivalent) is involved. A diver-worn or carried emergency gas supply shall provide a physiologically appropriate mixture of breathing gas. Furthermore, the EGS shall provide a minimum four-minute capacity calculated for the depths involved or deepest depth to be attained.

The diver-worn or carried emergency gas supply shall be of sufficient duration for use until the diver can reach the surface (including any required in-water decompression) from the maximum depth of the dive, can reach another source of breathing media, or can be reached by the standby diver equipped with another source of breathing media. When a stage is used, where additional gas supplies are available, the diver-worn emergency gas supply does not need to be of sufficient amount and duration to take the diver through any required decompression.

Note: Consideration of the reserve breathing gas cylinder duration should be a part of the pre-dive planning process. Consumption of an EGS can be determined from a bailout calculation. Appendix 5 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 dive operation.

Finally, the diver-worn or carried emergency gas supply must provide a positive indication to the diver that his or her reserve has been actuated. Such an indication can be the requirement for the diver to open a valve, a visual signal or other appropriate method, such as a pre-dive bailout drill. In all cases, the activation of the diver's reserve shall cause the dive to be aborted, unless primary gas can be immediately restored. The reason for activation of the diver's reserve must be ascertained and corrected prior to continued use of the involved equipment.

7.18 VOICE COMMUNICATIONS ON STATION

There shall be a properly functioning two-way audio-communication system between the diver and the normal station of the diving supervisor at the dive location. During the conduct of underwater operations, topside communications must be established, and continuously maintained for the duration of the dive, between the Experienced Dive Operator, DPIC, and other key personnel (e.g., Hose Tender) as determined necessary during the conduct of the JHA.

7.19 SAFE DIVE PLATFORM

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

7.20 PERSONAL PROTECTIVE EQUIPMENT

The appropriate American National Standards Institute (or standard used within a particular nation) approved personal protective equipment shall be worn when required. These items may include, but are not limited to:

- 1) Protective head gear;
- 2) Protective footwear;
- 3) Protective eyewear;
- 4) Personal flotation devices (PFDs) to appropriate regulatory standard;
- 5) Hearing protection;
- 6) Safety harness with approved double-locking elastic lanyard; and
- 7) Respiratory equipment.

7.21 SAFETY PROCEDURE GUIDELINES

The following are minimum guidelines that may require modification for each diving or underwater operations mode to meet individual LNR-registered dive vessel needs.

7.21.1 SAFE PRACTICES/OPERATIONS MANUAL

- 1) Safety procedure checklist;
- 2) Team member assignments and responsibilities;
- 3) Equipment procedures and checklist;
- 4) Emergency procedures for fire, equipment failure, adverse environmental conditions and medical illness/injury;
- 5) Specific individual procedures for tools, equipment and associated systems;
- 6) Available at the dive site to all team members; and
- 7) Copy given to the person in charge of the vessel or facility, when requested.

7.21.2 EMERGENCY AID

- 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.

7.21.3 FIRST AID

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

7.21.4 PLANNING AND ASSESSMENT

- 1) Dive plan;
- 2) Job hazard analysis for complex, technical diving operations (Appendices 9 and 10);
- 3) Site assessment;

- 4) Evaluate environmental pollution containment and response readiness where applicable;
- 5) Diving model/equipment system(s);
- 6) Means of water entry and exit;
- 7) Breathing gas supplies, including reserves (set up and tested);
- 8) Thermal protection (all dive team members);
- 9) Dive team assignments/briefing and fitness to dive;
- 10) Inert gas status of dive team members (repetitive dive designations);
- 11) Decompression and/or treatment procedures (including altitude);
- 12) Communications procedures and methods for all personnel involved in the operation;
- 13) Emergency procedures;
- 14) Dive station setup;
- 15) Any necessary modifications to the safe practices/operations manual; and
- 16) Report on the nature and planned times of the intended operation and the involvement of the vessel or facility's equipment and personnel to the person in charge.

7.21.5 HAZARDS TO DIVING OPERATIONS

- 1) Surface vessel, vehicular traffic or aircraft operations;
- 2) Overhead crane/gantry or fishing operations; and
- 3) Vessel and dive equipment weather limitations.

7.21.6 UNDERWATER HAZARDOUS CONDITIONS

- 1) Umbilical fouling and/or entrapment;
- 2) Differential pressures;
- 3) Lockout/tag-out;
- 4) Contaminated or toxic liquid;
- 5) Limited access/confined space/penetration;
- 6) Use of explosives or seismic activities;
- 7) Underwater sonar;
- 8) Cathodic protection;
- 9) Marine life;
- 10) High currents/severe tidal conditions; and
- 11) Foreign waterborne materials, such as logs, ice floe, etc.

7.21.7 RECORD KEEPING

- 1) Project description/accomplishment records completion;
- 2) Diving and treatment records, accident reports; and
- 3) Individual dive log book entries appropriate to the intended operation.

7.22 LIFE-SUPPORT EQUIPMENT PROCEDURES CHECKLIST

The following are minimum guidelines that may require modification for each diving mode to meet individual LNR-registered dive vessel needs.

7.22.1 EQUIPMENT PREPARATION

- 1) Assemble, lay-out 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 that they are certified and properly functioning.

7.22.2 GENERAL EQUIPMENT

- 1) Check that all accessory equipment — tools, lights, special systems, spares, etc. — are on site and in working order.

7.22.3 PREPARING THE BREATHING GAS SUPPLIES

Check that primary and suitable back-up breathing gas supplies are available and that breathing gases comply with regulations for purity, are available in sufficient volumes, are properly mixed to accommodate the diving mode and profile, and that supply pressures are adequate for the intended operations and helmets/masks to be utilized.

- 1) Ensure that the available breathing gas supply pressure is adequate for the intended depth and duration of the dive and that the supply pressure will accommodate the over bottom pressure requirements for the helmet or dive mask to be utilized as established by the manufacturers' instructions.
 - a. The over bottom supply pressure requirement for the intended helmet or mask to be utilized on the dive can be determined by reference to the manufacturer's specifications.
 - b. Minimum flow requirements for helmets/masks should be based on manufacturer's recommendations.
 - i. Air flow requirements can be calculated by:
 1. $\text{Flow} = ((D + 33)/33) * \text{ACFM} * n$, where D = depth in feet, ACFM = flow required based on manufacturer's recommendations, and n = number of divers.
 - a. Standby diver must be included in the equation. Thus, if the dive will be performed by one individual, (n) will be 2.
 - b. D equals the depth of the intended dive.
 - c. ACFM equals the minimum air flow requirement; however, it may be higher as determined by the manufacturer's specifications for the intended helmet/mask.
- 2) Ensure that the breathing gas supplies are adequate to include decompression, recompression and necessary equipment throughout all phases of the planned operation.
- 3) Verify that all breathing gas supply systems have a suitable volume tank and filtration system installed in the air supply line between the supply source and diver's hose connection. A filtration system must be installed between the volume tank and dive manifold.
- 4) Verify that all supply hoses running to and from the compressor have proper leads do not pass near high-heat areas such as steam lines, are free of kinks and bends and are not exposed on deck in such a way that they could be rolled over, damaged or severed by machinery or other means.
- 5) Verify that all high-pressure supply and interface hoses have safety lines and strain relief properly attached.
- 6) Should O₂ in excess of 50 percent be used for in-water breathing media, the equipment should be O₂ clean and designed for use with pure oxygen. All personnel should be formally trained in its use.
- 7) Checks on compressor system(s):
 - a. All compressors should be fully fueled, lubricated and serviced.
 - b. Determine that sufficient fuel, coolant, lubricants and anti-freeze are available to service all components throughout the operation.
 - c. Verify that oil in the compressor is of an approved type. Ensure that compressor oil does not overflow the fill mark during servicing, as this is a source of potential contamination of the air supply. Any oil spillage must be cleaned up immediately.
 - d. Check that the compressor's exhaust is vented away from the work area, and specifically that the air compressor intake is not in the path of exhaust gases.
 - e. Check that the compressor inlet is located in an area free of potential contamination.
 - f. Check that compressors are not covered during operation.
 - g. Check all filters, cleaners and oil separators for cleanliness.
 - h. Bleed off all condensed moisture from filters and from the bottom of volume tanks.
 - i. Check all manifold drain plugs.

- j. Check that all valves are properly aligned.
- k. Check that all belt-guards are properly in place on drive units.
- l. Check all pressure-release valves, check valves and automatic un-loaders.

7.22.4 ACTIVATING THE BREATHING GAS SUPPLIES

- 1) Compressors:
 - a. Ensure that all warm-up procedures are followed 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 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 and check delivery.

7.22.5 BREATHING GAS HOSES

- 1) Ensure all hoses have a clear lead and are protected from excessive heating or physical damage;
- 2) Briefly blow through hoses prior to connection;
- 3) Ensure that breathing gas hoses (umbilicals) are properly marked to determine the distance the umbilical is paid out from the dive control station; and
- 4) Ensure that breathing gas hoses (umbilicals) are suitable for the gases to be used and have been maintained in proper conditions of cleanliness.

7.22.6 TESTING OF EQUIPMENT WITH BREATHING GAS SUPPLY ACTIVATED

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

7.23 UNDERWATER LIFT BAG OPERATIONS

7.23.1 PURPOSE

Some commercial harvest diving operations utilize underwater lift bags to transfer harvested product from the bottom to topside. The purpose of this section is to identify potential hazards and recommend safety precautions when working with underwater lift bags. It is highly recommended that these guidelines be followed when using underwater lift bags for commercial harvest diving operations.

7.23.2 DEFINITIONS

Anchor point – A point where the 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 also out-fitted with an extra length line, which can allow 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 unplanned ascent.

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

Inversion line/upset line – A line attached to an appropriate anchor point, and to the top of the lift bag, to ensure that the bag inverts and deflates the air in the event of any 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.

7.23.3 RESPONSIBILITY

The Experienced Dive Operator is responsible for the welfare and safety of the dive team. However, the diver is responsible for ensuring that he or she is familiar with the principles of underwater lift bag operations, i.e., he or she is performing tasks utilizing underwater lift bags in a safe and responsible manner.

7.23.4 OPERATIONAL CONSIDERATIONS WHEN USING UNDERWATER LIFT BAGS

- 1) Environmental conditions, including weather, but also:
 - a. Currents;
 - b. Seabed conditions; and
 - c. Possible seabed obstructions.
- 2) Details of the object to be lifted and its position in the water column:
 - a. The composition (what the object is made of and its approximate center of gravity);
 - b. Assessment of the object's exact position and its stability; and
 - c. Determination of the object's lifting points.
- 3) Perform all necessary calculations to determine the object's weight, taking into consideration the object's submerged weight, stability, and its approximate center of gravity (Appendix 4).
- 4) When making calculations, assess the best position and number of lift bags required to avoid damage (e.g., bending or buckling) to the object(s).
- 5) Determination of inflation sequence when using multiple lift bags (it is important to establish a safe and damage-free lift).
- 6) Remember: In shallow water, air entering the lift bag will experience a greater percentage of change in volume as it rises compared to air entering the lift bag at deeper depths. In other words, underwater lift bags inflate more rapidly at shallow depths compared to deep depths.

7.23.5 PRECAUTIONS

When performing tasks underwater, divers are often required to move or lift objects using the assistance of underwater lift bags. Underwater lift bags are not like other forms of lifting devices. The lifting action is produced by the displacement of water when the bags are filled with air – using underwater lift bags can pose a threat of uncontrolled ascent to the diver and/or object – therefore, extreme caution must be used when inflating underwater lift bags. A diver must be aware of the position of his or her umbilical at all times to avoid fouling. Hose management is essential to prevent entanglement with the underwater air lift bag rigging or the object to be lifted. The use of enclosed lift bags or lift bags with multiple attachment points requires additional planning, and the user should refer to the manufacturer's suggested guidelines for proper use and operation. Common sense and remaining alert are considered essential components for approaching operations of this nature. Furthermore, a Job Hazard Analysis (JHA) by the Experienced Dive Operator would be prudent (Appendix 9) and the JHA should

be updated as work progresses, reflecting the current conditions and job status, with extra precautions implemented as appropriate.

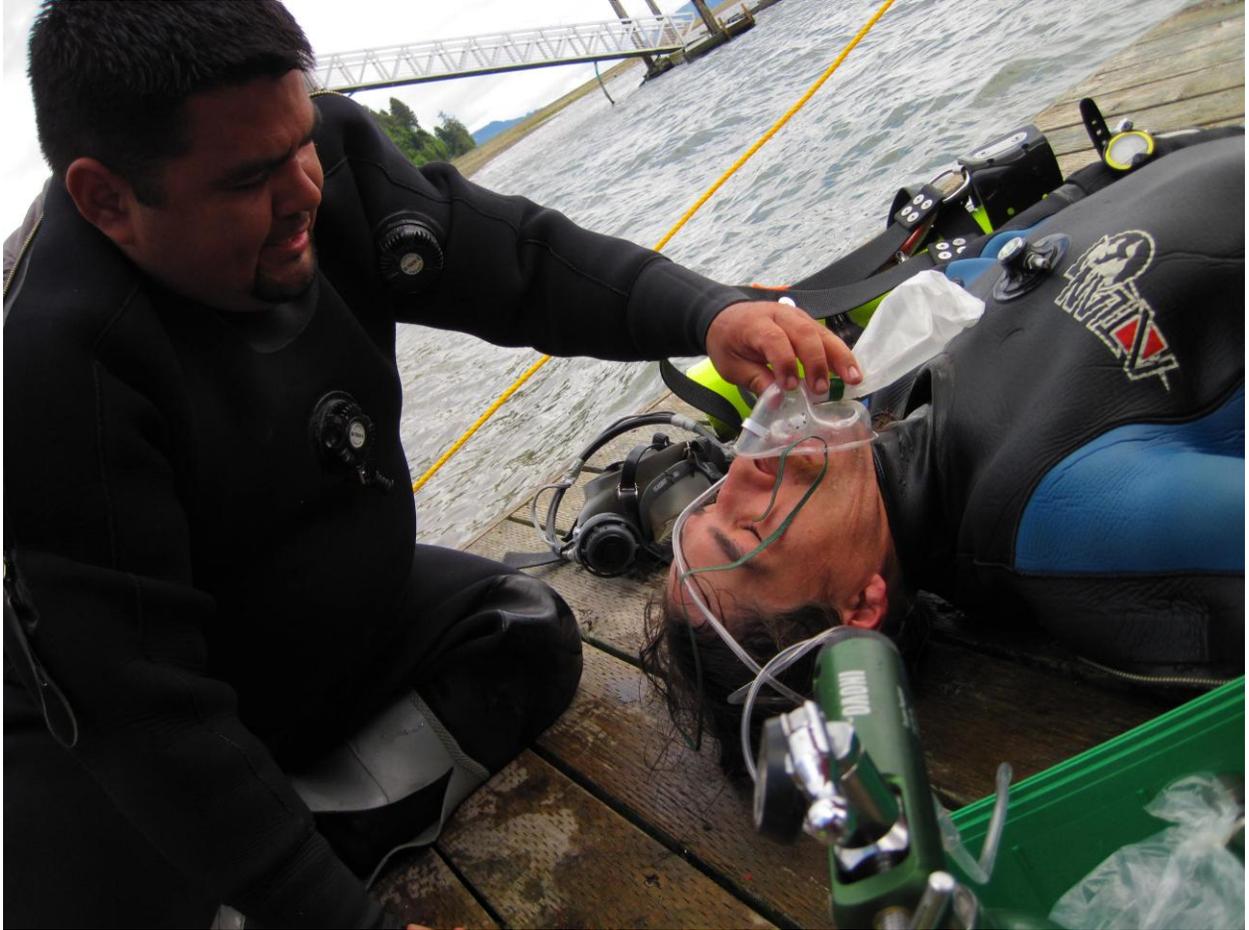
7.23.6 POTENTIAL HAZARDS ASSOCIATED WITH UNDERWATER LIFT BAG OPERATIONS

- 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) Utilization of a lift bag not rated for the load;
- 6) Obstructions in the path of the lift (water-column or surface);
- 7) Unplanned free ascent; and
- 8) Diver fouling on lift bag or rigging during unplanned ascent.

7.23.7 RECOMMENDED WAYS TO MITIGATE HAZARDS ASSOCIATED WITH UNDERWATER LIFT BAG OPERATIONS

- 1) Situational awareness on the part of the diver and topside personnel.
- 2) Proper education and training:
 - a. See Appendix 4 for applicable physics and formulas:
 - i. Boyles' Law;
 - ii. Archimedes' Principle; and
 - iii. Hydrostatic pressure/absolute pressure.
- 3) Ensure that an anchor/restraining line is present, when applicable, with sufficient strength to remain attached to the load and dead man anchor.
- 4) Ensure that dump lines are distinguishable from all other lines.
- 5) Ensure that diver's personal equipment and all other tools are not in a position to get fouled with the dump line.
- 6) Proper maintenance, inspection and testing of lift bag and its rigging. It is recommended that a log for the inspection and maintenance of each underwater lift bag accompany the lift bag wherever it is operationally deployed.
- 7) Attachment of an inversion line to the top of the lift bag (the inversion line should be secured to an anchor point).
- 8) Proper education and training, combined with visible markings to indicate the ratings of the lift bag and the units of measurement used to express that rating (lb/kg). It is important to utilize lift bags that have a lift capacity that is as close as possible to the weight of the object to prevent the potential for additional tilt on ascent.
- 9) A complete assessment and survey of the area must be performed prior to initiating lift (inflation of the lift bag).
- 10) Ensure anchor points, when applicable, are heavier than the greatest potential lift of the lift bag(s).
- 11) Do not use excess buoyancy to "break out" or "free" a load from the seabed since this can result in an uncontrolled ascent of the load (and possibly the diver).

COMMERCIAL HARVEST DIVING STANDARDS



8.0 FIRST AID AND EMERGENCY PROCEDURES, ASSESSMENTS, AND REPORTING OF ACCIDENTS

8.1 EMERGENCY AID

Each LNR-registered dive vessel owner shall develop and maintain a list of the available sources of emergency aid, equipment and professional assistance with call signs, phone numbers (Appendix 7) or other means and instructions for establishing contact with them for locations where operations are conducted. Each LNR-registered dive vessel owner shall make the contact list available at his/her principal place of business, at the field operations site, and to those who may have a need for it to fulfill the LNR-registered dive vessel owner's emergency response plan. The list shall include information necessary to obtain the following types of emergency aid as appropriate for the type of diving or underwater activity conducted (Appendix 7):

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

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

8.2 FIRST AID

First aid supplies appropriate to the type of operation being conducted should be provided and kept readily accessible in a clearly marked container at the work site. In addition to any other first aid supplies and standard first aid handbook (or equivalent), a means of manual resuscitation (pocket mask or others) is highly recommended. Each LNR-registered dive vessel is required to carry an emergency O₂ administration kit and dive team members must be formally trained in its use. A recommended list of the contents for a first aid kit is set forth below to reflect what should be considered the minimum contents. Note: This list will not be adequate for large-scale surface diving operations. Each LNR-registered dive vessel owner or Experienced Dive Operator should review this list and make additions or substitutions as necessary to ensure that effective and timely first aid can be furnished.

8.2.1 MINIMUM INVENTORY SUGGESTED FOR DIVING FIRST AID KIT:

- 1) 100 "Band-Aid" Strips – assorted;
- 2) One triangular bandage;
- 3) One roll adhesive tape;
- 4) Two ammonia inhalants;
- 5) One package absorbent cotton;
- 6) One bottle eye wash;
- 7) One gauze bandage, 1 inch x 10 yards;
- 8) 20 aspirin tablets;
- 9) One gauze bandage, 2 inches x 10 yards;
- 10) Four antiseptic wipes;
- 11) One elastic bandage, 3 inches x 5 yards;
- 12) One pair of scissors;
- 13) 10 non-adherent pads, 2 inches x 3 inches;
- 14) Six pairs of latex examination gloves;
- 15) Four oval eye patches;

- 16) One cold pack;
- 17) One gel pack, burn dressing kit;
- 18) One tourniquet;
- 19) One rescue airway;
- 20) One pair of tweezers;
- 21) One trauma dressing, 8 inches x 10 inches;
- 22) One first aid booklet;
- 23) Two one-way CPR shields;
- 24) One contents card (inventory);
- 25) One first aid cream;
- 26) One waterproof case;
- 27) One 1-1/2-ounce tube of triple antibiotic;
- 28) Four biohazard bags; and
- 29) One bag-type manual resuscitator with transparent mask and tubing.

The following items or equivalent are also recommended when operations are conducted at a remote site:

- 1) One bottle oral analgesic;
- 2) One package Alka Seltzer Plus;
- 3) One tube Benadryl cream;
- 4) One bottle antacid tablets;
- 5) One tube Neosporin ophthalmic ointment;
- 6) One basic poison antidote kit;
- 7) One bottle insect repellent;
- 8) One bottle Immodium AD;
- 9) One bottle Sudafed tablets;
- 10) One bottle/tube sunscreen, 15+ SPF;
- 11) One bottle Robitussin DM cough syrup;
- 12) One bottle nasal spray; and
- 13) One bottle ear drops.

8.2.2 MINIMUM INVENTORY REQUIRED FOR 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).

8.3 BASIC EMERGENCY PROCEDURES GUIDELINES

Table 1A7 (Appendix 7) outlines the causes, preventions, symptoms of, and treatments for, the most common diving maladies. In addition, the following procedures for situations that could affect the health and safety of diving personnel are offered as minimum guidelines only to assist LNR-registered dive vessel owners and their dive teams in developing detailed DSV- or operation-specific emergency procedures. The steps that are listed may not be in order of preference. Each emergency will dictate its own priorities (Appendix 7). In general, every emergency will cause the dive to be aborted until the cause has been fully remedied. Note: When available and used, the pneumofathometer hose (pneumo) should always contain the same gas mixture as the diver breathing

media; this is crucial when the pneumo is used during an emergency procedure. Finally, dive teams should practice emergency procedures drills on a periodic basis to ensure proficiency.

8.3.1 LOSS OF BREATHING MEDIA

- 1) Re-establish breathing media supply by:
 - a. Diver going on diver-worn or carried EGS (bailout);
 - b. Activating topside secondary breathing media supply; or
 - c. If applicable, charge diver's pneumo hose with breathing media and have diver insert pneumo hose into helmet/mask.
- 2) Alert standby diver.
- 3) Diver proceeds to downline or surface as applicable.
- 4) If necessary, send standby diver to assist diver.
- 5) Terminate dive.

8.3.2 LOSS OF COMMUNICATIONS

- 1) Attempt to reestablish electronic communications.
- 2) If communication cannot be reestablished, attempt to communicate through line-pull signals, e.g., **OATHE**:
 - a. 1 pull – **OK**
 - 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) If applicable, charge diver's pneumo hose with appropriate breathing gas.
- 4) Alert standby diver.
- 5) Diver proceeds to downline or surface as applicable.
- 6) Once line-pull signals are established, bring diver to first stop.
- 7) If required (unable to establish any form of communications with diver), send standby diver to assist diver before bringing diver to his or her first stop.
- 8) Terminate dive.

8.3.3 FOULED OR ENTRAPPED DIVER COMMUNICATIONS

- 1) Diver informs topside.
- 2) Avoid panic and ensure diver does not ditch equipment.
- 3) Alert standby diver.
- 4) Diver determines extent of entrapment.
- 5) Diver attempts to free self.
- 6) If required, send standby diver to assist diver.
- 7) When diver is free, if unable or unwilling to continue the dive, or if standby diver was required to go to diver's assistance, terminate dive.

8.3.4 INJURED DIVER IN WATER

- 1) Diver informs topside and dive is aborted.
- 2) Alert standby diver.
- 3) Diver determines nature and extent of injury.
- 4) If required, send standby diver down to assist diver, administer first aid, and evaluate injury.
- 5) Standby diver should remain with injured diver.
- 6) Monitor diver's breathing. If diver stops breathing, overpressure his or her regulator, if possible.
- 7) 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.

- 8) Institute planned diver recovery procedure.
- 9) Request required medical assistance and emergency evacuation, if required.

8.3.5 DIVER'S UMBILICAL SEVERED – GAS HOSE ONLY

- 1) Charge diver's pneumo hose with appropriate breathing gas.
- 2) Diver activates bailout bottle.
- 3) Alert standby diver.
- 4) If required, diver inserts pneumo hose inside helmet/mask.
- 5) Diver returns to surface.
- 6) If applicable, diver activates and uses emergency breathing media.
- 7) Terminate dive and follow proper decompression procedure.
- 8) If required, send standby diver down with additional bailout bottle or hose.

8.3.6 UMBILICAL COMPLETELY SEVERED – ALL COMPONENTS

- 1) Diver activates bailout bottle and returns to safety stop or surface.
 - a. If applicable, diver activates and uses emergency gas at safety stop.
- 2) Alert standby diver.
- 3) Deploy standby diver if the diver has not immediately surfaced.
- 4) If applicable, deploy marker buoy at diver's last known location.
- 5) If applicable and available, standby diver provides new hose/bailout bottle to diver; otherwise, send standby diver down the downline.
- 6) Terminate dive and, if applicable, follow proper decompression procedure.

8.3.7 FIRE TOPSIDE

- 1) Employ standard fire emergency procedures.
- 2) If required, suspend diving activities and evacuate diving station.

8.3.8 EQUIPMENT FAILURE - DIVER IN THE WATER

- 1) Evaluate effect on diver.
- 2) Inform diver of problem and action planned.
- 3) Alert standby diver.
- 4) Alert deck crew.
- 5) Diver informs topside of his or her readiness.
- 6) Activate plan and terminate dive.

8.3.9 ADVERSE ENVIRONMENTAL CONDITIONS

As a minimum, a specific procedure should be developed, as applicable, to address adverse environmental conditions including but not limited to:

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

8.3.10 OXYGEN TOXICITY (AS RELATED TO NITROX USE) – DIVER IN WATER

- 1) Supervisor notes signs, or diver reports symptoms to topside.
- 2) Reduce oxygen partial pressure (switch to air), or lower PPO₂ of mixed gases.

- 3) Deploy standby diver.
- 4) Continue decompression as per computer or on appropriate table(s).

8.3.11 OXYGEN TOXICITY (AS RELATED TO NITROX USE) DURING TREATMENT OF DIVING MALADY – TOPSIDE

- 1) Diver maintains communication with topside emergency care provider.
- 2) Instruct diver to remove oxygen mask for 15 minutes. After all symptoms disappear, start oxygen again. Do not count time not on oxygen. Continue treatment from where oxygen stopped.
- 3) If oxygen toxicity symptoms occur for the second time, repeat step 2.
- 4) If oxygen toxicity symptoms occur for the third time, discontinue oxygen and immediately request medical advice and assistance from EMS or a designated medical professional (e.g., Divers Alert Network or Virginia Mason Hospital, Appendix 7).

8.3.12 EMERGENCY EVACUATION

- 1) Notify diver and all surrounding personnel of emergency and terminate dive.
- 2) Decompress diver according to proper decompression procedures. If not possible, follow omitted decompression procedures.
- 3) Evacuate all unnecessary personnel to safe platform.
- 4) Inform Emergency Management Services (EMS – 911) of conditions as soon as possible.
- 5) Additional emergency procedures should be developed as needed, possibly including, but not limited to:
 - a. Loss of power supplies and
 - b. Adverse environmental conditions.

8.4 ACCIDENT REPORTING

Most jurisdictions outside of the Lummi Nation (e.g., U. S. Coast Guard or U. S. Department of Labor) require that commercial diving operations record and report the occurrence of any diving-related injury or illness. All LNR-registered dive vessel owners and associate dive team members shall record and report dive industry-related injuries (serious or catastrophic) and fatalities using the confidential LNR incident form (Appendix 9). Completed forms should be sent to the LNR Diving Safety Officer within seven (7) 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 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.

COMMERCIAL HARVEST DIVING STANDARDS



APPENDIX 1

CHRONOLOGY OF DEVELOPING/IMPLEMENTING THE LUMMI NATURAL RESOURCES COMMERCIAL HARVEST DIVING STANDARDS AND OTHER RELATED DIVE SAFETY MEASURES

COMMERCIAL HARVEST DIVING STANDARDS



Table 1A1. Chronology of 2012/2013 dive safety measures implemented/completed by Lummi Natural Resources (LNR) staff. DCB = diving control board, DSO = diving safety officer, Edmonds Technical Diving Services (ETDS), and LFNRC = Lummi Fisheries and Natural Resources Commission.

Date	Action Item	Description
February 9, 2012	Presentation before the LFNRC	Provided comparison of working diver standards from tribal, federal, and private entities.
February 23, 2012	Internal memo to LFNRC	Described 10-point plan to update/improve Lummi dive safety standards and procedures (see items listed in Section 1.3). Commission agreed with LNR recommendations, designating LNR staffer Karl Mueller as interim DSO.
February 28, 2012	Verification of training received	Developed standard forms/logs for applicants to dive fisheries to record their progress in fulfilling current regulatory requirements.
March 1–12, 2012	Requested proposals from training vendors	Solicited proposals from local commercial diving schools for conducting dive safety refresher training of Lummi commercial harvest diving personnel and for conducting dive vessel inspections.
March 8, 2012	Medical approval for divers	Met with Drs. Haveman and Tilley of the Lummi Tribal Health Center to discuss roles/responsibilities and current dive physical requirements.
March 16, 2012	Internal memo to LFNRC, LNR Executive Director, and Reservation Lead Attorney	Provided suggestions for possible changes to Natural Resources Code with respect to dive fisheries.
March 23, 2012	Internal memo to LNR Executive Director	At request of director, created flow chart outlining proposed roles/responsibilities of DSO, DCB, and LFNRC in approving applicants to dive fisheries.
March 29, 2012	Internal memo to LFNRC	Summarized estimates received from training vendors and outlined additional dive safety expenses (e.g., emergency oxygen kits and dive vessel inspections).
March 30, 2012	Presentation before the LFNRC	Commission agreed to seek funding for dive safety refresher training, training for interim DSO and LNR Enforcement Officers, emergency oxygen kits, and dive vessel inspections; Approved of Edmonds Technical Diving Services (ETDS) as training/vessel inspection vendor.

Table 1A1. Chronology of 2012/2013 dive safety measures implemented/completed by Lummi Natural Resources (LNR) staff. DCB = diving control board, DSO = diving safety officer, Edmonds Technical Diving Services (ETDS), and LFNRC = Lummi Fisheries and Natural Resources Commission.

Date	Action Item	Description
April 11–30, 2012	Training arrangements	Networked with ETDS and Lummi commercial harvest diving community to arrange dive safety refresher training.
May 2, 2012	LNR commercial harvest diving records	Initiated updates to LNR paper records of Lummi citizens participating in dive fisheries.
May 4–17, 2012	Training arrangements	Completed training arrangements for dive safety refresher training and other dive safety measures (e.g., training for DSO and LNR Enforcement Officers).
May 24, 2012	Funding approval for dive safety measures	Lummi Indian Business Council (LIBC) approved of funding dive safety refresher training, training for DSO and LNR Enforcement Officers, emergency oxygen kits, and dive vessel inspections.
May 22–26, 2012	Dive safety refresher training	ETDS conducted four overlapping two–day training sessions. One LFNRC commissioner, 32 members of the Lummi commercial harvest diving community, and four LNR staff members participated in training.
May 22–26, 2012	Conferred with stakeholders	During ETDS training, DSO met with participants nightly to discuss direction of LFNRC’s dive safety initiatives and to solicit input from the dive community.
June 5, 2012	LIBC contract development	Initiated LIBC contracts to cover expenses of previously-approved LNR dive safety measures.
June 29, 2012	Presentation before the LFNRC	Provided update on Lummi diving safety initiative.
July 3, 2012	Conferred with stakeholders	Met with members of Lummi commercial harvest diving community to solicit input and discuss proposed changes to diving standards and LNR regulations, scheduling dive vessel inspections and additional dive safety refresher training, and the distribution of emergency oxygen kits.
July 19, 2012	Dive vessel inspections	ETDS conducted safety inspections and tested air quality of air compressor systems on 10 Lummi dive vessels.
July 23, 2012	LNR commercial harvest diving records	Updates to LNR paper records of Lummi citizens participating in dive fisheries.
July 30–August 3,	DSO and LNR	Initiated Divemaster certification upgrade for LNR DSO and

Table 1A1. Chronology of 2012/2013 dive safety measures implemented/completed by Lummi Natural Resources (LNR) staff. DCB = diving control board, DSO = diving safety officer, Edmonds Technical Diving Services (ETDS), and LFNRC = Lummi Fisheries and Natural Resources Commission.

Date	Action Item	Description
2012	Enforcement Officer training	trained two enforcement officers in open water scuba. In addition, all three trained in surface supplied air diving.
August 9, 2012	Presentation before the LFNRC	Provided update on Lummi diving safety initiative.
August 10, 2012	Distribution of emergency oxygen kits	Initiated distribution plan for emergency oxygen kits; drafted equipment loan agreement for kits.
August 16, 2012	Presentation before the LFNRC	Commission approved and adopted LNR Regulation 12-40 Dive Vessel Registration.
August 21, 2012	LNR commercial harvest diving records	Met with LNR Natural Resources Analyst to develop management database for registering dive vessels and tracking participants in LNR-approved commercial harvest diving operations.
August 27, 2012	Presentation before the LFNRC	Commission approved and adopted LNR Regulations 96-03B and 96-04B, revisions of the original regulations that reflect the LFNRC's 2012 dive safety initiative.
August 30, 2012	Medical approval for divers	Met with Drs. Haveman and Tilley of the Lummi Tribal Health Center to discuss drug testing, roles/responsibilities, and dive physical requirements in updated LNR diving regulations.
September 14, 2012	Distribution of emergency oxygen kits	Continued distributing emergency oxygen kits to Lummi dive fleet (10 registered vessels).
September 17, 2012	LNR commercial harvest diving records	Reconciled archived paper records of LNR-approved dive vessels and dive fishery participants with new LNR diving management database system.
September 19, 2012	Conferred with stakeholders	Met with members of Lummi commercial harvest diving community to apprise them of the recent changes to the LNR diving regulations and to seek consensus on which standards to adopt. Group unanimously chose the standards used by the Association of Diving Contractors International (ADCI).
September 21, 2012	Diving standards development	Initiated compiling and editing the LNR Commercial Harvest Diving Standards based on those of ADCI, and to a lesser degree, those of the National Oceanic and Atmospheric Administration (NOAA), University of Washington (UW), Divers Alert Network

Table 1A1. Chronology of 2012/2013 dive safety measures implemented/completed by Lummi Natural Resources (LNR) staff. DCB = diving control board, DSO = diving safety officer, Edmonds Technical Diving Services (ETDS), and LFNRC = Lummi Fisheries and Natural Resources Commission.

Date	Action Item	Description
		(DAN), Technical Diving International (TDI), and ETDS.
October 19, 2012	Diving standards development	Completed first rough draft of LNR Commercial Harvest Diving Standards.
November 9, 2012	Diving standards development	Completed second rough draft of LNR Commercial Harvest Diving Standards.
December 3–4, 2012	Dive safety refresher training	ETDS conducted a two–day training session for seven (7) members of the Lummi commercial harvest diving community.
December 4–6, 2012	DSO and LNR Enforcement Officer training	ETDS conducted Solo Diver certification for LNR DSO and first level Emergency Response Diver training for two enforcement officers.
December 11, 2012	Conferred with stakeholders	Discussed LNR Commercial Harvest Diving Standards, posted second rough draft of standards on LNR Harvest Management website, and requested feedback from Lummi commercial harvest diving community.
December 18–20, 2012	Dive safety refresher training	ETDS conducted two overlapping two–day training sessions for seven (7) members of the Lummi commercial harvest diving community.
January 11, 2013	Distribution of emergency oxygen kits	Completed distributing emergency oxygen kits to Lummi dive fleet (11 registered vessels).
January 29–30, 2013	Dive safety refresher training	ETDS conducted a two–day training session for four (4) members of the Lummi commercial harvest diving community.
January 30, 2013	Conferred with stakeholders	Arranged meeting to review and comment on draft LNR Commercial Harvest Diving Standards; also, arranged fishing vessel inspections by United States Coast Guard (USCG).
February 5, 2013	Fishing vessel inspections	USCG conducted safety inspections of fishing vessels at Gooseberry Point.
February 6, 2013	Diving standards development	Completed third rough draft of LNR Commercial Harvest Diving Standards.
February 7, 2013	Conferred with	Met formally with members of Lummi commercial harvest diving community at Legacy Room, Silver Reef Casino, to review and

Table 1A1. Chronology of 2012/2013 dive safety measures implemented/completed by Lummi Natural Resources (LNR) staff. DCB = diving control board, DSO = diving safety officer, Edmonds Technical Diving Services (ETDS), and LFNRC = Lummi Fisheries and Natural Resources Commission.

Date	Action Item	Description
	stakeholders	comment on third rough draft of LNR Commercial Harvest Diving Standards.
March 5, 2013	Diving standards development	Completed fourth rough draft of LNR Commercial Harvest Diving Standards.
March 20, 2013	Internal memo to LFNRC	Reviewed and analyzed estimates received from several retail diving vendors concerning the cost of two sets of diving equipment for the LNR DSO and the LNR Harvest Manager.
April 24, 2013	Medical approval for divers	Exchanged e-mails and conversed with Lucy James of Safety West Coast (off Slater Road) regarding workplace drug testing.
April 24, 2013	Diving standards development	Met with Candy Solomon of the Communications Department to discuss printing copies of the LNR Commercial Harvest Diving Standards after adoption by LFNRC.
April 25, 2013	Medical approval for divers	Met with Drs. Haveman and Tilley of the Lummi Tribal Health Center to discuss drug testing, proposed DCB and LFNRC roles/responsibilities, and dive physical requirements in draft LNR commercial harvest diving standards. Afterward, met with Angel Finkbonner-Scott of Lummi Indian Business Council (LIBC) regarding HIPAA medical privacy issues.
April 30, 2013	Fishing vessel inspections	USCG conducted safety inspections of fishing vessels at Gooseberry Point.
May 6, 2013	Presentation before the LFNRC	LFNRC approved of funding two sets of diving equipment for LNR DSO and the LNR Harvest Manager (vendor: Adventures Down Under) and funding for an air quality testing instrument for dive vessel inspections.
June 5, 2013	Presentation before the LFNRC	LFNRC approved of adopting the LNR Commercial Harvest Diving Standards, including the creation of a Lummi DCB, diving reciprocity with other Treaty Tribes, and the updated medical requirements for commercial harvest diving, and passed Regulation 2013-24, Lummi Nation Commercial Harvest Diving Standards, citing the document as the standards for all commercial harvest diving activities permitted under the auspices of the Lummi Nation (effective July 1, 2013).

Table 1A1. Chronology of 2012/2013 dive safety measures implemented/completed by Lummi Natural Resources (LNR) staff. DCB = diving control board, DSO = diving safety officer, Edmonds Technical Diving Services (ETDS), and LFNRC = Lummi Fisheries and Natural Resources Commission.

Date	Action Item	Description
June 7, 2013	Conferred with stakeholders	Met with members of Lummi commercial harvest diving community to apprise them of recent LFNRC action to adopt new standards.
June 11, 2013	Medical approval for divers	Exchanged e-mails with Charles Hurt, LIBC staff attorney, and Angel-Finkbonner Scott regarding HIPAA medical privacy issues.
June 11, 2013	Diving standards development	Met with Julie Jefferson of the Communications Department to arrange printing copies of the newly-adopted LNR Commercial Harvest Diving Standards.

APPENDIX 2

LOCAL COMMERCIAL DIVING SCHOOLS AND SERVICE CENTERS

Note: Lummi Natural Resources Department (LNR) does not perform as an educational organization and as such does not endorse, certify, or accredit any commercial school participating in the training of personnel. Commercial schools are expected to obtain and preserve appropriate accreditation from agencies under whose jurisdiction their educational requirements must be maintained. **Listing centers here does not imply endorsement by LNR or the Lummi Indian Business Council.**

Dive Commercial International

7058 15th Avenue NW

Seattle, Washington 98117

(866) 784-5050 (toll free)

(206) 784-5050 (local)

(206) 696-2126 (after hours)

(206) 286-2723 (fax)

info@divecommercial.com

Divers Institute of Technology

4315 11th Avenue NW

Seattle, Washington 98107

(800) 634-8377 (toll free)

(206) 783-5542; (206) 783-2658

info@diversinstitute.com

Edmonds Technical Diving Services

P.O. Box 531

Edmonds, Washington 98020

(206) 618-3096

info@etds.org

Nisqually Marine Services

4820 She-Nah-Num Drive SE

Olympia, Washington 98513

(360) 456-5221, ext. 2135

luciadiver@msn.com

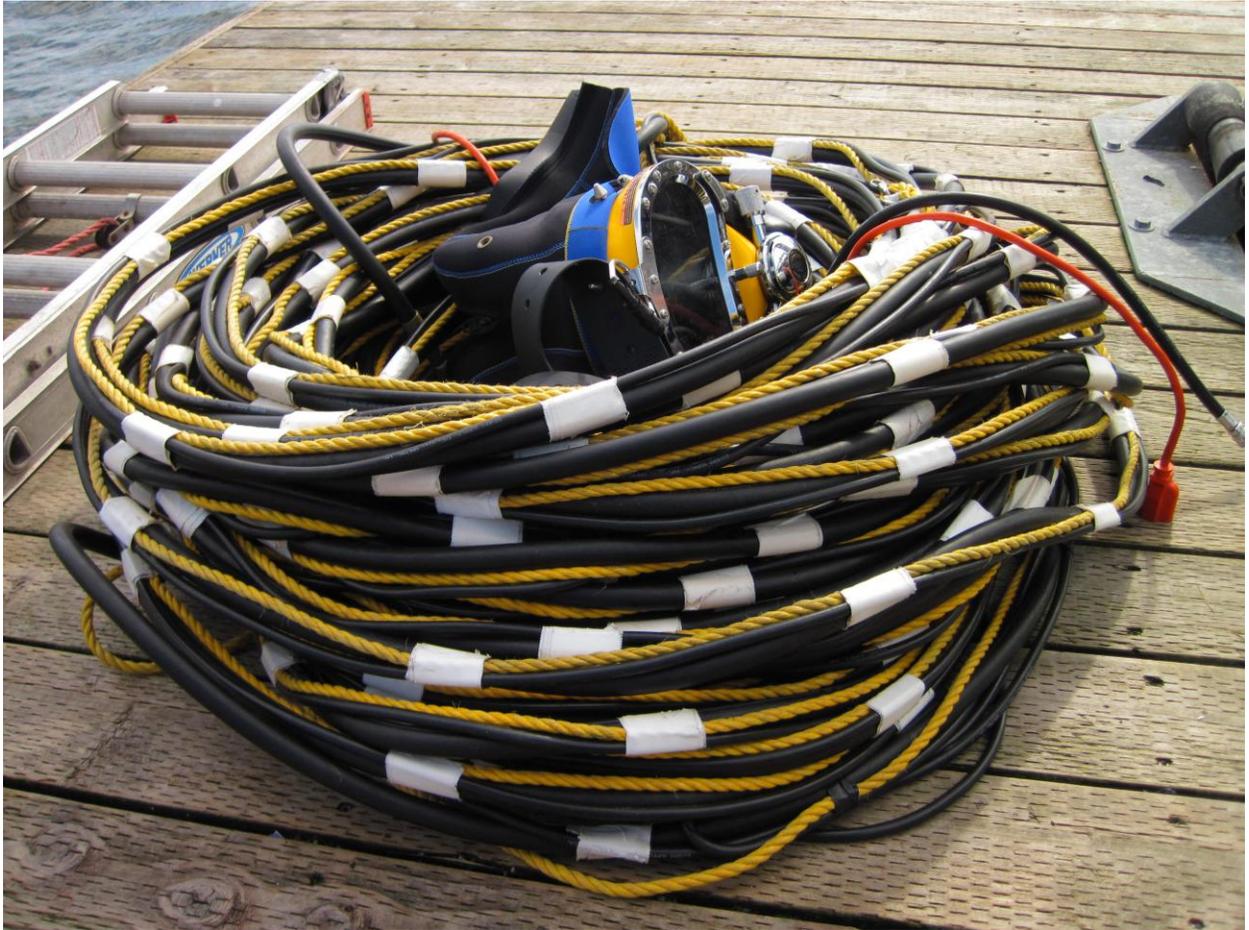
Alternatively, a formal course of study for a Hose Tender or Trainee Diver can be completed at any accredited school, military school, or equivalent whose curriculum satisfies elements of the American National Standards Institute (ANSI) technical document ANSI/ACDE-01-2009 relevant to surface supplied air diving. This standard can be found on-line at <http://www.acde.us/ansistd.pdf> or on file at the LNR office and is available from the LNR Diving Safety Officer. Although LNR primarily recognizes formal training certificates issued from local commercial schools such as Dive Commercial International, Divers Institute of Technology, Edmonds Technical Diving Services, and Nisqually Marine Services (see above), the department will also evaluate and recognize formal training certificates issued from within other nations. Surface supplied air diver certificates from other nations may include but are not limited to:

- 1) Australian Diver Accreditation Scheme Part 3
- 2) Canadian Category 1 Diver
- 3) Canadian Surface-supplied Mixed Gas Diver to 70m
- 4) Canadian Unrestricted Surface-supplied Diver to 50m
- 5) Dutch Part 1 Surface Dependent Diver
- 6) Finland National Surface Supply Division
- 7) Denmark Surface-supplied Diver to 50m
- 8) French Class 2
- 9) UK HSE Surface-supplied (with offshore top up)
- 10) UK HSE Part I (Transitional Part 1 — issued between 7/1/81 and 12/31/81)
- 11) Italy OTS.BF
- 12) New Zealand Part 1
- 13) Norwegian NPD Surface Diver
- 14) South African Class II

APPENDIX 3

GLOSSARY OF TERMS

COMMERCIAL HARVEST DIVING STANDARDS



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

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

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 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 mixture.

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

CDP – Certified dive physician.

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 document recognized to reflect the formal training, field experience, on-the-job performance and capabilities of the individual.

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

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

Cylinder – A pressure vessel for the storage of gases.

DCB – Diving Control Board.

DDC – Deck decompression chamber or PVHO (pressure vessel for human occupancy). A deck chamber capable of controlled pressurization and depressurization.

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 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 Carried Emergency Gas Supply (Bailout) – The gas required to be worn/carried by the diver, while underwater.

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.

DPO – Dynamically position operator. The operator of a dynamically positioned vessel.

DP Vessel – Dynamically positioned vessel. A vessel that, through a computer controlled system, automatically maintains its position and heading by using its thrusters and propellers.

DSO – Diving Safety Officer.

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

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

DSV – Dive support vessel.

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

EGS – Emergency gas supply (bailout).

Embolism – See Gas Embolism.

EMS – Emergency Management Services.

Excursion Tables – Two tables for use with saturation excursion diving that limit upward and downward excursions and provide a zone in which the diver can move freely without regard to the number of excursions or their duration without incurring a decompression penalty.

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.

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.

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.

Helium Unscrambler — Unscrambler — Speech Unscrambler – An electronic device designed to render intelligible the words spoken in a helium hyperbaric environment.

High-pressure Nervous Syndrome (HPNS) – A group of symptoms, including a lack of coordination, tremors of the extremities, disorientation, nausea, dizziness, and brief lapses of consciousness occurring at depths of 500 feet or deeper.

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.

Life-Support Control System or LSCS – Fly-away package for EES system. A system designed for the support of deployed emergency evacuation systems (HRC or SPHLB).

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).

LST – Life-support technician or rack operator. Responsible for safe operation of hyperbaric system chambers; reports to diving supervisor.

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

Manifold – Panel for the distribution of diver breathing gas.

Manifold Operator – Individual, such as an LST, diving supervisor or mixed-gas diver, who is designated to perform the duties of gas distribution on a surface-supplied diving operation, who is 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 – 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.

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

MSW – Meter or meters of seawater.

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 non-return valve at the gas supply inlet to prevent depressurization of the helmet and the resultant squeeze, should the gas supply be lost.

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 O₂) – A condition usually not encountered unless PPO₂ approaches or exceeds 1.6 ATA. However, could be encountered as low as 1.4 ATA.

Oxygen Toxicity (Pulmonary O₂) – A condition from long exposures to increased PPO₂ 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 – That portion of the total gas pressure exerted by a particular constituent of the breathing mixture.

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.

Pneumo – 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.

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

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

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.

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.

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.

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

Transfer Under Pressure Lock/Chamber (TUP) – A lock or chamber that allows the transfer to and from of diving personnel between the worksite and living chambers (also called deck decompression chambers) without disturbing off-duty divers in the complex. Transfer under pressure locks/chambers are essential where being subjected to ambient pressure may be life-threatening.

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 dive location and the diver or bell that supplies a lifeline,

breathing gas, communications, power and heat as appropriate to the diving mode or conditions. Underwater cameras and cabling can also be carried as component parts of the umbilical and can be taped or banded to it on a temporary basis.

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.

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

COMMERCIAL HARVEST DIVING STANDARDS



APPENDIX 4

DIVING PHYSICS AND FORMULAS

COMMERCIAL HARVEST DIVING STANDARDS



PSIG to PSIA

PSIA = PSIG + 14.7; Round up to the next whole number.

PSIA to PSIG

PSIG = PSIA – 14.7; Round up to the next whole number.

Depth (fsw) to PSIG

PSIG = Depth x 0.445; Round up to next whole number.

PSIG to Depth (fsw)

Depth = PSIG divided by 0.445; Round up to next whole number.

PSIG to Atmosphere Absolute (ATA)

ATA = (PSIG + 14.7)/14.7; Carry two decimal places.

Atmospheres Absolute (ATA) to PSIG

(ATA – 1) x 14.7 = PSIG

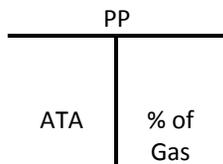
Depth (fsw) to Atmospheres Absolute (ATA)

ATA = (Depth + 33)/33; Carry two decimal places.

ATA to Depth (fsw)

(ATA – 1) x 33 = Depth (fsw); Round up to next whole number.

DALTON’S LAW (“T” Formula)



PP = Partial Pressure

% = Percent by Volume of the Identified Gas

ATA = Atmospheres Absolute

GAY-LUSSAC’S LAW

$P_2 = (P_1 \times T_2)/T_1$

Volume is constant.

T1 = Initial Temperature (absolute)

T2 = Final Temperature (absolute)

P1 = Initial Pressure (absolute)

P2 = Final Pressure (absolute)

CHARLES’ LAW

$V_2 = (V_1 \times T_2)/T_1$

Pressure is constant.

T1 = Initial Temperature (absolute)

T2 = Final Temperature (absolute)

V1 = Initial Pressure (absolute)

P2 = Final Pressure (absolute)

BOYLES’ LAW (Pressure/Volume Relationship)

$(DL + 33)/(DA + 33) \times OV = NV$

DL= Depth Left

DA = Depth Arrived

OV = Original Volume

NV = New Volume

HENRY’S LAW (The Law of Gas Absorption and Solubility)

EXPLANATION:

- 1) The amount of any given gas that will dissolve in a liquid at a given temperature is directly proportional to the partial pressure of that gas.
- 2) Gas diffuses and dissolves in blood, because of the difference in partial pressure, between inhaled and expired air.
- 3) The inert gas in the breathing media (nitrogen or helium) will be dissolved into the diver’s body tissues as the diver is

descending and during the time spent on bottom.

- 4) Whichever gases are dissolved into a diver's body tissues, at a given depth and pressure, will remain in the tissues, as long as the depth is maintained. As the diver starts to ascend, more and more of the dissolved gas will come out of his or her tissues. If his ascent is controlled, as through the use of the decompression table, the dissolved gas will be carried to the lungs and exhaled before it accumulates sufficiently to form significant bubbles in the blood or tissues.

GENERAL GAS LAW
(Pressure/Volume/Temperature Relationship)

$$(P1 \times V1) \div T1 = (P2 \times V2) \div T2$$

Degrees Fahrenheit to Rankine

$$R^\circ = F^\circ + 460^\circ$$

Degrees Celsius to Absolute

$$C^\circ + 273^\circ = \text{Degrees Kelvin}$$

Degrees Fahrenheit to Celsius

$$5 \times (F^\circ - 32^\circ) \div 9 = \text{Celsius; Carry 1 decimal place}$$

Degrees Celsius to Fahrenheit

$$(9 \times C^\circ) \div 5 = 32^\circ = \text{Fahrenheit; Carry 1 decimal place}$$

Gas Volume Requirement Formula if Using an LP Compressor

$$SCFM = \text{ATA} \times \text{ACFM} \times N$$

Gas Volume Requirement Formula if Using an HP Gas Bank

$$SCF = \text{ATA} \times \text{ACFM} \times N \times T$$

SCFM = Standard Cubic Feet per Minute

SCF = Standard Cubic Feet

ATA = Atmospheres Absolute

ACFM = Actual Cubic Feet per Minute

N = Number of Divers

T = Time (always expressed in minutes)

Minimum Manifold Pressure

MMP = D x 0.445 + Over Bottom Pressure (OBP is established by company or a set standard used); Round up to next whole number.

Average Gas Consumption Based Upon Moderate

Free-flow Type Hat (Desco, MK V)	4.5 ACFM
Demand Type Hat (Superlite/Miller)	1.4 ACFM
Built-in Breathing System (BIBS)	0.3 ACFM

Treatment Gas Mixtures (O₂/HeO₂/N₂O₂)

Depth (fsw)	Gas Mixture	PPO ₂
0 – 60 fsw	100 % O ₂	1.00 – 2.81 ATA
61 – 165 fsw	50/50% HeO ₂ or N ₂ O ₂	1.42 – 3.00 ATA
166 – 225 fsw	64/36% HeO ₂	2.17 – 2.80 ATA

Example of Calculating Surface Interval (SI) Using Expanded 24-hr Clock

Reached surface (RS) @ 2305; left surface (LS) @ 0317; 0317 may be expressed, ONLY FOR THE PURPOSE OF CALCULATION, as "2717"; subtract RS from 2717 to determine SI; SI = 2717 – 2305 = 0412 or 4 hrs and 12 min.

Calculating In-water Travel Time

- 1) Depth left (feet or m) minus (-) depth arrived (feet or m) = distance traveled (feet or m).
- 2) Distance traveled divided (÷) by ascent/descent rate = minutes (and/or percentage of a minute in decimal).
- 3) Whole number is minute(s); decimal is percentage of minute; take decimal and multiply by 60 (the number of seconds in one minute); decimal will then convert to actual seconds.

Example:

- 1) 215 fsw – 87 fsw = 128 fsw; ascent rate: 30 fpm
- 2) 128 fsw ÷ 30 fpm = 4.26 (4 minutes and 0.26 or 26% of one minute)
- 3) 0.26 x 60 = 15.6 seconds; round up to next whole second or 16 seconds
- 4) 4 minutes and 16 seconds is your travel time from 215 fsw to 87 fsw

FORMULA DEFINITIONS

ACF – Actual Cubic Feet

ACFM – Actual Cubic Feet per Minute

ATA – Atmospheres Absolute

ATM – Atmospheres

CFM – Cubic Feet per Minute

D – Diameter

FFW – Feet of Fresh Water

FSW – Feet of Sea Water

FV – Floodable Volume

HP – High Pressure

LP – Low Pressure

MSW – Meters of Fresh Water

MSW – Meters of Sea Water

MWP – Maximum Working Pressure

PP – Partial Pressure

PP02 – Partial Pressure of Oxygen

PPM – Parts Per Million

PSIG – Pounds per Square Inch Gauge

PSIA – Pounds per Square Inch Absolute

SCF – Standard Cubic Feet

SCFM – Standard Cubic Feet per Minute

V – Volume

W – Weight

WP – Working Pressure

ENGLISH–METRIC EQUIVALENTS

PRESSURE EQUIVALENTS				
Atmosphere	Bars	Pounds Per Square Inch (PSIG)	Columns of Mercury at 0°C	Columns of Water at 15°C
1	1.01325	14.696	.76 meters / 29.92 inches	10.33 MSW / 33.06 FSW
0.986923	1	14.50	.75 meters / 29.59 inches	10.20 MSW / 32.63 FSW
0.967841	.98066	14.22	.73 meters / 28.95 inches	10.00 MSW / 32.00 FSW
.068046	.068947	1	.05 meters / 2.03 inches	.70 MSW / 2.25 FSW
1.31579	1.33322	19.33	1 meters / 39.37 inches	13.60 MSW / 43.50 FSW
.0334211	.0338639	.4911	.0254 meters / 1 inch	.345 MSW / 1.10 FSW
.09674	.09798	1.421	.0735 meters / 2.89 inches	1 MSW / 3.19 FSW
.002456	.002489	.0360	.0018 meters / .0735 inches	.025 MSW / .0812 FSW
.029487	.029877	.4333	.0224 meters / .8822 inches	.304 MSW / .975 FSW
.030242	.03064271	.4444	.0229 meters / .9048 inches	.3126 MSW / 1 FSW

MASS EQUIVALENTS						
Kilograms	Grams	Ounces	Pounds	Tons (short)	Tons (long)	Tons (metric)
1	1000	35.274	2.20462	1.1023x10 ⁻³	9.942x10 ⁻⁴	0.001
0.001	1	0.035274	2.2046x10 ⁻³	1.1023x10 ⁻⁶	9.842x10 ⁻⁷	0.000001
6.479x10 ⁻⁵	0.6047989	2.2857x10 ⁻³	1.4286x10 ⁻⁴	7.1429x10 ⁻⁸	6.3776x10 ⁻⁸	6.4799x10 ⁻⁸
0.0283495	28.3495	1	0.0625	3.125x10 ⁻⁵	2.790x10 ⁻⁵	2.835x10 ⁻⁵
0.453592	453.592	16	1	0.0005	4.4543x10 ⁻⁴	4.5359x10 ⁻⁴
907.185	907185	32000	2000	1	0.892857	0.907185
1016.05	1.016x10 ⁶	35840	2240	1.12	1	1.01605
1000	106	35274	2204.62	1.10231	984206	1

LENGTH EQUIVALENTS								
Centimeters	Meters	Kilometers	Inches	Feet	Yards	Fathom	Miles	Nautical Mi.
1	0.01	0.00001	.3937	.0328	.0109	.005468	6.21x10 ⁻⁵	5.36x10 ⁻⁶
2.54	0.025	2540x10 ⁻⁵	1	.0833	.0277	.01388	1.57x10 ⁻⁵	1.37x10 ⁻⁵
30.48	0.3048	3048x10 ⁻⁴	12	1	.3333	.16666	1.89x10 ⁻⁴	1.64x10 ⁻⁴
91.44	0.9144	9.14x10 ⁻⁴	36	3	1	.5	5.68x10 ⁻⁴	4.93x10 ⁻⁴
100	1	0.001	39.37	3.28	1.093	.5468	6.21x10 ⁻⁴	5.39x10 ⁻⁴
182.88	1.828	.000182	72	6	2	1	.00113	9.86x10 ⁻⁴
100,000	1,000	1	39,370	3,280.83	1,093.61	546.8	.6213	.5395
160,935	1609.35	1,609	63,360	5,280	1,760	880	1	.8683
185,325	1853.25	1,853	72,962.4	6,080.4	2,026.73	1,013.36	1.1515	1

VOLUME AND CAPACITY EQUIVALENTS								
Cubic Centimeters	Milliliter	Liter	Cubic Inches	Cubic Feet	Cubic Yards	Pint	Quart	Gallon
1	.99997	9.99x10 ⁻⁴	.061023	3.53x10 ⁻⁵	1.30x10 ⁻³	2.113x10 ⁻³	1.056x10 ⁻³	2.641x10 ⁻⁴
16.387	16.3837	.016386	1	5.78x10 ⁻⁴	2.14x10 ⁻³	.034632	.017316	4.329x10 ⁻³
28,317	28,316.2	28316	1728	1	.037037	59.8442	29.9221	7.48052
764,559	764,538	764.53	46,656	27	1	1615.79	807.896	201.974
1.00	1	.001	.061025	3.53x10 ⁻⁵	1.308x10 ⁻⁶	2.11x10 ⁻³	1.056x10 ⁻³	2.641x10 ⁻⁴
1000.03	1,000	1	61.0251	.0353154	1.308x10 ⁻³	2.11342	1.05671	.264178
473.179	473.166	.47316	28.875	.0167101	6.188x10 ⁻⁴	1	0.5	.125
946.359	946.332	.9463	57.75	.0334201	1.237x10 ⁻³	2	1	.25
3,785	3,785	3.785	231	.133681	49511x10 ⁻³	8	4	1

Using Lift Bags - Example of Calculating Free Air Required to Complete a Lift

Approximately five (5) 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 ft³, b) the hypothetical density of geoduck clams is 75 lb/ft³, and c) the density of seawater is 64 lb/ft³. Calculate the volume of free air (ft³) required to complete the lift.

- 1) Calculate weight (lb) of object(s) in water ($W_{immersed}$):
 - 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 ($\text{Volume}_{5 \text{ crates}} = 5 \times 1.3 \text{ ft}^3 = 6.5 \text{ ft}^3$)
- ii. Weight of geoducks in air ($W_{\text{geoducks}} = \text{Volume}_{5 \text{ crates}} \times \text{Density}_{\text{geoducks}}$)
 - 1. $W_{\text{geoducks}} = 6.5 \text{ ft}^3 \times 75 \text{ lb/ft}^3 = 488 \text{ lb}$
- iii. Upthrust = $\text{Volume}_{5 \text{ crates}} \times \text{Density}_{\text{seawater}}$
 - 1. Upthrust = $6.5 \text{ ft}^3 \times 64 \text{ lb/ft}^3 = 416 \text{ lb}$ seawater displaced by about five crates worth of geoduck clams
- iv. $W_{\text{immersed}} = W_{\text{geoducks}} - \text{Upthrust} = 488 \text{ lb} - 416 \text{ lb} = 72 \text{ lb}$

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)
 - i. Note: At sea level, atmospheric pressure = 14.7 pounds/inch² (psi) = 1 atm; pressure of 1 ft seawater = 0.445 psi
 - ii. Ambient pressure (P_{ambient} ata) at 66 ft = 1 atm + ((66 ft X 0.445 psi)/14.7 psi)
 - 1. $P_{\text{ambient}} = 1 + (29.4/14.7) = 3 \text{ ata}$

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_{immersed})
 - i. Min. volume of lift bag required ($V_{\text{lift bag}} = W_{\text{immersed}} / \text{Density}_{\text{seawater}} = 72 \text{ lb} / (64 \text{ lb/ft}^3) = 1.13 \text{ ft}^3$)
 - ii. Free air required for lift ($\text{Air}_{\text{free}} = V_{\text{lift bag}} \times P_{\text{ambient}} = 1.13 \text{ ft}^3 \times 3 \text{ ata} = 3.4 \text{ ft}^3$)

COMMERCIAL HARVEST DIVING STANDARDS



APPENDIX 5

SAMPLE DIVE BRIEFING (HUNT)

PADI DIVE SIGNALS

ADCI PRE-DIVE SAFETY CHECKLIST

ADCI BAILOUT CALCULATIONS

COMMERCIAL HARVEST DIVING STANDARDS



Choose a dive leader to conduct the brief.
Include any helpers from the boat or beach in this brief.
Fill in the blanks as you discuss each item. Leave this card with your helpers to reference your plans or keep the card readily accessible on the surface.

Emergency Preparation

Number of divers in group: _____. The post-dive head count will be conducted by: _____

In case of emergency, contact (911, Coast Guard, DAN or other agency): _____

Method of emergency contact (cell phone, pay phone, VHF radio channel 16, other): _____

Names of CPR and first aid qualified: _____

100% oxygen available? Who knows how to use it? _____

How will an incapacitated diver be removed from the water to safety?

Are scissors available to cut off victim's wet/dry suit in case of unconsciousness?

Where is the nearest hospital? The nearest recompression chamber?

Plan Your Dive – Dive Your Plan

Purpose of dive: _____

Who will lead? _____

Max. depth _____ Bottom time _____ Min. PSI on surface _____

Discuss hand signals to include at a minimum: "Low on Air" "Out of Air"

"I don't understand" "Something's wrong" "Let's terminate the dive"

Where will the dive flag be flown? _____

Gear Configuration – Discuss/Demonstrate:

Accessibility of each diver's alternate air source.

Ability to release each diver's weights.

Valve locations and procedures to inflate/deflate each diver's BC.

Quickest method of removing each diver's BC/harness.

Does everyone have audio (whistle, horn) and visual (marker, lift bag) signals?

What is the safest and easiest method of getting in and out of the water?

Is this dive tide/current dependent? Time window for safe diving: _____

Hazards? For example: surf, fog, obstacles, or boat traffic.

Plan in case of loss of buddy contact:

- o Surface immediately?
- o Meet at a prearranged point on the bottom? _____
- o Search for _____ minutes and then surface?

Primary and backup out of air plan:

- o Share gas with dive buddy?
- o Self rescue (backup, independent gas source)?
- o Emergency ascent?

Contingencies specific to this dive, for example: poor visibility, unexpected current, use guide reel, light malfunction, possibility of entanglement or entrapment.

Ascent

Safety stop(s) during ascent: Depth(s): _____ Times(s): _____

What if the planned depth and/or bottom time is exceeded? _____

What if you cannot find the anchor line? _____

Free ascent procedures: _____

Water Exit

If the boat is not there or the current picks up unexpectedly, this is our plan:

Is somebody available on the boat/beach to call for help if you are overdue?

Time delay before flying (if applicable). _____

Notes

(Diver's full names, emergency contact info, local dive store phone #, etc...)



PADI STANDARD DIVING SIGNALS

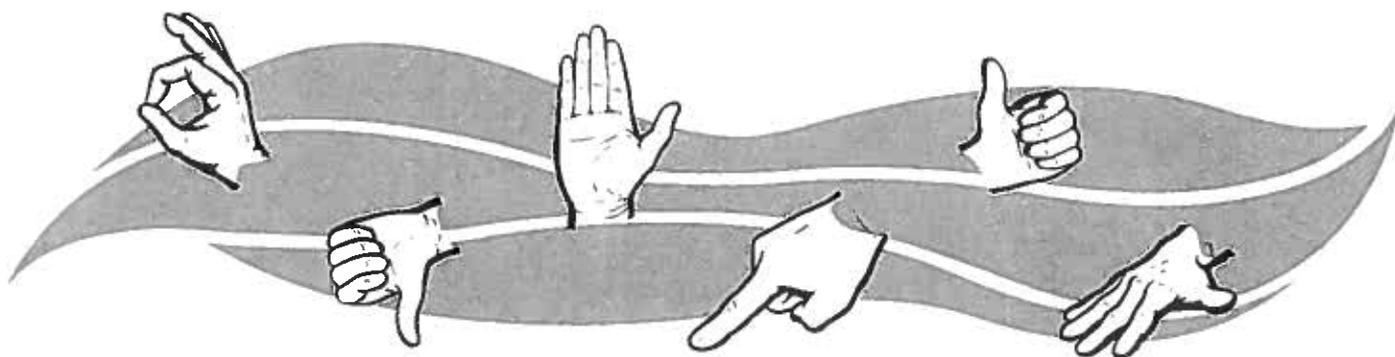
The primary form of underwater communication between divers is by hand signals. Signals 1 through 13 are National Standard hand signals. All of the other hand signals are basic and commonly used by most divers. If divers are operating under conditions of low visibility, they may communicate with tactual signals on a buddy line or by hand squeeze. Other forms of diver communication are by whistle, flashlight, flag, and underwater siren and are explained on the back page.

Hand signals and line-pull signals should be delivered in a forceful, exaggerated manner so there can be no

ambiguity about the signal and so it is obvious a signal is in fact being given. When a signal is given, it should immediately be acknowledged.

Divers in different areas of the world use different signals or variations of signals for the same message. Prior to a dive, the signals shown here should be reviewed. This review is particularly important when divers from different areas constitute a dive team. The following hand signals should be well understood and used by every diver.

- | | | |
|-------------------------------------|--------------------------------|-----------------------------|
| 1. Stop, hold it, stay there | 11. Low on air | 21. I am cold |
| 2. Something is wrong | 12. Out of air | 22. Take it easy, slow down |
| 3. OK? OK. | 13. Buddy breathe or share air | 23. Hold hands |
| 4. OK? OK. (glove on) | 14. Come here | 24. Get with your buddy |
| 5. Distress, help | 15. Me, or watch me | 25. You lead, I'll follow |
| 6. OK? OK. (on surface at distance) | 16. Under, over, around | 26. Yes |
| 7. OK? OK. (one hand occupied) | 17. Level off, this depth | 27. No |
| 8. Danger | 18. Go that way | 28. Look |
| 9. Go up, going up | 19. Which direction? | 29. What time? What depth? |
| 10. Go down, going down | 20. Ears not clearing | 30. I don't understand |



NATIONAL* STANDARD HAND SIGNALS (1 through 13)



1. Stop, hold it, stay there



2. Something is wrong



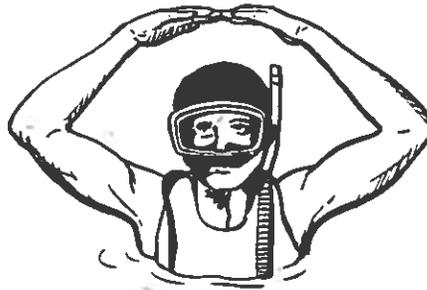
3. OK? OK.



4. OK? OK. (glove on)



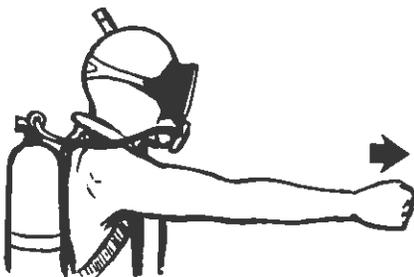
5. Distress, help



6. OK? OK. (on surface at distance)



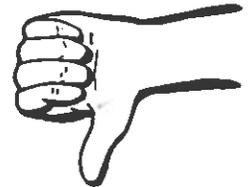
7. OK? OK.
(one hand occupied)



8. Danger



9. Go up, going up



10. Go down, going down



11. Low on air



12. Out of air



13. Buddy breathe or share air

* Hand signals 1 through 10 are recognized internationally in over 50 countries affiliated with CMAS—The World Underwater Federation. PADI is a member of the CMAS Technical Committee.

COMMONLY USED HAND SIGNALS (14 through 30)



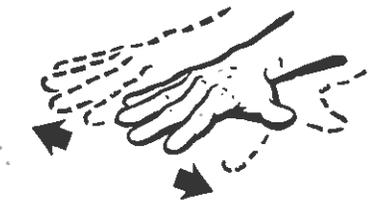
14. Come here



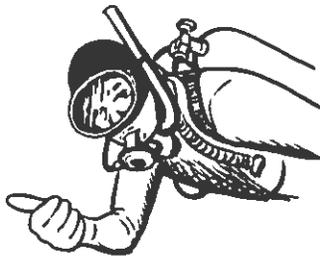
15. Me, or watch me



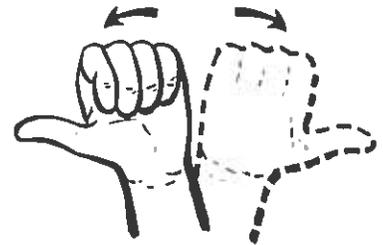
16. Under, over, or around.



17. Level off, this depth



18. Go that way



19. Which direction?



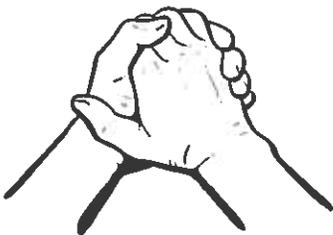
20. Ears not clearing



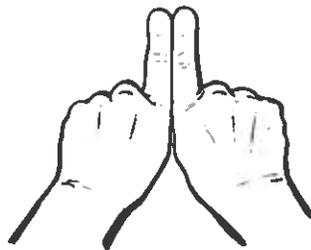
21. I am cold



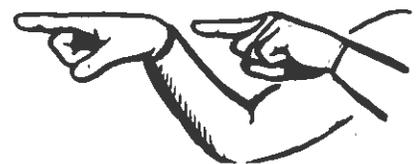
22. Take it easy, slow down



23. Hold hands



24. Get with your buddy



25. You lead, I'll follow

COMMONLY USED HAND SIGNALS (CONT.)



26. Yes



27. No



28. Look



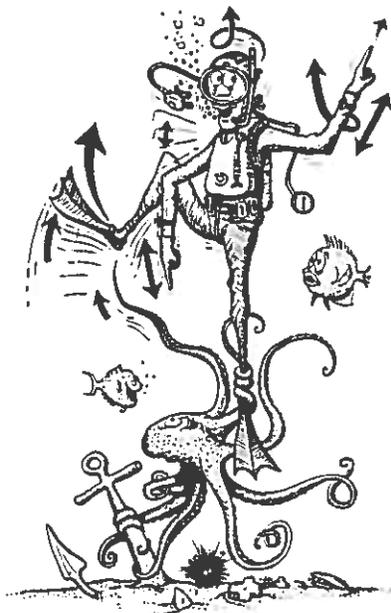
29. What time? What depth?



30. I don't understand

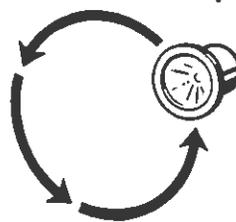
There are a multitude of other hand signals divers can employ during a sport dive. As divers dive together, they will develop other signals essential to their dive.

Some signals are naturally obvious as shown below.



NIGHT DIVING SIGNALS

(Buddy at Distance)



OK. All is well.

Large, slow circles with light.



Something is wrong.

Large, rapid up-and-down motions with arm extended.

When buddy is near, use regular hand signals in front of light.

UNDERWATER TACTUAL SIGNALS

- 1 Pull — ~~Stop~~ OK
- 2 Pulls — Go, ~~OK~~ Give slack
- 4 Pulls — Surface, Home
- 5 or more — Come here quickly, or EMERGENCY - Abort

These simple signals are easily remembered and can be transmitted by a hand squeeze instead of a buddy line. The lack of a three-pull signal allows rapid discrimination between routine "stop" and "go" signals and the more urgent "surface" and "come here quickly" signals.

WHISTLE SIGNAL

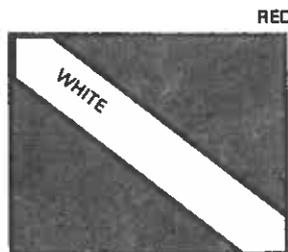
In diving, whistles are used only in emergency situations. Five or more short blasts on a whistle is an international distress signal for immediate assistance.

UNDERWATER RECALL

(SIREN, SPEAKER)

Surface and look to vessel for instructions.

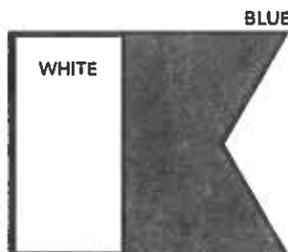
INTERNATIONAL FLAG SIGNALS



SPORT DIVER FLAG

Divers below, stay clear.

Displayed by sport divers internationally. Hoist on a different halyard from that bearing the official international flag below.



INTERNATIONAL CODE FLAG "A" BLUE

Divers below, stay clear at slow speed.

Displayed by all vessels and divers in international and foreign waters and by the U.S. Navy.



INTERNATIONAL CODE FLAG "P"

Diver recall. Return to vessel immediately.

Internationally recognized as the "Return-to-Ship" flag.

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 the dive team should have a valid ADCI Certification Card on record.)	

Place a check next to each item and record all applicable information.

DIVE STATION REQUIRED DOCUMENTATION:
JSA: _____ Tables/Schedules: _____ Dive Safety Manual: _____ Emergency Contacts and information: _____

DIVE STATION 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	Check on Delivery and Activation of Gas _____ Valves _____	
Pressure (PSI/Bar) _____		
Gas Supply		
HeO ₂ : Number of Banks/Bottles: _____	Online Pressure (PSIG/Bar): _____	
50/50: Number of Banks/Bottles: _____	Online Pressure (PSIG/Bar): _____	
O ₂ : Number of Banks/Bottles: _____	Online Pressure (PSIG/Bar): _____	
Air: Number of Banks/Bottles: _____	Online Pressure (PSIG/Bar): _____	
Bailout: Air: _____	HeO ₂ _____ (% _____)	

COMMUNICATIONS: _____ (Ensure all communications are hooked up and tested.)
Two-way communications on site for emergencies: _____ (Required by ADCI/USCG)

GAUGES

Calibrated: _____
(Required by ADCI/USCG)

Verifying Documentation: _____
(Required by ADCI/USCG)

ALPHA FLAGS/DAY SHAPES/NIGHT LIGHTS: _____ (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.)

BAILOUTS/REGULATORS: _____ (Ensure that EGS has been activated at the bottle; bailout check and hose pressurization prior to water entry.)

HARNESSES: _____ (Check for serviceability.)

Note: Hardhats, safety glasses, steel-toed boots and personal floatation devices adequate for the project are required by ADCI/USCG.

COMMENTS: _____

Signature(s) of Person(s) Completing Safety Checklist: _____

Name of Designated Person-in-Charge/Supervisor: _____
(Required by ADCI/USCG) (PRINT)

DPIC / Supervisor's Signature: _____

BAILOUT CALCULATIONS FOR 30 Cu. Ft. CYLINDERS									
Depth fsw	Depth psi	ATA	Rate cu.ft / min	Cylinder psi	Cylinder volume cu.ft	Delivery Pressure depth in psi + 150 psi reg press.	Usable Gas pressure	Usable Gas cu.ft / bottle	Duration Minutes at Depth
200	89.00	7.06	1.5	3000	30	239.00	2761.00	27.61	2.61
175	77.88	6.30	1.5	3000	30	227.88	2772.13	27.72	2.93
150	66.75	5.55	1.5	3000	30	216.75	2783.25	27.83	3.35
125	55.63	4.79	1.5	3000	30	205.63	2794.38	27.94	3.89
100	44.50	4.03	1.5	3000	30	194.50	2805.50	28.06	4.64
75	33.38	3.27	1.5	3000	30	183.38	2816.63	28.17	5.74
50	22.25	2.52	1.5	3000	30	172.25	2827.75	28.28	7.50
25	11.13	1.76	1.5	3000	30	161.13	2838.88	28.39	10.77

BAILOUT CALCULATIONS FOR 50 Cu. Ft. CYLINDERS									
Depth fsw	Depth psi	ATA	Rate cu.ft / min	Cylinder psi	Cylinder volume cu.ft	Delivery Pressure depth in psi + 150 psi reg press.	Usable Gas pressure	Usable Gas cu.ft / bottle	Duration Minutes at Depth
200	89.00	7.06	1.5	3000	50	239.00	2761.00	46.02	4.34
175	77.88	6.30	1.5	3000	50	227.88	2772.13	46.20	4.89
150	66.75	5.55	1.5	3000	50	216.75	2783.25	46.39	5.58
125	55.63	4.79	1.5	3000	50	205.63	2794.38	46.57	6.48
100	44.50	4.03	1.5	3000	50	194.50	2805.50	46.76	7.73
75	33.38	3.27	1.5	3000	50	183.38	2816.63	46.94	9.56
50	22.25	2.52	1.5	3000	50	172.25	2827.75	47.13	12.49
25	11.13	1.76	1.5	3000	50	161.13	2838.88	47.31	17.95

BAILOUT CALCULATIONS FOR 80 Cu. Ft. CYLINDERS									
Depth fsw	Depth psi	ATA	Rate cu.ft / min	Cylinder psi	Cylinder volume cu.ft	Delivery Pressure depth in psi + 150 psi reg press.	Usable Gas pressure	Usable Gas cu.ft / bottle	Duration Minutes at Depth
200	89.00	7.06	1.5	3000	80	239.00	2761.00	73.63	6.95
175	77.88	6.30	1.5	3000	80	227.88	2772.13	73.92	7.82
150	66.75	5.55	1.5	3000	80	216.75	2783.25	74.22	8.92
125	55.63	4.79	1.5	3000	80	205.63	2794.38	74.52	10.38
100	44.50	4.03	1.5	3000	80	194.50	2805.50	74.81	12.38
75	33.38	3.27	1.5	3000	80	183.38	2816.63	75.11	15.30
50	22.25	2.52	1.5	3000	80	172.25	2827.75	75.41	19.99
25	11.13	1.76	1.5	3000	80	161.13	2838.88	75.70	28.72

BAILOUT CALCULATIONS FOR 120 Cu. Ft. CYLINDERS									
Depth fsw	Depth psi	ATA	Rate cu.ft / min	Cylinder psi	Cylinder volume cu.ft	Delivery Pressure depth in psi + 150 psi reg press.	Usable Gas pressure	Usable Gas cu.ft / bottle	Duration Minutes at Depth
200	89.00	7.06	1.5	3500	120	239.00	3261.00	111.81	10.56
175	77.88	6.30	1.5	3500	120	227.88	3272.13	112.19	11.87
150	66.75	5.55	1.5	3500	120	216.75	3283.25	112.57	13.53
125	55.63	4.79	1.5	3500	120	205.63	3294.38	112.95	15.73
100	44.50	4.03	1.5	3500	120	194.50	3305.50	113.33	18.75
75	33.38	3.27	1.5	3500	120	183.38	3316.63	113.71	23.16
50	22.25	2.52	1.5	3500	120	172.25	3327.75	114.09	30.24
25	11.13	1.76	1.5	3500	120	161.13	3338.88	114.48	43.42

BAILOUT CALCULATIONS FOR 10L CYLINDERS (METRIC)												
Depth msw	Depth Kg/cm ²	Bar	Pressure Absolute	Rate Ltrs/Min	Cylinder Bar	Cylinder Kg/cm ²	Cylinder Ltrs FV	Cylinder Ltrs at 300 bar	Delivery Pressure depth in Kg/cm ² +10.54604 Kg/cm ² reg press.	Usable Gas Pressure	Usable Gas Ltrs/ Cyl	Duration Minutes at Depth
70	7.17949	7.04067	8.21	42.5	300	305.91	10	3000	17.73	282.27	2768.21	7.93
60	6.15385	6.03486	7.18	42.5	300	305.91	10	3000	16.70	283.30	2778.27	9.10
50	5.12821	5.02905	6.16	42.5	300	305.91	10	3000	15.67	284.33	2788.33	10.65
40	4.10256	4.02324	5.13	42.5	300	305.91	10	3000	14.65	285.35	2798.39	12.83
30	3.07692	3.01743	4.11	42.5	300	305.91	10	3000	13.62	286.38	2808.44	16.09
20	2.05128	2.01162	3.08	42.5	300	305.91	10	3000	12.60	287.40	2818.50	21.52
10	1.02564	1.00581	2.06	42.5	300	305.91	10	3000	11.57	288.43	2828.56	32.38
1	0.10256	0.10058	1.13	42.5	300	305.91	10	3000	10.65	289.35	2837.61	58.95

APPENDIX 6

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

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

U. S. NAVY DECOMPRESSION TABLES (AIR)

NOAA NITROX DIVE PLANNING WORKSHEET

NOAA NO-DECOMPRESSION TABLE (NITROX 32)

NOAA DECOMPRESSION TABLE (NITROX 32)

NOAA NO-DECOMPRESSION TABLE (NITROX 36)

NOAA DECOMPRESSION TABLE (NITROX 36)

EAD – PPO2 – MOD – OXYGEN EXPOSURE TIME LIMITS TABLES

U.S. Navy Dive Table 3

Unlimited/No-Decompression Limits and Repetitive Group Designation Table for Unlimited/No-Decompression Air Dives—1999

Depth (feet/meters)	No-Decompression		Group Designation Letter															
	Limits (min)		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
10	3.0	unlimited	60	120	210	300	797	*										
15	4.6	unlimited	35	70	110	160	225	350	452	*								
20	6.1	unlimited	25	50	75	100	135	180	240	325	390	917	*					
25	7.6	595	20	35	55	75	100	125	160	195	245	315	361	540	595			
30	9.1	405	15	30	45	60	75	95	120	145	170	205	250	310	344	405		
35	10.7	310	5	15	25	40	50	60	80	100	120	140	160	190	220	270	310	
40	12.2	200	5	15	25	30	40	50	70	80	100	110	130	150	170	200		
50	15.2	100		10	15	25	30	40	50	60	70	80	90	100				
60	18.2	60		10	15	20	25	30	40	50	55	60						
70	21.3	50		5	10	15	20	30	35	40	45	50						
80	24.4	40		5	10	15	20	25	30	35	40							
90	27.4	30		5	10	12	15	20	25	30								
100	30.5	25		5	7	10	15	20	22	25								
110	33.5	20			5	10	13	15	20									
120	36.6	15			5	10	12	15										
130	39.6	10			5	8	10											
140	42.7	10			5	7	10											
150	45.7	5			5													
160	48.8	5				5												
170	51.8	5				5												
180	54.8	5				5												
190	59.9	5				5												

*Highest repetitive group that can be achieved at this depth regardless of bottom time

U.S. Navy Dive Table 4

Residual Nitrogen Timetable for Repetitive Air Dives – 1999

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

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

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

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

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

Residual Nitrogen Times (Minutes)

† Read vertically downward to the 40/12.2 (feet/meter) repetitive dive depth. Use the corresponding residual nitrogen times (minutes) to compute the equivalent single dive time. Decompress using the 40/12.2 (feet/meter) standard air decompression table.

U.S. Navy Dive Table 5

Standard Air Decompression Table – 1999

Depth
feet/meters

Bottom time (min)	Time first stop (min:sec)	Decompression stops (feet/meters)					Total decompression time (min:sec)	Repetitive group
		50 15.2	40 12.1	30 9.1	20 6.0	10 3.0		
200						0	1:20	*
210	1:00					2	3:20	N
230	1:00					7	8:20	N
250	1:00					11	12:20	O
270	1:00					15	16:20	O
300	1:00					19	20:20	Z
Exceptional Exposure								
360	1:00					23	24:20	**
480	1:00					41	42:20	**
720	1:00					69	70:20	**

40

12.1

50

15.2

100						0	1:40	*
110	1:20					3	4:40	L
120	1:20					5	6:40	M
140	1:20					10	11:40	M
160	1:20					21	22:40	N
180	1:20					29	30:40	O
200	1:20					35	36:40	O
220	1:20					40	41:40	Z
240	1:20					47	48:40	Z

60

18.2

60						0	2:00	*
70	1:40					2	4:00	K
80	1:40					7	9:00	L
100	1:40					14	16:00	M
120	1:40					26	28:00	N
140	1:40					39	41:00	O
160	1:40					48	50:00	Z
180	1:40					56	58:00	Z
200	1:20				1	69	72:00	Z
Exceptional Exposure								
240	1:20					79	83:00	**
360	1:20				20	119	141:00	**
480	1:20				44	148	194:00	**
720	1:20				78	187	267:00	**

70

21.3

50						0	2:20	*
60	2:00					8	10:20	K
70	2:00					14	16:20	L
80	2:00					18	20:20	M
90	2:00					23	25:20	N
100	2:00					33	35:20	N
110	1:40				2	41	45:20	O
120	1:40				4	47	53:20	O
130	1:40				6	52	60:20	O
140	1:40				8	56	66:20	Z
150	1:40				9	61	72:20	Z
160	1:40				13	72	87:20	Z
170	1:40				19	79	100:20	Z

* See No Decompression Table for repetitive groups

** Repetitive dives may not follow exceptional exposure dives

U.S. Navy Dive Table 5

Standard Air Decompression Table – 1999 (Continued)

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

* See No Decompression Table for repetitive groups

** Repetitive dives may not follow exceptional exposure dives

U.S. Navy Dive Table 5

Standard Air Decompression Table – 1999 (Continued)

Depth feet/meters	Bottom time (min)	Time first stop (min:sec)	Decompression stops (feet/meters)					Total decompression time (min:sec)	Repetitive group
			50 15.2	40 12.1	30 9.1	20 6.0	10 3.0		
110 33.1	20						0	3:40	*
	25	3:20					3	6:40	H
	30	3:20					7	10:40	J
	40	3:00				2	21	26:40	L
	50	3:00				8	26	37:40	M
	60	3:00				18	36	57:40	N
	70	2:40			1	23	48	75:40	O
	80	2:40			7	23	57	90:40	Z
	90	2:40			12	30	64	109:40	Z
	100	2:40			15	37	72	127:40	Z

Depth feet/meters	Bottom time (min)	Time first stop (min:sec)	Decompression stops (feet/meters)						Total decompression time (min:sec)	Repetitive group
			70 21.3	60 18.2	50 15.2	40 12.1	30 9.1	20 6.0		
120 36.5	15							0	4:00	*
	20	3:40						2	6:00	H
	25	3:40						6	10:00	I
	30	3:40						14	18:00	J
	40	3:20					5	25	34:00	L
	50	3:20					15	31	50:00	N
	60	3:00				2	22	45	73:00	O
	70	3:00				9	23	55	91:00	O
	80	3:00				15	27	63	109:00	Z
	90	3:00				19	37	74	134:00	Z
100	3:00				23	45	80	152:00	Z	

Exceptional Exposure										
120	2:40				10	19	47	98	178:00	**
180	2:20			5	27	37	76	137	286:00	**
240	2:20			23	35	60	97	179	398:00	**
360	2:00		18	45	64	93	142	187	553:00	**
480	1:40	3	41	64	93	122	142	187	656:00	**
720	1:40	32	74	100	114	122	142	187	775:00	**

130 39.6	10							0	4:20	*
	15	4:00						1	5:20	F
	20	4:00						4	8:20	H
	25	4:00						10	14:20	J
	30	3:40					3	18	25:20	M
	40	3:40					10	25	39:20	N
	50	3:20				3	21	37	65:20	O
	60	3:20				9	23	52	88:20	Z
	70	3:20				16	24	61	105:20	Z
	80	3:00			3	19	35	72	133:20	Z
90	3:00			8	19	45	80	156:20	Z	

* See No Decompression Table for repetitive groups

** Repetitive dives may not follow exceptional exposure dives

U.S. Navy Dive Table 5

Standard Air Decompression Table – 1999 (Continued)

Depth
feet/meters

140
42.6

Bottom time (min)	Time first stop (min:sec)	Decompression stops (feet/meters)									Total decompression time (min:sec)	Repetitive group
		90 27.4	80 24.3	70 21.3	60 18.2	50 15.2	40 12.1	30 9.1	20 6.0	10 3.0		
10										0	4:40	*
15	4:20									2	6:40	G
20	4:20									6	10:40	I
25	4:00									14	20:40	J
30	4:00									21	30:40	K
40	3:40									26	48:40	N
50	3:40									44	78:40	O
60	3:40									56	99:40	Z
70	3:20									68	127:40	Z
80	3:20									79	157:40	Z
Exceptional Exposure												
90	3:00									18	168:40	**
120	3:00									12	242:40	**
180	2:40									26	388:40	**
240	2:20									34	513:40	**
360	2:00									42	686:40	**
480	2:00									84	803:40	**
720	1:40									114	926:40	**

150
45.7

5										0	5:00	C
10	4:40									1	6:00	E
15	4:40									3	8:00	G
20	4:20									7	14:00	H
25	4:20									17	26:00	K
30	4:20									24	37:00	L
40	4:00									33	62:00	N
50	4:00									51	91:00	O
60	3:40									62	115:00	Z
70	3:40									75	149:00	Z
80	3:20									84	176:00	Z
Exceptional Exposure												
70	3:40									22	169:20	**

160
48.7

5										0	5:20	D
10	5:00									1	6:20	F
15	4:40									4	10:20	H
20	4:40									11	19:20	J
25	4:40									20	32:20	K
30	4:20									25	43:20	M
40	4:20									39	74:20	N
50	4:00									55	101:20	Z
60	4:00									69	135:20	Z
Exceptional Exposure												
70	3:40									22	169:20	**

* See No Decompression Table for repetitive groups
 ** Repetitive dives may not follow exceptional exposure dives

U.S. Navy Dive Table 5

Standard Air Decompression Table – 1999 (Continued)

Depth
feet/meters

170
51.8

Bottom time (min)	Time first stop (min:sec)	Decompression stops (feet/meters)										Total decompression time (min:sec)	Repetitive group		
		110	100	90	80	70	60	50	40	30	20			10	
5		33.5	30.4	27.4	24.3	21.3	18.2	15.2	12.1	9.1	6.0	3.0	0	5:40	D
10	5:20												2	7:40	F
15	5:00												5	12:40	H
20	5:00												15	24:40	J
25	4:40												23	37:40	L
30	4:40												26	48:40	M
40	4:20												45	84:40	O
50	4:20												61	112:40	Z
60	4:00												74	155:40	Z
Exceptional Exposure															
70	4:00							8	17	19	51	86	186:40	**	
90	3:40						12	12	14	34	52	120	249:40	**	
120	3:00				2	10	12	18	32	42	82	156	359:40	**	
180	2:40			4	10	22	28	34	50	78	120	187	538:40	**	
240	2:40			18	24	30	42	50	70	116	142	187	684:40	**	
360	2:20		22	34	40	52	60	98	114	122	142	187	876:40	**	
480	2:00	14	40	42	56	91	97	100	114	122	142	187	1010:40	**	

180
54.8

5													0	6:00	D
10	5:40												3	9:00	F
15	5:20												6	15:00	I
20	5:00												17	29:00	J
25	5:00												24	43:00	L
30	5:00												27	56:00	N
40	4:40												50	96:00	O
50	4:20							2	9	19	30	65	131:00	Z	
60	4:20							5	16	19	44	81	171:00	Z	
Exceptional Exposure															
50	4:40							4	13	22	33	72	150:20	**	
60	4:40							10	17	19	50	84	186:20	**	

190
57.9

5	5:40												0	6:20	D
10	5:40												3	10:20	G
15	5:40												7	17:20	I
20	5:20												20	34:20	K
25	5:20												25	47:20	M
30	5:00												32	66:20	N
40	5:00												55	106:20	O
Exceptional Exposure															
50	4:40												72	150:20	**
60	4:40												84	186:20	**

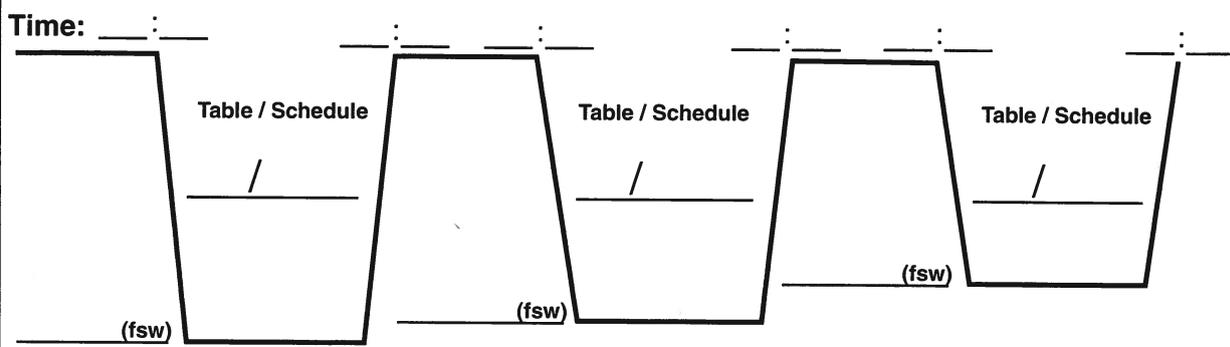
* See No Decompression Table for repetitive groups
 ** Repetitive dives may not follow exceptional exposure dives



NITROX DIVE PLANNING WORKSHEET

Group Letter: SIT SIT

○ : ○ ○ : ○ ○



<p>RNT = 0 PO₂ _____</p> <p>ABT = _____</p> <p style="margin-left: 100px;">% Limit _____</p> <p>ESDT = _____</p>	<p>RNT = _____ PO₂ _____</p> <p>ABT = _____</p> <p style="margin-left: 100px;">% Limit _____</p> <p>ESDT = _____</p>	<p>RNT = _____ PO₂ _____</p> <p>ABT = _____</p> <p style="margin-left: 100px;">% Limit _____</p> <p>ESDT = _____</p>
--	--	--

ABT – Actual Bottom Time — The time from the moment of descent until beginning a direct ascent to surface.

ESDT – Equivalent Single Dive Time — The sum of the RNT and ABT. This figure is used to obtain a group letter on Chart 1 for a repetitive dive.

Group Letter – A letter symbol for the Residual Nitrogen remaining in the body from a previous dive. Place in circle.

Oxygen Exposure Percent Limit – Maximum time on a single dive that the diver can be exposed to a certain partial pressure of oxygen.

PO₂ – Partial pressure of oxygen for the maximum depth obtained.

Repetitive Dive – Any dive made within 12 hours of a previous dive.

RNT – Residual Nitrogen Time – The time to be considered in planning a repetitive dive due to nitrogen remaining in the body from previous dives within the last 12 hours.

Safety Stop – A 3–5 minute safety stop at 15–20 fsw (4.6–6.1 msw) is strongly recommended for all dives deeper than 60 fsw (18.4 msw) and all repetitive dives.

SIT – Surface Interval Time – The time spent at the surface between dives.

Single Dive Oxygen Exposure Limits	
PO ₂ atm	Minutes
1.60	45
1.55	83
1.50	120
1.45	135
1.40	150
1.35	165
1.30	180
1.25	195
1.20	210

Remember

- Ascend no faster than 30 feet per minute (1 foot every 2 seconds).



NOAA NITROX 32 NO-DECOMPRESSION DIVE TABLE-Expanded

No-Decompression Limits and Repetitive Group Designation Table for No-Decompression Dive

Depth (feet/meters)	No-Decompression Limits (min)	Group Designation Letter															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
15	5	unlimited	60	120	210	300	797	*									
20	6	unlimited	35	70	110	160	225	350	452	*							
25	8	unlimited	25	50	75	100	135	180	240	325	390	917	*				
30	9	595	20	35	55	75	100	125	160	195	245	315	361	540	595		
40	12	405	15	30	45	60	75	95	120	145	170	205	250	310	344	405	
45	14	310	5	15	25	40	50	60	80	100	120	140	160	190	220	270	310
50	15	200	5	15	25	30	40	50	70	80	100	110	130	150	170	200	
60	18	100		10	15	25	30	40	50	60	70	80	90	100			
70	22	60		10	15	20	25	30	40	50	55	60					
80	25	50		5	10	15	20	30	35	40	45	50					
90	28	40		5	10	15	20	25	30	35	40						
100	31	30		5	10	12	15	20	25	30							
110	34	30		5	10	12	15	20	25	30							
120	37	25		5	7	10	15	20	22	25							
130	40	20			5	10	13	15	20								
**	140	43	15		5	10	12	15									
**	150	46	10		5	8	10										

- ** Oxygen Exceptional Exposures
- * Highest repetitive group that can be achieved at this depth regardless of bottom time



Residual Nitrogen Time

Repetitive Dive Depth (fsw)	Repetitive Group Designation Letter															
	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
10	**	**	**	**	**	**	**	**	**	**	**	797	279	159	88	39
20	**	**	**	**	**	**	917	399	279	208	159	120	88	62	39	18
30	+	+	+	349	279	229	190	159	132	109	88	70	54	39	25	12
40	+	+	+	349	279	229	190	159	132	109	88	70	54	39	25	12
50	257	241	213	187	161	138	116	101	87	73	61	49	37	25	17	7
60	169	160	142	124	111	99	87	76	66	56	47	38	29	21	13	6
70	122	117	107	97	88	79	70	61	52	44	36	30	24	17	11	5
80	100	96	87	80	72	64	57	50	43	37	31	26	20	15	9	4
90	84	80	73	68	61	54	48	43	38	32	28	23	18	13	8	4
100	73	70	64	58	53	47	43	38	33	29	24	20	16	11	7	3
110	73	70	64	58	53	47	43	38	33	29	24	20	16	11	7	3
120	64	62	57	52	48	43	38	34	30	26	22	18	14	10	7	3
130	57	55	51	47	42	38	34	31	27	24	20	16	13	10	6	3
140	52	50	46	43	39	35	32	28	25	21	18	15	12	9	6	3
150	46	44	40	38	35	31	28	25	22	19	16	13	11	8	6	3

Values are in Minutes

- ** If no Repetitive Nitrogen Time is given, then the Repetitive Group Letter does not change.
- + Read vertically downward to 50 Repetitive Dive Depth. Use the corresponding residual nitrogen time (minutes) to compute the equivalent single dive time. Decompress using the 50 NN32 Decompression Schedule Table 5.



NOAA NITROX **32** DECOMPRESSION DIVE TABLE

DEPTH fsw (msw)	PO ₂ (atm)	BOTTOM TIME (min)	TIME TO FIRST STOP (min:sec)	DECOMPRESSION STOPS				TOTAL ASCENT TIME (min:sec)	REPETITIVE GROUP LETTER
				40	30	20	10		
50 (15)	0.9	200					0	1:40	*
		210	1:20				2	3:40	N
		230	1:20				7	8:40	N
		250	1:20				11	12:40	O
		270	1:20				15	16:40	O
60 (18)	1.0	100					0	2:00	*
		110	1:40				3	5:00	L
		120	1:40				5	7:00	M
		140	1:40				10	12:00	M
		160	1:40				21	23:00	N
		180	1:40				29	31:00	O
200	1:40				35	37:00	O		
70 (22)	1.0	60					0	2:20	*
		70	2:00				2	4:20	K
		80	2:00				7	9:20	L
		100	2:00				14	16:20	M
		120	2:00				26	28:20	N
140	2:00				39	41:20	O		
80 (25)	1.1	50					0	2:40	*
		60	2:20				8	10:40	K
		70	2:20				14	16:40	L
		80	2:20				18	20:40	M
		90	2:20				23	25:40	N
		100	2:20				33	35:40	N
		110	2:00			2	41	45:40	O
120	2:00			4	47	53:40	O		
130	2:00			6	52	60:40	O		
90 (28)	1.2	40					0	3:00	*
		50	2:40				10	13:00	K
		60	2:40				17	20:00	L
		70	2:40				23	26:00	M
		80	2:20			2	31	36:00	N
		90	2:20			7	39	49:00	N
		100	2:20			11	46	60:00	O
110	2:20			13	53	69:00	O		
100 (31)	1.3	30					0	3:20	*
		40	3:00				7	10:20	J
		50	3:00				18	21:20	L
		60	3:00				25	28:20	M
		70	2:40			7	30	40:20	N
		80	2:40			13	40	56:20	N
90	2:40			18	48	69:20	O		
110 (34)	1.4	30					0	3:40	*
		40	3:20				7	10:40	J
		50	3:20				18	21:40	L
		60	3:20				25	28:40	M
		70	3:00			7	30	40:40	N
		80	3:00			13	40	56:40	N
90	3:00			18	48	69:40	O		
120 (37)	1.5	25					0	4:00	*
		30	3:40				3	7:00	I
		40	3:40				15	19:00	K
		50	3:20			2	24	30:00	L
		60	3:20			9	28	41:00	N
130 (40)	1.6	20					0	4:20	*
		25	4:00				3	7:20	H
		30	4:00				7	11:20	J
		40	4:00			2	21	27:20	L
		50	3:40	Exceptional Exposure		8	26	38:20	M**
		60	3:40			18	36	58:20	N**

* See No Decompression Table 3 for Repetitive Group Letter

** Time Exceeds Recommended Oxygen Partial Pressure Limits for Routine Diving Operations



NOAA NITROX 36 NO-DECOMPRESSION DIVE TABLE-Expanded

No-Decompression Limits and Repetitive Group Designation Table for No-Decompression Dive

Depth (feet/meters)	No-Decompression Limits (min)		Group Designation Letter															
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
15	5	unlimited	60	120	210	300	797	*										
20	6	unlimited	60	120	210	300	797	*										
25	8	unlimited	35	70	110	160	225	350	452	*								
30	9	unlimited	25	50	75	100	135	180	240	325	390	917	*					
40	12	405	15	30	45	60	75	95	120	145	170	205	250	310	344	405		
45	14	405	15	30	45	60	75	95	120	145	170	205	250	310	344	405		
50	15	310	5	15	25	40	50	60	80	100	120	140	160	190	220	270	310	
60	18	100		10	15	25	30	40	50	60	70	80	90	100				
70	22	100		10	15	25	30	40	50	60	70	80	90	100				
80	25	60		10	15	20	25	30	40	50	55	60						
90	28	50		5	10	15	20	30	35	40	45	50						
100	31	40		5	10	15	20	25	30	35	40							
110	34	30		5	10	12	15	20	25	30								
** 120	37	25		5	7	10	15	20	22	25								
** 130	40	25		5	7	10	15	20	22	25								

- ** Oxygen Exceptional Exposures
- * Highest repetitive group that can be achieved at this depth regardless of bottom time



Residual Nitrogen Time

Repetitive Dive Depth (fsw)	Repetitive Group Designation Letter															
	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A
10	**	**	**	**	**	**	**	**	**	**	**	797	279	159	88	39
20	**	**	**	**	**	**	**	**	**	**	**	797	279	159	88	39
30	**	**	**	**	**	**	917	399	279	208	159	120	88	62	39	18
40	+	+	+	349	279	229	190	159	132	109	88	70	54	39	25	12
50	257	241	213	187	161	138	116	101	87	73	61	49	37	25	17	7
60	169	160	142	124	111	99	87	76	66	56	47	38	29	21	13	6
70	169	160	142	124	111	99	87	76	66	56	47	38	29	21	13	6
80	122	117	107	97	88	79	70	61	52	44	36	30	24	17	11	5
90	100	96	87	80	72	64	57	50	43	37	31	26	20	15	9	4
100	84	80	73	68	61	54	48	43	38	32	28	23	18	13	8	4
110	73	70	64	58	53	47	43	38	33	29	24	20	16	11	7	3
120	64	62	57	52	48	43	38	34	30	26	22	18	14	10	7	3
130	64	62	57	52	48	43	38	34	30	26	22	18	14	10	7	3

Values are in Minutes

- ** If no Repetitive Nitrogen Time is given, then the Repetitive Group Letter does not change.
- + Read vertically downward to 50 Repetitive Dive Depth. Use the corresponding residual nitrogen time (minutes) to compute the equivalent single dive time. Decompress using the 50 NN32 Decompression Schedule Table 5.



NOAA NITROX

36

DECOMPRESSION DIVE TABLE

DEPTH fsw (msw)	PO ₂ (atm)	BOTTOM		DECOMPRESSION STOPS				TOTAL ASCENT	REPETITIVE	
		TIME (min)	STOP (min:sec)	40	30	20	10	TIME (min:sec)	GROUP LETTER	
60 (18)	1.1	100					0	2:00	*	
		110	1:40				3	5:00	L	
		120	1:40				5	7:00	M	
		140	1:40				10	12:00	M	
		160	1:40				21	23:00	N	
		180	1:40				29	31:00	O	
		200	1:40				35	37:00	O	
70 (22)	1.2	100					0	2:20	*	
		110	2:00				3	5:20	L	
		120	2:00				5	7:20	M	
		140	2:00				10	12:20	M	
		160	2:00				21	23:20	N	
		180	2:00				29	31:20	O	
		200	2:00				35	37:20	O	
80 (25)	1.25	60					0	2:40	*	
		70	2:20				2	4:40	K	
		80	2:20				7	9:40	L	
		100	2:20				14	16:40	M	
		120	2:20				26	28:40	N	
		140	2:20				39	41:40	O	
90 (28)	1.35	50					0	3:00	*	
		60	2:40				8	11:00	K	
		70	2:40				14	17:00	L	
		80	2:40				18	21:00	M	
		90	2:40				23	26:00	N	
		100	2:40				33	36:00	N	
		110	2:20		2	41	46:00	O		
		120	2:20		4	47	54:00	O		
100 (31)	1.5	40					0	3:20	*	
		50	3:00				10	13:20	K	
		60	3:00				17	20:20	L	
		70	3:00				23	26:20	M	
		80	2:40			2	31	36:20	N	
		90	2:40			7	39	49:20	N	
		100	2:40		11	46	60:20	O		
		110	2:40		13	53	69:20	O		
110 (34)	1.6	30					0	3:40	*	
		40	3:20				7	10:40	J	
		Exceptional Exposure								
		50	3:20			18	21:40	L**		
		60	3:20			25	28:40	M**		
		70	3:00			7	30	40:40	N**	
80	3:00		13	40	56:40	N**				

* See No Decompression Table 3 for Repetitive Group Letter

** Time Exceeds Recommended Oxygen Partial Pressure Limits for Routine Diving Operations

Equivalent Air Depths, Partial Pressures of Oxygen and Maximum Operating Depths

EAD	FO ₂	21%	22%	23%	24%	25%	26%	27%	28%	29%	30%	31%	32%	33%	34%	35%	36%	37%	38%	39%	40%
30	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	46	47	48	49		
	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.0
40	40	41	42	43	44	46	47	48	49	50	51	53	54	55	57	58	60	61	63		
	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.2
50	50	51	52	53	54	55	56	58	59	60	62	63	64	66	67	69	71	72	74	76	
	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.4
60	60	61	62	63	64	66	67	69	70	71	73	75	76	78	80	81	83	85	87	89	
	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.3	1.4	1.4	1.5	1.5	1.5
70	70	71	72	74	75	76	78	80	81	83	84	86	88	90	92	94	96	98	100	102	
	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.4	1.5	1.6	1.6	1.6
80	80	81	82	84	86	87	89	91	92	94	96	98	100	102	104	106	108	110	113		
	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.4	1.5	1.6	1.6	1.7	1.8	1.8
90	90	91	93	94	96	98	100	101	103	105	107	109	112	114	116	119					
	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.3	1.4	1.4	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.6
100	100	101	103	105	107	108	110	112	114	117	119	121	123	127							
	0.9	0.9	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
110	110	111	113	115	117	119	121	123	126	128	130	133									
	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.4	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
120	120	121	123	126	128	130	132	134	137	139	143										
	1.0	1.1	1.1	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
130	130	132	134	136	138	141	143	145	148	151	154	157									
	1.1	1.1	1.2	1.3	1.3	1.4	1.4	1.5	1.6	1.6	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
140	140	142	144	146	149	151	154	156	159												
	1.1	1.2	1.3	1.3	1.4	1.5	1.6	1.6	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7

PO₂ Maximum Operating Depths

1.4	187	177	167	159	151	144	138	132	126	121	116	111	107	102	99	95	91	88	85	82
1.5	202	192	182	173	165	157	150	143	137	132	126	121	117	112	108	104	100	97	93	90
1.6	218	207	196	187	178	170	162	156	149	143	137	132	127	122	117	113	109	105	102	99

Instructions for Use

- To determine Equivalent Air Depth (EAD) and partial pressure of oxygen (PO₂), start at the PO₂ value for the mixture used.
- Move down the PO₂ column until you find the depth value that exactly equals or just exceeds the actual dive depth.
- The PO₂ for this depth will appear immediately below this number.
- To determine the EAD, move left from the actual depth value to find the Equivalent Air Depth in the far left-hand column.
- As long as the actual dive depth does not exceed the Maximum Operating Depth (MOD) shown at the bottom of the table, it is okay to use the PO₂ associated with that MOD.
- *Depths shown are in feet of salt water at sea level. Fractional depth values have been rounded down to the next shallower integer. Fractional PO₂ values are have been rounded upward to the next higher 0.1 bar/ata.



WARNING

Susceptibility to decompression sickness and oxygen toxicity can vary from person to person, and from day to day - No dive table, computer or planning device can guarantee that - even if used correctly - you will not suffer from one or both of these problems - Therefore, the user must assume all risks associated with the use of this product - Caution is recommended

Oxygen Exposure Time Limits (CNS "Clock")

PO ₂	Single Dive Limit 24-Hour Limit		Time in Minutes													
	1	2	3	4	5	10	15	20	25	30	35	40	45	50	55	60
0.6	720	1%	1%	1%	1%	1%	1%	2%	3%	3%	4%	5%	6%	7%	8%	8%
	720	1%	1%	1%	1%	1%	1%	2%	3%	4%	5%	6%	6%	7%	8%	8%
0.7	540	1%	1%	1%	1%	1%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
	540	1%	1%	1%	1%	1%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
0.8	450	1%	1%	1%	1%	1%	1%	2%	3%	4%	6%	7%	8%	9%	10%	11%
	450	1%	1%	1%	1%	1%	1%	2%	3%	4%	6%	7%	8%	9%	10%	11%
0.9	360	1%	1%	1%	1%	1%	1%	3%	4%	6%	7%	8%	10%	11%	13%	14%
	360	1%	1%	1%	1%	1%	1%	3%	4%	6%	7%	8%	10%	11%	13%	14%
1.0	300	1%	1%	1%	1%	2%	2%	3%	5%	7%	8%	10%	12%	13%	15%	17%
	300	1%	1%	1%	1%	2%	2%	3%	5%	7%	8%	10%	12%	13%	15%	17%
1.1	240	1%	1%	1%	2%	2%	2%	4%	6%	8%	10%	13%	15%	17%	19%	21%
	270	1%	1%	1%	2%	2%	2%	4%	6%	8%	10%	13%	15%	17%	19%	21%
1.2	210	1%	1%	1%	2%	2%	2%	5%	7%	10%	12%	14%	17%	19%	21%	23%
	240	1%	1%	1%	2%	2%	2%	4%	6%	8%	10%	13%	15%	17%	19%	21%
1.3	180	1%	1%	2%	2%	3%	3%	6%	8%	11%	14%	17%	19%	22%	25%	29%
	210	1%	1%	2%	2%	3%	3%	6%	8%	11%	14%	17%	19%	22%	25%	29%
1.4	150	1%	1%	2%	3%	3%	3%	7%	10%	13%	17%	20%	23%	27%	30%	33%
	180	1%	1%	2%	2%	3%	3%	6%	8%	11%	14%	17%	19%	22%	25%	28%
1.5	120	1%	2%	3%	3%	4%	4%	8%	13%	17%	21%	25%	29%	33%	38%	46%
	180	1%	1%	2%	2%	3%	3%	6%	8%	11%	14%	17%	19%	22%	25%	28%
1.6	45	2%	4%	7%	9%	11%	11%	22%	33%	44%	56%	67%	78%	89%	100%	—
	150	1%	1%	2%	3%	3%	3%	7%	10%	13%	17%	20%	23%	27%	30%	33%

Instructions for Use

- This chart allows you to quickly calculate what percentage of your total oxygen exposure limits you have consumed on each dive.
- To use the chart, begin by determining the partial pressure of oxygen (PO₂) experienced at the deepest point during the dive (see reverse side).
- Find this PO₂ value in the left-hand column, and then move across horizontally until you find the column that matches the length of the dive, in minutes.
- The numbers in each box represent the percentage of the total time limits consumed during the dive. The topmost value represents the percentage of the single-dive limit consumed; the bottommost value represents the percentage of the 24-hour limit consumed.
- You can combine percentage values from different columns to determine totals that are precise to the minute. For example, for a 67-minute dive, add the percentages from the 60, 5 and 2 minute columns.
- For multiple dives separated by sufficient surface intervals, it may be possible to "recover" some of the time limits consumed on previous dives. Consult the TDI Advanced Nitrox Diver course manual for more information.
- Time values in this chart are based on the NOAA Oxygen Exposure Time Limits for Working Divers. Fractional percentage values have been rounded to the nearest whole number, with a minimum value of one percent.



WARNING

Susceptibility to decompression sickness and oxygen toxicity can vary from person to person, and from day to day. No dive table, computer or planning device can guarantee that — even if used correctly — you will not suffer from one or both of these problems. Therefore, the user must assume all risks associated with the use of this product. Caution is recommended.



APPENDIX 7

EMERGENCY CONTACT NUMBERS AND DIVING SAFETY RESOURCES

**DIVING MALADIES: CAUSES, PREVENTIONS, SYMPTOMS, AND
TREATMENTS**

FIRST AID/CPR/O₂ ADMINISTRATION SLATE

**DECOMPRESSION SICKNESS AND FIELD NEUROLOGICAL EVALUATION
SLATES**

**EMERGENCY OXYGEN ADMINISTRATION: EQUIPMENT AND
PROCEDURES**

COMMERCIAL HARVEST DIVING STANDARDS



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

Washington and Oregon
(206) 220–7001

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

Alaska
(907) 463–2000

HYPERBARIC (DIVING MEDICINE) CONSULTATION

Emergency Room, Virginia Mason Hospital (VMH)
(206) 583–6433

VMH Hyperbaric Unit 24-Hour Consultation
(206) 583–6543

Divers Alert Network (DAN)
(919) 684–9111

Dr. Edmond Kay
Director of Hyperbaric Medicine
HealthForce Partners
13033 Bel–Red Road, No. 110
Bellevue, Washington 98005–2633
ekay@uw.edu
(425) 468–6530 Office
(206) 954–3750 Mobile
(425) 468–6501 FAX

RECOMPRESSION CHAMBERS

Virginia Mason Hospital, Seattle
(206) 583–6543

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

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

St. Joseph’s Medical Center, Tacoma
(253) 426–6630

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

Vancouver General Hospital, Vancouver
(604) 875–4111

Fleet Diving Unit Pacific, Victoria
(250) 363–2379

Providence Hospital, Portland
(503) 215–1111

Anchorage Regional Hospital
(907) 264–1583

Bartlett Memorial Hospital, Juneau
(907) 586–2611

Ketchikan General Hospital, Ketchikan
(907) 225–5171

American Hyperbaric Center, Alaska
(907) 562–5420

NEAREST HOSPITAL

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

LUMMI INDIAN BUSINESS COUNCIL

Lummi Police Department and Natural Resources
Enforcement
(360) 312–2274; **after business hours, call 911**

Lummi Natural Resources Department
LIBC Front Desk
(360) 312–2000

Drs. Dale Haveman, John Tilley, and Janine Shaw

Lummi Tribal Health Center
(360) 384-0464

UW FRIDAY HARBOR LABORATORIES

FHL Office, San Juan Island
(360) 378-2165

David Duggins, UW FHL
(360) 378-2139 or (206) 616-0703

Pema Kitaeff, UW FHL
(206) 543-0876

Sam Sublett

Diving Safety Officer, UW
(206) 616-3776

WWU SHANNON POINT MARINE CENTER

SPMC Office, Fidalgo Island
(360) 650-7400

Gene McKeen
SPMC Manager
(360) 650-7400, ext. 223

Nathan Schwarck
Diving Safety Officer, WWU
(360) 319-1474

Table 1A7. Causes, preventions, symptoms of, and treatments for, the most common diving maladies.				
Medical condition	Cause	Prevention	Symptoms	Treatment
SQUEEZE Damage done to tissues that do not pressurize with the ambient pressure.	Gas-filled space; Rigid walls; Ambient pressure change; Vascular penetration; and Enclosed space.	Stay ahead of the pressure.	Dependent upon type of squeeze.	Dependent upon type of squeeze.
HYPOXIA An O ₂ deficiency in the body's tissues	Air supply failure; Diver loses mouthpiece; Airway obstruction or restriction; Insufficient O ₂ in the diver's breathing media; Inadequate vent in chamber; and O ₂ falls below 0.16 ATA.	Gas analysis; Cylinder line-ups; Pre-dive check-outs or procedures; and Monitor O ₂ sensors throughout the dive.	Cyanosis (bluing of skin); increased pulse rate; lack of muscle control; lack of concentration; inability to perform delicate tasks; weakness; loss of consciousness; or drowsiness.	In water, perform emergency procedure for rig/helmet. At surface, 100% O ₂ by mask, CPR if necessary, and transport to medical facility.
HYPERCAPNIA (CO₂ Toxicity) An excess of CO ₂ built up in the blood	Skip breathing; Excessive working at depth; Over breathing rig or helmet; Inadequate lung ventilation; or Rig malfunction.	Follow pre-dive; moderate work pace; avoid skip breathing; avoid over-breathing diving apparatus.	Increased respiration; confusion; headache; inability to concentrate; loss of consciousness; or drowsiness.	In water, notify topside, decrease work rate, breathe normally, follow EPs, abort dive (if necessary), and seek medical attention. At surface, remove diving apparatus and give neuro exam to rule out AGE, 100% O ₂ by mask, and transport to medical facility.
NITROGEN NARCOSIS A narcotic feeling caused by the effects of inert gases on the nervous system; usually starts around 4 ATA	Primarily because of O ₂ toxicity; nitrogen is an inert gas that the body does not use or metabolize.	Avoidance of excessive partial pressure of nitrogen; limit depth; and workup dives.	Confusion; lack of concern for job or safety; apparent stupidity; sense of well-being; or impaired judgment.	Ascend above depth of onset; will normally resolve in 1 min.
INNER EAR BAROTRAUMA (IEB) Inner ear contains no gas and is not subject to barotraumas.	Common cold; Abnormal anatomy; Dysfunctional Eustachian tube; Running nose; head cold or congestion. TYPES: round	Do not perform forceful valsalva maneuver; No diving with a cold; stay ahead of the pressure; and proper training.	Vertigo; hearing loss; nystagmus; nausea/vomiting; imbalance; roaring tinnitus; and symptoms of MEB will be present.	May be the result of AGE; avoid straining; and transport to medical facility.

Table 1A7. Causes, preventions, symptoms of, and treatments for, the most common diving maladies.

Medical condition	Cause	Prevention	Symptoms	Treatment
However, it is located next to the middle ear and affected by the same conditions that produce MEB.	window rupture, oval window rupture, violent shift in fluid in the inner ear, or hemorrhage into inner ear.			
MIDDLE EAR BAROTRAUMA (MEB) Most common type of barotraumas.	Common cold; abnormal anatomy; dysfunctional Eustachian tube; running nose, head cold, or congestion.	No diving with cold; stay ahead of the pressure; and proper training.	Fullness or pain in ear; slight bloody drip from oral/nasal cavity via Eustachian tube; and mild hearing loss.	Notify topside; stop travel; ascend or descend a few feet; attempt to clear; and abort dive if necessary.
EXTERNAL EAR BAROTRAUMA Occurs if external auditory canal is blocked.	Wax impaction; tight wet suit hood; or ear infection.	Pull wet suit hood from face to allow water in and pressurize; do not dive with ear infection; and do not use ear plugs.	Canal swelling; possible hemorrhaging; and considerable pain in the canal.	Transport to medical facility.
CARBON MONOXIDE (CO) TOXICITY Produced as a result of incomplete combustion of hydrocarbons.	Compressor intake down-wind of exhaust; improper compressor oils; or faulty air compressor system.	Do proper pre-dive checks; compressor intake located away from engine exhausts; and proper maintenance of compressors.	Tightness across forehead; headache; nausea; confusion; and vomiting.	Remove patient from CO exposure; neuro exam to rule out AGE; 100% O ₂ ; and transport to medical facility.
CNS O₂ TOXICITY Central nervous system oxygen toxicity.	Excessive partial pressure usually not encountered unless PPO ₂ approaches or exceeds 1.6 ATA; however, could be encountered as low as 1.4 ATA.		Visual disturbance; ears ringing or roaring; nausea; tingling/twitching; dizziness; and convulsions.	Off O ₂ – wait for symptoms to subside; wait 15 min; back on O ₂ at point of interruption; further incidents consult certified dive physician.
ARTERIAL GAS EMBOLISM (AGE) The most serious diving injury. Alveolar rupture with air bubbles entering capillaries of lungs and traveling to heart and then distributed throughout body.	Lungs over-inflate, alveolar rupture occurs, and air is forced into the capillaries of the arterial system. These bubbles are carried to the left side of the heart and pumped out the arteries. Bubbles that accumulate in narrow areas create	Breathe normally, never hold breath on ascent. If out of air, exhale during ascent.	Unconsciousness; weakness; paralysis; numbness; ringing/roaring in ears; blurred vision; dizziness; fatigue; tingling/twitching; any neurological symptom that presents itself within first 10 min after surfacing from dive is considered to	Immediate recompression; complete neuro exam; 100% O ₂ ; transport to medical facility below 1,000 feet above sea level; if patient experiences relief of symptoms upon entering chamber, treat original disorder; contact

Table 1A7. Causes, preventions, symptoms of, and treatments for, the most common diving maladies.

Medical condition	Cause	Prevention	Symptoms	Treatment
	an obstruction of blood flow. All tissue beyond is deprived of blood and turns hypoxic. Damage and symptoms depend on location of blockage. Brain is most significant site for bubbles.		be a sign of AGE by non-medical personnel.	certified dive physician.
PULMONARY O₂ TOXICITY	Occurs during long exposures to increased PPO ₂ , causing a direct pulmonary irritant; can occur during DCS treatment (hyperbaric chamber) tables 4,7,8, and back-to-back TT6		Severe coughing; shortness of breath; and sub-sternal chest pain.	Discontinue O ₂ use and consult certified diving physician.

COMMERCIAL HARVEST DIVING STANDARDS



Assess person and provide basics

Person Breathing?

NO: Administer CPR follow steps on back of slate →

YES: Administer first aid

- **Bleeding:**

Pressure - apply directly to major sites of bleeding

- **Breaks:**

Immobilize - neck & obvious broken bones

- **Burns:**

Cool - remove burn source, rinse with cool water, avoid contact

- **Bites:**

Cover - protect from further injury, warm but don't rub frostbite

- **Baffled:**

Observe - for the other Bs while you wait for help

- ✓ **Talk Calmly**

- ✓ **Offer Comfort**

- ✓ **Don't Force**

- ✓ **It is safe to give emergency O₂ to anyone who is badly injured**

- ✓ **Use non-rebreather mask @ 15 LPM flow rate**

- ✓ **Maintain airway and mask position**

CONTINUE 1st AID AS LONG AS NEEDED



Assess scene and person involved in incident

Alert EMS. Approach person. Statement "Are you OK?"

Person Breathing?

YES: Administer first aid follow steps on back of slate →

NO: Administer CPR

(Open Airway, Provide Breathing and Circulation)

- ✓ **Airway**
- ✓ **Breathing**
- ✓ **Circulation**

Chin lift and gentle
Head tilt protect the neck

- Follow the RULE of 2's**
- ✓ Give **2 Full Breaths**
Blow in for **2 seconds** each
 - ✓ **Check Pulse Now**
and every few cycles

No Pulse - Administer CPR

- Stack **2** hands
- **2"** up from bottom of sternum
- Compress **2"** a little slower than **2x** a second
- For **30** compressions
- **Repeat cycle**

2 Rescuer CPR

- **2 rescuers** – breathe **2x** as often
- After **2** cycles try AED if available

- ✓ **Reassess periodically but continue CPR as long as needed**
- ✓ **Give O2 @ 15 LPM if oro-nasal mask available**
- ✓ **Do not interrupt CPR for more than a few seconds**

BE PERSISTENT - YOU'RE SAVING A LIFE!

DCS Field Evaluation



Diver (and/or Buddy) Interview

Details of all dive profiles

Check One: Air Nitrox Trimix _____ O₂%

Any unusual events ?

	Entanglement
Out-of-Air Emergency	Significant Over-Exertion
Equipment Malfunction	Loss of Buoyancy Control
Buddy Separation	Rapid Ascent
Other:	

Any Prior History of DCS ? No Yes (if yes, enter Date _____)

Any Other Medical Issues ? No Yes (if yes, explain)

Signs and Symptoms of DCS

Skin Rash	Hearing Disturbances
Tingling or Numbness	Visual Disturbances
Joint or Limb Pain	Slurred Speech
Back or Abdominal Pain	Distressed Breathing
Chest Pain or Discomfort	Severe Coughing
Extreme Fatigue	Blood or Froth in Mouth
Loss of Muscle Strength	Paralysis
Loss of Coordination	Convulsions
Dizziness	Unconsciousness
Disorientation	Cardiac Arrest
Neck Swelling	Rapid or Erratic Pulse
Abnormal Sounding Voice	Signs of Shock

First Aid for Suspected DCS

	Administer Oxygen
EMS / Medical Attention	Monitor Patient
Patient Laying Down (left side)	Treat for Shock
Provide Fluids (if conscious)	CPR when appropriate

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 clench teeth, evaluate uniform movement, and check for equal tension in jaw muscles.
Ears	With patient's eyes closed, rub your fingers together and determine 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 breathing 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 balance 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.

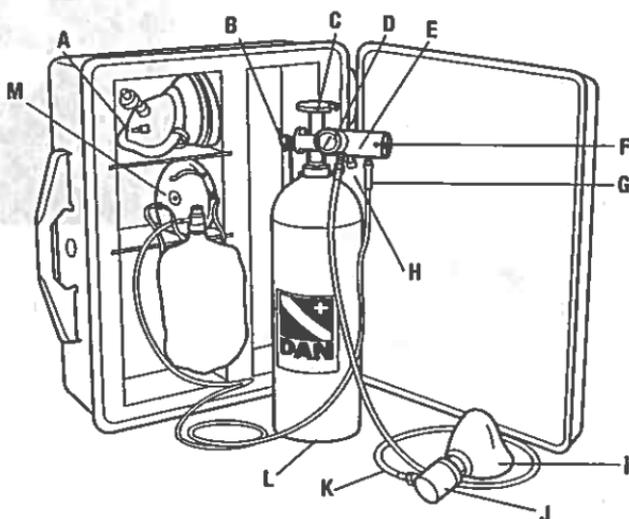
- Look for deviations from the expected norm
- Look for differences, one side versus the other
- Look for any changes over time

Name of individual(s) being examined:

Time (hr : min)	_____ : _____	<input type="checkbox"/> +15 minute	<input type="checkbox"/> +15 minute	<input type="checkbox"/> +15 minute
Orientation				
Eyes				
Forehead				
Face				
Ears				
Gag Reflex				
Tongue				
Shoulders				
Arms & Hands				
Chest				
Legs				
Heel-to-Toe Walk				

Oxygen Equipment Identification

DAN Oxygen Unit Components



A. Oronasal resuscitation mask with oxygen inlet

B. T-handle

C. Handwheel wrench

D. Pressure gauge

E. Multifunction regulator

F. Constant-flow controller

G. Barbed constant-flow outlet

H. DISS outlet

I. Oronasal mask

J. Demand inhalator valve

K. Intermediate pressure hose

L. Oxygen cylinder and valve

M. Non-rebreather mask

Oxygen Equipment Assembly and Disassembly

Follow these simple steps to assemble and disassemble the DAN Oxygen Unit.

- Ensure oxygen unit is depressurized.
- Open constant-flow control.
- Check pressure gauge.
- Remove multifunction regulator from the oxygen cylinder valve.
- Secure oxygen cylinder.
- Remove oxygen washer from multifunction regulator.



Note: Washer is different from standard scuba O-ring.

- Remove oxygen hose from multifunction regulator.
- If the fitting is too tight, use handwheel/wrench to unscrew the hose.



Note: Check valves assure oxygen does not flow from DISS (demand) ports.

- Remove oxygen hose from demand inhalator valve.

Note: Both ends of the oxygen hose are identical.

- Unscrew the plastic mask adapter from the demand inhalator valve.
- Remove inhalation / exhalation assembly.
- To assemble: repeat steps in reverse.

Demand Inhalator Valve

Follow these simple steps to provide oxygen to a responsive or unresponsive breathing injured diver with the Demand Inhalator Valve. This is the preferred method of providing emergency oxygen to any breathing injured diver.

Remember S-A-F-E.

Assess airway and breathing.

- Inform the injured diver that oxygen may help.
- State: "This is oxygen and it may make you feel better. May I help you?"
 - If the diver is unresponsive, permission to help is assumed.

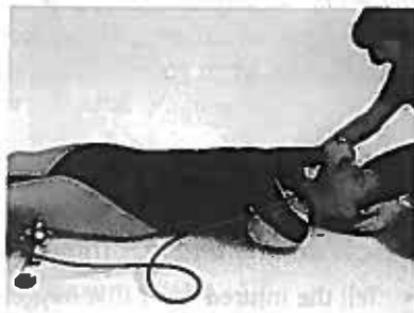
Deploy the oxygen unit.

- Open cylinder valve with one complete turn.
- Check cylinder pressure.
- Assure that there are no leaks in the system.
- Constant-flow setting should be in "Off" position.
- Take a breath from demand valve and exhale away from it.



Place the mask over the injured diver's mouth and nose.

- Check the mask for any leaks around injured diver's face.



Instruct the injured diver to breathe normally from the mask.

- Reassure and comfort injured diver.



Instruct the injured diver to hold the mask to help maintain a tight seal.

Monitor the injured diver and the oxygen pressure gauge.

- Listen for the demand inhalator valve to open during inspiration.
- Observe mask fogging during exhalation and clearing with inhalation.
- Watch the chest rise during inhalation and fall with exhalation.



Activate Emergency Action Plan.

- Call EMS or other appropriate medical facility.
- Contact DAN for consultation and coordination of hyperbaric treatment.

Non-Rebreather Mask

Follow these simple steps to provide oxygen to a responsive or unresponsive breathing injured diver with the non-rebreather mask. The non-rebreather mask is ideal when you have two injured divers or if an injured diver who will not tolerate the demand inhalator valve.

Remember S-A-F-E.

Assess airway and breathing.

- Tell the injured diver that oxygen may help and ask permission to help.

Deploy the oxygen unit.

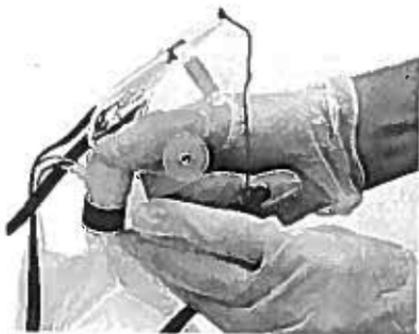
- Remove non-rebreather mask from bag.
- Stretch oxygen tubing to avoid kinks.
- Attach oxygen tubing to barbed constant flow outlet on multifunction regulator.



Set constant-flow control to 15 liters per minute (lpm).

Prime mask reservoir bag.

- Place a thumb or finger inside the nosepiece, closing the non-return valve, until the reservoir bag fully inflates.



Place the mask over the injured diver's mouth and nose.

- Check the mask for any leaks around injured diver's face.
- Adjust the elastic band around head to hold the mask in place.
- Squeeze the metal clip over the nose to improve the seal and prevent oxygen leakage.

Instruct the injured diver to breathe normally.

- Ensure reservoir bag remains inflated.
 - If not, increase flow rate up to 25 lpm.
- Reassure and comfort injured diver.
- Place the injured diver in the proper position.
- If responsive, instruct the injured diver to hold mask to maintain a tight seal.
- Monitor the injured diver and the oxygen pressure system.
- Look for the reservoir bag to slightly inflate and deflate and for movement of the non-return valves.
- Observe mask fogging during exhalation and clearing with inhalation.
- Watch the chest rise during inhalation and fall with exhalation.
- Activate Emergency Action Plan.
- Call EMS and DAN.



Oronasal Resuscitation Mask

Follow these simple steps to provide oxygen as part of CPR. The oronasal resuscitation mask with supplemental oxygen is the preferred method of providing oxygen to a non-breathing injured diver for the single rescuer. **IMPORTANT NOTE:** Do not delay CPR in order to obtain oxygen.

Remember S-A-F-E.

Deploy the oxygen unit.

- Prepare the oronasal resuscitation mask.
- Remove mask from case.
- Attach one-way valve.
- Remove oxygen tubing from the non-rebreather mask.
- Attach oxygen tubing on the barbed constant-flow outlet on the multifunction regulator and the oxygen inlet on the oronasal resuscitation mask.
- Set constant-flow control to 15 liters per minute (lpm).
- Listen for flow of oxygen.



Place the oronasal resuscitation mask over the injured diver's mouth and nose.

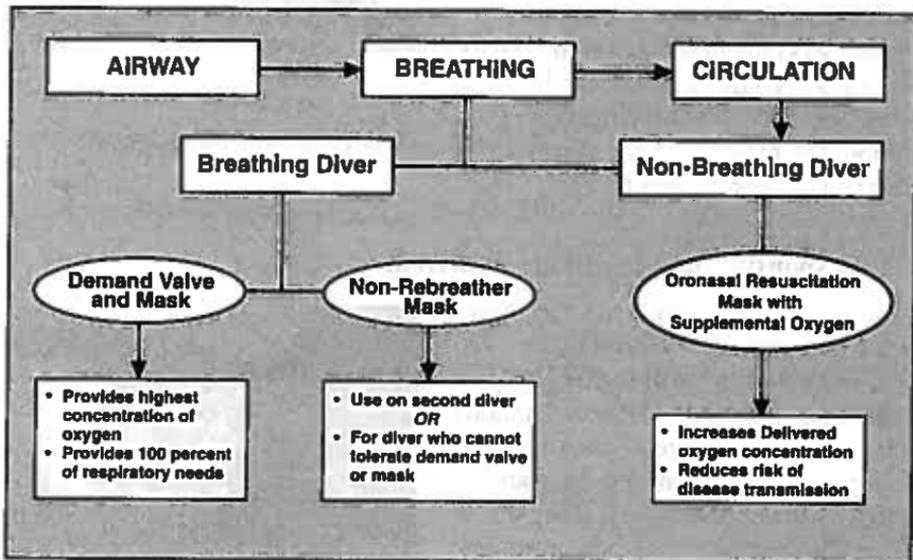
- Adjust the elastic band around head to hold the mask in place.
- Maintain open airway and lift the chin up to the mask.
- Deliver two normal rescue breaths, about one second in duration.
- Avoid forceful rapid ventilations.
- If the rescue breaths are unsuccessful, reposition the airway and reattempt ventilations.
- After delivering the two breaths, immediately deliver 30 chest compressions, followed by two breaths. Reassess the diver every two minutes or five cycles.



Recommendations for Oxygen Providers

Basic Life Support

Learn cardiopulmonary resuscitation (CPR) before you are trained to provide emergency oxygen. Proficiency in CPR is not difficult, but it does require training and practice under the supervision of a qualified instructor. This manual is not intended as a resource in learning CPR.

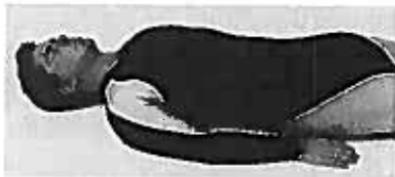


Dive Accident Positioning

Place the injured diver in a proper position. The diver's responsiveness and breathing status determine the best position for providing basic life support and oxygen.

• *Responsive, breathing injured diver*

If an injured diver is responsive and fully alert, he may be placed in any comfortable horizontal position such as the supine position (lying flat on the back) or the recovery position, also known as the lateral recumbent position, where the person is placed on the side with head supported at a low angle and the upper leg bent at the knee.



It is important not to obstruct blood flow by crossing the injured diver's arms or legs. Inert gas elimination is still occurring, and obstructed blood flow to an extremity may interfere with efficient offgassing.

- ***Unresponsive, breathing injured diver***

An injured diver who is unresponsive but breathing, should be placed in the lateral recumbent position. This minimizes the risk of airway obstruction by the tongue for the injured diver with a reduced conscious level. And, if vomiting occurs in this position, gravity will help keep the airway clear. In this situation, the Oxygen Provider should remove the mask, clear the airway and reassess the airway and breathing before resuming oxygen first aid.



- ***Unresponsive, non-breathing injured diver***

When an injured diver is not breathing, place him on the back (supine) so that either rescue breathing (artificial ventilations or expired air resuscitation) or CPR may be initiated. Vomiting in this position is extremely dangerous, and if it occurs, the injured diver should be quickly turned to the side until the airway is cleared so that aspiration (inhaling) of vomitus does not occur. Once the airway is cleared, resuscitation efforts can resume, with the diver in the supine position.



- ***Turning the injured diver***

Care should be taken when turning an injured diver from the supine into the recovery position or onto the side. Avoid excessive movement and remember to protect the head, neck and spine.



Overview of Dive Accident Management

First priority always goes to airway and breathing.

Every injured diver in respiratory distress or whose injury suggests possible hypoxia should receive oxygen as soon as it becomes available.

Assume that every unresponsive injured diver has respiratory insufficiency and needs:

- Protection of airway;
- Careful monitoring to determine if resuscitation is required;
- The highest possible concentration of inspired oxygen.

When in doubt, provide oxygen. Never, for any reason, withhold oxygen from anyone suspected of hypoxia.

When providing oxygen, check:

- Oxygen supply frequently;
- Adequate delivery of oxygen:
 - Can you hear the demand valve opening?
 - Is the reservoir bag inflating and deflating?
 - Can you hear the flow of oxygen to the pocket mask?
- The injured diver's condition.

Providing Oxygen for Divers

Upon completion of this course, you may have uncertainties about your ability to perform in a real situation. When someone is injured, anxiety is a natural reaction both for the injured diver and rescuers. Expect to have a pounding heart and breathless feeling, if you are suddenly confronted with an emergency of any kind. These feelings generally do not interfere with your ability to use your skills, and in fact, your knowledge and training should reduce the level of your anxiety.

There are other concerns, including the fear of making a mistake, harming an injured diver or possible death. Although unlikely, these concerns are real. However, it is more important to make the effort, since the person who needs assistance may be in worse shape without your help than with a possibly imperfect effort to provide assistance.

Rescuers may have another concern about liability and the possibility of being sued. However, if one acts in good faith, as a reasonably prudent person would do, and perform appropriately within your realm of training and expertise, you have little fear of liability. Although an injured diver may not improve, this is not evidence that you were responsible or that you performed below standards.

Your responsibility as a first aid provider is to treat the injured diver, family, and friends with respect during an emotionally difficult situation. You should act in a decisive manner and perform according to your knowledge and skill level. You should also see that the injured diver is referred to medical care or to someone whose ability is equal to or greater than yours. You are not obligated to start a first aid procedure, but once you do, you must continue until you are relieved by someone with equal or greater skill and/or qualifications.

Finally, practice what you have learned at every opportunity so that you will be prepared if your skills are needed.

Place the injured diver in the recommended position for dive accidents. If an injured diver vomits, temporarily discontinue oxygen use. After vomiting has ended, evaluate the airway, clear if necessary and resume providing oxygen at the earliest possible moment.

Provide injured breathing divers with the highest possible concentration of oxygen by demand inhalator valve or non-rebreather mask. Adjust the flow rate to the non-rebreather mask so that the reservoir bag does not completely deflate during inhalations. If the reservoir bag is continually deflated, check the seal of the mask and adjust the flow rate accordingly.

Continue oxygen use until the injured diver has reached a definitive care facility or until the oxygen supply is depleted. Do not reduce oxygen flow to the injured diver to make the supply last. High concentrations of inhaled oxygen, even if delivered over a shorter period of time, will be more beneficial to the injured diver. It creates a higher pressure gradient that results in a more effective washout of nitrogen. Lower concentrations of inspired oxygen may not be as effective, even though the rescuer can deliver oxygen for a longer period of time.

If the injured diver has a seizure, the rescuer may have to remove the oxygen. Resume oxygen delivery as soon as possible after seizure ceases.

Seizures occurring during surface oxygen administration are usually the result of a hypoxic event to the brain. Except to call for assistance with an

unresponsive diver, never leave an injured diver alone or unattended while emergency oxygen is being provided.

A flow rate of 15 lpm is suggested for injured divers using constant flow with the non-rebreather mask or pocket mask.

Administer fluids orally to the alert and oriented injured diver who has no risk of vomiting. If oral fluids are given to the injured diver, use water, since it is rapidly absorbed by the body, and it presents a lower risk of inducing vomiting. Other non-carbonated, non-caffeinated beverages are acceptable if water is unavailable.

Frequently practice all first aid, resuscitation, CPR and related oxygen skills.

Oxygen Safety Reminders

- Use oxygen only in well-ventilated areas.
- Extinguish all burning materials before using oxygen.
- Never combine oxygen and flammables, like petroleum products. In the presence of high-pressure oxygen, the combination of these materials may support spontaneous combustion.

Dive Accident Solution

Throughout this manual, you have reviewed several factors that may contribute to the dive accident. Now that you are informed as oxygen first aid providers, you are part of the dive accident solution.

As a prepared diver, you can do this by recognizing the warning signs of scuba diving injuries and illnesses.

Prepare a comprehensive Emergency Assistance Plan with a backup. Facets of the plan include:

- Using communications equipment;
- Knowing the location of the nearest medical facility;
- Accessing the DAN 24-Hour Diving Emergency Hotline for medical consultation and assistance in locating an appropriate hyperbaric facility; and
- Assisting in transportation.

If possible, activate the local Emergency Medical Services (EMS).

Have sufficient oxygen available until the injured diver arrives at the nearest available medical facility. Do not reduce the oxygen flow rate to the injured diver to make the supply last. Provide accident information to medical personnel.

Remember to go to the nearest, most appropriate medical facility and not necessarily to the nearest hyperbaric chamber. This is advised for a number of reasons:

- Only a small number of hospitals are equipped with hyperbaric chambers.
- Many hospitals with hyperbaric chambers are not equipped to treat diving injuries 24 hours a day. It takes time to assemble a chamber crew for the treatment of a diving injury.
- Before accepting the transfer of an injured diver, many hospitals require a referral from DAN or a physician.
- Some chambers are open only when they have patients.
- Some chambers are not equipped to treat divers.

Hyperbaric chamber status continually changes, and it is nearly impossible for any individual to maintain accurate daily information. This situation may create unnecessary delays if a dive team relies on obsolete information. DAN and most training agencies consider it unwise for dive instructors to advise students to go directly to the nearest chamber.

DAN advises divers to call the DAN or DAN-supported emergency number for your area, day or night, if you suspect a diving injury.

Every dive injury is unique, and crucial medical decisions must be made individually by a physician trained in dive medicine. The decision on where to treat an injured diver can only be made after a thorough medical evaluation and appropriate consultation.

Understand legal considerations:

There are no medical contraindications for providing oxygen to an injured scuba diver. International laws are not well-defined for oxygen use and for filling oxygen cylinders.

Understand misconceptions about oxygen and its use; read up-to-date literature, take other courses and learn from others.

Shock Management

Managing shock is the next step in providing first aid. Shock is caused by the inadequate delivery of oxygenated blood to body tissues. This can happen for multiple reasons. Allergic reactions can cause the body's blood vessels to dilate, reducing the flow of blood. Or the diver may have sustained a serious injury causing him to bleed away much of the body's blood supply. This injury may be from internal or external bleeding.



Ensuring the ABCs and controlling bleeding also manages shock. In addition, provide supplemental oxygen while keeping the diver warm. Avoid overheating, and don't give food or drinks.

Keep the diver on his back, but you may allow him to rest in a position of comfort. Once you complete these aspects of providing first aid, it's important to continually monitor the diver's responsiveness, airway, breathing and circulation. If changes occur, provide the appropriate first aid or basic life support



Giving Oxygen in an Emergency

“It is safe to give O₂ to anyone who is badly injured.”

Oxygen (O₂) is the primary fuel for our bodies and giving O₂ in an emergency helps assure that an injured or ill person has adequate energy to help them recover. There is no danger in giving O₂ in the first aid setting.

The most intimidating thing about giving O₂ for most rescuers is setting up and turning on unfamiliar equipment, especially since it is usually labeled with danger or warning stickers. Like most things, O₂ can be dangerous if mishandled, but it is very safe to use O₂ equipment as it was intended.

The cautions are simple; avoid extreme heat and don't directly expose pressurized O₂ to flames, grease or oil.

O₂ Equipment

Your choice of O₂ supply will be dictated by what you have available. The non-rebreather mask is nearly universal.

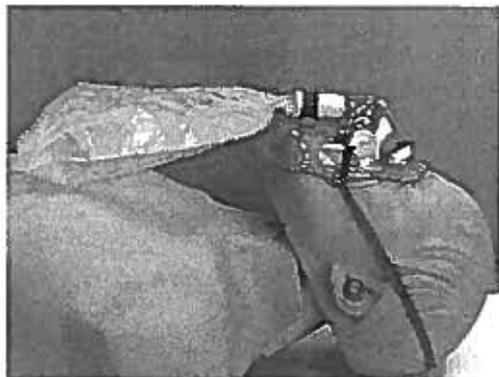
Giving O₂

There are only two steps to giving O₂. The first step is to assemble (if needed) the regulator to the tank and turn on the O₂. The second step is to connect the line and mask to the O₂ supply and apply it to the victims face.

Oro-nasal mask with O₂ inlet and one way valve



Non-rebreather mask on person's face-
Watch Airway!



You use the key to turn on the bottle and select 15 LPM on the regulator. Then fit the mask snugly on the victims face. Note that the non-rebreather bag acts as a reservoir but need not fill between each breath. It is important to maintain airway and mask position in victims who are too weak to do so for themselves.

Practical O2

If possible, you should practice with the O2 equipment you are likely to have available in an emergency so you will be comfortable with it. Practice connecting the regulator to the valve, turning on the O2 and setting it to 15 liters per minute. Try fitting the mask to another person and to yourself. Be sure you experience breathing O2 through the mask to increase your comfort level with its use.

CPR - The response to not breathing

CPR is the most dramatic and intimidating of all first-aid procedures. CPR is also the most important first-aid response and should always be given first if needed. Common Sense Lifesaving is structured to make the skill of CPR more “approachable” by eliminating anatomy and physiology and by utilizing the “Rule of 2s” to make CPR simpler and easier to remember.

Almost half of the people in America die of heart attack and many of those lives could be saved by CPR. Unfortunately, only a small percent of the public is CPR trained. There are many reasons for this disappointing statistic but one problem is that CPR & first-aid training are perceived as time consuming, expensive & confusing. Sadly, even those who are trained often fail to offer help in an emergency. Reasons for this failure to act include “I forgot what to do” and “I was afraid I would hurt the victim.”

Many emergency professionals have concluded that CPR must become simpler to learn, easier to remember and less intimidating to use in an emergency. Common Sense Lifesaving has been designed from the ground up to accomplish the goals of CPR with AED, O2 administration and first-aid.

CPR is the process by which a person (rescuer) mechanically delivers O₂ to the lungs and circulation of blood throughout the body of another person (victim) whose heart or breathing has failed. You only need to know a few simple concepts to effectively provide CPR.

The human body requires oxygen to function. We inhale O₂ (in air) into our lungs where it is absorbed by our blood and carried to our brain, body organs and other tissues. The flow of blood through heart, lungs and body tissues and back again is called circulation. Our heart is the pump that circulates the blood.

Breathing in delivers fresh O₂ to our lungs to be absorbed by the circulating blood and breathing out gets rid of the stale CO₂ from our circulating blood. The process is very simple; inhale O₂ - circulate it through our body - exhale bad CO₂, over and over again in a continuous lifelong cycle.

Failure of either process, breathing or circulation, results in inadequate O₂ delivery to the tissues and the tissues will become damaged or die. Lack of fresh O₂ causes injury to the heart and brain within seconds. We call injury to these organs heart attack or stroke, respectively. Damage to either organ can be fatal.

CPR can be lifesaving and the Rule of 2s was developed to help you learn and remember the essential steps of CPR.

APPENDIX 8

MEDICAL GUIDELINES, RECOMMENDATIONS, AND REQUIREMENTS FOR EXAMINING PHYSICIANS

LUMMI NATURAL RESOURCES DEPARTMENT (LNR) PHYSICAL EXAMINATION STANDARDS FOR DIVERS

The following medical requirements and recommendations were adapted from the 2011 Association of Diving Contractors International (ADCI) standards, adopted by the Lummi Fisheries and Natural Resources Commission in 2013, and are intended to be used with the Lummi Natural Resources Department (LNR) medical history/physical examination form (Appendix 9 of the LNR Commercial Harvest Diving Standards). These standards deal with specific aspects of the subject's physical fitness to dive and are offered with what LNR and the Lummi commercial harvest diving community believe, in most cases, to be the minimum requirements. The use of these standards is intended to be tempered with the good judgment of the examining physician. Where there is doubt about the medical fitness of the subject, the examining physician should seek the further opinion and recommendations of an appropriate specialist in that field (Appendix 7). Particular attention must be paid to past medical and diving history. In general, a high standard of physical and mental health is required for diving. Consequently, in addition to excluding major disqualifying medical conditions, examining physicians should identify and give careful consideration to minor, chronic, recurring or temporary mental or physical illnesses that may distract the diver and cause him or her to ignore factors concerned with his or her own safety or others' safety.

Where available, it is recommended that the medical examination be performed by a physician that has completed formal training in the medical assessment of fitness for commercial harvest diving. Examinations should not be performed by non-physicians.

The spectrum of commercial diving activities includes industrial tasks performed from just below the surface to deep saturation diving. Job descriptions and therefore job-limiting disabilities may vary widely. These standards, in general, apply to most divers; however, additional consideration must be given to the following: subject's medical history, work history, and age among others.

There is no maximum age limit, providing all the medical standards can be met; however, the LNR will not issue commercial diver classification cards to persons younger than 18 years of age. Serious consideration must be given to the need for all divers to have adequate reserves of pulmonary and cardiovascular fitness for use in an emergency. The lack of these reserves may possibly lead to the termination of a professional diving career. The examining physician should exercise the appropriate professional judgment to determine whether, in particular circumstances, additional testing may be warranted. Disqualification for an inability to meet any of these standards must be determined on a case-by-case basis related only to the specific job functions of the position being applied for, and assuming reasonable accommodations cannot be made.

Upon application by an individual, and with concurrence by the examining physician, particular medical circumstances may justify that a variance be granted until the diver's next periodic diving physical. At that time, the permitted variance is to be subject to the examining physician's review and comment. Examining physicians should be familiar with the essential job functions of diving personnel (Section 3 of the LNR Commercial Harvest Diving Standards) to review with each commercial harvest diving physical examination. The examining physician is encouraged to make any recommendations for reasonable accommodations necessary for a person to meet these standards.

The numbered items in Table 1A8 below refer to boxes on the LNR medical history/physical examination form for diver applicants only. Hose Tender applicants will use a standard sport physical examination form. These forms are available in Appendix 9 of the LNR Commercial Harvest Diving Standards and from the LNR Diving Safety Officer (DSO). Diver patient history is recorded on the first two pages of the LNR medical history/physical examination form. The third and fourth pages are used to record specific findings during the conduct of the examination. Use of this form ensures quality and consistency throughout the Lummi Nation commercial harvest diving community. If any further clarification of this recommended standard is desired, please contact the LNR DSO or his/her designee (Telephone: 360-312-2000).

Table 1A8. Physical examination standards to be used by medical professionals when evaluating applicants who want to participate in commercial harvest diving activities permitted under the auspices of the Lummi Nation. These standards apply to diver applicants only.

No.	Exam	Results, indication, or action
1	Name	Record.
2	Social Security Number, Passport Number, or Lummi Fisher ID	Record.
3	Height	No set limits.
4	Weight	The weight standards listed in this section and the following tables are for reference purposes only and should be used as educational guidelines for applicants. It should be noted that ADCI considers these ideals for commercial divers and potentially disqualifying. If a diver exceeds these standards and the alert physician feels the increase is due to muscular build and physical fitness, a variance is appropriate. Furthermore, individuals who fall within these weight standards but who present an excess of fatty tissue should be strongly encouraged to lose excess weight and possibly discouraged from commercial diving activity until the excess weight is shed or lost.
5	Body Fat	Optional. According to U. S. Navy, 23% for males, 34% for females.
6	Body Mass Index (BMI)	Optional. BMI is calculated as (weight in pounds x 703)/(height in inches ²).
7	Temperature	The diver should be free of any infection/disease that would cause an abnormal temperature.
8	Blood Pressure	Ideally, the 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. The blood pressure should be controlled without target organ damage. Beta blockers are not acceptable. Low-dose diuretics are acceptable. Medications required to control blood pressure should be noted on the physical exam form.
9	Pulse/Rhythm	Persistent tachycardia, marked arrhythmia except of the sinus type, or other significant disturbance of the heart or vascular system should be disqualifying.
10	General Appearance/ Hygiene	Should be good.
11	Build	Record.
12	Distant Vision	Should have vision corrected to 20/40, O.U., in both eyes. Monocular vision is not necessarily disqualifying for commercial harvest diving. Divers who have had vision corrective surgery should be restricted from diving until cleared by a certified diving physician.
13	Near Vision	Correctable to 20/40.
14	Color Vision	Record. Color blindness does not disqualify for diving, but diver must have color vision specific for duties.
15	Field of Vision	Should be normal, with any discrepancies documented. A minimum of 85 degrees field of vision is required.
16	Contact Lenses	Record if used. Appropriate lenses for diving may be used (gas permeable/fenestrated hard lens).
17	Head, Face and	The causes for rejection may be:

Table 1A8. Physical examination standards to be used by medical professionals when evaluating applicants who want to participate in commercial harvest diving activities permitted under the auspices of the Lummi Nation. These standards apply to diver applicants only.

No.	Exam	Results, indication, or action
	Scalp	a) Deformities of the skull in the nature of depressions, exostosis, etc., of a degree that would prevent the individual from wearing required equipment. b) Deformities of the skull of any degree associated with evidence of disease of the brain, spinal cord or peripheral nerves. c) Loss or congenital absence of the bony substance of the skull.
18	Neck	Conditions affecting the neck must not impair the diver to cause insufficient range of motion. The causes for rejection may be: a) Cervical ribs if symptomatic. b) Congenital cysts of bronchial cleft origin or those developing from the remnants of 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. e) Neural impingement.
19	Eyes	Active pathology or previous eye surgery may be cause for restriction or rejection. Divers who have had vision corrective surgery should be restricted from diving until cleared by a certified diving physician. History of cataract surgery with intraocular lens implant is not disqualifying.
20	Fundulus	Optional. No pathology.
21	Through # 25	The following conditions are disqualifying: a) Acute disease including vestibular disease. b) Chronic serious otitis. c) Otitis media. d) Perforation of the tympanic membrane. e) PE tubes in place. f) Any significant nasal or pharyngeal respiratory obstruction. g) Chronic sinusitis if not readily controlled. h) Speech impediments due to organic defects. i) Inability to equalize pressure due to any cause. j) Meniere's disease. k) Recurrent or persistent vertigo. l) Recent piercings are potentially disqualifying. If Eustachian tube dysfunction is suspected, then referral or testing should be done. Adequately repaired round window ruptures that have no significant residual deficits may be approved for diving.
26	Mouth and Throat	a) Candidate should have a high degree of dental fitness; any abnormalities of dentition or malformation of the mandible likely to impair the diver's ability to securely and easily retain any standard equipment mouthpiece should disqualify. b) Removable dentures should not be worn while diving. c) Severe dental caries is disqualifying until repaired.
27	Chest/Breast	Note any chest deformities, breast abnormalities or masses.
28	Lungs	Pulmonary: Congenital and acquired defects that may restrict pulmonary function, cause air entrapment, or affect the ventilation-perfusion or balance shall be disqualifying for both initial training and continuation. Obstructive or restrictive pulmonary functions require further evaluation. Pulmonary disease requiring medication use may be disqualifying. History of recurrent or spontaneous pneumothorax is disqualifying.

Table 1A8. Physical examination standards to be used by medical professionals when evaluating applicants who want to participate in commercial harvest diving activities permitted under the auspices of the Lummi Nation. These standards apply to diver applicants only.

No.	Exam	Results, indication, or action
29	Heart (thrust, size, rRhythm, sounds)	Cardiovascular system: There should be no evidence of heart disease. Any arrhythmias must be fully investigated. Any evidence of heart disease or arrhythmias other than sinus arrhythmias must be fully investigated. Ejection fractions must be at least 40%. For evaluation purposes, Bruce protocol functional stress testing must be to 13 METS without evidence of ischemia. Pacemakers and implantable cardiac defibrillators are disqualifying. PFO repairs are not disqualifying. Coumadin or any anticoagulants are considered disqualifying.
30	Pulse	Record. Peripheral pulses should be regular, full and symmetric.
31	Vascular System (varicosities, etc.)	Cardiovascular system: The cardiovascular system shall be without significant abnormality in all respects as determined by physical examination and tests as may be indicated. Persistent tachycardia and arrhythmia except sinus type, evidence of symptomatic arteriosclerosis, severe varicose veins and marked symptomatic hemorrhoids may be disqualifying.
32	Abdomen and Viscera	a) Active peptic ulceration should be disqualifying until treated and healed. History of gastrointestinal bleeding may be disqualifying from diving and is disqualifying from saturation diving. b) Any other chronic gastrointestinal disease (e.g., ulcerative colitis, cholelithiasis) may be cause for rejection. c) Crohn's disease may be disqualifying. d) Hepatitis may be disqualifying.
33	Hernia (all types)	All inguinal or femoral hernias are disqualifying until repaired. Ventral hernias more than one cm must be repaired prior to diving.
34	Endocrine System	Diabetics controlled with diet and exercise and with Hgb A1C < 7.0 are acceptable. History of thyroid disease adequately controlled with medication is acceptable to dive. Any other endocrine disorders requiring medication may be disqualifying.
35	G-U System (genital-urinary)	a) Venereal disease will disbar until adequately treated. b) Evidence or history of nephrolithiasis must be fully investigated and treated and may be disqualifying. c) Any renal insufficiency or chronic renal disease may be disqualifying. d) History of kidney stones are disqualifying for saturation diving. e) Evidence or history of urinary dysfunction or retention must be fully investigated and treated.
36	Upper Extremities (strength, ROM)	Any impairment of musculoskeletal function should be carefully assessed against the general requirements that would interfere with the individual's performance as a diver. Amputations may be disqualifying. Orthopedic internal fixation hardware is not disqualifying if the fracture site is healed.
37	Lower Extremities, Except Feet	Any impairment of musculoskeletal function should be carefully assessed against the general requirements that would interfere with the individual's performance as a diver. Amputations may be disqualifying. Orthopedic internal fixation hardware is not disqualifying if the fracture site is healed.
38	Feet	Any impairment of musculoskeletal function should be carefully assessed against the general requirements that would interfere with the individual's performance as a diver.
39	Spine	Any impairment of musculoskeletal function should be carefully assessed against the general requirements that would interfere with the individual's performance as a diver. Neural impingement is considered disqualifying.

Table 1A8. Physical examination standards to be used by medical professionals when evaluating applicants who want to participate in commercial harvest diving activities permitted under the auspices of the Lummi Nation. These standards apply to diver applicants only.

No.	Exam	Results, indication, or action
40	Skin and Lymphatic System	Active, acute or chronic disease of the skin or lymphatic system may be disqualifying. Tattoos must be fully healed prior to diving.
41	Anus and Rectum	Any conditions that interfere with normal function (e.g., stricture, prolapse, severe hemorrhoids) may be disqualifying.
42	Sphincter Tone	Note and record.
43	Pelvic Exam	If not done by the diving medical examiner, must be documented by diver's gynecologist or family physician within the previous 12 months and must be within limits. Pregnancy at any stage is disqualifying. Any menstrual disorder manifested by abnormal or prolonged bleeding, as well as excessive pain, may be disqualifying.
	Neurological Exam (44-51)	A full 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 nervous system disease can be excluded. Any history of seizure (apart from childhood febrile convulsions, oxygen toxicity or withdrawal seizures) is disqualifying. Intracranial surgery, loss of consciousness, and severe head injury involving more than momentary unconsciousness or concussion, may be disqualifying. If the severity of head injury is in doubt, special consultation and studies should be considered. All neurodegenerative conditions are disqualifying.
44	Cranial Nerves	Examine, evaluate and record.
45	Reflexes	Should be symmetrical and free from pathology. Document any abnormalities. Pathological reflexes should be evaluated.
46	Cerebellar Function	Test and record.
47	Strength and Tone of Muscles	Examine and record. Note any atrophy or loss of tone.
48	Proprioception/ Stereognosis	Examine and record.
49	Nystagmus	Do and record. Congenital nystagmus is not necessarily disqualifying. End point lateral gaze nystagmus is considered normal.
50	Sensations and Vibration	Test and record. Vibration should be tested using a 128 Hz tuning fork. Two point discrimination should be tested at the thumb (C6), 3rd finger (C7) and the 5th finger (C8) and should be discernible at 4 mm.
51	Rhomberg	Do and record. May perform rhomberg for up to two minutes.
52	Miscellaneous Remarks and Dermatome Diagram	Record findings and comments.
53	Urinalysis	Includes color pH, specific gravity, glucose, albumin and micro, and all results should be within normal limits.
54	Blood Tests	a) Hematology: Any significant anemia or history of hemolytic disease must be evaluated. When due to a variant hemoglobin state, it shall be disqualifying. b) Serology/AIDS test done. If positive, cause for rejection until properly treated and cleared. c) All applicants for diving duty should have a sickle cell and AIDS test done and recorded. d) Pregnancy test for females: Consider repeating prior to each saturation dive.

Table 1A8. Physical examination standards to be used by medical professionals when evaluating applicants who want to participate in commercial harvest diving activities permitted under the auspices of the Lummi Nation. These standards apply to diver applicants only.

No.	Exam	Results, indication, or action
55	Pulmonary Function	Pulmonary function tests: 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 METS.
56	X-ray/Imaging	a) 14 x 17 chest: No pathology within normal limits. b) Lumbar/sacral spine (optional on new hire). c) Long bones (optional): Any lesions, especially juxta-articular, should be evaluated to determine patient's fitness to dive. d) MRI (optional): Neural impingements on MRI examinations are disqualifying.
57	Electrocardiogram	ECG examinations: Resting standard 12 lead ECG are optional on new hire examinations and required annually after the age of 35. Exercise stress tests should be considered and may be indicated after the age of 40.
58	Audiogram Pure Tone	A hearing loss in either ear of 40 dB in the range of 500, 1000 and 2000 Hz is an indication for referral of the candidate to a specialist for further opinion, unless the examining doctor is convinced that such a hearing loss is unlikely to be significantly increased by continued diving activities. Doubts about function of labyrinths require specialized examination. Monaural hearing is not disqualifying.
59	Comprehensive Metabolic Panel	Optional. If done, record.
60	Drug Screen	Evidence of substance misuse: a) Alcohol-, drug-, or chemical-dependence, i.e., active, untreated addiction; b) At the time of medical examination, use of any illegal or controlled substance, drug, or behavior-altering chemical, as indicated by a drug screening or urinalysis, when the use cannot be accounted for as a result of prescription by a physician.

NEUROPSYCHIATRIC

The nature of diving duties requires a careful appraisal of the individual's emotional and temperamental fitness. Personality disorders, bipolar disorders, psychosis, instability and anti-social traits shall be disqualifying. Any psychiatric condition requiring medication may be disqualifying. Temporary situational depression may be approved on low-dose antidepressants that do not affect seizure thresholds or have any side effects of CNS depression. Any past or present evidence of psychiatric illness shall be cause for rejection unless the examining doctor can be confident that it is of a minor nature and unlikely to occur.

Particular attention should be paid to any past or present evidence of alcohol or drug abuse. The diver may not be taking steroids or any illicit substances. Any abnormalities should be noted in block No. 52 of the physical examination form (Appendix 9).

Past or current symptoms of neuropsychiatric disorder or organic disease of the nervous system shall be disqualifying. No individual with a history of any form of epilepsy, or head injury with sequelae, or personality disorder shall be accepted. Neurotic trends, emotional adjustment, shall be disqualifying. Stammering or other speech impediment that might become manifest under excitement is disqualifying. Intelligence must be at least normal. Any abnormalities should be noted in block No. 52 of the physical examination form.

DISCLAIMER

Because of the lack of medical literature concerning commercial diving, these guidelines were developed consensually among ADCI-associated diving physicians and are intended for only that purpose. The diving medical examiner may use discretion in deviating from these guidelines on an individual basis given the circumstances.

BODY MASS INDEX TABLES AND BODY FAT CHARTS

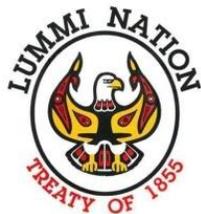
BMI Table										
Height (inches)	BMI									
	19	20	21	22	23	24	25	26	27	28
	Body Weight (pounds)									
58	91	96	100	105	110	115	119	124	129	134
59	94	99	104	109	114	119	124	128	133	138
60	97	102	107	112	118	123	128	133	138	143
61	100	106	111	116	122	127	132	137	143	148
62	104	109	115	120	126	131	136	142	147	153
63	107	113	118	124	130	135	141	146	152	158
64	110	116	122	128	134	140	145	151	157	163
65	114	120	126	132	138	144	150	156	162	168
66	118	124	130	136	142	148	155	161	167	173
67	121	127	134	140	146	153	159	166	172	178
68	125	131	138	144	151	158	164	171	177	184
69	128	135	142	149	155	162	169	176	182	189
70	132	139	146	153	160	167	174	181	188	195
71	136	143	150	157	165	172	179	186	193	200
72	140	147	154	162	169	177	184	191	199	206
73	144	151	159	166	174	182	189	197	204	212
74	148	155	163	171	179	186	194	202	210	218
75	152	160	168	176	184	192	200	208	216	224
76	156	164	172	180	189	197	205	213	221	230

BMI Table										
Height (Centimeters)	BMI									
	19	20	21	22	23	24	25	26	27	28
	Body Weight (kilograms)									
147.3	41.3	43.5	45.4	47.6	49.9	52.2	54.0	56.2	58.5	60.8
149.9	42.6	44.9	47.2	49.4	51.7	54.0	56.2	58.1	60.3	62.6
152.4	44.0	46.3	48.5	50.8	53.5	55.8	58.1	60.3	62.6	64.9
154.9	45.4	48.1	50.3	52.6	55.3	57.6	59.9	62.1	64.9	67.1
157.5	47.2	49.4	52.2	54.4	57.2	59.4	61.7	64.4	66.7	69.4
160.0	48.5	51.3	53.5	56.2	59.0	61.2	64.0	66.2	68.9	71.7
162.6	49.9	52.6	55.3	58.1	60.8	63.5	65.8	68.5	71.2	73.9
165.1	51.7	54.4	57.2	59.9	62.6	65.3	68.0	70.8	73.5	76.2
167.6	53.5	56.2	59.0	61.7	64.4	67.1	70.3	73.0	75.7	78.5
170.2	54.9	57.6	60.8	63.5	66.2	69.4	72.1	75.3	78.0	80.7
172.7	56.7	59.4	62.6	65.3	68.5	71.7	74.4	77.6	80.3	83.5
175.3	58.1	61.2	64.4	67.6	70.3	73.5	76.7	79.8	82.6	85.7
177.8	59.9	63.0	66.2	69.4	72.6	75.7	78.9	82.1	85.3	88.5
180.3	61.7	64.9	68.0	71.2	74.8	78.0	81.2	84.4	87.5	90.7
182.9	63.5	66.7	69.9	73.5	76.7	80.3	83.5	86.6	90.3	93.4
185.4	65.3	68.5	72.1	75.3	78.9	82.6	85.7	89.4	92.5	96.2
188.0	67.1	70.3	73.9	77.6	81.2	84.4	88.0	91.6	95.3	98.9
190.5	68.9	72.6	76.2	79.8	83.5	87.1	90.7	94.3	98.0	101.6
193.0	70.8	74.4	78.0	81.6	85.7	89.4	93.0	96.6	100.2	104.3

Body Fat Percentages Comparison Table		
Fat Level	Men (%)	Women (%)
Very Low	7-10	14-17
Low	10-13	17-20
Average	13-17	20-27
High	17-25	27-31
Very High	above 25	above 31

Current U.S. Navy Maximum Allowable Weight Chart (2008)				
Males Weight in Pounds	Males BMI	Height (inches)	Females BMI	Females Weight in Pounds
142	28	60	28	142
147	28	61	28	145
152	28	62	28	149
157	28	63	28	152
162	28	64	28	156
167	28	65	28	160
172	28	66	28	163
177	28	67	28	167
182	28	68	28	170
188	28	69	28	174
192	28	70	28	177
196	28	71	28	181
201	28	72	28	185
206	28	73	28	188
211	28	74	28	192
216	28	75	28	195
221	28	76	28	199
226	28	77	28	203
231	28	78	28	199
236	28	79	28	210
241	28	80	28	213

COMMERCIAL HARVEST DIVING STANDARDS



APPENDIX 9

**LUMMI NATURAL RESOURCES DEPARTMENT (LNR) MEDICAL HISTORY
AND PHYSICAL EXAMINATION FORMS FOR DIVERS**

**LNR STANDARD SPORT PHYSICAL EXAMINATION FORM FOR HOSE
TENDERS**

LNR PHYSICIAN APPROVAL FORM

LNR HOSE TENDER AND TRAINEE DIVER TRAINING LOG

LNR TRAINEE DIVER LOG

**LNR CONFIRMATION OF SATISFYING COMMERCIAL HARVEST DIVING
TRAINING REQUIREMENTS**

**LUMMI TRIBAL HEALTH CENTER AUTHORIZATION FOR USE OR
DISCLOSURE OF HEALTH INFORMATION**

**VIRGINIA MASON MEDICAL CENTER AUTHORIZATION TO RELEASE
PATIENT HEALTH INFORMATION**

**LNR ASSUMPTION OF RISK FOR TECHNICAL DIVING INCLUDING DEEP
DIVING AND PLANNED DECOMPRESSION**

LNR DIVING ACCIDENT/INCIDENT REPORTING FORM

**EXAMPLE CHECKLISTS (ADCI) TO ENSURE COMPLIANCE WITH
COMMERCIAL HARVEST DIVING STANDARDS**

HOW TO CONDUCT A JOB HAZARD ANALYSIS (JHA)

UNITED STATES COAST GUARD FISHING VESSEL SAFETY CHECKLISTS

LUMMI NATURAL RESOURCES DEPARTMENT

MEDICAL HISTORY FORM

Employer			Job Title			Date		
1. Last Name	First Name	Middle Name	2. Date of Birth		3. Gender	4. SSN or PASSPORT No.		
5. Address (Number, Street)			6. City		7. State	8. Zip Code		9. Area Code - Phone Number ()
10. Emergency Contact Person - Relationship - Address - Telephone Number							11. Cell Phone Number ()	

12. MEDICAL HISTORY: Have you ever had or been treated for (positive answers must be explained below):

Yes	No		Yes	No		Yes	No	
<input type="checkbox"/>	<input type="checkbox"/>	Convulsions or Seizures	<input type="checkbox"/>	<input type="checkbox"/>	Cardiac Angiogram or ECHO	<input type="checkbox"/>	<input type="checkbox"/>	Herniated Disc or Sciatica
<input type="checkbox"/>	<input type="checkbox"/>	Epilepsy	<input type="checkbox"/>	<input type="checkbox"/>	PFO Repair	<input type="checkbox"/>	<input type="checkbox"/>	Shoulder Injury
<input type="checkbox"/>	<input type="checkbox"/>	Concussion or Head Injury	<input type="checkbox"/>	<input type="checkbox"/>	High Blood Pressure	<input type="checkbox"/>	<input type="checkbox"/>	Elbow Injury
<input type="checkbox"/>	<input type="checkbox"/>	Disabling Headaches	<input type="checkbox"/>	<input type="checkbox"/>	Asthma or Wheezing	<input type="checkbox"/>	<input type="checkbox"/>	Arm/wrist/hand Injury
<input type="checkbox"/>	<input type="checkbox"/>	Loss of Balance/Dizziness	<input type="checkbox"/>	<input type="checkbox"/>	Coughing up Blood	<input type="checkbox"/>	<input type="checkbox"/>	Hip/Leg/Ankle Injury
<input type="checkbox"/>	<input type="checkbox"/>	Severe Motion Sickness	<input type="checkbox"/>	<input type="checkbox"/>	Tuberculosis	<input type="checkbox"/>	<input type="checkbox"/>	Knee Injury or "Trick Knee"
<input type="checkbox"/>	<input type="checkbox"/>	Unconsciousness	<input type="checkbox"/>	<input type="checkbox"/>	Shortness of Breath	<input type="checkbox"/>	<input type="checkbox"/>	Foot Trouble or Injuries
<input type="checkbox"/>	<input type="checkbox"/>	Fainting Spells	<input type="checkbox"/>	<input type="checkbox"/>	Chronic Cough	<input type="checkbox"/>	<input type="checkbox"/>	Dislocations
<input type="checkbox"/>	<input type="checkbox"/>	Wear Contacts/Glasses	<input type="checkbox"/>	<input type="checkbox"/>	Pneumothorax	<input type="checkbox"/>	<input type="checkbox"/>	Swollen Joints
<input type="checkbox"/>	<input type="checkbox"/>	Color Vision Defect	<input type="checkbox"/>	<input type="checkbox"/>	Lung Disease or Surgery	<input type="checkbox"/>	<input type="checkbox"/>	Broken Bones or Fractures
<input type="checkbox"/>	<input type="checkbox"/>	Eye Disease or Injury	<input type="checkbox"/>	<input type="checkbox"/>	Gallbladder Disease or Stones	<input type="checkbox"/>	<input type="checkbox"/>	Varicose Veins
<input type="checkbox"/>	<input type="checkbox"/>	Eye Surgery	<input type="checkbox"/>	<input type="checkbox"/>	Stomach Trouble or Ulcers	<input type="checkbox"/>	<input type="checkbox"/>	Muscle Disease or Weakness
<input type="checkbox"/>	<input type="checkbox"/>	Hearing Loss	<input type="checkbox"/>	<input type="checkbox"/>	Stomach Bleeding	<input type="checkbox"/>	<input type="checkbox"/>	Numbness or Paralysis
<input type="checkbox"/>	<input type="checkbox"/>	Ear Disease or Injury	<input type="checkbox"/>	<input type="checkbox"/>	Frequent Indigestion	<input type="checkbox"/>	<input type="checkbox"/>	Sleep Disorders
<input type="checkbox"/>	<input type="checkbox"/>	Ear Surgery	<input type="checkbox"/>	<input type="checkbox"/>	Jaundice	<input type="checkbox"/>	<input type="checkbox"/>	Diabetes
<input type="checkbox"/>	<input type="checkbox"/>	Perforated Eardrum	<input type="checkbox"/>	<input type="checkbox"/>	Liver Disease or Hepatitis	<input type="checkbox"/>	<input type="checkbox"/>	Goiter or Thyroid Disease
<input type="checkbox"/>	<input type="checkbox"/>	Difficulty Clearing	<input type="checkbox"/>	<input type="checkbox"/>	Rectal Bleeding/Blood in Stools	<input type="checkbox"/>	<input type="checkbox"/>	Blood Disease
<input type="checkbox"/>	<input type="checkbox"/>	Nose Bleed	<input type="checkbox"/>	<input type="checkbox"/>	Hemorrhoids (Piles)	<input type="checkbox"/>	<input type="checkbox"/>	Anemia: Sickle Cell or Other
<input type="checkbox"/>	<input type="checkbox"/>	Airway Obstruction	<input type="checkbox"/>	<input type="checkbox"/>	Gas Pains	<input type="checkbox"/>	<input type="checkbox"/>	Skin Rash or Disease
<input type="checkbox"/>	<input type="checkbox"/>	Hay Fever or Allergies	<input type="checkbox"/>	<input type="checkbox"/>	Crohn's Disease/Ulcerative Colitis	<input type="checkbox"/>	<input type="checkbox"/>	Staph Infections
<input type="checkbox"/>	<input type="checkbox"/>	Chest Pain	<input type="checkbox"/>	<input type="checkbox"/>	Rupture or Hernia	<input type="checkbox"/>	<input type="checkbox"/>	Tumor or Cancer
<input type="checkbox"/>	<input type="checkbox"/>	Heart Murmur	<input type="checkbox"/>	<input type="checkbox"/>	Kidney Disease	<input type="checkbox"/>	<input type="checkbox"/>	Claustrophobia
<input type="checkbox"/>	<input type="checkbox"/>	Rheumatic Fever	<input type="checkbox"/>	<input type="checkbox"/>	Kidney Stones	<input type="checkbox"/>	<input type="checkbox"/>	Mental Illness/Depression/Anxiety
<input type="checkbox"/>	<input type="checkbox"/>	Heart Attack	<input type="checkbox"/>	<input type="checkbox"/>	Protein, Sugar or Blood in Urine	<input type="checkbox"/>	<input type="checkbox"/>	Nervous Breakdown
<input type="checkbox"/>	<input type="checkbox"/>	Abnormal Heart Rhythm	<input type="checkbox"/>	<input type="checkbox"/>	Joint Pain/Arthritis	<input type="checkbox"/>	<input type="checkbox"/>	Any Sexually Transmitted Disease
<input type="checkbox"/>	<input type="checkbox"/>	Heart Disease	<input type="checkbox"/>	<input type="checkbox"/>	Back Strain or Injury	<input type="checkbox"/>	<input type="checkbox"/>	Contagious Disease
<input type="checkbox"/>	<input type="checkbox"/>	Cardiac Stent or Angioplasty	<input type="checkbox"/>	<input type="checkbox"/>	Spine Problems	<input type="checkbox"/>	<input type="checkbox"/>	Other Illness or Injury or Any Other Medical Condition

<input type="checkbox"/>	<input type="checkbox"/>	For Females ONLY	<input type="checkbox"/>	<input type="checkbox"/>	Painful Menses	Last Menstrual Period _____	
<input type="checkbox"/>	<input type="checkbox"/>	Irregular Menses	<input type="checkbox"/>	<input type="checkbox"/>	Pregnancy		

PLEASE EXPLAIN THE DETAILS OF EACH ITEM CHECKED YES _____

13. LIST ALL SURGERIES

_____	YEAR
_____	_____
_____	_____

14. LIST ALL HOSPITALIZATIONS

_____	YEAR
_____	_____
_____	_____

15. LIST ALL INJURIES

_____	YEAR
_____	_____
_____	_____

16. LIST ALL MEDICATIONS, PRESCRIPTION OR OVER THE COUNTER

17 ANSWER THE FOLLOWING QUESTIONS:

Every Item Checked Yes Must Be Fully Explained Below

	YES	NO		YES	NO
Do you have any physical defects or any partial disabilities?			Have you ever resigned, been terminated, or changed jobs for medical reasons?		
Have you ever been rejected or rated for insurance, employment, license, or armed forces for health reasons?			Have you ever been dismissed from employment because of excess use of drugs or alcohol?		
Have you ever had illnesses, injuries, or lost time accidents from any work that you have done?			Do you have any allergies or reactions to food, chemicals, drugs, insect stings, or marine life?		
Have you been advised to have a surgical operation or medical treatment that has not been done?			Are you presently under the care of a physician? Give physician's name and address on the next page.		

COMMENTS: _____

18. My Personal Physician is: Name _____
 Address _____
 City, State _____
 Phone Number _____

19. DIVING HISTORY How long have you been commercial diving? _____

Surface Air Diving History
 Maximum Depth Surface Air _____
 Maximum Depth Surface Mixed Gas _____
 Longest Bottom Time Air _____
 Longest Bottom Time Mixed Gas _____

Saturation Diving History
 Heliox Yes No
 Trimix Yes No
 Nitrox Yes No

Maximum Depth _____
 Maximum Duration (Days) _____

20. DIVING EXPERIENCE (Number of years experience):
 Air _____ Have you passed an oxygen tolerance test?
 Yes No
 Mixed Gases _____
 Saturation _____ Name of Diving School _____

21. INDICATE THE NUMBER OF DECOMPRESSION INCIDENTS
 If None put 0 (Zero) List any residuals
 Bends, pain only _____
 Bends, neurological _____
 Chokes _____
 Inner ear _____

22. IN DIVING HAVE YOU HAD A HISTORY OF: (Provide details of dates and severity)

	Yes	No	Details
Gas Embolism	<input type="checkbox"/>	<input type="checkbox"/>	_____
Oxygen Toxicity	<input type="checkbox"/>	<input type="checkbox"/>	_____
CO ₂ Toxicity	<input type="checkbox"/>	<input type="checkbox"/>	_____
CO Toxicity	<input type="checkbox"/>	<input type="checkbox"/>	_____
Ear/Sinus Squeeze	<input type="checkbox"/>	<input type="checkbox"/>	_____
Ear Drum Rupture	<input type="checkbox"/>	<input type="checkbox"/>	_____
Deafness	<input type="checkbox"/>	<input type="checkbox"/>	_____

	Yes	No	Details
Lung Squeeze	<input type="checkbox"/>	<input type="checkbox"/>	_____
Near Drowning	<input type="checkbox"/>	<input type="checkbox"/>	_____
Asphyxiation	<input type="checkbox"/>	<input type="checkbox"/>	_____
Vertigo (Dizziness)	<input type="checkbox"/>	<input type="checkbox"/>	_____
Pneumothorax	<input type="checkbox"/>	<input type="checkbox"/>	_____
Nitrogen Narcosis	<input type="checkbox"/>	<input type="checkbox"/>	_____
Loss of Consciousness	<input type="checkbox"/>	<input type="checkbox"/>	_____

23. Have you been involved in a diving accident (decompression sickness or others) since your last physical examination? Yes No
 Date of last physical examination: _____ Name of Physician who performed your last exam _____
 For what company or organization were you last examined? _____ Address of Physician _____
 _____ City, State _____

24. Have you ever had any of the following? If so, give approximate date:

Yes	No	Give Date	Yes	No	Give Date
<input type="checkbox"/>	<input type="checkbox"/>	Chest X-Ray _____	<input type="checkbox"/>	<input type="checkbox"/>	Nerve Condition Studies _____
<input type="checkbox"/>	<input type="checkbox"/>	Longbone Series _____	<input type="checkbox"/>	<input type="checkbox"/>	Pulmonary Function Studies _____
<input type="checkbox"/>	<input type="checkbox"/>	Back (Spine) X-Ray _____	<input type="checkbox"/>	<input type="checkbox"/>	Audiogram _____
<input type="checkbox"/>	<input type="checkbox"/>	ENG _____	<input type="checkbox"/>	<input type="checkbox"/>	EKG _____
<input type="checkbox"/>	<input type="checkbox"/>	EEG _____	<input type="checkbox"/>	<input type="checkbox"/>	Exercise (Stress) EKG _____
<input type="checkbox"/>	<input type="checkbox"/>	EMG _____	<input type="checkbox"/>	<input type="checkbox"/>	MRI _____

25. Physician Remarks: _____

I CERTIFY THAT I HAVE REVIEWED THE FOREGOING INFORMATION SUPPLIED BY ME AND THAT IT IS TRUE AND COMPLETE TO THE BEST OF MY KNOWLEDGE. I UNDERSTAND THAT LEAVING OUT OR MISREPRESENTING FACTS CALLED FOR ABOVE MAY BE CAUSE FOR REFUSAL OF EMPLOYMENT OR receiving approval to participate in commercial harvest diving activities permitted under the auspices of the Lummi Nation.

LUMMI NATURAL RESOURCES DEPARTMENT

PHYSICAL EXAMINATION FORM

Employer		Date		Date of Birth		Age	
1. Last Name			First Name		Middle Name		2. SSN or PASSPORT No.
3. Height (inches)		4. Weight (pounds)		5. Body Fat (%) (Optional)		6. BMI (Optional)	
7. Temperature		8. Blood Pressure		9. Pulse/Rhythm		10. General Appearance/Hygiene	11. Build
12. Distant Vision:		13. Near Vision: Jaeger		Near Vision Corrected		14. Color Vision (Test Performed and Results)	
R. 20/_____		R. 20/_____		R. 20/_____			
L. 20/_____		L. 20/_____		L. 20/_____			
15. Field of Vision (Degrees)		R _____ ° L _____ °		16. Contact Lenses <input type="checkbox"/> Yes <input type="checkbox"/> No			
NORMAL	ABNORMAL	Check each item in appropriate column (enter NE for Not Evaluated)			REMARKS		
		17. Head, Face, Scalp					
		18. Neck					
		19. Eyes					
		20. Ears – General (internal and external canal)					
		21. Eustachian Tube Function					
		22. Tympanic Membrane					
		23. Nose (Septal Alignment)					
		24. Sinuses					
		25. Mouth and Throat					
		26. Chest					
		27. Lungs					
		28. Heart (Thrust, Size, Rhythm, Sounds)					
		29. Pulses (Equality, etc.)					
		30. Vascular System (Varicosities, etc.)					
		31. Abdomen and Viscera					
		32. Hernia (All Types)					
		33. Endocrine System					
		34. G-U System					
		35. Upper Extremities (Strength, ROM)					
		36. Lower Extremities (Except Feet)					
		37. Feet					
		38. Spine					
		39. Skin, Lymphatics					
		40. Anus and Rectum					
		41. Sphincter Tone					
		42. Pelvic Exam					

NEUROLOGICAL EXAMINATION

43. CRANIAL NERVES

		NORMAL	ABNORMAL	NE
I	Olfactory			
II	Optic			
III	Oculomotor			
IV	Trochlear			
V	Trigeminal			
VI	Abducens			

		NORMAL	ABNORMAL	NE
VII	Facial			
VIII	Auditory			
IX	Glossopharyngeal			
X	Vagus			
XI	Spinal Accessory			
XII	Hypoglossal			

44. REFLEXES

DEEP TENDON

	Left	Right
	0 1 2 3 4	0 1 2 3 4
Triceps		
Biceps		
Patella		
Achilles		

PATHOLOGICAL

	Left	Right
	Present Absent	Present Absent
Babinski		
Hoffman		
Ankle Clonus		

SUPERFICIAL

	Present	Absent	NE
Upper Abdomen			
Lower Abdomen			
Cremasteric			

45. CEREBELLAR FUNCTION

	0	1	2	3	4
Ataxia					
Tremor (intention)					
		Normal	Abnormal		
Finger to Nose					
Heel to Shin (Sliding)					

46. MUSCLE

	1	2	3	4	5
Right Upper Extremity					
Left Upper Extremity					
Right Lower Extremity					
Left Lower Extremity					

TONE

	Normal	Abnormal

47. PROPIOCEPTION

	Left		Right	
	Normal	Abnormal	Normal	Abnormal
Joint Position Sense				
Stereognosis				
Vibratory Sensation				

48. NYSTAGMUS

	Present	Absent
End Point Lateral Gaze		
Pathological		

49. SENSATION

	Normal	Abnormal		Normal	Abnormal
Hot			Sharp		
Cold			Soft		

50. RHOMBERG

Two Point Discrimination		Absent	Present
Normal			
Abnormal			

Name _____ Birth Date _____ School _____ Exam Date _____
 Address _____ City _____ Phone _____
 Parent's Name _____ Work Phone _____ Sport (s) _____
 In case of emergency contact: Name _____ Phone _____ Cell _____

MEDICAL HISTORY

Yes/No

- Y N 1. Have you had any illness/injury recently or now?
- Y N 2. Have you had a medical problem, illness or injury since your last exam?
- Y N 3. Do you have any chronic or recurrent illness?
- Y N 4. Have you ever had an illness lasting more than a week?
- Y N 5. Have you ever been hospitalized overnight?
- Y N 6. Have you had any surgery?
- Y N 7. Have you ever had any injuries requiring treatment by a physician?
- Y N 8. Do you have any organs missing? (*appendix, eye, kidney, testicle, etc.*)
- Y N 9. Are you presently taking any medications? (*including vitamins, aspirin*)
- Y N 10. Do you have any allergies? (*medicine, bees, foods*)
- Y N 11. Have you ever had chest pain, dizziness, fainting, or passing out during or after exercise?
- Y N 12. Do you tire more easily or quickly than your friends during exercise?
- Y N 13. Have you ever had any problem with your blood pressure or your heart?
- Y N 14. Have any close relatives had heart problems, heart attacks, or sudden death before they were age 50?
- Y N 15. Do you have any skin problems? (*acne, itching, rashes, etc.*)
- Y N 16. Have you ever had fainting, convulsions, seizures or severe dizziness?
- Y N 17. Do you have frequent severe headaches?
- Y N 18. Have you ever had a "stinger" or "burner" or "pinched nerve"?
- Y N 19. Have you ever been "knocked out" or "passed out"?
- Y N 20. Have you ever had a neck or head injury?
- Y N 21. Have you ever had heat exhaustion, heat stroke, heat cramps, or similar heat-related problems?
- Y N 22. Do you have asthma, trouble breathing, or cough during or after exercise?
- Y N 23. Do you wear eyeglasses, contact lenses, or protective eyewear?
- Y N 24. Have you had any problem with your eyes or vision?
- Y N 25. Do you wear any dental appliance? (*braces, bridge, plate, retainer*)
- Y N 26. Have you ever had a knee or ankle injury?
- Y N 27. Have you ever injured any other joint? (*shoulder, wrist, fingers, etc.*)
- Y N 28. Have you ever had a broken bone? (*fracture*)
- Y N 29. Have you ever had a cast, splint, or had to use crutches?
- Y N 30. Must you use special equipment for competition? (*braces, etc.*)
- Y N 31. Has it been more than eight years since your last tetanus booster shot?
- Y N 32. Are you worried about your weight?
- Y N 33. Have you any medical concerns about participating in your sport?
- Y N 34. Are you taking any pills or drugs to increase your strength or performance?
- Y N 35. **FEMALES:** Have you any menstrual problems?

I attest, by my signature below, that to the best of my knowledge, my answers to the above questions are complete and correct.

Signature of Parent/Guardian _____ Date _____
 Signature of TENDER _____ Date _____

PHYSICAL

(to be completed by doctor)

Age _____ Height _____
 Weight _____ BP _____
 Pulse _____
 Vision R ____ / ____ L ____ / ____

MEDICAL

Normal/Abnormal	Findings
N A	Appearance _____
N A	Eyes _____
N A	Ears _____
N A	Nose _____
N A	Throat _____
N A	Heart _____
N A	Lymph Nodes _____
N A	Pulses _____
N A	Lungs _____
N A	Abdomen _____
N A	Genitalia (<i>males only</i>) _____
N A	Skin _____

MUSCULOSKELETAL

N A Neck _____
 N A Back _____
 N A Shoulder/Arm _____
 N A Elbow/Forearm _____
 N A Wrist/Hand _____
 N A Hip/Thigh _____
 N A Knee _____
 N A Leg/Ankle _____
 N A Foot _____

ASSESSMENT

Full Participation Limited Participation

Describe limitations, restrictions _____

Participation contraindicated (*list reasons*) _____

Recommendations (*equipment, taping, rehabilitation, referral*) _____

Examiner's Name _____

Signature _____

Phone _____ Date _____



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. He or she will be participating as a commercial harvest diver or as a hose tender. Typically, a diver is physically engaged in the harvest using surface supplied air equipment, including an umbilical hose, a harness weighing in excess of 50 lb, and a full face mask or helmet. The hose tender must be capable of coordinating his/her movements in variable sea conditions while lifting over 50 lb. Commercial harvest diving activities put unusual stresses on individuals in many ways; therefore, your opinion of the applicant's medical fitness is requested. Surface supplied air diving requires heavy exertion. The diver must be free of cardiovascular and respiratory diseases. An absolute requirement for the diver is the ability of the lungs, middle ears, and sinuses to equalize pressure. Any condition that risks the loss of consciousness should disqualify the diver or the hose tender applicant. Please consult the most recent edition of the Lummi Natural Resources Department Commercial Harvest Diving Standards for additional information for the medical professional and for contra-indications to commercial harvest diving.

APPROVAL

I find no medical condition(s) which I consider incompatible with participating in commercial harvest diving activities.

REJECT

The applicant has medical condition(s) which, in my opinion, clearly would constitute unacceptable hazards to health and safety in commercial harvest diving.

Remarks:

Physician's Signature:

Date:

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



Hose Tender and Trainee Diver Training Log

As per the Lummi Natural Resources Department (LNR) Commercial Harvest Diving Standards, Trainee Divers and Hose Tenders must complete a thorough review of the standards and receive an additional four (4) hours training in the operation and maintenance of equipment used in the dive operations and the procedures to be followed by each member of a dive team. Trainee Divers and Hose Tenders must have this training verified by the LNR-registered dive vessel owner or the designated person-in-charge (e.g., the Experienced Dive Operator). Please log your training in the table provided below. The completed table must be returned to the LNR office before receiving your LNR classification card.

Date	Hours	Activities Completed	Supervisor's Name

I attest that _____ (Printed name of Trainee Diver or Hose Tender) has completed the required training above.

Printed name of vessel owner or person-in-charge (circle one) _____

Signature of vessel owner or person-in-charge _____

Phone number for vessel owner or person-in-charge _____

Dive No.	Date	Area Fished	Start time (24-hr clock)	Max. Depth (ft)	Avg. Depth (ft)	Total Dive Time (min)	Name and contact number of Experienced Dive Operator supervising trainee
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							

Dive No.	Date	Area Fished	Start time (24-hr clock)	Max. Depth (ft)	Avg. Depth (ft)	Total Dive Time (min)	Name and contact number of Experienced Dive Operator supervising trainee
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							

Dive No.	Date	Area Fished	Start time (24-hr clock)	Max. Depth (ft)	Avg. Depth (ft)	Total Dive Time (min)	Name and contact number of Experienced Dive Operator supervising trainee
33							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							
45							
46							

Dive No.	Date	Area Fished	Start time (24-hr clock)	Max. Depth (ft)	Avg. Depth (ft)	Total Dive Time (min)	Name and contact number of Experienced Dive Operator supervising trainee
47							
48							
49							
50							
51							
52							
53							
54							
55							
56							
57							
58							
59							
60							

Dive No.	Date	Area Fished	Start time (24-hr clock)	Max. Depth (ft)	Avg. Depth (ft)	Total Dive Time (min)	Name and contact number of Experienced Dive Operator supervising trainee
61							
62							
63							
64							
65							
66							
67							
68							
69							
70							
71							
72							
73							
74							

Dive No.	Date	Area Fished	Start time (24-hr clock)	Max. Depth (ft)	Avg. Depth (ft)	Total Dive Time (min)	Name and contact number of Experienced Dive Operator supervising trainee
75							
76							
77							
78							
79							
80							
81							
82							
83							
84							
85							
86							
87							
88							

Dive No.	Date	Area Fished	Start time (24-hr clock)	Max. Depth (ft)	Avg. Depth (ft)	Total Dive Time (min)	Name and contact number of Experienced Dive Operator supervising trainee
89							
90							

**As per the Lummi Natural Resources Department Commercial Harvest Diving Standards, the first four dives are non-commercial, i.e., no harvest and practicing only with the equipment to be used during a typical harvest diving operation.



Confirmation of Commercial Harvest Diving Training Requirements

I, _____ (vessel owner/lead diver print name), confirm that

_____ (print name of Trainee Diver/Hose Tender) has completed four (4) hours of training in the operation and maintenance of equipment used in dive operations and the procedures to be followed by each dive team member aboard my fishing vessel(s),

_____ and/or _____.

I further confirm that the Trainee Diver/Hose Tender named above has reviewed and understands the Lummi Natural Resources Department (LNR) Commercial Harvest Diving Standards.

Signature _____ Date _____

Phone # _____

Lummi Tribal Health Center

AUTHORIZATION FOR USE OR DISCLOSURE OF HEALTH INFORMATION

Complete all sections, date, and sign

I. I, _____, hereby voluntarily authorize the disclosure of information from my record. (Name of Patient)

II. The information is to be disclosed by:
 Name of Facility: LUMMI TRIBAL HEALTH CENTER
 Address: 2592 KWINA RD FAX(360)380-2214
 City/State: BELLINGHAM, WA 98226

And is to be provided to:
 Name of Person/Organization/Facility: Diving Safety Officer, Lummi Natural Resources Department
 Address: Lummi Indian Business Council, 2665 Kwina Road
 City/State: Bellingham, Washington 98226

III. The purpose or need for this disclosure is: Review by Diving Safety Officer and Diving Control Board when requested by signatory if signatory does not meet the minimum medical standards to participate in dive fisheries

IV. The information to be disclosed from my health record: (check appropriate box(es))
 Entire Record
 Only information related to (specify): Results of physical examination and/or drug screening pertaining to participating in commercial dive fisheries
 Only the period of events from: _____ to _____
 Other (specify): _____
 Psychotherapy Notes ONLY (by checking this box, I am waiving any psychotherapist-patient privilege)

If you would like any of the following sensitive information disclosed, initial the applicable box(es) below.

- Alcohol/Drug Abuse Treatment/Referral HIV/AIDS-related Treatment
 Sexually Transmitted Diseases Mental Health (Other than Psychotherapy Notes)

V. I understand that I may revoke this authorization in writing submitted at any time to the Health Records Department, except to the extent that action has been taken in reliance on this authorization, or if this authorization was obtained as a condition of providing insurance coverage, other law provides the insurer with the right to contest a claim under the policy. If this authorization has not been revoked, it will terminate one year from the date of my signature unless I have specified a different expiration date. Expiration Date: _____

I understand that LTHC will not condition treatment or eligibility for care on my providing this authorization except if such care is: (1) research related or (2) provided solely for the purpose of creating Protected Health Information for disclosure to a third party.

I understand that information disclosed by this authorization may be subject to redisclosure by the recipient and may no longer be protected by the Health Insurance Portability and Accountability Act (HIPAA) [45 CFR Part 164], and the Privacy Act of 1974 [5 USC 552a].

Signature of Patient: _____ Date _____

Signature of Authorized Representative (state relationship to patient) _____ Date _____
 or Witness (if signature is by thumb print or mark)

This information is to be released for the purpose stated above and may not be used by the recipient for any other purpose. Any person who knowingly and willfully requests or obtains any record concerning an individual from a Federal agency under false pretenses shall be guilty of a misdemeanor (5 USC 552a(i)(3)).

PATIENT IDENTIFICATION	NAME (Last, First MI)	RECORD NUMBER
	ADDRESS CITY/STATE	DATE OF BIRTH

INSTRUCTIONS TO COMPLETE FORM “AUTHORIZATION FOR USE OR DISCLOSURE OF HEALTH INFORMATION”

1. Print legibly in all fields using ink.
2. Section I, print name of patient whose information is to be released.
3. Section II, print the name and address of the facility releasing the information. Also, provide the name of the person, facility and address that will receive the information.
4. Section III, state the reason why the information is needed, e.g., disability claim, continuing medical care, legal, etc.
5. Section IV, check the appropriate box as applicable.
 - a. **Entire Record** – the complete record except for the sensitive information (alcohol and drug abuse treatment/referral, sexually transmitted diseases, HIV/AIDS related treatment, and mental health other than psychotherapy notes)
 - b. **Only information related to** – specify diagnosis, injury, operations, special therapies, etc.
 - c. **Only the period of events from** -- specify date range, e.g., Jan 1, 2002 to Feb 1, 2002.
 - d. **Other (specify)** – e.g., CHS, billing, employee health
 - e. **Psychotherapy Notes ONLY – IN ORDER TO AUTHORIZE THE USE OR DISCLOSURE OF PSYCHOTHERAPY NOTES, ONLY THIS BOX SHOULD BE INITIALED ON THIS FORM. AUTHORIZATIONS FOR THE USE OR DISCLOSURE OF OTHER HEALTH RECORD INFORMATION MAY NOT BE MADE IN CONJUNCTION WITH AUTHORIZATIONS PERTAINING TO PSYCHOTHERAPY NOTES.**

IF THIS BOX IS INITIALED WITH OTHER BOXES, ANOTHER AUTHORIZATION WILL BE REQUIRED TO AUTHORIZE THE USE OR DISCLOSURE OF PSYCHOTHERAPY NOTES ONLY.

Psychotherapy notes are often referred to as process notes, distinguishable from progress notes in the medical record. These notes capture the therapist’s impressions about the patient, contain details of the psychotherapy conversation considered to be inappropriate for the medical record, and are used by the provider for future sessions. These notes are often kept separate to limit access because they contain sensitive information relevant to no one other than the treating provider.
 - f. **IN ORDER TO RELEASE SENSITIVE INFORMATION, ALCOHOL/DRUG ABUSE TREATMENT/REFERRAL, HIV/AIDS-RELATED TREATMENT, SEXUALLY TRANSMITTED DISEASES, MENTAL HEALTH (OTHER THAN PSYCHOTHERAPY NOTES), YOU MUST CHECK THE APPROPRIATE BOX!**
6. Section V, sign and date.
7. Section V, Authorized Representative, e.g., legal guardian, power of attorney, etc.
8. A copy of the completed Form will be given to the patient.



AUTHORIZATION TO RELEASE PATIENT HEALTH INFORMATION

Virginia Mason Medical Center
1100 9th Avenue, Seattle WA 98101, A-HIS-ROI ph 206-223-6975 fax 206-223-8885 www.virginiamason.org

Patient Name _____ Medical Record # (if known) _____

Date of Birth ____ / ____ / ____

I authorize the following organization to release information as stated below from the patient health information record:

INFORMATION TO BE RELEASED FROM:	INFORMATION TO BE RELEASED TO:
<input type="checkbox"/> Virginia Mason Medical Center or <input type="checkbox"/> _____ Organization	<input type="checkbox"/> Virginia Mason Medical Center or <input type="checkbox"/> _____ Organization / Person
Street Address _____ City, State, Zip _____	Street Address _____ City, State, Zip _____
Phone _____ Fax _____	Phone _____ Fax _____
	<input type="checkbox"/> Additional recipient(s). Please see supplemental page. (Form 903346)

INFORMATION TO BE RELEASED

Dates of service for records requested: Beginning _____ Thru _____

Discharge Summaries Operative Reports Radiology Reports ED Records Lab/Pathology Report
 Clinic Notes Radiology CD Other (please specify) _____

Format for records (please check ONLY one box): Paper CD (requires email address) _____
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 School
 Other _____

AUTHORIZATION FOR GENERAL RELEASE OF INFORMATION

I understand that:

- Authorizing the disclosure of this healthcare information is voluntary. I do not need to sign this form in order to assure treatment or payment.
- I can cancel this authorization at any time by writing to the Health Information Services Department. I understand that once the information has been released according to the terms of this authorization, the information cannot be recalled.
- Any disclosure of information carries with it the potential for further release or distribution by the recipient that may not be protected by confidentiality laws.

This authorization will expire 90-days from the date signed below unless another date or event is entered here _____

(Note: If the disclosure is to an employer or financial institution, this authorization will expire 90 days from the date signed by you.)

Sensitive Records may require specific patient authorization. Please check the applicable box below to request the following records:

Mental Health Treatment **Sexually Transmitted Diseases** **AIDS/HIV Treatment** **Alcohol/Drug Abuse Treatment**
(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 _____

SIGNATURE OF MINOR PATIENT REQUIRED FOR THE FOLLOWING RECORDS

A minor patient's signature is required to release the following information: 1) Information related to reproductive care such as birth control, pregnancy-related services and Sexually Transmitted Diseases, including HIV/AIDS (age 14 and older); 2) Substance abuse and mental health treatment (age 13 and older).

Signature of Minor Patient _____

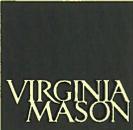
Date (month/day/year) _____

PATIENT NAME & ID # _____

VIRGINIA MASON MEDICAL CENTER – Seattle WA

Authorization To Release Patient Health Information





AUTHORIZATION TO RELEASE PATIENT HEALTH INFORMATION

Virginia Mason Medical Center
1100 9th Avenue, Seattle WA 98101, A-HIS-ROI ph 206-223-6975 fax 206-223-8885 www.virginiamason.org

Patient Name _____ Medical Record # (if known) _____

Date of Birth ____ / ____ / ____

I authorize the following organization to release information as stated below from the patient health information record:

INFORMATION TO BE RELEASED FROM:	INFORMATION TO BE RELEASED TO:
<input type="checkbox"/> Virginia Mason Medical Center or <input type="checkbox"/> _____ Organization	<input type="checkbox"/> Virginia Mason Medical Center or <input type="checkbox"/> _____ Organization / Person
Street Address _____ City, State, Zip _____	Street Address _____ City, State, Zip _____
Phone _____ Fax _____	Phone _____ Fax _____
	<input type="checkbox"/> Additional recipient(s). Please see supplemental page. (Form 903346)

INFORMATION TO BE RELEASED

Dates of service for records requested: **Beginning** _____ **Thru** _____

Discharge Summaries Operative Reports Radiology Reports ED Records Lab/Pathology Report
 Clinic Notes Radiology CD Other (please specify) _____

Format for records (please check ONLY one box): Paper CD (requires email address) _____
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 School
 Other _____

AUTHORIZATION FOR GENERAL RELEASE OF INFORMATION

I understand that:

- Authorizing the disclosure of this healthcare information is voluntary. I do not need to sign this form in order to assure treatment or payment.
- I can cancel this authorization at any time by writing to the Health Information Services Department. I understand that once the information has been released according to the terms of this authorization, the information cannot be recalled.
- Any disclosure of information carries with it the potential for further release or distribution by the recipient that may not be protected by confidentiality laws.

This authorization will expire 90-days from the date signed below unless another date or event is entered here _____
(Note: If the disclosure is to an employer or financial institution, this authorization will expire 90 days from the date signed by you.)
Sensitive Records may require specific patient authorization. Please check the applicable box below to request the following records:

Mental Health Treatment **Sexually Transmitted Diseases** **AIDS/HIV Treatment** **Alcohol/Drug Abuse Treatment**
(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 _____

SIGNATURE OF MINOR PATIENT REQUIRED FOR THE FOLLOWING RECORDS

A minor patient's signature is required to release the following information: 1) Information related to reproductive care such as birth control, pregnancy-related services and Sexually Transmitted Diseases, including HIV/AIDS (age 14 and older); 2) Substance abuse and mental health treatment (age 13 and older).

Signature of Minor Patient _____ Date (month/day/year) _____

PATIENT NAME & ID # _____

VIRGINIA MASON MEDICAL CENTER – Seattle WA

Authorization To Release Patient Health Information



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 [RCW 71.05], alcohol and drug abuse [RCW 70.96A; 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:

- 1) 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];
- 2) 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



Voluntary Assumption of Risk for Technical Diving Operations Including But Not Limited To Dives Conducted at Depths Greater than 100 feet (30 meters) Or Dives Involving Planned Decompression

I, _____, hereby affirm that I am a Lummi Natural Resources Department (LNR)-classified Experienced Diver or Trainee Diver under the control and supervision of an LNR-classified Experienced Dive Operator and/or dive-qualified LNR-registered dive vessel owner, and that I thoroughly understand that commercial harvest diving, especially technical diving below 100 feet (30 meters) or involving planned decompression, with compressed air or oxygen-enriched air (NITROX) supplied by a standard onboard surface supply compressor or open circuit scuba involves certain inherent risks including air expansion injuries, drowning, decompression sickness, embolism, oxygen toxicity, inert gas narcosis, hypoxia, hypercapnia, or other barotrauma or hyperbaric injuries. Such injuries can occur that require treatment in a recompression chamber or medical facility that is located over two (2) hours away from the Lummi Reservation and the Lummi Nation Usual and Accustomed fishing grounds. I further understand that dive activities can be at remote sites, and isolated by time and distance, from such a recompression chamber or medical facility. I still freely choose, without coercion by the Experienced Dive Operator and/or the dive-qualified LNR-registered dive vessel owner, to proceed with such dives in spite of the absence of a recompression chamber in proximity to the dive site. Finally, I thoroughly understand that the hazards of commercial harvest diving also include but may not be limited to those hazards occurring during boat travel to and from the dive site, slipping or falling while on board, being cut or struck by a boat while in the water, injuries occurring while getting on or off a boat, and other perils of the sea.

Participant's Signature _____ Date _____

Signature of Supervisor or Owner _____ Date _____

EMERGENCY CONTACT INFORMATION:

Name _____ Phone # _____ Relationship _____



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

Other comments

Summary details (circle relevant item)

Diving purpose:	Harvest	Maintenance	Other			
Diving gas:	Air	NITROX	Mixed Gas			
Diving mode:	Open Circuit Scuba	Surface Supplied	Rebreather	Other		
Decomp. planning:	Dive Tables	Dive Computer	PC Software			
Depth range:	0 – 30 ft	31 – 60 ft	61 – 100 ft	101 – 130 ft	Other	
Incident type:	Hyperbaric	Barotrauma	Injury	Illness	Near-Drowning	Hyperoxic
	Hypoxia/Hypercapnea	Fatality	Other			
Incident rating:	Minor	Moderate	Serious			

Disposition of case

Name(s) of person(s) completing form

Date completed

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	
2.1 Personnel Qualifications (must be on file at the company location for each diver).	
2.2 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 certification card number.</u>	
Name of Diver	
Diver's Training Course(s) Section 3	
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 (Must be on-file at the company location for each diver). Note: It is not intended that disclosure of doctor-to-patient information is required but rather that a valid medical examination has been conducted and 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 Procedures	
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 Section 5	
Dive Team Briefing Section 5	
Minimum Dive Team Numbers Section 4	
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 Responsibilities (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-support (Saturation) Technician Section 3				
3.3 Safety Procedure Checklist – Section 5 and Section 10				
3.4 Equipment Procedure Checklist – Section 5 and Section 10				
3.5 Specific Operations Procedures (hand-held power tools; welding and burning equipment; explosives) – Section 5				
3.6 Emergency Procedures (fire; equipment failure; adverse environmental conditions; medical illness; treatment of injuries) – Section 7				
4. Equipment and Systems				
4.1 Does the company have established check-off lists for inspection of equipment and systems intended to be used for commercial diving and underwater operations to ensure functional and operational readiness and safety for intended use? _____				
4.2 Identify personnel who perform the initial and periodic examination, testing and certification of diving equipment and system: _____				
4.3 Diver's Dress – 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 Masks – Section 6				
Item	Description	Numbers	Last Inspection or Testing Date(s)	Comments
1	Heavyweight Helmet			
2	Lightweight Helmet			
3	Masks			

4.5 Hoses and Manifolds – 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	Air-purity Tests			

4.7 Diver Entry and Egress Systems – Section 6				
Item	Description	Numbers	Last Inspection or Testing Date(s)	Comments
1	Ladder and Stage			

4.9 Gauges – Section 6				
Item	Description	Numbers	Last Inspection or Testing Date(s)	Comments
1				
2				
3				

4.10 Relief Valves – Ss Appropriate to System Installed – Section 6				
Item	Description	Numbers	Last Inspection or Testing Date(s)	Comments
1				

4.11 Timekeeping Devices - 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 recorded in company records/insurance information.?
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	
<p>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.</p> <p>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></p>	
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 SUPERVISORS			
ITEM	DESCRIPTION	AUDIT RESPONSE	REMARK
1	Formal Supervisor Training Course	Yes <input type="checkbox"/> No <input type="checkbox"/>	
2	Supervisor Certification	Yes <input type="checkbox"/> No <input type="checkbox"/>	
3	Supervisor Appointment Letter	Yes <input type="checkbox"/> No <input type="checkbox"/>	
4	Supervisor Log Book	Yes <input type="checkbox"/> No <input type="checkbox"/>	
5	Number and Valid Date of Other Certifications or Required Documentation	Yes <input type="checkbox"/> No <input type="checkbox"/>	
6	Health Certificate and Valid Current Physical	Yes <input type="checkbox"/> No <input type="checkbox"/>	
2. DIVERS			
ITEM	DESCRIPTION	AUDIT RESPONSE	REMARK
1	Formal Diver Training Course	Yes <input type="checkbox"/> No <input type="checkbox"/>	
2	Diver Certification	Yes <input type="checkbox"/> No <input type="checkbox"/>	
3	Diving Log Book	Yes <input type="checkbox"/> No <input type="checkbox"/>	
4	Current Diving Physical: Fit for Diving?	Yes <input type="checkbox"/> No <input type="checkbox"/>	
5	Number and Valid Date of Other Certifications or Required Documentation	Yes <input type="checkbox"/> No <input type="checkbox"/>	
6	NDT Certificate (if needed)	Yes <input type="checkbox"/> No <input type="checkbox"/>	
7	Welding Certificate (if needed)	Yes <input type="checkbox"/> No <input type="checkbox"/>	
8	Water-jetting Operating Certificate (if needed)	Yes <input type="checkbox"/> No <input type="checkbox"/>	
9	H2S Training Certificate (if needed)	Yes <input type="checkbox"/> No <input type="checkbox"/>	

DIVING CONTRACTORS' AUDIT FORM

Chapter III: Equipment and System

SCOPE				
Maintenance Records of Life-support Equipment				
ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT RESPONSE	REMARK
1	Equipment Logs	Suitable equipment logs must be established and maintained in a correct and current condition.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
2	Unique Identity	All equipment must have a unique identity traceable to the equipment log.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
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 <input type="checkbox"/> No <input type="checkbox"/>	
4	Signature	Any equipment repair and maintenance must be signed by divers or technicians.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
5	Instruction	Inspection and maintenance for any helmets or masks must be in accordance with instruction of manufacturer.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
DIVER'S DRESS				
Dry Suits				
ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT RESPONSE	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 <input type="checkbox"/> No <input type="checkbox"/>	
2	Material	Be constructed of material suitable to the environment in which it is to be used.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
3	Environmental Protection	Protect the diver from the environment, whether temperature or hazardous material.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
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 <input type="checkbox"/> No <input type="checkbox"/>	
2	Quick-release Device	Have a mechanical quick-release between the harness and the umbilical.	Yes <input type="checkbox"/> No <input type="checkbox"/>	

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 <input type="checkbox"/>	No <input type="checkbox"/>
4	Usage	Not be used as a weight belt.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
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 <input type="checkbox"/>	No <input type="checkbox"/>
Weight Belts				
1	Weight	Be of sufficient weight to maintain the diver at working depth.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2	Usage	Not be used as an attachment for the diving umbilical.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3	Release Buckle	Be equipped with an appropriate release buckle.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
4	Avoid Accidental Disengagement	Be attached to the diver in a manner to avoid accidental disengagement.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Diver-worn or Carried Emergency Gas (Bailout)				
1	Suitability	Be manufactured to recognized codes or standards.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2	Cylinder Overpressure Relief Disk	Be equipped with an overpressure relief device	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3	Annual Inspection	Be inspected internally and externally for damage or corrosion within 1 year.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
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 stamped with the date of test.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
5	Record and Certificate	Have a unique identity with results of all tests being recorded or certified in the equipment log.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
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 <input type="checkbox"/>	No <input type="checkbox"/>
7	Prevent Disengagement Device	Have a means of attachment to the helmet or mask that prevents accidental disengagement.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
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 <input type="checkbox"/>	No <input type="checkbox"/>
9	Sufficient Capacity	Capable of providing 4 minutes of EGS at depth.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
10	Appropriate Content	Be charged with an appropriate breathing gas mixture to accommodate mode of diving/depth requirement.	Yes <input type="checkbox"/>	No <input type="checkbox"/>

Helmets & Masks				
General				
ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT RESPONSE	REMARK
1	Suitability for Usage	Be appropriate for the task intended.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
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 <input type="checkbox"/> No <input type="checkbox"/>	
3	PP CO ₂	Be capable of maintaining the diver's respired CO ₂ partial pressure below 0.02 ATA.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
4	Communication	Be fitted with two-way communications	Yes <input type="checkbox"/> No <input type="checkbox"/>	
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 <input type="checkbox"/> No <input type="checkbox"/>	
6	Material	Be made of corrosion-resistant material.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
7	Over-pressure Protection	Be protected from over-pressurization.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
8	Marking	Each helmet or mask should have a unique serial number.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
9	Maintenance	Each helmet or mask must be subject to regular planned maintenance and a record of such maintenance should be available.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
10	Inspection and Testing	Inspection and function test at atmospheric pressure at least annually with record or certificate .	Yes <input type="checkbox"/> No <input type="checkbox"/>	
Hoses				
Breathing Gas Hoses				
1	Burst Pressure	Have a minimum burst pressure equal to 4 times the maximum working pressure.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
2	Flow Rating	Flow rating to meet intended use.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
3	Connector Pressure	Connector pressure equal to or greater than the system on which they are installed.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
4	Material	Have fittings of corrosion-resistant material that cannot be accidentally disengaged.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
5	Collapse Prevention	Be kink-resistant or arranged to prevent kinking.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
6	Annual Testing	Examine visually and pressure test to 1.5 times maximum working pressure within 1 year with record .	Yes <input type="checkbox"/> No <input type="checkbox"/>	
7	Testing After Repair	Examine visually and pressure test after each repair and alteration with record .	Yes <input type="checkbox"/> No <input type="checkbox"/>	
8	Suitability	Be suitable for breathing gas service.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
Umbilicals				
ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT RESPONSE	REMARK
1	Burst Pressure	Have a minimum burst pressure equal to 4 times the maximum working pressure.	Yes <input type="checkbox"/> No <input type="checkbox"/>	

2	Flow Rating	Flow rating not less than the system in which it is installed or used and suitable for the service intended.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3	Connector Pressure	Connector pressure equal to or greater than the system on which they are installed.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
4	Material	Have fittings of corrosion-resistant material that cannot be accidentally disengaged.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
5	Collapse Prevention	Be collapse-resistant or arranged to prevent collapse.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
6	Annual Testing	Examine visually and pressure test to 1.5 times maximum working pressure within 1 year with record , and pull test for fitting.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
7	Testing After Repair	Examine visually and pressure test after each repair and alteration with record	Yes <input type="checkbox"/>	No <input type="checkbox"/>
8	Marking	Umbilical must be marked for length using a recognized system that allows easy visual identification of the length paid out.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
9	Maintenance Plan	Be marked with a unique identity and subjected to a planned maintenance program.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
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 <input type="checkbox"/>	No <input type="checkbox"/>
11	Material	Have a minimum member made of material unaffected by immersion in water for extended period.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
12	Minimum Break Strength	Have a minimum hose assembly break strength of 1,000 lbs.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
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 <input type="checkbox"/>	No <input type="checkbox"/>
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 <input type="checkbox"/>	No <input type="checkbox"/>
Oxygen Hoses for Life Support				
1	Burst Pressure	Have a minimum burst pressure equal to 4 times the maximum working pressure	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2	Flow Rating	Flow rating not less than the system in which it is installed or used and suitable for the service intended.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3	Connector Pressure	Connector pressure equal to or greater than the system on which they are installed.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
4	Material	Have fittings of corrosion-resistant material that cannot be accidentally disengaged.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
5	Collapse Prevention	Be collapse-resistant or arranged to prevent collapse.	Yes <input type="checkbox"/>	No <input type="checkbox"/>

6	Annual Testing	Examine visually and pressure test to 1.5 times maximum working pressure within 1 year with record .	Yes <input type="checkbox"/>	No <input type="checkbox"/>
7	Testing After Repair	Examine visually and pressure test after each repair and alteration with Record .	Yes <input type="checkbox"/>	No <input type="checkbox"/>
8	Oxygen Cleaning	Hose assemblies used in systems containing greater than 50% oxygen are to be cleaned for oxygen service.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
9	Marking	Hoses used for 100% oxygen service should be identified by a consistent color code or tagged "FOR OXYGEN USE ONLY"	Yes <input type="checkbox"/>	No <input type="checkbox"/>
10	Lubricants	Lubricants used to assemble fittings on hoses for oxygen service must be compatible with oxygen.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
11	Hose and Fittings	Hose and fittings must be brass or other alloys suitable for O ² use.	Yes <input type="checkbox"/>	No <input type="checkbox"/>

Compressor Systems

Compressors & Gas Pumps for Life Support

1	Personnel Protection	Have suitable personnel protection around rotating machinery.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2	Instruction	Have the necessary instruction to facilitate operations	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3	Suitability	Be of the proper type, pressure and flow rate, suitable for service intended.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
4	Pollution Protection	Have its air intake positioned to be clear of exhaust fumes and other contaminants.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
5	Piping	Have piping system in accordance with recognized codes of standards.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
6	Flexible Hoses	Have flexible hoses in accordance with "hoses requirement."	Yes <input type="checkbox"/>	No <input type="checkbox"/>
7	Electrical Controls	Have electrical controls, wiring and drive units meeting the jurisdictional requirements when so equipped.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
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 <input type="checkbox"/>	No <input type="checkbox"/>
9	Access	Be easily accessible to diving personnel, both for routine maintenance and during an emergency.	Yes <input type="checkbox"/>	No <input type="checkbox"/>

Recording of Maintenance and Repairs

ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT RESPONSE	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 <input type="checkbox"/>	No <input type="checkbox"/>
2	Quality Tests	Results of air quality tests must be retained to document their results and accomplishment.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
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 <input type="checkbox"/>	No <input type="checkbox"/>

4	Planned Maintenance	Compressor units must be subjected to planned maintenance.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Volume Tanks				
1	Manufacture	Be designed, fabricated, inspected, tested and certified in accordance with recognized codes or statutory or classification society requirements.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2	Pressure Gauge	Be equipped with a pressure gauge.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3	Check Valve	Be equipped with a check valve on the inlet side.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
4	Relief Valve	Be equipped with a relief valve as required by code of manufacturer.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
5	Drain Valve	Be equipped with condensate drain valve located at its lowest point.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
6	Annual Inspection	Be inspected internally and externally within 1 year for damage or corrosion with record .	Yes <input type="checkbox"/>	No <input type="checkbox"/>
7	Pneumatically Testing	Be pneumatically tested to maximum working pressure within 1 year for the breathing mixture normally used with record .	Yes <input type="checkbox"/>	No <input type="checkbox"/>
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 stamped with the test date.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
9	Record and Certificate	Have a unique identity with results of all tests being recorded in the equipment log with certificate .	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Filtration				
ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT RESPONSE	
1	Filters	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	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Air Purity Requirements				
1	Quality Testing	All compressor, transfer pumps or booster pumps used for breathing air service must be subjected to a quality test in last 6 months.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2	Selecting Point	Tests must be taken at the discharge point that would normally supply the breathing gas system, the diver's hose or cylinder fill point.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3	Testing Record	Documentation of these tests must be kept on file and available upon request.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
Diver Entry & Egress System				
Diving Ladder and Stage				
1	Capability	Be capable of supporting the weight of two divers plus their gear.	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2	Material	Be made of corrosion-resistant material or be maintained free corrosion.	Yes <input type="checkbox"/>	No <input type="checkbox"/>

3	Purpose	Be suitable for the purpose intended	Yes <input type="checkbox"/> No <input type="checkbox"/>
4	Ladder Length	Ladder must extend a minimum of 1 meter (3 feet) below surface where installed.	Yes <input type="checkbox"/> No <input type="checkbox"/>
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 <input type="checkbox"/> No <input type="checkbox"/>
6	Cylinder and Regulator	Stage be provided with breathing gas cylinder and regulator for emergency breathing if required.	Yes <input type="checkbox"/> No <input type="checkbox"/>

Gauges

Gauges utilized with diving equipment or systems must:

ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT RESPONSE	REMARK
1	Suitability	Be suitable for purpose intended.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
When used to indicate a diver's depth:				
2	Range and Graduation	Be of appropriate range and graduation.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
3	Consistent	Be graduated in units consistent with the decompression tables to be utilized.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
4	Calibration	Be calibrated to a known standard every 6 month with certificate	Yes <input type="checkbox"/> No <input type="checkbox"/>	
5	Discrepancy	Be recalibrated when a discrepancy exists exceeding 2% of full scale.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
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 <input type="checkbox"/> No <input type="checkbox"/>	
7	Deviation	Have a tag or label indicating amount of deviation (+/-) to the calibration standard.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
8	Calibrations Log	Have calibrations documented in the equipment log .	Yes <input type="checkbox"/> No <input type="checkbox"/>	
9	Pressure-limiting Device	A pressure-limiting device may be fitted to gauges being over-pressurized.	Yes <input type="checkbox"/> No <input type="checkbox"/>	

Timekeeping Devices

Devices utilized to monitor a diver's exposure time under pressure must:

1	Suitability	Be suitable for purpose and easily readable, and have suitable backup.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
---	-------------	--	--	--

Compressed Gas Equipment				
Gas Storage Cylinders and Tubes				
High-pressure gas cylinders or tubes must:				
ITEM	DESCRIPTION	DIVING OPERATIONS REQUIREMENT	AUDIT RESPONSE	REMARK
1	Manufacture Standard	Be manufactured to recognized code or standard.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
2	Over-pressure Relief Device	Be equipped with an over-pressure relief device.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
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 <input type="checkbox"/> No <input type="checkbox"/>	
4	Hydrostatic Testing and Stamp	Be hydrostatically tested according to manufacturer and/or regulatory authorities, and stamped with the test date.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
5	Annual Internal and External Inspection	Visually inspected internally and externally for damage or corrosion within 1 year if used underwater.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
6	Contents Label	Be labeled as to contents. Fire-hazard warning signs must be erected in the vicinity of stored oxygen.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
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 <input type="checkbox"/> No <input type="checkbox"/>	
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 <input type="checkbox"/> No <input type="checkbox"/>	

Diving Contractors' Audit Form
Chapter IV: Operation Procedures

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

3	First Aid	First aid supplies are appropriate and available for the type of operation being conducted.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
		First aid kit is readily accessible in a clearly marked container at the work site.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
		First aid handbook is available at the diving location.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
		A bag-type manual resuscitator/defibrillator is available at the diving location.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
		The first aid kit's contents meet with the ADCI recommendations.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
4	Planning and Assessment	There was a dive plan established for each operation.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
		The dive plan included a job safety analysis.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
		The dive plan included personnel assignments, tasks and responsibilities.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
		The dive plan included operational equipment preparation.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
		The dive plan included decompression procedure and treatment procedure.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
		The dive plan included all emergency procedures.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
5	Team Briefing	There was a safety meeting conducted before any dive operation.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
		During the meeting, dive team members were briefed on underwater tasks, safety procedures and any hazards, related to the underwater operation.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
		Before/after each dive, the diver's physical condition was reported and recorded.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
6	Inspection of Systems, Equipment and Tolls	Checklists were used to confirm that the systems and equipment are in safe working order.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
7	Decompression Chamber	For any diving excess of 30 MSW/100 FSW, a chamber must be available and ready for use at the diving site.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
		The minimum capability of chamber must be not less than 6 ATA.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
		The chamber must be a dual-lock decompression chamber.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
8	Standby Diver	Standby diver must be assigned for any diving operation.	Yes <input type="checkbox"/> No <input type="checkbox"/>	
		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 <input type="checkbox"/> No <input type="checkbox"/>	
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 <input type="checkbox"/> No <input type="checkbox"/>	

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

17	Equipment Procedure Checklist	Is there a pre-dive checklist that can show all equipment is operational ready?	Yes <input type="checkbox"/> No <input type="checkbox"/>	
	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 <input type="checkbox"/> No <input type="checkbox"/>	
	Minimum Qualification of Personnel	Do diving personnel meet the minimum qualifications, as outlined in the ADCI CS?	Yes <input type="checkbox"/> No <input type="checkbox"/>	
	Minimum Equipment	Does the contractor's equipment meet the minimum requirements, as outlined in the ADCI CS?	Yes <input type="checkbox"/> No <input type="checkbox"/>	
18	Hand-held Power Tools	Does the contractor have operating procedures for hand-held power tools?	Yes <input type="checkbox"/> No <input type="checkbox"/>	
19	Welding and Burning	Does the contractor have procedures for underwater welding and burning?	Yes <input type="checkbox"/> No <input type="checkbox"/>	
20	Emergency Procedure	Does the contractor have any emergency procedures for loss of breathing media, loss of communications, etc.?	Yes <input type="checkbox"/> No <input type="checkbox"/>	
		Does the emergency procedure satisfy the requirements of ADCI CS?	Yes <input type="checkbox"/> No <input type="checkbox"/>	

DIVING UMBILICAL(S)				
ITEM	DESCRIPTION	REQUIREMENT	RESPONSE	REMARK
1	Dividing umbilicals are designed and fit for purpose.			
	1. Umbilical are properly marked for visual identification of the amount paid out.		Yes <input type="checkbox"/> No <input type="checkbox"/>	
	2. Standby diver/bellman's umbilical is greater in length than the primary diver's.		Yes <input type="checkbox"/> No <input type="checkbox"/>	
	3. Procedures for bell and surface umbilical management are available for review.		Yes <input type="checkbox"/> No <input type="checkbox"/>	
	4. Testing, maintenance and inspection documents for diving umbilicals are available for review.		Yes <input type="checkbox"/> No <input type="checkbox"/>	
INDIVIDUAL DIVING EQUIPMENT				
ITEM	DESCRIPTION	REQUIREMENT	RESPONSE	REMARK
1	Helmets			
	1. Helmets are labeled with unique serial number (as recommended by manufacturer).		Yes <input type="checkbox"/> No <input type="checkbox"/>	
	2. Helmets are designed and fit for purpose.		Yes <input type="checkbox"/> No <input type="checkbox"/>	
	3. Testing, maintenance and inspection documents are available for review.		Yes <input type="checkbox"/> No <input type="checkbox"/>	

2	Diver-Worn Emergency Gas Supply (Bailout Bottle/Emergency Rebreather) 1. Diverworn emergency gas supply for all bell occupants. 2. EGS is designed and fit for purpose (4-minute minimum EGS duration for deepest depth of dive). 3. All EGS cylinders/SLS are marked with the name and mixture percentages. 4. Testing and inspection documents for cylinders /SLS are available for review.	Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/>		
3	Whips and Connectors for EGS and Helmets			
	1. Fittings and connections are fit for purpose (as recommended by manufacturer).	Yes <input type="checkbox"/> No <input type="checkbox"/>		
	2. Testing and maintenance documents for whips and connectors are available for review.	Yes <input type="checkbox"/> No <input type="checkbox"/>		
COMPRESSORS AND PUMPS				
ITEM	DESCRIPTION	REQUIREMENT	RESPONSE	REMARK
1	Compressor is designated and fit for purpose 1. Compressors are located in accessible area for dive team personnel. 2. Testing, maintenance (filters, etc.) and operation documents for all pumps and compressors are available for review. 3. Fire-suppression system and procedures are available in the event of a fire. 4. Testing and inspection documentation for fire-suppression equipment are available for review. 5. Compressors are equipped with safety devices. a. Solenoid switches. b. Relief valves. c. Other manufacturer-recommended or supplied safety devices.		Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/>	
AIR AND GAS RECEIVERS				
ITEM	DESCRIPTION	REQUIREMENT	RESPONSE	REMARK
1	All air and gas receivers are designed and manufactured to a recognized code and fit for a purpose. 1. Testing and inspection documentation is available for review.		Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/>	
ELECTRICAL SUPPLIES				
ITEM	DESCRIPTION	REQUIREMENT	RESPONSE	REMARK
1	All electrical supplies and equipment are designed and fit for purpose. 1. Testing and inspection documentation is available for review.		Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/>	
EXTERNAL ENVIRONMENTAL CONTROL UNIT				
ITEM	DESCRIPTION	REQUIREMENT	RESPONSE	REMARK
1	All components of the external environmental control unit are designated and fit for purpose. 1. Testing and inspection documentation is available for review.		Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/>	

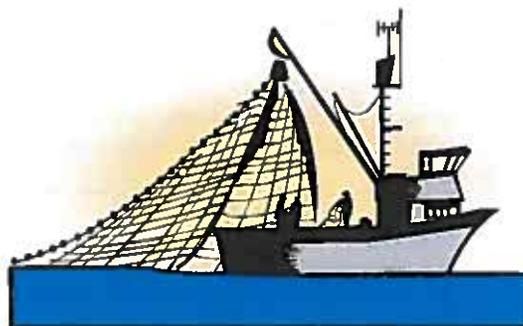
A9.1 HOW TO CONDUCT A JOB HAZARD ANALYSIS (JHA)

Before conducting complex or technical underwater operations such as deep diving or planned decompression (Appendix 10), a job hazard analysis (JHA) should be performed. The purpose of the JHA is to provide a written document identifying hazards associated with each step of a job and develop solutions that will reduce, eliminate, or guard against hazards. On the 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
 - i. Number each step
 - b. Begin with an active verb
 - i. For example, "Disconnect all...", "Start the...", "Check for...", "Invert the...", "Assemble the...", "Isolate all..."
 - c. Do not be too general or overly detailed
 - d. If the job is complex, break it into several tasks and prepare a JHA for each task
- 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)
 - 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 (ventilate, isolate, allow to cool, secure, guard, train, etc.)
 - c. List personal protective equipment (PPE) required (personal flotation devices, gloves, eye protection, respirators, fall protection, etc.)
- 4) Assign Responsibility
 - a. Assign a specific person the responsibility of implementing the safety procedures or protection required, usually the Experienced Diver or Experienced Dive Operator
- 5) Personnel Involved
 - a. Identify the person(s) preparing, reviewing, and approving the JHA – usually the Experienced Dive Operator
 - 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

Commercial Fishing Vessel Safety Examination Checklist

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



GENERAL VESSEL REQUIREMENTS

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	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
46 CFR 28.165	Injury Placard (All Vessels)	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
33 CFR 155.450	Oil Pollution Placard (Vessels \geq 26 Feet)	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
33 CFR 151.59	MARPOL (Garbage) Placard (Vessels \geq 26 Feet)	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
33 USC 1602 33 USC 2020 72 COLREGS	Navigation Lights: Required during darkness and/or in or near areas of restricted visibility (fog) Side Lights (112.5°) All around white light or masthead (225° and sternlight 135°) Fishing lights Red over White (360°) 1 meter apart, required on all fishing vessels except TROLLERS. Trawlers use green over white.	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
33 USC 1602 33 USC 2020 72 COLREGS	Dayshapes Required fishing dayshape, two black cones apex to apex. Not required on TROLLERS.	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> 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	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> 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	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> 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.	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
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	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
46 CFR 25.35	Flame Arrestor (gas power) Approved and in good condition	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
46 CFR 25.40	Ventilation (gas power) Adequate/Working ventilation to engine compartment	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> 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	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
POLICY	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: 1. Serviced and properly maintained in good working order, 2. Marked "For Training Only" and kept separate from serviceable items, or 3. Removed from the vessel.	

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

State Registered
Less than 26 feet in length
Inside Boundary Line
Waters Inside Coastal



GENERAL VESSEL REQUIREMENTS

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		<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
46 CFR 28.165	Injury Placard (All Vessels)		<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
33 USC 1602 33 USC 2020 72 COLREGS	Navigation Lights: Required during darkness and/or in or near areas of restricted visibility (fog) Side Lights (112.5°) All around white light or masthead (225° and sternlight 135°) Fishing lights Red over White (360°) 1 meter apart, required on all fishing vessels except TROLLERS. Trawlers use green over white.		<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
33 USC 1602 33 USC 2020 72 COLREGS	Dayshapes Required fishing dayshape, two black cones apex to apex. Not required on TROLLERS.		<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
33 USC 1602 33 USC 2020 72 COLREGS	Sound Producing Devices: Vessels < 12m: Means of Making an Efficient Sound Signal		<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> 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	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> 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.	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> 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.	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> 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	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
46 CFR 25.35	Flame Arrestor (gas power) Approved and in good condition	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
46 CFR 25.40	Ventilation (gas power) Adequate/Working ventilation to engine compartment	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> 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	<input type="radio"/> Yes <input type="radio"/> No <input type="radio"/> N/A
POLICY	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 style="list-style-type: none"> 1. Serviced and properly maintained in good working order, 2. Marked "For Training Only" and kept separate from serviceable items, or 3. Removed from the vessel. 	

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!

APPENDIX 10

**SURFACE SUPPLIED AIR DIVING FOR THE COMMERCIAL HARVESTER
(2011 MANUAL FROM EDMONDS TECHNICAL DIVING SERVICES)**

**SURFACE SUPPLIED AIR DIVING 0–100 fsw (0–30 msw) WITH PLANNED
DECOMPRESSION**

**SURFACE SUPPLIED AIR DIVING 101–190 fsw (30–57 msw) WITH
PLANNED DECOMPRESSION**

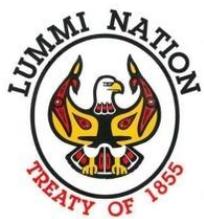
DECOMPRESSION PROCEDURE ASSESSMENT

SCUBA DIVING 0-100 fsw (0-30 msw) WITH NO DECOMPRESSION

CONSIDERATIONS FOR GEODUCK CLAM HARVESTING OPERATIONS

**DIFFERENTIAL PRESSURE (Delta P): DEFINITIONS, APPLICABILITY, AND
RECOMMENDATIONS**

COMMERCIAL HARVEST DIVING STANDARDS



Edmonds Technical Diving Services

SURFACE SUPPLIED AIR DIVING FOR THE COMMERCIAL HARVESTER

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



Edmonds Technical Diving Services

Contents

COMPRESSOR4

MANIFOLD7

UMBILICALS9

HARNESS / BAILOUT ASSEMBLIES / WEIGHT SYSTEMS11

COMMUNICATIONS14

ROLES AND RESPONSIBILITIES.....17

MAINTENANCE30

SAVE A DIVE KIT & ACCESSORIES.....36

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 an 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.

PREREQUISITES:

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

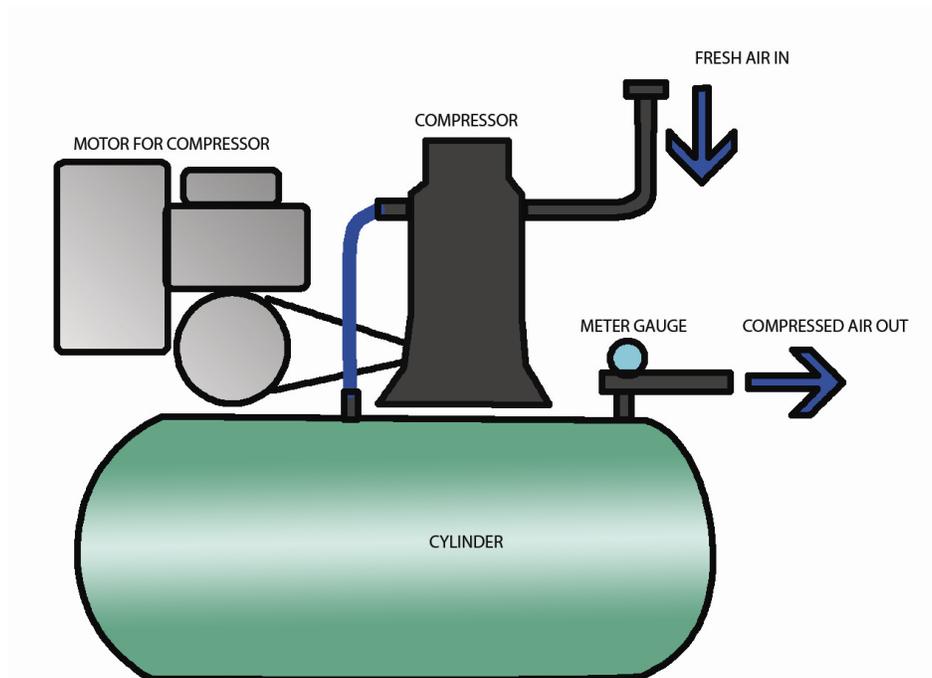
Contributing Editors:

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 125 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 (activate the unloader), thereby disengaging the drive belt, and stopping the compressor. The Diver utilizes the stored air in the tank until the pressure drops below the preset pressure, which causes the engine to start, 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 6-8 HP.

The engine of the compressor requires oil for normal operation. Most engines come with standard motor oil not compatible with breathing air. It is mandatory that the oil for the engine and compressor (if required) is safe for breathing air. In order to change out the non-compatible oil, the original oil is drained and breathing compatible oil is added. The engine is then operated for approximately one hour. 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 is paramount to the Diver's safety.

**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 U.S.A. - Net Contents 1 Gallon ©**

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 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 10 cfm, with a preferred capacity of 13 cfm, which is enough to support most diving operations. Many inexpensive compressor systems fall well below the desired 10 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 20 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 contaminants 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.

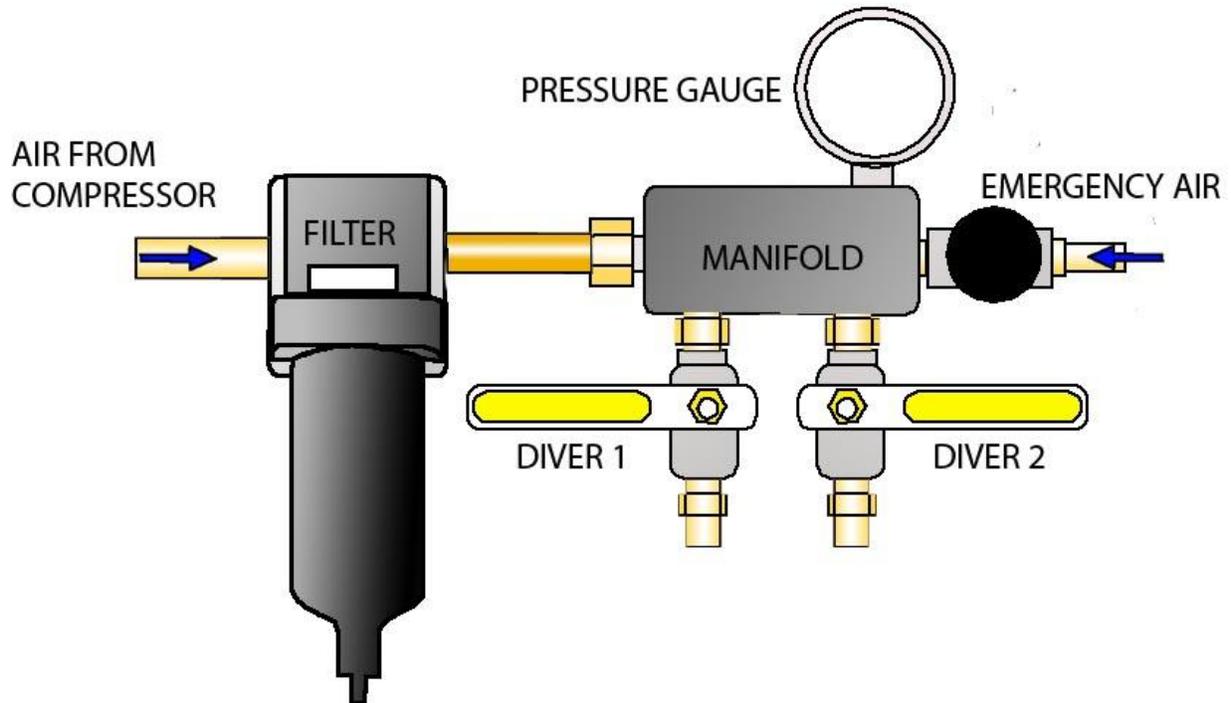
The storage tank should be drained on a regular basis, at least once during each day of use. Failure to drain the moisture from the tank will cause corrosion. The corrosion will weaken a storage tank and the rusting can cause the stored air to reduce its oxygen content. At a minimum, not draining the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

The filtration system should be capable of filtering out contaminants 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 is not corroding or cracked. If any cracks or deep penetrating pitting is 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 90 and 110 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 110 psi the compressor may be malfunctioning or the valve to the emergency supply is open, and the emergency supply first stage is 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.

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.

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.

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 400'. 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.

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 125 psi. However, to ensure the air reaches the Diver the air line must have an internal diameter of at least 1/4" 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.

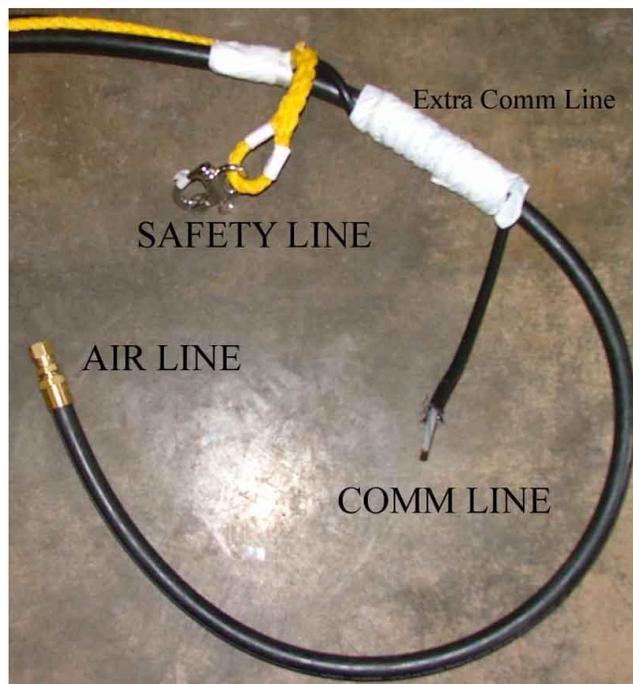
The air line should be durable and capable of handling at least 300 psi to prevent bursting. The air line should also be abrasion resistant and flexible to reduce kinks during operation. One other important feature would be for nontoxic substances used in the manufacturing process. The Diver is using the line to supply his breathing gas. If the gas passes through the air line, which contains contaminants, those contaminants 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 design is for simple topside to Diver communication consisting of a positive and a negative lead. 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.

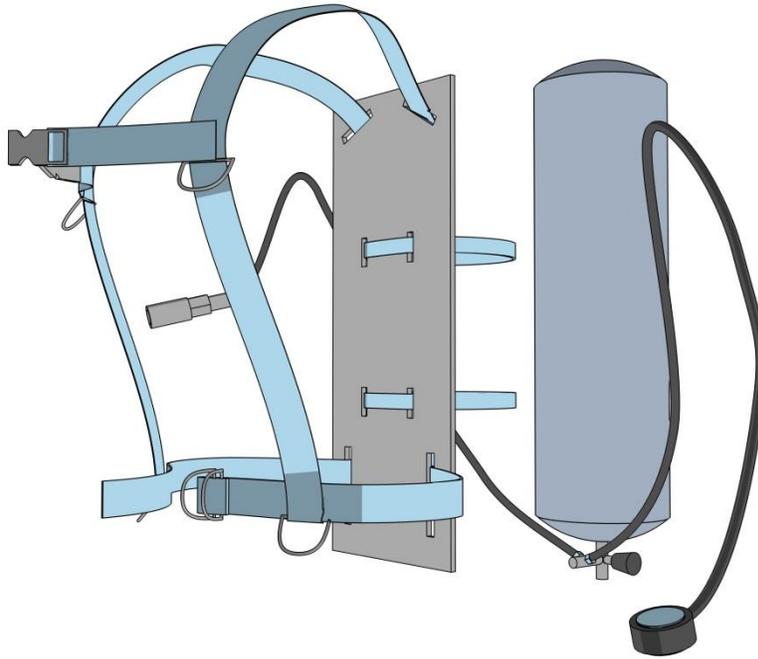
However, with a 4-wire system the topside communication system (Comm Box) must have the capability of Diver to Diver communication.

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 be 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.



HARNES / 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.

Harness

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 40 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.

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 prevent 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.

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 gear 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).
- 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 electronics communications 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 electronics 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 = **OK**

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 government entities laws 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.

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 no-decompression 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, 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.

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) [www.DiversAlert Network.org](http://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.

Umbilical

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 taught 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.

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.

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.

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 well-being.

The same situation holds true for a Diver's mental well-being. 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 taught. A taught 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.

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 thus 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 bags can be reached. When pulling the umbilical line to retrieve the bags, 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. The water hose, 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. 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 harvesting 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.

Back Up 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, back up 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

NOTES:

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 contaminants 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.

Safety

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 CHECKSHEET

Pre-Dive

- Make sure Diver has checked one way valve on helmet
 - 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 CHECKSHEET

Pre-Dive

- Don exposure suit (remove excess air)
- Check helmet's one way valve
 - Turn on "C" auxiliary valve 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

MAINTENANCE
SURFACE SUPPLIED AIR
DIVING EQUIPMENT

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. Other anti-corrosion techniques include 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.

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[®] Exhaust With Whisker Wings which retrofits to many previous Kirby Morgan Helmets and BandMasks[®], has less breathing resistance than the older single valve exhaust while providing an extremely dry hat. The Tri-Valve[®] Exhaust is made of a chemical resistant compound.

H. Water Exhaust helps keep water drained from the mask.

I. Demand Regulators The SuperFlow[®] 350 KMB 18 and KMB 28 regulator provides easy breathing for hard work.

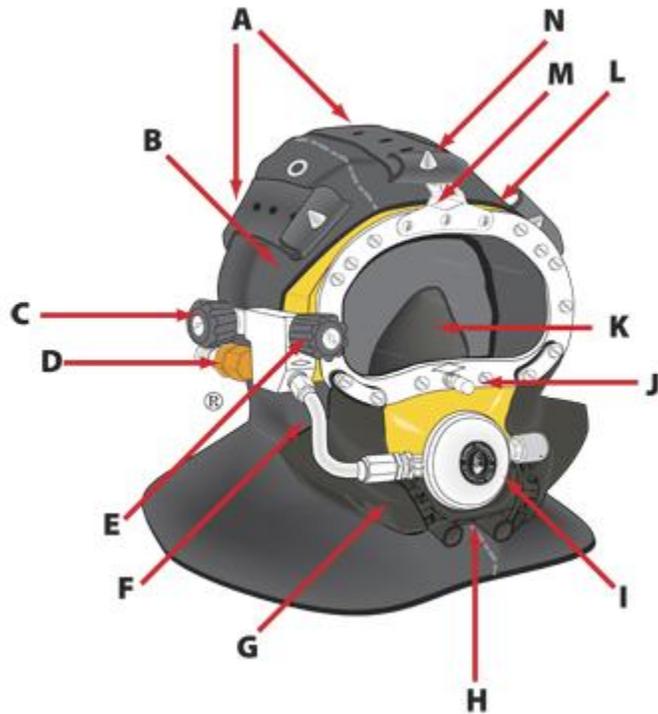
J. Nose Block Device allows the diver to block the nose to equalize ears.

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 [525-775](#) with oral nasal and [525-776](#) 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[®] BandKeepers[®] 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).



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.

1. Remove the band (N) from the helmet leaving the screw in the screw slot. Remove any remnants from the band, clean and set aside.
2. Remove the Hood (B) from the helmet.
 - a. The comms are placed into the hood between the flaps. Remove the comms and clean
 - b. Check the foam around the hood. This is one of the components which needs to be replaced regularly
 - c. Soak the hood in fresh water while continuing with the maintenance procedures
3. Remove the nose block (J)
4. Remove the oral nasal mask (J)
 - a. Check for degradation
 - b. Inspect the one way valve (flap)
 - c. Check the comms which are placed into the oral nasal cavity
5. Remove the wired comms (F)
 - a. Ensure that each wire is going to a separate terminal
 - i. It does not matter which wire goes to which terminal
 - ii. Ensure that the wires are separated so there is no bleed over
 - iii. FYI – A speaker is a microphone and a microphone is a speaker. They are interchangeable.
6. Check the Water dump valve (H)
 - a. Check for slime or organic material and clean as necessary
 - b. If the valve is not working it will allow water into the mask
7. Check the “Whiskers” (G)
8. Perform Safety Check on check Valve (D).
 - a. 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.
 - b. 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 contaminants.

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, 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 may require 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 deeper 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. An issue the Tender must deal with concerns being 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 accidentally 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.

Hand tools – 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.

Electrical cable – 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.

Batteries (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.

Diver Microphone / Speakers – It is never 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.

Connectors (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.

Fittings (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 your save a dive kit.

Tape (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.

Silicone grease - 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.

First aid / Oxygen – 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.

Manuals – 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.

Dive timer – 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.

Log sheets – 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.

Dive tables – 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.

Water – 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.

Dive Computer- 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.

Batteries for computer – 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.

Disinfectant spray – 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 another diver.

Medicines – 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.

Exposure Suit maintenance – 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 then 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. The waxing should be extensive enough that the zipper glides smoothly and does not create unnecessary wear on the teeth or sealing surface.

NOTES:

DIVE LOG (Example)

DATE _____

Diver's name	Dive Start Time	Safety / communication check	Bailout Pressure check	Depth and Time check	Dive End Time	Maximum Depth			

- 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.

A10.1 SURFACE SUPPLIED AIR DIVING 0–100 fsw (0–30 msw) WITH PLANNED DECOMPRESSION

Decompression diving shall be defined as any diving during which the diver cannot perform a direct return to the surface without performing a mandatory decompression stop to allow the release of inert gas from the diver's body. Decompression diving requires additional specialized training and a thorough understanding of the physics and physiology of decompression, decompression planning and procedures, gas management, equipment configurations, decompression method, and emergency procedures. The Lummi Natural Resources Department (LNR)-registered dive vessel owner or Experienced Dive Operator should carefully assess whether conducting a commercial harvest diving operation of this type is economically viable or, given the constraints outlined in Section 7.13, whether all of the precautions and guidelines outlined below have been met or addressed. To reiterate, All Lummi citizens permitted to participate in commercial harvest diving operations under the auspices of the Lummi Nation must recognize/acknowledge the risks associated with decompression diving and that the nearest recompression chamber is at least two (2) hours away from the Lummi Reservation and the Lummi Usual and Accustomed fishing grounds (Appendices 7 and 9); hence, only diving personnel formally trained in decompression diving will be permitted to do so as part of an LNR-approved commercial harvest diving operation. The formal training should be appropriate for the conditions in which commercial harvest dive operations are to be conducted. Besides the procedures outlined in Section 6.2, the following procedures must be observed when conducting dives requiring planned decompression stops.

A10.1.1 MINIMUM PERSONNEL REQUIREMENTS

- 1) One Experienced Dive Operator;
- 2) One Experienced Diver (can be same as # 1);
- 3) One Experienced Diver in Standby Mode; and
- 4) One other, e.g., additional Experienced Diver, Trainee Diver, or Hose Tender.

In addition to the requirements outlined in Section 6.2, the minimum training for personnel conducting decompression harvest diving operations should include the following:

- 1) Experienced Divers must have at least 90 logged dives under normal commercial harvest diving conditions.
- 2) Hose Tender (if used) must have formal training in planned decompression diving as well.
- 3) Demonstration of the ability to safely plan and conduct air dives deeper than 100 fsw (30 msw).
- 4) NITROX certification/authorization (see Section 6.3).
- 5) A minimum of eight (8) hours of classroom training to ensure theoretical knowledge to include physics and physiology of decompression, decompression planning and procedures, gas management, equipment configurations, decompression method, and emergency procedures.
- 6) At least one training session conducted in a pool or sheltered water setting, to cover equipment handling and familiarization, dive platform/staging and buoyancy control (when applicable), to estimate gas consumption rates, and to practice emergency procedures.
- 7) At least six (6) training dives conducted in open water simulating/requiring decompression, emphasizing planning and execution of required decompression dives, and including practice of emergency procedures.
 - a. No open-water training dives requiring decompression should be conducted until the dive team has demonstrated acceptable skills under simulated conditions.
 - b. The following are the minimum skills the dive team member must demonstrate proficiently during dives simulating and requiring decompression:
 - i. Proper ascent rate;
 - ii. Proper depth control and, when applicable, buoyancy control;
 - iii. Equipment manipulation;
 - iv. If applicable, stage/decompression bottle use as pertinent to planned diving operation;
 - v. Communications between topside and diver(s);

- vi. Gas management;
- vii. Time management; and
- viii. Emergency skills.

Upon completion of training, dive team members shall demonstrate, to the satisfaction of the LNR Diving Safety Officer (DSO) or his/her consulting decompression diving specialist, proficiency in planning and executing required decompression dives appropriate to the conditions in which commercial harvest diving operations are to be conducted.

A10.1.2 OPERATIONAL GUIDELINES

- 1) The approximate depth of each dive should be determined prior to the start of operations.
- 2) All breathing media other than air should be verified for proper composition prior to being placed on-line.
- 3) Since a decompression chamber will not likely be ready for use at the dive location/station or accessible by the diver within the allowed time frame as prescribed by a decompression schedule, emergency procedures must be planned and discussed amongst the dive team before conducting harvest operations in the event of a diving accident requiring recompression.
- 4) Each diver should be continuously tended while in the water by a separate dive team member.
- 5) Each diving operation should have a primary breathing gas supply sufficient to support all divers for the duration of the planned dive, including decompression, and for foreseeable emergency situations as well as a secondary independent breathing gas supply.
- 6) Except when heavy gear (e.g., MK V type equipment) is worn, a diver-worn or carried emergency gas supply (EGS) shall be utilized.
- 7) The maximum PO₂ to be used for planning required decompression dives is 1.6.
 - a. It is recommended that a PO₂ of less than 1.6 be used during exposures at depth.
- 8) Decompression dives may be planned using standard dive tables (Appendix 6), dive computers, or appropriate PC software.
 - a. Dive computers and PC software shall be made available to appropriate LNR representatives (e.g., LNR Diving Safety Officer or Natural Resources Enforcement Officers) upon request to validate dive planning and dive profiles and to ensure compliance with the LNR Commercial Harvest Diving Standards.
 - i. If a dive computer fails at any time during the dive, the dive must be terminated and appropriate surfacing procedures should be initiated immediately using appropriate dive tables (Appendix 6).
 1. All dive team members must be proficient in the use of standard dive tables.
- 9) Breathing gas used while performing in-water decompression shall contain the same or greater oxygen content as that used during the bottom phase of the dive.
- 10) If breathing gas mixtures other than air are used for required decompression, their use shall be in accordance with those requirements set forth in the appropriate sections of this standard.
 - a. Use of additional NITROX and/or high-oxygen fraction decompression mixtures as travel and decompression gases to decrease decompression obligations is encouraged (see Section 6.3).
 - b. If a period of more than six (6) months has elapsed since the last mixed gas dive, a series of progressive workup dives to return the diver(s) to proficiency status prior to the start of harvest diving operations are recommended.
- 11) Mission-specific workup dives are recommended.
- 12) If no decompression chamber is on site, the nearest manned operational chamber should be known, and an evacuation plan should be in place.

A10.1.3 MINIMUM EQUIPMENT REQUIREMENTS

- 1) Two independent air sources and volume tank to support two divers preferred;

- a. Valve and regulator systems for primary (bottom) gas supplies should be configured in a redundant manner that allows continuous breathing gas delivery in the event of failure of any one component of the regulator/valve system.
- 2) Dive station emergency air source;
 - a. Adequate supply of gases for the planned dive profile and potential treatment;
 - b. Cylinders with volume and configuration adequate for planned diving operations.
- 3) Two hose groups preferred consisting of:
 - a. Air hose;
 - b. Strength member/strain relief (the strength member may be the entire hose assembly, if so designed); and
 - c. Communications cable.
- 4) Pneumofathometer hose;
- 5) One set of air decompression tables and procedures;
- 6) For planned in-water decompression:
 - a. Third source of diver's emergency air supply, in addition to the diver's umbilical and EGS.
- 7) One control station consisting of:
 - a. Communication systems;
 - b. Depth gauges and gas distribution system with the capability to supply and control two divers at the maximum work depth.
- 8) Two time-keeping devices;
- 9) One basic first aid kit with bag-type manual resuscitator with transparent mask and tubing;
- 10) Emergency O₂ administration kit;
- 11) Two sets of diver's personal diving equipment preferred consisting of:
 - a. Helmet or mask;
 - b. Diver-worn emergency gas supply;
 - c. Weight belt if needed;
 - d. Protective clothing;
 - e. Tools as required;
 - f. Safety harness;
 - g. Knife or cutting device;
 - h. Spare parts as required; and
 - i. Log books, dive sheets, safe practices manual, first aid handbook and written JHA applicable to job.

A10.2 SURFACE SUPPLIED AIR DIVING 101–190 fsw (30–57 msw) WITH PLANNED DECOMPRESSION

All requirements and cautions outlined in Sections 6.2 and A10.1 above shall apply to surface supplied air diving at depths between 101 and 190 fsw (30–57 msw) with planned decompression. The LNR-registered dive vessel owner or Experienced Dive Operator should carefully assess whether conducting a commercial harvest diving operation of this type is economically viable or, given the constraints outlined in Section 7.13, whether all of the precautions and guidelines outlined below have been met or addressed. To reiterate, all Lummi citizens permitted to participate in commercial harvest diving operations under the auspices of the Lummi Nation must recognize/acknowledge the risks associated with decompression diving and that the nearest recompression chamber is at least two (2) hours away from the Lummi Reservation and the Lummi Usual and Accustomed fishing grounds (Appendices 7 and 9); hence, only diving personnel formally trained in decompression diving will be permitted to do so as part of an LNR-approved commercial harvest diving operation. The formal training should be appropriate for the conditions in which commercial harvest dive operations are to be conducted. Besides the procedures outlined in Sections 6.2 and A10.1 above, the following procedures must be observed when conducting dives requiring planned decompression stops.

A10.2.1 OPERATIONAL GUIDELINES

- 1) The maximum depth for required decompression using air as the bottom gas shall be 190 fsw (57 msw).
- 2) Use of alternate inert gas mixtures to limit the effects of nitrogen narcosis (Table 1A7, Appendix 7) is encouraged for depths greater than 150 fsw (46 msw).
 - a. Formal training is required for blending and using breathing gases other than air.
 - b. Documentation of this training must be presented to LNR representatives (e.g., LNR Diving Safety Officer or Natural Resources Enforcement Officers) upon request.
- 3) When using mixed gas or enriched air, all gases must be analyzed for proper mixture necessary to support the maximum depth of the planned dive or decompression.
- 4) All breathing media other than air shall be verified for proper composition prior to being placed on-line.
- 5) Additional workup or training dives are required (see Section A10.1 above). Proficiency at and progression to greater depths should be accomplished in four-dive increments at depth intervals of:
 - a. 60–100 fsw (18–30 msw);
 - b. 101–130 fsw (30–40 msw);
 - c. 131–150 fsw (40–46 msw); and
 - d. 151–190 fsw (46–57 msw).
- 6) If no decompression chamber is on site, the nearest manned operational chamber should be known (Appendix 7), and an evacuation plan should be in place.

A10.3 DECOMPRESSION PROCEDURE ASSESSMENT

Each LNR-registered dive vessel owner or Experienced Dive Operator shall:

- 1) Investigate and evaluate each incident of decompression sickness (DCS) based on the recorded information, consideration of the past performance of the decompression table used, and individual susceptibility;
- 2) Take appropriate corrective action to reduce the probability of recurrence of decompression sickness; and
- 3) Prepare a written evaluation of the decompression procedure assessment, including any corrective action taken, and submit to the LNR Diving Safety Officer.
 - a. Completed forms should be sent to the LNR Diving Safety Officer within seven (7) 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 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.

A10.4 SCUBA DIVING 0-100 fsw (0-30 msw) WITH NO DECOMPRESSION

Scuba (self-contained underwater breathing apparatus) diving procedures are not generally used for the conduct of commercial harvest diving operations except where it can be shown to be more safe and efficient than the alternative modes of diving. The following are minimum requirements for commercial scuba diving operations at 0-100 fsw (0-30 msw) with no decompression.

A10.4.1 MINIMUM PERSONNEL REQUIREMENTS

- 1) One Experienced Dive Operator;
- 2) One Experienced Diver (can be same as # 1);
- 3) One Experienced Diver in Standby Mode; or
- 4) One other, e.g., additional Experienced Diver, Trainee Diver, or Hose Tender.

A10.4.2 OPERATIONAL GUIDELINES

- 1) Two-way audio-communications between the diver and topside are recommended;
- 2) The planned time of a scuba diving operation should not exceed either the no-decompression limits or the air supply duration of the cylinders exclusive of the reserve supply (the cylinder pressure should be determined immediately before each dive);
- 3) Dive depths should not exceed 100 fsw (30 msw) without additional training at such depths;
- 4) Dives should not be conducted against currents exceeding one knot;
- 5) Dives should not be conducted in enclosed or physically-confining spaces;
- 6) During all dives, a standby diver should be available while a diver is in the water;
- 7) When two divers are simultaneously in the water and can maintain visual contact, they can act as standby diver for each other;
- 8) Scuba divers should be line-tended from the surface, or accompanied by another diver in the water in continuous visual contact during the diving operations;
- 9) All divers on scuba shall wear a buoyancy compensator and whistle or other audio signaling device;
- 10) During periods of low or poor surface visibility, the diver should also carry a lighted beacon or submersible light;
- 11) When solo line-tended, scuba divers should be equipped with a diver-carried emergency gas supply:
 - a. Diver worn/carried emergency gas supply (bailout) must have a minimum calculated four-minute supply at the anticipated depth (see Appendix 5);
 - b. Refer to Section 7.17.
- 12) Scuba divers shall be equipped with a submersible pressure gauge (tank contents gauge).

A10.4.3 MINIMUM EQUIPMENT REQUIREMENTS

- 1) Each diver shall be equipped with a knife, diving wristwatch and depth gauge;
- 2) Full face masks with through water communication to the surface (supervisor), with diver-to-diver communications a desirable option;
- 3) A weight belt with a quick release that is appropriate for the suit and depth of the dive should be worn;
- 4) A buoyancy compensator device (BCD) should be used to secure the cylinders to the diver and provide underwater buoyancy compensation or surface buoyancy as needed;
- 5) If a dry suit is being worn by the diver, then a cylinder harness with a quick release may be worn to secure the cylinders to the diver; and
- 6) One set of air decompression tables and procedures (Appendix 6).

A10.5 CONSIDERATIONS FOR GEODUCK CLAM HARVESTING OPERATIONS

A10.5.1 UNDERWATER GEODUCK CLAM EXCAVATION OR 'DEEP DITCH' OPERATIONS

A10.5.1.1 PURPOSE

Commercial harvest divers use hydraulic jets (Section A10.5.2) to remove product, e.g., geoduck clam (*Panopea generosa*), buried 1-m deep in bottom sediments. The purpose of this section is to identify potential hazards and recommend safety precautions when conducting underwater operations below the 'mud line' (commonly referred to as 'deep ditch' operations).

A10.5.1.2 RESPONSIBILITY

The Experienced Dive Operator is responsible for the welfare and safety of the dive team; however, the diver is ultimately responsible for ensuring that he or she is familiar with the principles of underwater excavation operations, i.e., he or she is performing these tasks in a safe and responsible manner. All members of the dive team should be trained and experienced for the tasks to be performed.

A10.5.1.3 MINIMUM PERSONNEL REQUIREMENTS

- 1) One Experienced Dive Operator;
- 2) One Experienced Diver (can be same as # 1);
- 3) One Experienced Diver in Standby Mode; or
- 4) One other, e.g., additional Experienced Diver, Trainee Diver, or Hose Tender.

A10.5.1.4 PRECAUTIONS

When performing tasks underwater, harvest divers are sometimes required to excavate areas or enter excavated areas. Harvesting the geoduck clam requires hand-jetting material from the bottom to remove the organism from the substrate (Section A10.5.2). Suspended material might foul the diver's personal equipment (e.g., helmet/regulator) or at the least, obscure visibility. Furthermore, 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. Common sense and remaining alert are considered essential components for approaching operations of this nature.

A10.5.1.5 POTENTIAL HAZARDS ASSOCIATED WITH GEODUCK CLAM EXCAVATION OR 'DEEP DITCH' OPERATIONS

- 1) Unintentional creation of a small hole/tunnel which collapses posing a temporary entrapment hazard to the diver while hand-jetting;
- 2) Malfunction of jet nozzle or other component of hand-jetting tool;
- 3) Injury to diver or his or her equipment due to jet hose or water directed from the hand-jet; or
- 4) Injury to topside personnel due to malfunction in hand-jetting equipment.

A10.5.2 UNDERWATER HIGH-PRESSURE WATER BLASTERS

A10.5.2.1 PURPOSE

High-pressure water blasters (or hydraulic jets) are used for a variety of underwater tasks such as cleaning submerged material. High-pressure water blasters are used also for excavating geoduck clam (*Panopea generosa*) from bottom sediments during commercial harvest diving operations.

A10.5.2.2 RESPONSIBILITY

The Experienced Dive Operator is responsible for the welfare and safety of the dive team. Personnel assigned to an underwater high-pressure water blasting operation, particularly divers, should be adequately trained in using the equipment (water pump, hose, and hand-held nozzle or jet) associated with this activity. Finally, dive team members should be able to properly demonstrate their knowledge and ability to perform a task prior to being required to do so.

A10.5.2.3 MINIMUM EQUIPMENT REQUIREMENTS FOR HIGH-PRESSURE WATER BLASTING OPERATIONS

Serious harm and injury may result from the misuse of water blasting equipment and from the use of improperly selected fittings, hoses or attachments; hence, 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.

A10.5.2.4 PRECAUTIONS

High-pressure water blasters are dangerous and can cause serious injuries. ALL dive team members should be familiar with the equipment intended for use and the hazards associated with its operation. Recommended practices and procedures do not replace proper training in the operation of high-pressure water blasting systems. Injuries caused by water blasters 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 Experienced Dive Operator, and seek proper medical advice or treatment.

A10.5.2.5 POTENTIAL HAZARDS ASSOCIATED WITH HIGH-PRESSURE WATER BLASTING OPERATIONS

- 1) Using substandard equipment or parts in the system that affect discharge pressure of the water blaster;
- 2) Diver inadvertently directs pressure stream onto self, umbilical, or other equipment;
- 3) Valve and nozzle assemblies malfunction affecting diver's ability to properly direct pressure stream;
- 4) A hose or fitting failure that allows leaking pressure stream to contact/injure diver or topside personnel;
- 5) Topside personnel inadvertently direct frontal- or retro-pressure stream onto themselves or others when preparing, testing, or using the system;
- 6) Airborne debris or particles resulting from using/testing system topside;
- 7) Bodily strains incurred by topside personnel while handling hose;
- 8) Inadvertently reducing, blocking, or shutting off water supply to pump resulting in overheating or damage to water pump; and
- 9) Diver's umbilical tangling with water blaster hose or nozzle.

A10.5.3 RECOMMENDED WAYS TO MITIGATE HAZARDS ASSOCIATED WITH GEODUCK CLAM HARVESTING OPERATIONS

- 1) Situational awareness on the part of the diver and topside personnel;
- 2) Routine checks on diver location;
- 3) Diver should periodically assess any potential hazards to him- or herself, his or her umbilical, or hand-jet equipment;
- 4) Routine pre-dive and post-dive inspections of all equipment and systems to reduce risk of malfunction(s);
- 5) Diver should be capable of handling the force of pressure being emitted from the jet nozzle;
- 6) Diver should maintain proper balance, footing, and positioning to ensure that back or frontal spray from the jet nozzle does not injure the diver or damage his/her equipment;
- 7) 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" are other recommended practices while conducting geoduck clam excavations or 'deep-ditch' operations.

A10.6 DIFFERENTIAL PRESSURE (Delta P): DEFINITIONS, APPLICABILITY, AND RECOMMENDATIONS

A significant number of fatalities in the commercial diving industry involve working situations where a diver encounters differential pressure (Delta P). Delta P is 'invisible' to the diver and strikes suddenly, without warning. Once a diver is trapped by Delta P, there is virtually no escape. This section provides information about how to recognize and avoid Delta P. Note: The risk to Lummi personnel of encountering Delta P during normal LNR-approved commercial harvest diving operations is low; however, qualified Lummi citizens may be offered other forms of diving employment where Delta P should be a serious consideration. Additional information about Delta P hazards is also available on the Association of Diving Contractors International (ADCI) video, "*The Hazards of Working in "Delta-P" Work Environments*". For ordering information, go to www.adc-int.org/products.php.

A10.6.1 TYPES OF DELTA P

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

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

A10.6.2 EXAMPLES OF DELTA P

- 1) Clogged intake screen (type 1 from above);
- 2) Outlet screen/trash rack on dams (type 1 from above);
- 3) Hole in water storage tank (type 1 from above);
- 4) Open sluice gates (type 1 from above);
- 5) Opening in a barrier between two areas (type 1 from above);
- 6) Transfer pipes (type 1 from above);
- 7) Water tower drain (type 1 from above);
- 8) Diver installing a section of pipe with flange protectors over the ends without a vent (type 2 from above);
- 9) An existing hole in an underwater pipeline (type 2 from above);
- 10) Cutting into an underwater pipeline or other void with Delta P (type 2 from above);
- 11) Pump house intake (type 3 from above);
- 12) Air lifts or dredges (type 3 from above); and
- 13) Draw from thrusters on a ship (type 4 from above).

A10.6.3 RECOMMENDATIONS

- 1) Attend a pre-job meeting to understand where the hazards may be;
- 2) Familiarize self with the facility to be worked in (e.g., if available, review plans of facility or as-builts);
- 3) Understand where the potential for Delta P exists;
- 4) Ensure that high-quality, well-informed leadership and adequate information, instruction, and training, are available for dive teams and other relevant personnel;
- 5) Ensure that both diver and supervisor know how piping and valve systems work together, if applicable;
- 6) Inquire about and inspect any pumps, suction, gates or valves;
- 7) Voice concerns about potential Delta P hazards to personnel of the hiring company;
- 8) Physically verify that all gates or valves around the divers' work area are properly positioned and locked/tagged out as applicable;
- 9) Perform any lockout/tag-out procedures necessary to perform the job as safely as possible;
- 10) Check for flow using a flow meter, if applicable; and
- 11) Calculate the water forces in the potential Delta P areas:
 - a. For example, a properly-trained Experienced Dive Operator or Experienced Diver 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.

A10.6.4 MISCELLANEOUS CAUTIONS AND FACTS REGARDING DELTA P

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

A10.6.5 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.

